NATURE

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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THURSDAY, MAY 4, 1876

THE PROGRESS OF THE LOAN COLLECTION[1]

THE investigation of the nature of those forces by which the material world is ceaselessly being moved and transformed, enlists in our day the energies of a host of scientific workers. It would be hard, perhaps, to mention a department of natural science for the study of which a good knowledge of the fundamental principles of what we now term physics is not at least a valuable aid and qualification, if not indispensably requisite. To the geologist and the biologist, no less than to the astronomer and the chemist, will such knowledge seem imperative. Considering the widespread ramifications of this division of science, it is not wonderful that the apparatus belonging to it should occupy so large a share of the available space in the present collection.

The remark formerly made, that much of the interest awakened in this loan collection will centre in its historical element—in the primitive forms of apparatus that represent, in some sort, the germs of some great development of scientific thought—holds good for the departments of which we propose now to take a brief survey in continuation of our last week's article. On entering the room devoted to physics (exclusive of electricity and magnetism), attention is drawn to some aged-looking apparatus on the right. These are the celebrated original Magdeburg hemispheres of Otto von Guericke. They were exhibited by him in 1654 before the Princes of the Empire and the foreign ministers assembled at the Diet of Ratisbon. The force of two teams, each consisting of a dozen horses, made to pull in opposite directions (a portion of the rope is shown) was insufficient to separate the exhausted hemispheres. It was shortly after this date that the Burgomaster of Magdeburg heard of Torricelli's great discovery. The original air-pump of Otto von Guericke is also exhibited. It consisted of a globe of copper, with a stop-cock, to which a pump was fitted. The pump-barrel was entirely immersed in water to render it air-tight. The improvements in the air-pump by Boyle and Hooke, Papin, Hawksbee, and others, can be followed by the actual instruments they made. Among modern improved methods of producing a vacuum, is the pump of M. Deleuil, in which the pistons are solid cylinders of considerable length, without packing or lubricants, and not fitting tightly in the tubes. The internal friction of the air in the narrow space is so great that the rate at which it leaks into the exhausted part of the vessel, is not comparable with the rate at which the pump is exhausting air from the receiver. In the well-known air-pump of Sprengel, air is drawn from the vessel to be exhausted into a vertical tube, through the descent of small successive portions of mercury in the latter. Thilorier's apparatus for liquefying carbonic acid, the apparatus used by Dr. Andrews in his researches on continuity of the gaseous and liquid states of matter, and a small model of M. Colladon's new air and gas compressor used for the St. Gothard tunnel, may also be noticed here.

The musical commencement of sound is generally put at about thirty-two (single) vibrations, and the upper limit of audition at about 73,000. Here will be found apparatus illustrating both extremes; including two organ pipes, the individual sounds of which are inaudible, but whose resultant tone or beat is within the limits of hearing. Helmholtz's double siren, and various other instruments connected with his invaluable researches on sound, will repay examination. Among musical instruments we may note some models of ancient Egyptian pipes, from the British Museum and that of Turin; an enharmonic harmonium, tuned according to the division of the octave into fifty-three equal intervals; and the first of the now generally adopted upright pianofortes patented by Robert Wornum in 1811. Mr. Baillie Hamilton contributes a series of apparatus illustrating very instructively the progress of the Æolian principle. The velocity of transmission of sound in water was experimented on by Colladon, on the lake of Geneva, in 1826, and again in 1841, and some of his apparatus is shown in the present section. With the long tube like a speaking trumpet, it is possible, in calm weather, at the distance of more than a hundred kilometres, to hear the strokes on a bell of half a ton weight immersed in the water. Once more, the apparatus is to

[1] Continued from vol. xiii. p. 505.

be seen by which Prof. Tyndall recently illustrated the reflection of sound by heated air or vapours; these, being made to stream up through six openings in the long chamber through which the sound is directed, are effectual in stopping its progress.

Of historical interest in the section of Light are some early stereoscopes, comprising that of Sir David Brewster; a camera-obscura said to have belonged to Sir Joshua Reynolds (which, when closed, has the form of a large folio leather-bound book), the original form of Brewster's kaleidoscope made by Bate, in 1815, the first heliostat, invented by Gravesande, &c. The vigour of the young science of spectroscopy is indicated by the fine array of instruments belonging to it, constructed by Steinheil, Browning, and others. There is shown the spectroscopic apparatus which Sir John Herschel used in photographing actions of different parts of the spectrum, and in his investigations on some supposed new elements. For illustrating the theoretical side of the subject of polarised light, various forms of instrument have been devised, the most comprehensive of which is known as the wave machine of Wheatstone; its object is to exhibit the results of the combination of various kinds of vibration meeting at various phases. Instruments based on the three different methods of producing plane polarisation are exhibited; and the various phases of rotatory and other polarisation can be shown simultaneously by means of an instrument which was invented independently by M. Mach and Mr. Spottiswoode. It is known that Wheatstone invented a "polar clock," based on the fact that the light from certain parts of the sky is polarised, and the plane of polarisation depends on the position of the sun; this is included in the collection. It would take too long to refer in detail to the now numerous varieties of photometric apparatus, or the apparatus for observing phosphorescence, fluorescence, and other phenomena connected with light. Several specimens exhibited of the enigmatical radiometers recently devised by Mr. Crookes will doubtless excite lively interest and speculation. In the photographic collection is the first known photograph on glass, taken on precipitated silver chloride by Sir J. Herschel; also the second daguerreotype obtained by Daguerre in 1839. The Woodbury and other processes are fully illustrated.

In the Heat department we cannot allow ourselves to linger at the fine collection of thermometric and other instruments. Among them is a milligrade thermometer, in which the interval between the freezing and boiling points of water is divided into one thousand degrees; it obviates the use of fractions. Wedgwood's pyrometer and Lavoisier's calorimeter are here; and many will feel interested in such apparatus as that by which Tyndall conducted researches on radiant heat, Regnault, De la Rive, and Marcet on the specific heat of gases, or Favre and Silbermann on the heat disengaged in combustion.

In the room devoted to Chemistry we come upon some old apparatus which is of the simplest and even the rudest character; it is a part of that with which John Dalton carried on his classical researches. Most of it was made with his own hands, and the articles here exhibited are chosen as illustrating this fact, and as indicating the genius which, with so insignificant an equipment, was able to produce such great results. The study of pneumatic chemistry was much advanced by the experiments of Black and Cavendish. Black showed that the difference between the caustic and mild alkalies was that the latter contained *fixed air*, a kind of air identical with that obtained from fermenting liquids. Cavendish pointed out the difference between inflammable air, which we now call hydrogen, and fixed air, now known as carbonic acid gas. Black's pneumatic trough and balance, and Cavendish's balance, are among the collection. The latter is rude in exterior but of singular perfection. Here, also, is the balance, belonging to the Royal Institution, which was used by Young, Davy, and Faraday. The researches of Faraday on the condensation and liquefaction of gases are well known, and one may here see the apparatus he employed, along with a number of the original tubes containing gases which he liquefied. Thomas Graham's apparatus, also exhibited, is remarkable, like that of Dalton, for the contrast between its simplicity and the great results that were achieved by means of it. The amateur or professional chemist will doubtless receive not a few happy hints in inspection of the large variety of apparatus connected with qualitative and quantitative analysis; and the comprehensive collection of chemicals contains many novelties. We further note some of the apparatus that Messrs. Lawes and Gilbert have used in their important researches in agricultural chemistry, and they exhibit a case of casts of white Silesian sugar-beet illustrating the influence of different manures on the amount of produce and on the percentages of dry matter and sugar in the roots. The great chemical industries of this country, in fine, are well represented by models of manufactories and by products.

Coming to Biology, we may notice first an interesting collection of old microscopes. Here is the silver microscope that was used by Anthony von Leeuwenhoek, the Dutch philosopher, and probably made by him; also the microscope used by Sir W. Hooker, in his description of the British Jungermannieæ, &c. The microscopes of Dawson Turner, Robert Brown, Muschenbroek, and others, are also included. There is a compound microscope invented and constructed about the year 1590, by Jansens, the inventor of the telescope. This object, with its tin tube, is one of the most interesting things in the Collection. It is instructive to compare these instruments with their modern neighbours, of which there is a large variety.

The older physiologists obtained only qualitative results from their experiments; but the present generation has witnessed a remarkable advance in the application of instruments of precision to the quantitative determination of the effects of physiological processes. From this point of view a singular interest attaches to the muscle balance, constructed and used just forty years ago, by the eminent anatomist and physiologist who laid the foundations of animal histology. It is intended to demonstrate that muscular contraction takes place in accordance with the laws of elastic bodies, and it may be regarded as the first of the class of instruments referred to. The department contains a rich collection of such instruments; and no better illustration could be taken than the apparatus by which M. Marey has so successfully investigated the phenomena of animal locomotion and other physiological movements. The study of physiological optics has been

greatly cultivated in Germany, and the instruments connected with it (whose nomenclature, by the way, seems unusually bristling and difficult) offer many novel points for consideration. The mechanism of circulation and respiration in the animal subject is studied by means of a variety of delicate apparatus, and we note also some good schematic representations in which the movements are reproduced mechanically. The anatomist and histologist will find many beautifully prepared specimens from animal and plant life.

Leaving the biological section we enter that of geography, geology, and the allied sciences. Here the instruments used by the late Dr. Livingstone in his last journey possess a melancholy interest; they comprise a pocket chronometer, a sextant, hypsometrical boiling apparatus, and three thermometers. Specimens are shown of the dredging, sounding, and other apparatus that have been used on board the *Challenger*, the *Porcupine*, and other exploring vessels. The collection of maps is a large one; in it will be found a selection designed to illustrate the progress of cartography and surveying in India, the maps of the Geological Survey of this country, &c.; also the MS. maps of Livingstone, Burton and Speke, Baker, Stanley, and others. In a glass case may be observed several open log-books. One is Capt. Cook's log of the *Endeavour* in his voyage round the world (1768-71), another is that of one of his later voyages; another, the log of the proceedings of the *Bounty*, including an account of the mutiny. The subject of geology is largely illustrated by sections, maps, models, and specimens. We only note here the illustrations of the recent Sub-Wealden boring. There are numerous fine models in illustration of crystallography, and one of the goniometers exhibited is that of the Abbé Hauy. Among the objects connected with mining may be noted the apparatus constructed by Sir Humphrey Davy in his researches on the safety lamp.

The section of Applied Mechanics, which we have left to the last, might well claim a separate paper or a series of such. We can do no more than briefly refer to the collection of James Watt's models, which indicate, *e.g.*, the progress of his thoughtful labour in connection with the idea of separate condensers, and the expansive working of steam. In Watt's first engine great difficulty was experienced in fitting the piston accurately to the cylinder. Such difficulties exist no longer; and a remarkable example of the skill now attained in metallic constructions is afforded in the fine surface plate lent by Sir J. Whitworth; this is probably the closest approximation to an absolutely plane surface that has yet been realised. Finally, the old "Rocket" constructed by Stephenson in 1829, and the original engine of Henry Bell's steamboat, appear in this collection, the venerable quondam precursors of a great social revolution.

PREJEVALSKY'S MONGOLIA

Mongolia, the Tangut Country, and the Solitudes of Northern Tibet. By Lieut.-Colonel N. Prejevalsky, Translated by E. Delmar Morgan, F.R.G.S. With Introduction and Notes by Colonel Henry Yule, C.B. (Sampson Low and Co., 1876.)

WE have had occasion once or twice to refer briefly to Col. Prejevalsky's travels in Eastern High Asia, and some of our readers may have seen more or less detailed notices of his journey in the German and English geographical journals. These have been sufficient to show that the narrative of the Russian officer is of unusual value, and we are therefore thankful that not much time has been lost in making it accessible to the English public, to which Russian is practically an unknown tongue. The two volumes before us, however, contain only Col. Prejevalsky's general account of his expedition; and we regret that there seems to be no intention of making the special scientific results accessible to English readers. Judging from what is contained in the two volumes before us, these must be of the highest importance, and we hope that by some means they will be made known to English men of science.

The present translation has been brought out with great care. Mr. Delmar Morgan has put the narrative into clear and idiomatic English, which, we have reason to believe, faithfully represents the original Russian. He has, moreover, added to the value of the narrative for English readers by numerous supplementary and foot notes. We consider that both Col. Prejevalsky and the English reader are particularly fortunate in having the advantage of Col. Yule's knowledge to supplement and correct the original narrative. In an introduction he connects the journey of the Russian officer with those of previous explorers in Central and Eastern Asia, and especially with that of the well-known Huc and his companion Gabet. Considerable discredit has been thrown on the narrative of Huc, but Col. Yule shows that in the main it may be regarded as trustworthy, allowance being made for the missionary's love of exaggeration and his desire to produce effect. Prejevalsky's journey from Pekin to the south-west into Tibet coincided to some extent with that of Huc, and the former on several occasions impugns the accuracy, if not the veracity, of the latter. Those who are familiar with the old Abbé's delightful narrative will be glad to know that so great an authority as Col. Yule thinks that after all he is in the main trustworthy. Col. Yule's numerous notes will, moreover, be found to add much to the value of the work, both as supplementary to the main narrative and as corrective of occasional statements by Col. Prejevalsky arising from imperfect knowledge or rashness. This narrative Col. Yule shows, is an additional confirmation of the remarkable accuracy of that of Marco Polo.

The starting-point of Col. Prejevalsky's expedition was the town of Kiakhta, on the border of Siberia and Northern Mongolia, from which the small party set out in November, 1870, and returned to it after having done three years' hard and fruitful work, in October, 1873. The expedition seems to have been essentially a Government one, sent out at the instigation of the Russian Geographical Society. It is, therefore, difficult to understand how Col. Prejevalsky should have been so seriously hampered from want of sufficient funds. Yet so it was; the resources at the leader's command were a mere pittance as compared with the magnitude of the undertaking. The entire party consisted only of the Colonel, a companion, and two Cossacks, and the instrumental equipment was the most meagre possible. All things considered, it is marvellous that the results achieved were so many and so valuable. From Kiakhta the party went by Urga across the desert of Gobi, probably the dreariest desert in the world, to

Kalgan, and hence to Pekin. From Pekin a preliminary tour was made to the north, to Lake Dalai-nor, one object being to observe the spring flight of the birds of passage. This is a subject in which Col. Prejevalsky takes great interest, and throughout the whole extent of his journey he continued to make observations on the migrations of birds, and the present volumes contain many valuable notes on the subject. Lake Dalai-nor, which like many other lakes in this region, is salt, is described as a great rendezvous for migratory birds. The flight and habits of these birds are described fully in the more strictly scientific part of Col. Prejevalsky's account of the expedition, which is not included in the present translation. There is, however, a list of the various birds observed at this lake. In this, as in subsequent parts of his journey, Col. Prejevalsky noted as far as possible all the important features and products of the country as he proceeded. Surveying, however, was attended with many difficulties, on account of the suspicions of the natives, Chinese and Mongols, and it was only by stealth and by resorting to various artifices that Col. Prejevalsky could make use of his note-books. Another cause of difficulty and especially of delay was the insurrection of the Chinese Mohammedans, who had overrun and devastated much of the country through which Col. Prejevalsky's expedition passed.

On returning to Kalgan the expedition commenced the serious part of the undertaking, proceeding westwards by the In-shan Mountains, and crossing the Hoang-ho at Bauta, near the centre of its great northern bend. Proceeding along the left bank of the river through the country of the Ordos, the party recrossed the Hoang-ho at Ding-hu, into the Ala-shan country, and were well received by the prince at Din-yuan-ing. A number of days were spent here hunting and exploring among the Ala-shan mountains ; but want of funds compelled the expedition to return to Kalgan. The return route was along the left side of the northern bend of the Hoang-ho, through the Khara-narin-ula mountains, where the cold experienced was quite Arctic. After staying a couple of months at Kalgan, the party again set out, this time fortunately much better equipped. They followed

Fig. 1.—The Gobi Plateau.

pretty much the same route as on their return, until they again reached Din-yuan-ing, where their reception was by no means so hospitable as on the previous occasion. Fortunately they fell in here with a caravan of Tangutans bound for the Lama Monastery of Chobsen, within a short distance of Lake Koko-nor, the great goal of Col. Prejevalsky's efforts. After many attempts to prevent it on the part of the prince of Din-yuan-ing, the party set out with the Tangutan caravan, and, notwithstanding the country being overrun with the Dungans or Mohammedan rebels, Chobsen was safely reached. This monastery is about forty miles north of Sining-fu, on the south-western slope of the mountains bordering on the Tatung river, which lie to the north-east of Lake Koko-nor, and form part of the southern boundary of the Desert of Gobi. Among these mountains a considerable time was spent in hunting and making collections in natural history. The party "also investigated, *de visu*, for the first time it is believed in modern history, the famous rhubarb plant in its native region." The inadequacy of his means compelled Col. Prejevalsky reluctantly to give up the idea of penetrating as far as Lhassa. The basin of Lake Koko-nor was, however, explored, and the travellers pushed on to the south-west, through the region of Tsaidam, which is described as a vast salt-marsh covered with reeds, as if recently the bed of a great lake, and is said by the Chinese to stretch west and north to Lake Lob. Col. Prejevalsky proceeded as far as the lofty and uninhabited desert of Northern Tibet, turning at the upper stream of the great Yang-tse-Kiang, here called by the Mongols the Murui-ussu.

The party retraced their steps leisurely as far as Din-yuan-ing, where they arrived in a most worn and ragged condition. After a rest here they set out to attempt what was probably the most arduous part of their undertaking, the crossing of the heart of the great desert of Gobi from south to north, a feat never before attempted by any European. "This desert is so terrible, that in comparison with it the desert of Northern Tibet may be called fruitful. There, at all events, you may find water and good pasture-land in the valleys ; here there is neither the one nor the other, not even a single oasis ;

everywhere the silence of the Valley of Death." Kiakhta was reached on October 1, 1873.

Such is a very brief outline of the route traversed by the small expedition under Col. Prejevalsky. It gives no idea of the amount of work done, and the many difficulties which had to be overcome. Though the Colonel had a pass from the Chinese Government, it was not of much use to him. At almost every stage obstructions were thrown in his way, and had the party not been able to obtain a living by their guns they would either have had to starve or turn back. The whole distance traversed was upwards of 7,400 miles.

Col. Prejevalsky's object was not simply to get over a certain amount of ground. In many respects he is well qualified to conduct a scientific exploring expedition. Not only is he skilled in all kinds of surveying work necessary to map a country, but has evidently a good

FIG. 2.—Mongol Girl.

knowledge of geology, and is above all an accomplished zoologist and botanist. At every stage he stops to describe deliberately the natural features of the region, its inhabitants, its history, and to give long lists of the animals and plants collected. Some idea of the importance of the expedition from a scientific point of view may be learned from the fact that the plants collected amounted to 5,000 specimens, representing upwards of 500 species, of which a fifth are new. But especially important was the booty in zoology, which is Prejevalsky's own specialty, for this included thirty-seven large and ninety smaller mammals, 1,000 specimens of birds, embracing 300 species, 80 specimens of reptiles and fish, and 3,500 of insects.

It would be impossible within the space of a notice like the present to give any adequate idea of the kind and amount of information contained in these volumes. No such keen-sighted and accomplished traveller has been over the same ground before. We shall endeavour to indicate a few of the points referred to. In the Introduction, besides the matters already referred to, Col. Yule adduces strong proofs for the existence of the wild camel on the north-west borders of China, and gives a few valuable notes on the real nature of Tibetan Lamaism. The Gobi desert, both in its eastern and central positions, is at last described with something like adequacy; it is probably one of the dreariest tracks on the face of the earth. One of the strong features of the book is its ethnology; all the groups of people passed through are described in detail. A whole chapter is devoted to the Mongols, containing minute particulars as to their manners and customs. In the same way many important notes are given concerning the Chakhars, the Ordos, the Oluet or Ala-shan Mongols, the Tangutans, and the Dungans or Tungani. A large space is devoted to an account of the Mongol camel, in which some points are brought out that will be new to many; and the Argali (*Ovis argali*) and its habits are described in considerable detail, as also the White-breasted Argali of Northern Tibet (*Ovis poli*). Geographers will find some valuable information concerning the present course of the northern bend of the Hoang-ho, which is many miles south of that which is found on many modern maps. There seems to be now only one main channel, the two northern ones being dry. Many evidences are adduced to show that much of the region through which the expedition travelled was at one time an inland sea; most of the lakes are salt, and the country of Ala-shan seems to be one great desert of sand and clay mixed with salt. Col. Prejevalsky mentions an interesting fact showing how particular may grow into general terms. He tells us that the Mongols apply the term "Russian" to all Europeans, and affix "French" or "English" as they wish to designate either of these nations. They also believe the latter to be vassals and tributaries of the former, and Col. Prejevalsky mentions several circumstances tending to show the great opinion of Russian power held by the inhabitants of Central Asia. Lake Koko-nor and the region around it, as well as the province of Kan-su generally, in which the expedition spent many months, are described in all their aspects with the greatest minuteness.

But it is needless to attempt to give any adequate idea of the contents of these two volumes; they are a perfect mine of information about the whole of the little-known region visited by Col. Prejevalsky and his companions. The work is a fine example of what the narrative of a scientific exploring expedition should be, and although Col. Prejevalsky delivers "a plain unvarnished tale," his work is full of interest from beginning to end, even for the omnivorous "general reader." The map which accompanies the work is on a large scale and is filled in with such minuteness as to present a satisfactory bird's-eye view of the principal results of the expedition, and the illustrations are both attractive and useful. To quote the words of Col. Yule, "the journey and its acquisitions form a remarkable example of resolution and persistence amid long-continued toil, hardship, and difficulty of every kind, of which Russia may well be proud."

THE MOABITE QUESTION

Die Aechtheit der Moabitischen Alterthümer Geprüft. Von Prof. E. Kautzsch und Prof. A Socin. (Strassburg, 1876.)

Moabitisch oder Selimisch? Die Frage der Moabitischen Alterthümer neu untersucht. Von Adolf Koch. (Stuttgart, 1876.)

IT was perfectly natural that the discovery in 1868 of the famous Moabite Stone, which created such a sensation all over the civilised world, should have made literary and scientific men wish to explore the dangerous eastern side of the Dead Sea. Hence, when Dr. Ginsburg set forth the importance of an expedition to Moab in his paper before the Geographical Section of the British Association (Liverpool, 1870), the Association willingly granted 100*l.* towards the contemplated expedition, and in the following year supplemented this grant by another 100*l.* But this expedition which took place in the beginning of 1872, contributed next to nothing to our former knowledge of the trans-Jordanic regions. The only thing which it did effect was indirectly to encourage the designing Arabs in their production of Moabite antiquities.

Travellers in Syria well know the pertinacity with which they are pursued by the Arabs, who in every locality offer all sorts of relics for *Bakshish*. Hitherto these antiquities were principally confined to coins, chiefly of course shekels and half-shekels, bronzes, armoury, gems, wooden utensils, and pictures from the time of Christ, made by eye-witnesses of the scenes described in the Gospels. Since the discovery of the Sinaitic Codex and the Moabite Stone, however, which fetched so high a price, and which have created a perfect rage among a certain class of itinerant scholars for acquiring like precious relics, the finds have in a marvellous way corresponded to the desires of the inquiring travellers. A few months after the Tristram-Ginsburg expedition, in search for antiquities and specimens of natural history in Moab, was fitted out on such a pompous scale at Jerusalem, where the object of the journey became at once blazoned about, a number of inscribed stones were discovered, among which was one recording Psalm cxvii. As Herr Weser, the Chaplain to the German Consulate and Colony at Jerusalem, is the principal literary and scientific agent, who not only tested these Moabite antiquities on the spot, but also forwarded drawings of them to Germany and finally, with Prof. Schlottmann, induced the Prussian Government to purchase them and deposit them in the Berlin Museum, we cannot do better than give this learned Divine's own words :—"The fourth stone is to me the most interesting. It contains Psalm cxvii. in magnificent ancient Hebrew characters, similar to those on the stone of Mesha. Who knows but that this stone contains the very original from which the Psalm was read and adopted into the collection of Psalms." (*Die Aechtheit*, p. 13.)

As the famous Moabite stone records a biblical event, parallel to the one recorded in 2 Kings, iii., a discovery was at once made which should completely eclipse the narrative of this lapidary document, and at the same time vie with the celebrated Codex Sinaiticus. Prof. Scholz, who has been working for several years on the Massoretic text of Jeremiah in its relation to the Greek Septuagint, was in Jerusalem in 1870. Of course he visited Shapira's Antiquarian establishment, and naturally enough inquired after MSS. of the Hebrew Scriptures, when lo, and behold! this honest merchant showed the Professor, amongst other ancient Biblical documents, a remarkable manuscript of the very prophet on which Dr. Scholz was commenting. Here again we must give the words of the learned German, but this time no less a person than "Professor of Exegesis of the Old Testament and the Biblical Oriental Languages at the University of Wurzburg." In his work on Jeremiah which appeared at Regensburg, 1875, this learned Professor remarks :—"Perhaps it is not beyond all hope that science will come into possession of the text of Jeremiah which the Septuagint translated. In 1870 the author visited the bookseller Shapira at Jerusalem, who showed him a manuscript of Jeremiah, written very beautifully, without vowels and accents, which he averred corresponded to the translation of the Septuagint. When I called again, after a few days, it was sold to an Englishman. According to Herr Shapira, who declared that he possessed evidence for his statement, the MS. is of about the time of Christ."

But though *savans* like Pastor Weser and Prof. Scholz were easily deceived by the Psalm Stone and the Jeremiah MS., yet it was soon found that to continue discoveries in the department of Old Testament documents was both unprofitable and hazardous for very simple reasons. It is well known, even at Jerusalem, that no manuscript of any portion of the Hebrew Bible prior to A.D. 800 has as yet been discovered. If a MS. pretending to be of even 200—800 A D. were to be forthcoming, the science of palæography is now so definite and unerring that it would be detected at once. Nor could discoveries of any lapidary documents which exhibited a continuous narrative in any known Semitic dialect be safe, since the science of language is now so exact that an attempt to impose upon philology or palæography is almost certain to break down. Hence if the rage for inscriptions created by the discovery of the Moabite stone, and increased by the Tristram-Ginsburg Moabite expedition, which left England at the beginning of January, 1872, was at all to be gratified with any chance of safety and profit, nothing was left to the dealers in antiquities at Jerusalem but to open up new mines. This was easily done.

Selim, who was in the service of the Duc de Luynes and M. de Saulcy, when these French *savans* travelled in Moab, and who had also been employed by M. Ganneau to negotiate with the Arabs at Dibon for the Moabite stone, was out of employment. Such an indication of Providence was too plain to be mistaken by good Shapira. Accordingly Mr. Shapira employed him at a monthly salary, to go to Moab in search of antiquities, and in addition to his fixed pay promised him a premium on every discovery. With such a temptation before him, this unmitigated rascal whom Drake describes as "a well-known scoundrel and forger," set out for Moab. No wonder that the search conducted by such a man and with such prospects, was eminently productive. In May, 1872, that is about a month or six weeks after the Tristram-Ginsburg expedition returned from Moab, a few specimens of pottery appeared at Mr. Shapira's depôt. In July the collection increased to 600 pieces, in October

to 700 pieces, and soon after it mounted up to 1,800 pieces. Shapira was now enabled to divide the finds into three collections, as follows :—

Collection 1. Containing 911 pieces, 465 inscribed ;
„ 2. Containing 493 pieces, 60 inscribed ; and
„ 3. Containing 410 pieces, 68 inscribed.

These collections embrace urns and pots, figures, idols, and birds partly entire and partly broken. Some of these antiquities have found their way to Stuttgart, but the bulk, consisting of the choicest specimens and numbering in all about 1,700 objects, have been bought from Shapira by the Prussian Government for 22,000 thalers = 3,300*l.*, and are now deposited in the Berlin Museum. Prof. Koch, the author of the second treatise under review, who visited Shapira's depôt in 1875, tells us that this dealer has now another collection consisting of no less than 724 pieces, of which 133 are inscribed, containing in all 4604 letters (Dr. Koch, p. 3–22).

The interest of science in these discoveries is immense. If these antiquities could be proved to be genuine, their contribution to ethnology, history, mythology, philology, and palæography could hardly be overrated. They would exhibit to us the history of the mental and moral condition of a country, which has played an important part in ancient times, and about which we know next to nothing from the incidental and fragmentary allusions in the Old Testament. Literary and scientific opinion in England has almost unanimously declared these finds as forgeries. In Germany, however, where so many of the articles themselves are deposited, not a few men of eminent scientific attainments believe in their genuineness. Some of the results of these discoveries have even been embodied in no less a work than Riehm's "Dictionary of Biblical Antiquities," the distinguished editor of which professes to exclude everything that is controvertible, thus stamping this contribution as veritable history. The divided opinion in Germany may moreover be seen from the fact that of the two treatises which head this article, No. 1, by Professors Kautzsch and Socin, is against, whilst No. 2, by Prof. Koch is for the genuineness of these discoveries. After a careful study of the question, we shall endeavour to describe as briefly as possible the arguments adduced by Professors Kautzsch and Socin against the finds, with which we fully agree, unless those scholars who believe in the antiquities can produce more conclusive evidence.

1. The Duc de Luynes, M. de Saulcy, Palmer and Drake, Tristram and Ginsburg have more or less searched the country, and could find no traces of such articles, though the Moabites were perfectly alive to the value which Europeans set upon the most insignificant relic of any kind ; and though these Arabs, as we ourselves can testify, scraped together and offered for sale the most contemptible objects bearing the semblance of a relic.

2. In consequence of the large sum which was paid for the original Moabite stone, manufactories were opened in Jerusalem and elsewhere which produced inscribed stones, pottery, and other relics. That such forgeries were constantly forthcoming is admitted even by those who believe in the genuineness of the pottery in question. Indeed, Prof. Koch himself gives a detailed description of some of them (p. 67, &c.).

3. There can be no doubt that Selim was perfectly qualified to design these articles, both by his previous occupation as a Christian artist of sacred pictures, and by his subsequent training under the Duc de Luynes, M. de Saulcy, and M. Ganneau. That such an undertaking would be in perfect harmony with his well-known character as scamp and wholesale forger will likewise not be questioned.

4. The extraordinary rapidity with which these Moabite antiquities were supplied by Selim, when nothing of the kind could be found before, goes far to show that they were made under his direction. Only a few months before, we ourselves visited and searched some of the spots where Selim pretends to have made these discoveries, and could find no trace of such antiquities. The American exploration party have been there since (1873), and could likewise find nothing.

5. Drake and Ganneau traced the spot where these antiquities were made, and declared that they were manufactured in Jerusalem, transported to Moab, where they were buried, and then exhumed and sold to Shapira.

6. The intermixture of the earliest Phœnician with later forms of letters of which the inscriptions are made up, betrays the clumsy and unskilful manner in which they have been put together. That Selim and his companions knew these characters is perfectly certain. Not only did Selim copy for Ganneau some of the veritable Moabite inscription, but he and others possessed a fac-simile of the inscription ; and we ourselves have seen in the hands of Mr. Shapira and other dealers in Jerusalem parts of the *Transactions* of the German Oriental Society, Levy's "Phœnizische Studien," with fac-similes of various inscriptions, the fac-simile of the Eshmunazar Inscription, and the leaf from Madden's "History of Jewish Coins," which gives the different Semitic alphabets. These were carefully studied in Jerusalem.

7. But what confirms us in the belief that these inscriptions have been produced by individuals who simply knew the ancient alphabets but did not know how to compile a single sentence is the fact that, even under the immense pressure of Prof. Schlottman's great learning, the inscriptions have yielded no sense. So eminent an epigraphist, as the late Rödiger was forced to say, "that though these extensive Moabite texts are mostly written in characters, the value of which is perfectly fixed and certain, no connected sense can be discovered in them." ("Zeitschrift der Deutschen Morganländischen Gesellschaft," xxvi. 817.) The force of this remark will be felt all the more when it is remembered that the language of the real Moabite stone can be understood by every Semitic scholar. Prof. Schlottman, who is too scientific an epigraphist not to see the strength of this argument is obliged to resort to the expedient that the inscriptions contain "strong abbreviations and permutations of letters."

The most extraordinary part of the controversy is the indecision about the clay of the pottery. We should have thought there could not have been two opinions among experts upon this question. If the authorities in the keramic art cannot definitely decide whether a pot or urn is three years or three thousand years old, there is little encouragement for those who have lately paid such enormous prices for old China. But whatever be the result of the controversy, the treatises of Professors

Kautzsch, Socin, and Koch which it has elicited will remain valuable contributions to palæography, and if it should call forth any more such solid disquisitions, science will be permanently benefited.

HOOKER'S "PRIMER OF BOTANY"

Science Primers. Edited by Professors Huxley, Roscoe, and Balfour Stewart.—"Botany." By Dr. J. D. Hooker, C.B., P.R.S. (London: Macmillan and Co., 1876.)

IT is now almost universally admitted that the study of botany may be made an excellent training for children; but the extent of the subject is so great, and the phraseology has become so overwhelmed with technical terms that even those who have been the most anxious to see the science generally introduced into our schools as a branch of education, are much perplexed when called upon to determine in what way it can best be taught. Some think it most prudent to confine the attention of children to such points as may be observed with the unaided eye, or at any rate to such points as only require the help of an ordinary magnifying-glass; hence they limit the teaching of botany to a study of the more conspicuous parts of the higher groups of vegetable life, and leave the study of physiology and histology to a more advanced age. There is, no doubt, much that can be said in favour of this view, for in order to become fully acquainted with these branches of botany a much greater experience and skill in manipulation and experiment are required, as well as the use of high magnifying powers, than, it is quite certain, a child can be expected to possess. At the same time this limitation to so small a portion of botanical science has the tendency to produce in the mind contracted ideas respecting the true scope of the subject; for to a large extent it only admits of facts being heaped upon facts, without their proper connection one with another being made manifest. It is owing to this want of concatenation in the teaching that has led many to think less highly of botany as a branch of education than they otherwise might have done, and that its introduction into schools has not met with so much success as its more sanguine advocates could have wished to see.

The "Primer" of Botany by Dr. Hooker will go far to remove these difficulties, which have hitherto stood in the way of a more successful treatment of the subject; for in the simplest language, and with an absence of all technical terms but such as are absolutely necessary for a proper comprehension of the subject—and which, when they do occur, are always fully explained—the pupil is introduced to all the most important facts connected with structural and physiological botany. These facts, by means of a judicious arrangement and proper explanations, are made to exhibit their mutual dependence upon one another, and the work thus forms a continuous argument from beginning to end. Although the book contains only 112 pages, and is profusely illustrated, there is hardly a point in structure or physiology that is not touched upon, and so far as the scope of the book will allow, fully explained. A further very noticeable characteristic of the "Primer" is that the pupil is instructed to draw conclusions from information derived from observation founded upon experiment as well as from direct observation.

To teachers the "Primer" will be of inestimable value, and not only because of the simplicity of the language and the clearness with which the subject matter is treated, but also on account of its coming from the highest authority, and so furnishing positive information as to the most suitable methods of teaching the science of botany, and for the want of which the instruction given in schools has hitherto been too often of a most capricious description. Again, those who have the formation or management of gardens, set aside for botanical purposes, entrusted to them, will find the list of plants at the end of the book extremely useful, as it contains those which experience has shown to afford the best examples of the particular characters it is desirable to illustrate; they are also such as may be readily procured and easily grown.

If the "Primer" has long been looked for, the high expectations which have been raised are not doomed to be disappointed, and it may be confidently anticipated that its introduction into schools will determine very largely the direction which the teaching of botany in this country will take for the future.

M. A. LAWSON

OUR BOOK SHELF

Aventures Aériennes et Expériences Mémorables des Grands Aéronautes. Par W. de Fonvielle. Ouvrage orné de 40 gravures. (Paris: E. Plon, 1876.)

M. DE FONVIELLE'S name is no doubt familiar to our readers as that of an experienced scientific aëronaut and writer on aëronautics. In the work before us he has traced in an interesting and instructive manner the history of ballooning from the first rude attempts to rise in the air, down to the elaborate experiments and machines which have been devised at the present day. He has evidently spent considerable pains to obtain a complete knowledge of the history and methods of ballooning, and his scientific knowledge enables him to point out in the many experiments which have been made, the causes of failure or success. The work is evidently meant mainly for popular reading, and those who understand French will find it full of interest. The author attempts to show how practically to utilise a discovery which up to the present time has produced few practical results. He is quite opposed to all the fantastical projects which have been proposed and tried in aëronautics, and treats his subject, on the whole, in a sensible and moderate fashion, showing that those chimerical schemes have been really hindrances to the improvement of aërial navigation. He shows that important meteorological results might be obtained by properly organised ascents, and that indeed in this respect results of some importance have already been obtained. The numerous illustrations are interesting, and altogether the work may be regarded as an important contribution to the history of aëronautics.

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.*]

New Laurentian Fossil

MR. JAMES THOMSON, of Glasgow, who has been for some years on the out-look for fossils in the Laurentian rocks of Scotland, and has searched parts of Argyleshire, Inverness-shire, Ross-shire, and Caithness with this object, has lately been rewarded by the discovery, in the neighbourhood of Tarbert,

Harris, of what is regarded by every Palæontologist who has seen the specimen as an unquestionable *organism*. It forms part of a limestone bed intercalated with dark grey shale, and occurs in the midst of highly metamorphic rocks (among them a graphite granite), which were regarded by Sir Roderick Murchison as of Laurentian age, and which have ever since passed as such—no doubt being entertained as to their antiquity by Dr. Heddle, of St. Andrew's, who has geologised over the whole of Harris.

Judging from the sections which Mr. Thomson has forwarded to me, the fabric seems to have consisted of superposed layers of calcareous shell-substance, whose continuity is frequently interrupted; the spaces between these layers, which are much thinner than the lamellæ themselves, being irregularly and imperfectly divided (very much as in Eozoon) into separate chambers, which are filled up with calcite. The state of preservation of the fossil thus corresponds exactly with that of the Silurian *Stromatopora*, to which, indeed, it bears a strong general resemblance, except in the larger proportion borne by the solid fabric to the chambers it encloses. The shelly layers are as distinct in character from the calcite contents of the chambers, as are those of the Nummulites of the pyramid-limestone, with which they agree in their remarkable hardness, corresponding with that of porcellanous shell. Altogether I have no hesitation in concurring with Prof. H. A. Nicholson, Prof. Geikie, and Mr. Etheridge in affirming it to be so unmistakeably organic, that, if it be claimed by mineralogists as a "rock-structure," a large number of universally-accepted fossils will have to go along with it. As it is *essentially calcareous* in its composition, there is no room for the hypothesis of its production by the process of "mineral segregation," which is maintained by certain Mineralogists (others of at least equal eminence, however, entirely dissenting from them) to have been adequate to the production of the alternating layers of serpentine and calcareous shell-substance in the Canadian *Eozoon*. And though mineralogical analysis might not improbably detect small particles of various minerals in its substance, their presence no more establishes its claim to be regarded as a mere rock-structure, than does the presence of siliceous films (probably replacing the soft parts of the animal) in a piece of coral-limestone.

Not having made any other than a general examination of the structure of the Harris specimen, I do not feel able to give a positive opinion upon its affinities; and it may be that these may long remain doubtful. But this doubt no more constitutes an adequate reason for refusing to accept its organic origin, than it does in the case of *Stromatopora;* which no Mineralogist that I ever heard of claims as a mineral, though the Zoologist cannot say with certainty whether it is a foraminifer, a sponge, a coral, or a polyzoary. It is to be borne in mind that in very few Palæozoic fossils is there a *precise* conformity to any existing type; and such conformity is, of course, still less to be expected in a Laurentian than in a Silurian fossil.

It is not a little singular that I should have received about the same time from Prof. Möbius of Kiel, specimens of a new Foraminiferal organism, discovered by him in 1874 on a coral reef off Mauritius; which presents more resemblance in its spreading and encrusting mode of growth to the indefinite expansions of *Eozoon* and *Stromatopora*, than does any Foraminiferal type previously known. Truly, as I have before had occasion to say, "there is no limit to the possibilities of Foraminifera."

I have only to add, in regard to the Harris fossil, that the further prosecution of the inquiry into its structure and relations has been placed by Mr. Thomson in the able hands of Prof. H. Alleyne Nicholson, and that it is at the joint request of these two gentlemen that I make the present communication.

WILLIAM B. CARPENTER

The Warm Rain Band in the Daylight Spectrum

ON taking my accustomed spectroscopic peep at the sky today, through a little garret window in the Royal Observatory here, I was instantly struck with the presence of the same dark band in the spectrum to which I called your attention last summer twice over (vol. xii. pp. 231, 251).

The band was very faint, but it was there, and this was its first appearance, to me at least, during the present year. I have not indeed been so persevering in that sort of observation as I perhaps should have been if furnished with better instruments, yet for weeks and weeks past I *have* scanned the sky, not only when it was heavily clouded, but also when rain was actually falling with west, south-west, and north-east winds, and sometimes during dense, wet fogs, when very little daylight at all was left, and under some preternaturally low barometric pressures. Yet, under all these circumstances, I put the spectroscope back into its box after each trial with the assurance that no rain-band had then been shown by it. This morning, however, and under a barometer not low, viz., 29·8 British inches, the band exhibited itself instantly; and on my going out to look at the direction of the wind, behold it was from the south-east. Wherefore I had no scruple in informing a professor whom I met in the afternoon at the College, and who, after his day's work there was going home to indulge in the amenities of horticulture, that his flowers were certain of presently having the luxury of *warm rain*.

Such rain, too, did begin, within an hour of that interview, with large heavy drops, and the evening has ended with almost a soaking rain.

It is rather too soon to attempt fully to describe the spectrum appearance, much less to explain it, before I have had the privilege of using anything in the way of a notable spectroscope upon it. But having been already written to for some practical information, even from St. Petersburg (where NATURE is evidently read with attention), I may remark that the nebulous band character of the phenomenon is simply a result of want of light; for when the quality to give the band was present in the air, and the sun has been prevailed on to shine for a moment through that air, and into the spectroscope, the band was instantly resolved into a group, or groups, of fine and sharp black lines, exquisitely visible.

But as the sun is seldom to be seen in any weather threatening rain, whether warm or cold, in fact, cannot be consulted precisely at those times when he is most wanted, it is better to restrict such pluvio-spectroscopy to ordinary sky, *i.e.*, clouds or air; and if possible in a polar direction, so as to be equally distant from the sun, whether visible or not, all the day through; and not too low, in altitude, lest smoke, local moisture, and other impurities have too great and variable an influence. The Observatory garret-window here, I regret to say, is not so unexceptionably situated in azimuth as it might be, for it looks out straight to the south, and the angle at which I usually look through it, on being measured to-day, turned out to be 23°.

Nevertheless, at that altitude, keeping to it steadily on all occasions, and in that direction, avoiding always the garish spectra of actual sunshine, and depending not on any particular and absolute spectrum representation in the published maps of other observers, but chiefly or entirely attending to the *differences* observed by myself from day to day in my own manner with my own little tube, there was no difficulty in instantly pronouncing this morning that there was something in the air through which daylight was then passing different from what it has been for several months past.

Whether that something is only watery vapour at a high temperature (seeing that watery vapour at a low temperature does not produce it), or whether the air is carrying something else with it, giving to the south-east winds here a slight approach to the quality of the siroccos of the Mediterranean, which are often transfused with fine dust along with their warm rain, and do produce some very noteworthy markings in the spectrum, is a matter for further and wider research by those who are instrumentally and financially better able to follow it up; and who should therefore be implored in the present state and needs of science to perform their part without further delay.

PIAZZI SMYTH,
Astronomer-Royal for Scotland

Edinburgh, April 24

Limestone Makers

MR. J. MUNRO'S interesting letter and sketch which appeared in NATURE, vol. xiii. p. 510, show how much may be done in the Tropics by ordinary observers towards elucidating many geological problems. His sketch is that of one of the genus Corallina, a member of the Florideæ, and it is a very common lime maker at the Bermudas. Although Mr. Munro will not find a list of the different limestone makers in books, still in the vast unwritten knowledge of geology it is well known that shells, foraminifera, serpulæ in numbers, and huge masses of Nullipores, besides the corallines, contribute to the coral stock.

The corallines present many and varied forms on our own coasts, but their beauty and construction are remarkable in the warm waters of the Gulf Stream and Caribbean Sea. Through the kindness of Mr. Henry Lee I have lately had the opportunity of examining the newly-started growth of the common *Corallines officinalis*, but curious as its cellular development is, it is

a dwarf in comparison with those seen by Mr. Munro and Mr. Quin. Doubtless the broken-down and pulverised corallines fill up many a crack in the reef's limestone. Should Mr. Munro be desirous of seeing some of his old West Indian corallines, I shall be glad to show him some microscopical results of work upon them.

P. MARTIN DUNCAN

Geological Society, May 1

History of Magnetism

A PARAGRAPH in the article on "The Early History of Magnetism," in your last number, contains a passage which requires, I think, a note of explanation. The writer says: "A Latin letter ascribed to Peter Adsiger, 1269, preserved among the manuscripts of the University of Leyden, contains the following remark on the declination of the needle . . ." Now Humboldt, on the authority of Libri, denies the existence of the passage in the Leyden MSS., affirming that it is only an interpolation in a Paris copy. But what is of more importance, he also states that the title of the letter is "Epistola Pêtri P. de Maricourt *ad Sigernum* de Foucoucourt." E. Walker, in his well-known essay on Magnetism, refers to Cavallo as quoting the supposed letter of Adsiger.

S. J. PERRY

Meteorological Society

WHILE thanking you for your friendly notice of the Annual Report of this Society, I trust you will allow me to state that we have not made "the mistake in science regarding the height of the thermometers above the ground," as very naturally imagined by you from the matter not having been mentioned. The fact is, we have been unusually strict on that point; our thermometers are all 4 feet (within, perhaps, 2 in. + or −), and as the uniformity was so strict, it was considered useless to repeat the statement for each station, and so, finally, it escaped mention altogether in the printed abstract. Of course the question (Report, p. 52), "What is the height of the bulbs above grass?" is duly answered on the MS. inspection forms deposited in the library of the Society.

May I, in conclusion, express the hope that the example which we have set by publishing the lithograph ground-plans, and which you so highly approve, may be generally followed both in this country and abroad?

G. J. SYMONS

Meteorological Society, 30, Great George Street, Westminster, S.W., April 28

Destruction of Flowers by Birds

THE enclosed blossoms of the common "wild" cherry (*Prunus avium*, L.) have been mutilated in a precisely similar manner with those of the blackthorn noticed about a year ago in NATURE (vol. xii. p. 26), the petals and stamens still adhering to the separated limb of the calyx, which has been cut through at the exact level of the ovary, which has perhaps been the object of attack. Orchard trees in the neighbourhood from the same stock have also suffered to a serious extent, but the wall-cherries (*P. cerasus*, L.), which are later in flowering, have hitherto been untouched.

R. A. PRYOR

Hatfield, May 2

OUR ASTRONOMICAL COLUMN

THE NEBULA IN ORION.—M. Tisserand, Director of the Observatory at Toulouse, commenced on Feb. 17 of the present year, a close examination of the small stars in the vicinity of the trapezium in the great nebula of Orion, with the Foucault telescope of $0^{m}\cdot80$ aperture, which had been completely mounted at the beginning of the same month. To facilitate the study of this region, which it is intended shall form part of the work with this fine instrument, a chart was prepared on a large scale containing the 155 stars, the positions of which relatively to θ^{1} Orionis, were determined by M. O. Struve (*Observations de la Grande Nebuleuse d'Orion* in the St. Petersburg Memoirs, vol. v.); of these 155 stars it may be mentioned that 150 occur in Sir John Herschel's list in the volume of observations made at the Cape of Good Hope. Especial attention was directed at Toulouse during the few weeks that the nebula could be observed in the last season, to the stars which M. O. Struve had indicated as variable. The star II ($\Delta\alpha\ldots -7''\cdot3$, $\Delta\delta\ldots -27''\cdot6$) which is not in Herschel's catalogue, was noted on Feb. 17 and 21 at the extreme limit of visibility: on following days, when the sky was more transparent, it could not be discerned; at maximum according to Struve this star is of the twelfth magnitude, the smallest star which can be distinctly seen in the Pulkowa refractor being considered 13·5—a very different scale of magnitude, it will be remarked, from that of Bessel; No. 78 ($\Delta\alpha\ldots +34''\cdot5$, $\Delta\delta\ldots +9''\cdot7$), varying, according to Struve, from 12·5 to invisibility, was not discerned; No. 75 ($\Delta\alpha\ldots +21''\cdot3$, $\Delta\delta\ldots +39''\cdot2$) was 14-15 on March 14; Tisserand found No. V. of the Pulkowa list ($\Delta\alpha\ldots +378''\cdot3$, $\Delta\delta\ldots +66''\cdot3$) extremely faint on Feb. 24, and quite invisible subsequently, whence he concludes this star to be also variable, and that its non-insertion by Herschel may have arisen from its being at a minimum at the epoch of his observations.

Thirty-two stars have been remarked at Toulouse, which are not in the Pulkowa catalogue; of these fifteen occur in Bond's catalogue, in vol. v. of "Annals of the Harvard Observatory"; the remaining seventeen which have not, as it appears, been previously observed, are generally very faint, the only notable exceptions being in the cases of two stars, which have the following estimated co-ordinates relative to θ^{1}.

$\Delta\alpha$	... ...	+ 180″	... $\Delta\delta$	... ...	− 180″
,,	... ...	− 110″	... ,,	... ...	− 480″

The first star was 13 (an object termed *très belle* with the Toulouse instrument) on February 17, but had become extremely faint on March 14 and 26. The second star is estimated 13, almost as bright as its neighbour, No. 55 of Struve's catalogue. M. Tisserand states that he has not been able to recognise all the stars in Bond's catalogue, more particularly in the neighbourhood of the trapezium.

The numerous variable stars, which we have now reason to suppose exist in the nebula of Orion, certainly form one of the most significant and interesting features in the history of that grand object.

It may be added here that M. Tisserand has also employed the powerful optical means now at his command, upon observations of the satellites of Uranus.

NEW MINOR PLANETS.—Still another small planet is announced during the last week. It was found by M. Perrotin at Toulouse on April 26, in R.A. 14h. 11m. 48s., N.P.D. 96° 24′; twelfth magnitude.

The planet detected by Prof. Watson at Ann Arbor on April 19 is called No. 161 in the *Astronomische Nachrichten*. These numbers, however, are now in much confusion, and names for those which are observed a sufficient length of time to allow of the determination of elements have an obvious advantage over the system of leaving these planets to be distinguished by a number only. As regards numbers there is even doubt as far back as No. 149, which has not yet been shown to be distinct from Frigga (No. 77).

BIELA'S COMET AND THE NOVEMBER METEOR-STREAM.—If we take for the orbit of the November meteor-stream the elements calculated by Prof. J. C. Adams, and communicated to the Royal Astronomical Society in April, 1867, and for Biela's comet a mean of the sets of elements for the two nuclei in 1866, given by Clausen in "Melanges Mathématiques et Astronomiques," &c., t. iii., of the Imperial Academy of St. Petersburg, we find for the least distance between the tracks of the comet and the meteors, 0·054, the mean distance of the earth from the sun being taken as unity. This nearest point of approach is in heliocentric longitude 61° 30′ (equinox of 1866), where we have—

	Comet.	Meteors.
Heliocentric latitude ...	0° 58′ N.	2° 57′ N.
True anomaly... ...	311° 44′	356° 24′
Radius-vector... ...	1·0266	0·9865

The approximation of the orbit of Biela's comet to that of the November meteor-stream, and consequently to that of Tempel's comet, 1866 (I.), was first pointed out by Prof. Bruhns, of Leipsic, in *Astron. Nach.*, No. 1681, but the heliocentrics there employed were deduced from the geocentric places of Santini's rough ephemeris.

PROF. FLOWER'S HUNTERIAN LECTURES ON THE RELATION OF EXTINCT TO EXISTING MAMMALIA [1]

IX.

THE disputed zoological position of the Lemurs, and the great importance which has been attached to them by some zoologists, who regard them as the direct transition between the lower and higher mammals, and as survivors of a large group now almost extinct, through which the higher Primates must have passed in the progress of their development, give great interest to the consideration of their ancient history.

Until very recently fossil Lemurs were quite unknown, at all events the affinities of certain remains provisionally assigned to the group were much questioned, but within the last few years the existence of Lemuroid animals in Europe during the early Tertiary period has been perfectly established, and remains of a large number of animals attributed, though with less certainty, to the order, have been found in beds of corresponding age in North America.

In 1872, a nearly complete skull of an animal somewhat allied to the modern African Pottos and Galagos, though of a more generalised character both of cranial conformation and dentition, was described by M. Delfortrie, under the name of *Palæolemur betillei*. It was found in phosphatic deposits, probably of early Miocene age, in the department of Lot. It was soon afterwards discovered that certain more or less fragmentary specimens which had been long before described, and had been generally though doubtfully referred to the *Ungulata*, were really nothing more than animals of the same group, and probably even of the same species. These are *Adapis parisiensis*, Cuvier, from the Paris gypsums, *Aphelotherium duvernoyi*, Gervais, and *Cænopithecus lemuroides*, Rutimeyer. The recognition of these animals as Lemuroids shows how little reliance can be placed upon the characters of the molar teeth alone in judging of affinities, and should also lead to the re-examination of some of the smaller mammals of our own Tertiaries, such as *Miolophus*, as it is not improbable that Lemurs may be found among them. The same deposits in which M. Delfortrie's specimen was found, have since yielded two other skulls, one of smaller and the other of larger size, named by M. Filhol, *Necrolemur antiquus* and *Adapis magnus* respectively. It should, however, be mentioned that M. Filhol only admits the first to be a true Lemur, and considers the genus *Adapis* as the type of a hitherto unknown group of mammals, intermediate between the Lemurs and Pachyderms, to which he gives the name of *Pachylemur*.

Of the supposed low and generalised forms of Primates from the Tertiaries of North America, the existence of which was announced almost simultaneously by Professors Marsh and Cope in 1872, it is difficult to speak with certainty at present, as the descriptions which have reached this country are not very detailed. As many as fifteen genera have already been named. They are nearly all from the Eocene formations, two only having been found in the lower Miocene.

The remains of no true monkeys have hitherto been discovered in the Eocene, but several species have been found both in Miocene and Pliocene formations in Europe. The most abundant and best preserved are those from Greece, *Mesopithecus pentelici*, allied to the existing genus *Semnopithecus*, though with shorter and stouter limbs. Others have been found in the Siwalik Hills of India allied to the same form, and in France, the South of Germany, and Italy, related to the Macaques and to the Gibbons. The most interesting species is one known by the lower jaw only, from a Miocene bed at St. Gaudens, in France, described by Lartet under the name of *Dryopithecus fontani*. Its affinities have given rise to some discussion, but as far as can be decided from the evidence before us, it appears intermediate between the chimpanzee and gorilla, and of the size of the former. Considering how nearly the Miocene fauna of Europe resembles in its general features the actual fauna of Africa, it is not surprising that an ape of the genus *Troglodytes* should have formed part of it. No remains of monkeys allied to the existing American forms have been found in the Old World, and conversely, all those discovered by Lund in the Brazilian caverns belong to the families now inhabiting the same part of the world. No monkeys have yet been found in the alluvial deposits of the plains, which are so rich in the great Edentates, nor in fact have they been met with in any older South American Tertiaries. The ancient history of the group, as revealed to us by palæontology, is therefore extremely incomplete. Further researches into the fauna of the North American Eocenes may throw some light upon it.

No actual remains of man have been met with which can be said with certainty to be older than the Pleistocene period, though it is asserted that his existence upon the earth in the Pliocene and even Miocene epoch is proved by works of art found in deposits of those ages. These, however, are questions to be decided by the antiquary and the geologist, and are beyond the scope of the anatomist. The oldest known remains of man from European caves (with perhaps the exception of the celebrated skeleton from the Neanderthal, the age of which is doubtful) do not differ more from modern Europeans than do several of the lowest modern races. In other words, no proof of the existence in former times of a race of men inferior in general organisation to the Australians, and forming any nearer approach to the lower animals, has yet been discovered.

In reviewing our present knowledge of the palæontology of the Mammalia we see immense progress of late years, giving hopes for the future. Here and there we have tolerably complete histories of gradual modification of forms with advancing time, and adapted to the exigencies of changing circumstances, as among the Ungulata and the Carnivora; and we have many instances of extinct forms filling the gaps between those now existing. But still there are great gaps or rather gulfs between most of the large groups or orders, without at present any trace of connecting links, or anything to indicate how they were once filled up, as must have been the case if they have all been gradually evolved from a common origin. We have very much to learn before we can speak with any confidence upon the manner in which all the diversities of form we see around us have been brought about, or attempt to construct pedigrees or phylogenies, except in the most provisional and tentative manner.

[1] Abstract of a course of lectures delivered at the Royal College of Surgeons "On the Relation of Extinct to Existing Mammalia, with Special Reference to the Derivative Hypothesis," in conclusion of the course of 1873. (See Reports in NATURE for that year.) Continued from vol. xiii. p. 514.

INTERNATIONAL METEOROLOGY

THE Permanent Committee of the Vienna Meteorological Congress has just held its third meeting in London, which lasted from the 18th to the 22nd April inclusive. The members present were Prof. Buys Ballot (Holland), president, Professors Bruhns (Germany), Cantoni (Italy), Mohn (Norway), Wild (Russia), and Mr. Scott. Prof. Jelinek (Austria) was unfortunately absent owing to ill-health.

Among numerous subjects which came up for consideration, it appeared that the scheme for publication, in a uniform manner, of actual observations and monthly results from a limited number of stations in each country, which are to be considered as international, had been already accepted almost without exception or suggestion of amendment by all the countries which had been present at Vienna. It is hoped that this measure will ultimately tend to bring about uniformity in hours and methods of observation.

In weather telegraphy it was resolved to calculate gradients in the metric scale, as millimetres per one degree (sixty nautical miles). In this country they will be referred to English units. It was not found practicable to endeavour to introduce uniform hours for observations in weather telegraphy in Europe at present. As to weather charts, a proposal for the exclusion of all meridians except that of Greenwich was postponed to the next Congress. It was resolved to take advantage of that meeting to attempt to effect the comparison of the principal standard barometers by means of travelling barometers to be conveyed to the place of meeting, and left there for a considerable time.

It was recognised as impracticable at present to create an International Meteorological Institute, and consequently it was decided that international investigations must be carried on at the expense of individual nations, other nations to be requested to furnish materials, as far as possible, in a usable form. A list of upwards of 200 subscribers to the international synoptic weather charts of Capt. Hoffmeyer was announced.

Resolutions were adopted in favour of the establishment of stations on high mountains, and in distant localities, and Lieut. Weyprecht's proposition for a circle of observing stations in the Arctic Regions round the Pole was recognised as scientifically of high importance and deserving of general support.

With reference to universal instructions for observations it was stated that no general form of instructions could be drawn up to suit all climates, and it appeared to the committee that the instructions recently prepared in the German, Russian, and English languages respectively, as well as in Italian (as soon as some contemplated modifications shall have been introduced), were sufficiently in accordance with the requirements of the Vienna Congress. It was hoped that ere long French instructions of the same tenor would be issued.

It was announced that the Italian Government was prepared to invite the next Congress to meet at Rome in September 1877, and the proposal was most gratefully accepted. In preparation for this meeting a number of reports on the present state of the different departments of the science are called for from various meteorologists. The questions to be treated in these reports are mainly instrumental, and they are of great importance in the present state of the subject. The detailed Report of the Committee will be published without delay.

SOIRÉE OF THE ROYAL MICROSCOPICAL SOCIETY

ON Friday, April 21st, Mr. H. C. Sorby, president of the Royal Microscopical Society, gave a large *soirée* in the apartments of King's College. Invitations had been issued for above 1,500, including the whole of the Fellows of the Royal Microscopical Society, the presidents and leading officers of many of the London Scientific Societies; all the distinguished foreigners now in London as commissioners from the various foreign Governments to the Exhibition of Scientific Apparatus at South Kensington; and many of the President's private friends. About 800 were present, including about 300 ladies. After having been received by the President and one of the secretaries, the visitors passed into the various rooms of the College, in which were exhibited many objects connected with microscopical science. For the number, variety, scientific value, or general interest of the specimens, this exhibition has probably never been surpassed. Amongst the new instruments may be mentioned Mr. Sorby's arrangement for accurately measuring the wave-length of the centre of absorption-bands in spectra; a new form of Stephenson's erecting binocular microscope, by Mr. Bevington, and another by Mr. Browning, of somewhat different construction. Mr. Browning also exhibited his new portable microscope, which is so constructed that the body can be turned on one side and reversed in such a manner as to reduce the height to about one half. The President also exhibited a large series of specimens illustrating his own special subjects, shown by means of fifty microscopes, lent to him by four of the principal makers in London (Becks, Browning, Crouch, and Ross), and about 150 first-rate instruments and objects were contributed by the Fellows of the society and other friends. These were so distributed over the large apartments of the College as to avoid crowding in any part. Almost every branch of science to which the microscope has been applied was well represented, and many of the finest specimens ever prepared were shown and described. Many very interesting living objects were sent direct from the Brighton Aquarium and elsewhere. In the lecture theatre were exhibited Dr. Hudson's most beautiful drawings of microscopic objects shown in a new manner as transparencies; Mr. Spottiswoode's splendid polarising apparatus, and various objects shown with the oxy-hydrogen microscope by How and Company. The large entrance hall was decorated with plants and flowers, and used as a promenade. The two museums of the College were also thrown open. Refreshments were supplied by the steward of the College. The guests were provided with a classified catalogue of the objects exhibited, but they were so numerous that it was impossible for any one to examine more than a small part of the whole. One of the most satisfactory results of the *soirée* is the great impression produced by it on the foreign scientific men, who appear to have been quite unprepared for, and greatly surprised at, what they saw during the evening.

ON CERTAIN METHODS OF CHEMICAL RESEARCH[1]

THE lecturer began by describing the simple form of apparatus which he employed many years ago in his researches on the heat evolved in the combination of oxygen, chlorine, bromine, &c., with other bodies. In every case the bodies to be combined were inclosed in a vessel surrounded with water, and the combination was effected either by the ignition of a fine platinum wire, or where they acted directly upon one another, by the fracture of a glass capsule containing one of the combining bodies, the heat being measured by the rise of temperature of the water. He next referred to the arrangement by which he had been the first to decompose water so as to render visible the hydrogen and oxygen, and to measure their relative volumes by means of atmospheric electricity and of electrical currents from the ordinary machine. For this purpose fine platinum wires were hermetically sealed into fine thermometer tubes, which were then filled with dilute sulphuric acid by withdrawing the air by ebullition. The same current of frictional electricity will decompose the water in almost an indefinite number such couples arranged in a consecutive series. Capillary tubes of this kind may be employed for eudiometric experiments, which would be exceedingly tedious in wide tubes. Thus oxygen gas can at once be absorbed by passing the silent discharge through it while standing

[1] Abstract of a Lecture to the Chemical Society by Dr. Andrews, F.R.S., April 28. Communicated by the author.

over a solution of iodide of potassium. By means of the air pump it is easy with a gentle exhaustion to expand the gas so that it may fill the whole tube while the open end is immersed in the liquid which it is desired to introduce; on removing the pressure the gas will be in contact with the new liquid.

The lecturer exhibited some of the original tubes with which Prof. Tait and he first determined that ozone is a condensed form of oxygen, and explained a form of apparatus by means of which this important fact can be exhibited as a class experiment. A full description of this apparatus will be found in his lecture on ozone, which was delivered some time ago before the Royal Society of Edinburgh, and has since been published by the Scottish Meteorological Society. With this apparatus the lecturer has been able to determine that chlorine gas undergoes no change of volume from the prolonged action of the electrical discharge. His experiments on this subject have not yet been published, but they were made under singularly favourable conditions for discovering a very small change of volume in the gas if any such change had occurred.

The lecturer in the next place briefly alluded to the method he formerly employed for determining the latent heat of vapours of which a detailed account was given in a former communication to the Chemical Society. The apparatus employed admits of exact experiments being made on a small scale, and consequently on substances in an absolutely pure state, an object of even greater importance in inquiries of this kind than in ordinary chemical analyses. He remarked that a large field for investigation in this part of the domain of science lay comparatively uncultivated and would yield a rich harvest of results to anyone who would enter upon it.

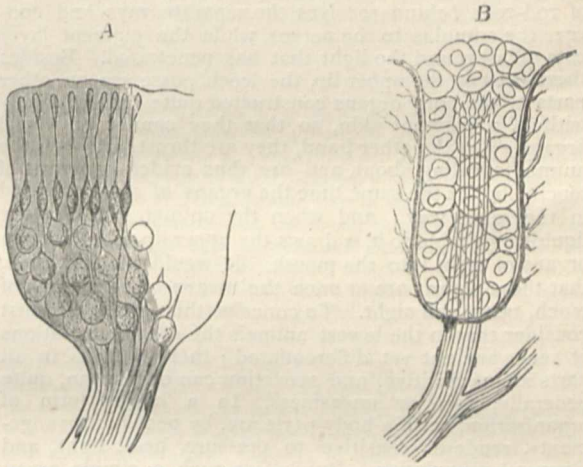
Passing from this subject, the lecturer described a dividing and calibrating machine which he contrived some years ago for the special work in which he has been engaged, and which has given to many of his investigations an accuracy otherwise hardly attainable. He has been enabled by means of it to construct thermometers whose readings are absolutely coincident throughout every part of the scale, and to calibrate with almost perfect accuracy the glass tubes used in his pressure experiments. It would be impossible in an abstract to describe the construction of this machine, but it may be important to mention that the screw which moves the microscope or divider is a short one of remarkable accuracy constructed by Troughton and Simms.

The last subject treated was the lecturer's method of investigating the properties of gaseous and liquid bodies at high pressures and under varied temperatures. By means of his apparatus, which was exhibited to the meeting, pressures of 500 atmospheres can be readily observed and measured in glass tubes—in a word, a complete mastery obtained over matter under conditions hitherto beyond the reach of direct observations. This has been effected by a novel mode of *packing* a fine steel screw, so that while entering a confined portion of water no leakage whatever occurs under enormous pressures, and also by a peculiar method of forming a tight junction between glass and metal. The lecture was concluded by a short statement of the more important results lately communicated to the Royal Society on the properties of matter in the gaseous state.

SCIENCE IN GERMANY

(*From a German Correspondent.*)

IN my last communication (NATURE, vol. xiii. p. 75), I noticed the researches of Ranke on various organs of sense of the lower animals. A new series of these researches having since appeared, I will give some account of them in what follows. Ranke (*Zeitschrift für Wissenschaftliche Zoologie*, xxv., 2 Heft. Supplement.) has studied more closely, in their physiological relations, the organ of hearing of certain grasshoppers (*Acridia*) and snails (*Pterotrachea*), and the eye of the leech, which organs were previously known in general from the researches of Siebold, Leuckart, Leydig, Boll, and others. The Acridia carry their organ of hearing on the base of the hindermost extremity. It consists essentially of a membrane, which is stretched within the body wall on a fixed ring, and an auditory nerve, which is connected from within to that membrane, and ends on it in a swelling or so-called ganglion. That membrane is undoubtedly to be compared with the membrane of the tympanum in the ear of the most highly organised animals; inasmuch as, like this, it is put in vibrations corresponding to the sound-waves in the air, and transfers these vibrations to the parts lying within. In the higher animals, these parts consist of rigid lever arrangements (small bones of the ear), which, however, are connected with the acoustic nerve not directly, but through a transmitting apparatus, which separates the vibrations produced by various sound-waves, and specially prepares them for conveyance by the nerves. In the Acridia, the whole internal conduction of the sound-waves is more simply arranged; the ganglion on the tympanic membrane consists of two different halves; in the interior the finest nerve-threads proceeding from the auditory nerve unite with large round nerve-cells, from



Ganglion of organ of hearing in Acridia (schema after Ranke).

Eye of leech (schema after Ranke).

which they proceed to the boundary of this half of the ganglion, and there end in smaller nerve-cells. The outer half of the ganglion consists of a brighter and delicate ground mass, in which very fine rods, transparent like glass, and fixed, run parallel towards the tympanic membrane; they spring out of those smaller cells, terminate on the tympanic membrane with longish thickenings, and may be regarded as the end-apparatus of the nerve-conduction. But while thus the vibrations of the tympanic membrane are communicated to the rods and from these direct, without further intervention, to the nerve-apparatus, there is not entirely wanting a weakening or damping arrangement for the sound-waves; for the ground-mass, in which the rods rest, may very well be regarded as such an arrangement. As the rods are all formed alike, the sensations of tone by the Acridia must be always homogeneous and simple; and if we may suppose that the organ of hearing of these animals is adapted to their own production of tone, by which they excite sexual desire, then their monotonous rattle agrees with the arrangement of the auditory apparatus for a simple sensation. In other grasshoppers, the Locustida, the vocal organ produces a sound compounded of more tones; and correspondingly, they have on their fore legs an organ of hearing, the rods in which are of various length and breadth, and, arranged like the wires in a

piano, evidently serve for excitation of different sensations of tone. The organ of hearing of the Acridia is then, simple, in a similar sense to that of the simple eyes which perceive light, but not colours and forms; and therefore it closely approximates to the organs of touch, which likewise render sensible simple mechanical stimuli, and are often arranged in a way similar to those organs of hearing.

The eye of the leech consists of a cup-like inflexion of the skin, which is so lined with large transparent cells that only a narrow axial canal remains. The nerve-stem which enters at the bottom of the cup, fills this canal up to a certain height, and ends there with a ganglion, while the nerve-fibres pass into small cells, whose outer end runs out into a short rod; the entire cup is coated round with a pigment skin and enveloped in muscles, which are directed partly parallel, partly at right angles to the skin surface, and therefore can draw the whole cup with its sheath inwards, or press the contents somewhat outwards. The former happens when the animal is surprised by sudden light, just as we close our eyes in like circumstances. After some time, the leech opens its eyes, a part of the glass-like cells on the rim of the open cup being pressed out in form of a compact hemisphere. In this way a pretty perfect visual apparatus is arranged. The outer glass-like hemisphere corresponds to the light-refracting medium of a more perfect eye. The mosaic of rod-cells behind receives the separate rays and conveys the stimulus to the nerves, while the pigment layer cuts off all round the light that has penetrated. Besides these eyes on the upper lip, the leech possesses on other parts of the body organs constructed quite similarly, only without a pigment skin, so that they cannot be visual organs. On the other hand, they are thrust out when the animal is feeling about, and are thus evidently organs of touch; but at the same time the organs of sight are used in the same way; and when the animal sucks in the liquids agreeable to it, it draws the upper lip with the open organs of sight into the mouth. It would appear, then, that these organs are at once the means of sensations of touch, taste, and sight. To conceive this rightly we must consider that in the lowest animals the special sensations of sense are not yet differentiated; their body is in all parts alike sensitive, and sensation can only mean, quite generally, ease or uneasiness. In a higher form of organisation, certain body-parts are, by peculiar arrangements, rendered sensitive to pressure, heat, light, and chemical stimulation. But before such a simple organ of sense develops in one direction for a particular kind of stimulus, it can also communicate simple sensations of a different kind. We ourselves know such a combination of different sensations through the same organ of sense; *e.g.* our ear, at the boundary of the tone-conductors, may feel, instead of tones, simply a vibration or a tickling, and thus has a sensation of touch like that produced in a finger-point when a vibrating tuning-fork is applied to it. Again, in our tongue, sensations of taste, smell, and touch are mixed together. Thus the organ of hearing of Acridia, which can only feel hissing noises, but no tones, may be compared, in the quality of its sensation, to an organ of touch; and of the visual organ of the leech, it may perhaps be said that it receives somewhat of the sensation of touch and taste. In short, Ranke holds these organs to be of such a kind that the general feeling is not yet fully separated into the categories of touch, hearing, seeing, &c.

The ear of the Pterotrachea had long been known as a bladder, on whose inner wall are tufts of hair, the motions of which throw to and fro the otoliths or small spherical stones freely suspended within the bladder. It was believed that these continuous motions were connected with the sensation of hearing. Ranke proves, however, that they are merely due to convulsive movements of the animal in dying under the observation, and that the acoustical apparatus proper consists of a ganglion in the bladder wall, organised similarly to that in the Acridia. In the normal condition, the otoliths are pressed by the surrounding hair-tufts against the acoustical apparatus only in the case of stronger sound-stimuli, and they have then a damping action.

NOTES FROM THE "CHALLENGER" [1]

PROF. THOMSON in this paper after briefly referring to a visit to the Hawaiian crater of Kilauea, proceeds as follows:—

In the section between Hawaii and Tahiti, except at one station close to Tahiti, where the depth was 1,525 fathoms, the depth ranged throughout the section from 2,000 to 3,000 fathoms with a mean of about 2,600 fathoms, and the nature of the bottom was very uniform. Except in the neighbourhood of the groups of volcanic islands, where it was found to be largely composed of volcanic *débris* and shore mud, it consisted mainly of red clay, in many of the soundings containing a large admixture of the decaying shells of Foraminifera, and in almost all including a large proportion of manganese peroxide in the form of concretions from the size of a nut to that of an *Orbulina*, and passing into fine, almost microscopic granules visible under a low power in every sample of sounding. In two patches the siliceous skeletons of Radiolarians were so abundant as almost to entitle the deposit to the name of "Radiolarian ooze," and a patch between these, nearly halfway between Hawaii and Tahiti, in its abundance of surface Foraminifera approached a true "Globigerina ooze." The larger samples of bottom brought up in the dredge or trawl had of course generally the same character as the contents of the "Bailic" sounding-tubes; but in these large manganese concretions, up to the size of an orange, or even larger, were collected in quantity, the greater part of the red clay being usually washed out.

The surface-temperature naturally rose in passing southwards from Hawaii towards the equator, and again sank from the equatorial belt towards Tahiti. The isothermobaths [2] between 14° C. and 24° C. gathered together and approached much nearer to the surface in the region of the trade-winds, owing no doubt to the rapid removal to the hot surface-water by evaporation and the driving action of the wind. Thus the isothermobathic line of 14° C., which is at a depth of 200 fathoms a little to the north of Tahiti, is at a depth of 100 fathoms on the line. In the Atlantic all the isothermobaths seem to participate in the rise in the region of the trade-winds; it is not so in the Pacific; the lines below 14° C. uniformly sink, forming a depression which extends from lat. 10° N. to lat. 10° S.; thus the isothermobath of 5° C., which may be taken as a type of these deeper lines, is found in lat. 10° N. at a depth of 450 fathoms; and in lat. 10° S. at the same temperature within the limits of error of observation, while in lat. 2° 34′ N. it is found at 625 fathoms. The point where the isothermobaths gather together most markedly and approach nearest to the surface is a little to the north of the northern border of the equatorial counter current. This fall of temperature is so decided as to indicate some special areas of cold water; and it may possibly be to some extent due to the pressing up of deeper and therefore colder layers of the colder trade-current against the hot stream. In the equatorial region between lat. 10° N. and 10° S. there is a belt of water about 80 fathoms in thickness at a temperature generally over 25° C., and the whole of this water, with the exception of the narrow band of the counter current, is running to the westward at the rate of from forty to seventy miles a day.

The bottom fauna over the whole of the manganese area is very meagre, both as to number of species and number of individuals.

After a week's stay at Tahiti the *Challenger* left the harbour of Papeete on the 3rd of October, and arrived at Valparaiso on the 19th.

[1] "Preliminary Report to the Hydrographer to the Admiralty, on some of the Results of the Cruise of H.M.S. *Challenger* between Hawaii and Valparaiso," by Prof. Wyville Thomson, F.R.S., Director of the Civilian Scientific Staff on board. Paper read before the Royal Society.

[2] The word *Isotherm* having been hitherto so specially appropriated to lines passing through places of equal temperature on the surface of the earth, I have found it convenient, in considering these questions of ocean temperature, to use the terms *Isothermobath* and *Isobathytherm*; the former to indicate a line drawn through points of equal temperature in a vertical section, and the latter a line drawn through points of equal depth at which a given temperature occurs. Isothermobaths are shown in a scheme of a vertical section, such as Plate II. Isobathytherms are of course projected on the surface of the globe.

The section from Papeete to Valparaiso (Plate III.) is about 5,000 miles in length, and is naturally divided into two parts, the run southwards to the parallel of 40° S., and the course along that parallel towards Valparaiso.

Setting aside Station 279 in 680 fathoms close to Tahiti, the mean depth throughout the section was 2,139 fathoms, considerably less than that of the meridional section from Honolulu to Tahiti, and very much less than that of the section in the North Pacific, between Japan and San Francisco. The nature of the bottom is very much the same as in the meridional section, red clay imbedding nodules, and lumps of various sizes of manganese peroxide, and passing in the shallower soundings into more or less pure Globigerina ooze, and as in the section between Hawaii and Tahiti the fauna is generally meagre. The trawling between Juan Fernandez and Valparaiso (Station 298) was particularly interesting; animal forms were much more abundant than they usually are in the Pacific; and the general character of the assemblage resembled in a remarkable degree that of the fauna of the Southern Sea in the neighbourhood of the Crozets and Kerguelen, many of the species, including some singular Urchin of the family Ananchytidæ, being identical. The bottom at this station was a bluish mud, the surface layer containing little or no carbonate of lime, and curiously enough a deeper layer, with a considerable proportion of Globigerina shells. There was no considerable quantity of manganese in the sounding. Notwithstanding the considerable depth of 2,225 fathoms, the conditions in this locality seem much more favourable to animal life than even the manganese area; and I am inclined to think that we had struck upon one of the highways by which migration takes place to the northward from the Southern Sea.

Although there are certain points which have yet to be worked out in detail, the general distribution of temperature in the Pacific seems sufficiently simple. In the first place, the whole mass of water consists of two well-marked divisions, an upper layer of no great depth, in which there is rapid cooling from the surface downwards, and considerable variation in temperature in different localities; and a mass of water of incomparably greater amount, which extends to the bottom, and which may be said to have nearly the same temperature throughout. These two divisions shade into one another, but the isothermobath of 5° C. may be taken as indicating generally the limit between them; below this line the isothermobaths are still affected by surface thermal conditions, but comparatively slightly. Above the line of 5° C. the course of the isothermobaths is to all appearance entirely regulated by causes affecting the surface-temperature, that is to say directly or indirectly by surface currents produced by permament, periodic, or variable winds. The equatorial current occupies the region of the trade-winds, approximately from lat. 20° N. to 20° S., and there is a strong but narrow counter current entirely comparable with the counter current in the Atlantic between the parallels of 5° and 8° N. The water of the equatorial current has no free egress to the westward, being intercepted by the peninsula of Malacca and the islands of the Malay archipelago; but neither is it completely arrested, as the equatorial current is in the Atlantic by the unbroken coast of America; consequently a return current less permanent and less defined than the return current in the Atlantic finds its way to the north-eastward along the coast of Japan. The course of the Japan current is much the same as that of the Gulf-stream, and is due, as in the Atlantic return current, to the high initial velocity of the intercepted water; its influence on the temperature of the ocean is, however, much sooner reduced and obliterated.

The hot water of the Pacific equatorial current, instead of being gathered together and focussed by the form of the land-barrier, as it is in that of the Atlantic, spreads out in the middle and West Pacific in a vast sheet of abnormally warm water, extending to a depth of nearly 100 fathoms; thus the isobathytherm of 25° C. at 80 fathoms passes near Hawaii and Tahiti, and near the parallel of 20° N. on sections between the Admiralty Islands and Japan. The lower isothermobaths of the upper layer are a little nearer the surface in lat. 40° N. than in lat. 40° S.; and this I believe to be due to the banking of the Antarctic indraught against the Arctic land-barrier, and to be the only case in which the position of the lines of equal temperature in the upper layer is not absolutely dependent upon the wind.

The temperature of the underlying cold water is derived from another source, and its distribution is governed by other laws. Throughout the Pacific the isothermobath of 5° C. maintains on the whole a very even course, oscillating between the 400 and 500-fathom lines. These oscillations depend upon causes acting on the surface, for the line rises and falls in harmony with the higher isothermobaths. The line of 5° C. deviates sensibly on two occasions from its comparatively straight course. In the equatorial region it sinks to a depth of 625 fathoms, probably from the communication of heat from the upper layer of water by mixing; and in lat. 40 it rises to 300 fathoms, probably, as I have already said, from the accumulation of cold water against the Arctic barrier. The next three degrees of temperature are lost with increasing slowness in the next 700 fathoms, the line of 2° C. making a very even course at a depth of 1,100 fathoms, and the remaining degree or degrees and a fraction is lost between 1,100 fathoms and the bottom. The depth of the Pacific increases slowly from the south to the north, the mean difference between the depth of the South Pacific and that of the north being perhaps as much as 1,000 fathoms. Notwithstanding this increase in depth, we have satisfied ourselves, although the determination is one of great difficulty, that the bottom temperature rises slightly from the south northwards. We can scarcely say more than that it rises slightly, for the differences in the temperatures below 1,500 fathoms are so small that a result can only be arrived at by a careful combination and comparison of many observations, taking into full consideration the errors of the thermometers arising from all sources. There is a like very slight decrease in the bottom-temperatures from east to west.

I think we can scarcely doubt that like the similar mass of cold bottom water in the Atlantic, the bottom water of the Pacific is an extremely slow indraught from the Southern Sea. That it is moving, and moving from a cold source, is evident from the fact that it is much colder than the mean winter temperature of the area which it occupies, and colder than the mean winter temperature of the crust of the earth; that it is moving in one mass from the southward is shown by the uniformity of its conditions, by the gradual rise of the bottom-temperatures to the northward, and by the fact that there is no adequate northern source of such a body of water, Behring's Strait being only forty fathoms deep, and a considerable part of that area being occupied by a warm current from the Pacific into the Arctic Sea, and by our knowledge from observations that one or two trifling currents from the Sea of Okotsk and the Behring Sea, which are readily detected and localised, and are quite independent of the main mass of cold water, represent the only Arctic influx. During its progress northwards the upper portion of the mass becomes slightly raised in temperature by mixture with, and possibly by slow conduction from, the upper layers which are affected by solar heat. At the end of the Gulf, that is to say in the extreme north, furthest from the cold source, the temperature is, as I have already pointed out, influenced to the very bottom; and the isothermobaths between 8° and 5° C. are obviously raised and pressed together, probably by the accumulation of the cold water against the land. The colder bottom-water to the westward might be expected from the lower initial velocity of the Antarctic water causing it to drag against the west coast.

I am every day more fully satisfied that this influx of cold water into the Pacific and Atlantic oceans from the southward is to be referred to the simplest and most obvious of all causes, the excess of evaporation over precipitation in the northern portion of the land hemisphere, and the excess of precipitation over evaporation in the middle and southern part of the water-hemisphere.

After what I have already said I need scarcely add that I have never seen, whether in the Atlantic, the Southern Sea, or the Pacific, the slightest ground for supposing that such a thing exists as a general vertical circulation of the water of the ocean depending upon differences of specific gravity.

NOTES

THE forty-seventh anniversary of the Zoological Society was held on Saturday last, Viscount Walden, F.R.S., the President, being in the chair. Mr. P. L. Sclater, F.R.S., the Secretary, read the report, which showed that the income (28,738*l.*) was greater than it had been in any previous year since the foundation of the Society. The total number of visitors in 1875 had been 699,918. The new lion house had been, as far as its main portions were concerned, completed and opened to the public. The building contains fourteen dens, the

larger of which measure 20 ft. by 12 ft., the smaller being 12 ft. square. The out-door cages are to be completed by the end of July next; they will measure 44 ft. by 29 ft. Mr. Sclater desired it to be known that of the larger Felidæ, the Ounce (*Felis uncia*) was a desideratum. The adoption of the report was moved by Prof. Huxley, seconded by Prof. Tennant, and carried unanimously.

OUR readers will regret the very sudden death of Lieut. J. E. Cornelissen, which occurred at Brussels in the month of March. Those who enjoyed the pleasure of his acquaintance will remember the hearty sailor-like demeanour of the man, while all who have paid attention to maritime meteorology will be ready to recognise his high scientific merits and the practical turn of mind which made the marine publications of the Utrecht Institute so eminently useful to seamen. He had been for sixteen years at the head of the marine branch of that establishment, having succeeded Andrau. He leaves a wife and four children utterly unprovided for.

THE following are the names of the Commissioners appointed to inquire into various matters connected with the Scottish University:—Lord Justice-General Inglis, the Duke of Buccleuch, Lord Moncreiff, the Right Hon. Lyon Playfair, C.B., Sir William Stirling Maxwell, James Craufurd, one of the Senators of the College of Justice in Scotland, William Watson, her Majesty's Solicitor-General for Scotland, John Muir, D.C.L., James Anthony Froude, Archibald Campbell Swinton, LL.D, Prof. Huxley, Dr. James Alexander Campbell, LL.D.

WE learn from the *Illustrated Australian News*, of Feb. 23, that a party consisting of Mr. Lawes, M. O. C. Stone, F.R.G.S., Mr. Hargreave, of Sidney, and Mr. K. Broadbent, bird collector, together with several Southsea Islanders, have made a successful excursion into the interior of New Guinea from Port Moresby. They attained a village called Munikaihila, situated 1,000 feet above the sea-level, and were well received by the natives. The view from this point was very fine. "All around were mountains and hills of every shape and size, covered with trees to the very summits," and Mount Owen Stanley rose as a grand background to the panorama apparently about twenty miles distant. We shall no doubt shortly receive a notice of Mr. Broadbent's discoveries.

WE have much pleasure in noting that in the monthly publication of tri-daily meteorological observations issued from Vienna, Dr. Jelinek has this year included two stations the observations at which, in addition to their climatological importance, cannot fail to be of the greatest value in constructing weather-maps, viz., Sulina, near the mouth of the Danube, and Alexandria, in Egypt.

IN a further discussion of the temperature observations made at the Museum of Natural History, at Paris, the MM. Becquerel point out that the mean temperature of the soil under grass is a little in excess of that under bare soil, and that under grass the temperature has not fallen below 32°, a fact of some importance in horticulture.

PROF. NORDENSKJÖLD is to leave Gothenburg, on July 10, in a steamer of 163 tons for another cruise to the mouth of the Jenesei. He will sail up the river as far as Dudinko, when the steamer will take merchandise on board and return to Norway, the object of this expedition being to prove that there is a maritime route between Norway and the Siberian coast. We learn from *L'Explorateur*, moreover, that a Russian steamer is to leave the Jenesei and proceed to St. Petersburg by the Kara Sea, the North Sea, and the Baltic.

M. MARIÉ DAVY, the Director of the Montsouris Observatory, is to try whether Crookes's rotating radiometer can be utilised for actinometric purposes. No establishment is in a better position to try the experiment, Montsouris being supplied with regular actinometers, and special tables having been calculated for regulating as far as possible, their daily use.

IT is announced that Sir Bartle Frere is to be made a baronet.

THE Queen has conferred upon Lieut. Cameron—who was presented to her Majesty last Friday—the honour of Companion of the Bath, in recognition of his distinguished services in Africa.

AT the Annual Meeting of the Royal Institution on Monday, a piece of plate and a purse containing 300 guineas, were presented to Prof. Tyndall as a testimonial of congratulation on his recent marriage.

DURING the siege of Paris experiments were tried to make use of the conductibility of the Seine in order to establish communications with the outer world in spite of the Prussian blockade. Paris, however, surrendered before the apparatus had been arranged on the Upper Seine. This scheme has not been totally abandoned, and M. Bourbouge a *preparateur* of the Sorbonne has tried to establish the telegraph without wire. According to M. Parville, the plan has succeeded at a small distance by expending a large quantity of electricity, not less than forty elements being required to work a magnetic needle at a distance of a quarter of a mile. The same experimenter is said to collect spontaneous currents from the earth with large electrodes. The interest of these experiments is unquestionable.

FROM the "Annual Report upon the Survey of Northern and North-western Lakes, in charge of C. B. Comstock, Brigadier-General, U.S.A.," we learn that the triangulation has been carried around the south end of Lake Michigan, and stations have been located for its extension south and east toward Lake Erie. On Lake Ontario the topography has been essentially completed from the head of the Saint Lawrence along the south shore to within twenty miles of the Niagara River, and the off-shore hydrography has made about the same progress. Triangulation-stations have been located as far west as Erie, Pa., and have been built as far as the Niagara River. Charts of Lake Saint Clair, and No. 2 of the Saint Lawrence River are completed. It is proposed during the present fiscal year to complete the field-work of the survey of Lake Ontario and commence that of Lake Erie. In the estimate of $184,000 for the survey of the lakes for the next fiscal year, an item of $25,000 has been included for the survey of the Mississippi River. No complete and accurate survey of the river has ever been made.

PART I., No. IV., for 1875, of the *Journal of the Asiatic Society of Bengal*, contains papers on the Angámi Nágás and their language, by Capt. J. Butler, on the Maiwár Bhils, by Mr. T. H. Hendley, and specimens of popular songs of the Hamírpur District, Bundelkund, by Mr. F. A. Smith.

THE fifth part of the Bulletin of the Bussey Institution of Harvard University for 1876, completing vol. i., has just been published, and contains a number of valuable papers, principally by Prof. Storer, Dr. Farlow, and Mr. Sargent. Dr. Farlow's papers treat of the fungi found in the vicinity of Boston, of the olive and orange trees of California, of the American grape-vine mildew, and of the black knot. Mr. Sargent reports the addition of 165 species of trees and shrubs to the arboretum during the past year, and that over 100,000 plants have been raised. The papers of Prof. Storer, as usual, are of much scientific value.

ON the 10th of January last, Mr. Lancelot Studdert, LL.D., read a paper before the Royal Irish Academy (since published in the *Proceedings* of that learned body) on "The free and

albuminoid ammonia yielded by the stagnant waters of the Dublin streets, as compared with the quantities of those substances obtained from the Liffey water receiving the sewage." Twenty-nine street waters were examined; the mud, also, left from some was examined for ammonia. The following are Dr. Studdert's deductions:—The average of free ammonia from the four samples of the river was 0·0982, or under 1·10 of a grain in the gallon; the average of albuminoid ammonia from the same is 0·0779, or under 1·12 of a grain in the gallon. The average of free ammonia obtained from the twenty-nine street waters is seventeen grains to the gallon; that is, over 170 times the like average from the river. The average of albuminoid ammonia from the street water is three grains to the gallon, or thirty-eight times the Liffey average. The maximum of free ammonia from the river only reached 0·175, or less than 1·5 of a grain to the gallon; whilst the maximum of free ammonia from the street waters was 105 grains to the gallon, that is exactly 600 times greater than the river maximum. The least impure of the twenty-nine street waters yielded nearly three times more albuminoid ammonia than the most impure sample of the river water. The average of disintegrating animal refuse in the Liffey is 0·779, or just 3·4 of a grain in the gallon; whilst the average of such refuse in the street waters is twenty-nine grains to the gallon. That much of this animal matter must, if not rapidly removed, take forms that will vaporise, seems to the writer all but certain, since the conditions for spontaneous decomposition may be said to be always present; and he concludes that the continued presence of so much dirt in the streets would go far to account for the high death-rate (33 to the 1,000, yearly), then lately recorded for Dublin, and that better scavenging and a level surface for the streets are at once required.

THE proposal for establishing a mountain exploration club in America, with similar objects to the Alpine clubs of England and Switzerland, is meeting with a good deal of encouragement, and several meetings have been held for the purpose of organising it.

MR. BRYCE M. WRIGHT, of No. 90, Great Russell Street, Bloomsbury, has just received a most perfect specimen of Fossil Turtle (*Chelonia Hoffmanni*) from the Upper Chalk of Maestricht. It is 4 feet 1 inch in length and 22 inches wide, more than twice as large as the largest English specimens from Harwich and Swanage, Dorset, and is indeed the largest known.

THE correspondent J. C., who last year sent us a query concerning the cause of death of the house-fly, writes that recently he noticed that a humble-bee had five small animals like yellow spiders on its neck, and two more on its body. He had previously noticed a number of hive-bees lying dead on the greenhouse floor. Another correspondent explained that the death of the fly was caused by parasites, and J. C. wishes to know if those on the bee are the same, and if they cause the death of bees as well as flies.

THE Lord Mayor and the Lady Mayoress will entertain the President of the Royal Society, the Astronomer-Royal, the Presidents of the Royal Colleges of Physicians and Surgeons, and other distinguished representatives of science, at a grand banquet in the Mansion House, on Saturday-week, the 13th instant.

THE opening meeting of the Northamptonshire Natural History Society and Field Club was held at Northampton on April 21, Lord Lilford in the chair. This Society starts under good auspices, with a roll of sixty members, and we hope it will soon get into vigorous working trim.

IT is officially announced that the Philadelphia Exhibition will be opened on the 10th instant.

THE additions to the Zoological Society's Gardens during the past week include two Bennett's Cassowaries (*Casuarius bennetti*) from New Britain, presented by the Rev. George Brown; an Indian Gazelle (*Gazella bennettii*) from India, presented by Lieut. King, 76th Regiment; a Common Badger (*Melestaxus*) European, presented by Mr. W. Barneby; a Dusky Ichneumon (*Herpestes pulverulentus*) from India, a broad-fronted Crocodile (*Crocodilus frontatus*) from W. Africa, presented by Dr. Alex. Jennens; four Blackish Sternotheres (*Sternothærus subniger*) from Madagascar, presented by Mr. Lionel Hart; two Protei (*Proteus anguinus*) European, presented by Sir Bartle E. Frere; a White-fronted Capuchin (*Cebus albifrons*) from S. America, a White-throated Capuchin (*Cebus hypoleucus*) from Central America, a Lyre Bird (*Menura superba*) from Australia, a Hoffmann's Sloth (*Cholopus hoffmanni*) from Panama, three Common Boas (*Boa constrictor*) from S. America, deposited; a Collared Fruit Bat (*Cynonycteris collaris*) born in the Gardens.

SCIENTIFIC SERIALS

Journal of the Chemical Society, No. clix., March 1876.—This number contains a lengthy account of the researches of Dr. Wright and Mr. G. H. Beckett on narcotine, cotarnine, and hydrocotarnine, being the third of a series of papers read by them before the Chemical Society on their researches in this direction.—Mr. E. Neison gives an account of the sebates of the alcoholic series and an additional note on the sebate of cobalt.—A paper by Mr. P. P. Bedson, B.Sc., on some compounds of ether with anhydrous metallic chlorides, and one by Mr. R. W. Emerson MacIvor, on the iodides of antimony, complete the list of those papers read before the Chemical Society.—Numerous abstracts of papers published in other journals on various bodies in the different departments of chemistry occupy the greater part of the work now before us.

Gazzetta Chimica Italiana, Fascicolo IX. e X., Anno V., 1875, These parts contain the following papers:—Action of anhydrous chloral, and of the hydrate on aniline, by D. Amato. The author has obtained by this reaction a new base formed according to the equation:—

$$CCl_3COH + 2C_6H_5NH_2 = H_2O + CCl_3CH\begin{cases} NHC_6H_5 \\ NHC_6H_5 \end{cases}.$$

Chloral Aniline New base.

The new substance forms square tabular crystals melting at 100°, soluble in alcohol, ether, and benzene, and insoluble in water. Distilled with excess of potash it yields phenylic cyanide:—

$$CCl_3CH\begin{cases} NHC_6H_5 \\ NHC_6H_5 \end{cases} + 3KHO = 3H_2O + 3KCl + 2C_6H_5CN.$$

The author describes also the hydrochloride $CCl_3(NHC_6H_5)_2HCl$, and the platino-chloride $[CCl_3CH(NHC_6H_5)_2HCl]_2PtCl_4$.—Study of essence of Cubibs, by A. Oglialoro. The author shows that this substance contains:—(1) a small quantity of a hydrocarbon $C_{10}H_{16}$, boiling at 158°—163°. 2. A hydrocarbon $C_{15}H_{24}$, boiling at 264°—265°, forming with hydrochloric acid the compound $C_{15}H_{24}\,2HCl$. 3. A hydrocarbon boiling at 262°—263° not forming a compound with HCl, the composition of which is at present doubtful. The action of these hydrocarbons on the polarised ray is also described.—On the natural poison of the extract of human bodies, by Prof. A. Moriggia and A. Battistini. The remainder of the part is occupied by extracts from foreign journals.

Poggendorff's Annalen der Physik und Chemie. Ergänzung. Band vii. Stück 3.—In a paper in this number on the magnetism of steel bars, by M. Fromme, it is shown that the temporary magnetism increases at first more slowly, then more quickly, and again more slowly than the magnetising force. M. Fromme also got the interesting result that when the remanent magnetism, through repeated action of a force P, has reached its limit, (the saturation corresponding to this force), a smaller force, p, is not capable of altering it. For every permanent moment of a steel bar there are, from zero onwards, a series of magnetising forces, in relation to which the bar has the properties of a bar of soft iron (without coercive force). Exact determinations were made of the function of magnetisation for forces having this effect; and it is shown that the Neumann-Kirchhoff developments on this subject cease to hold good as soon as the steel is permanently magnetic. M. Fromme further finds that the temporary magnetism of a steel bar, with repeated magnetisation by a constant current, decreases, but in such a way that the whole magnetism

remains unchanged; thus, what is gained in remanent magnetism is lost in temporary.—Dr. Dibbit observes that ammonium-sulphate, ammonium-oxalate, and ammonium-acetate, in boiling solution, are partly decomposed, on addition of equivalent quantities of the chloride or the nitrate of potassium, sodium, or barium; that decomposition is greater, the greater the quantity of chloride or nitrate added; and that in all cases the solution contains, at 100°, four salts. From other experiments he infers that the presence of salts in ammonia solution increases the quantity of evaporated ammonia in relation to the evaporated water (even where the salts are such as enter into known combinations with ammonia), and this both at the ordinary and at the boiling temperature.—M. Holtz calls attention to the polar electric attraction of fine particles suspended in liquids when under the influence of electric currents. There is always, along with the movements of translations, an attachment to one pole or the other; very well seen with lycopodium powder in sulphuric ether. Some substances seem indifferent, neither wandering nor clinging to the poles, but if the bottom of the vessel be clean and free from air moisture, they form into beautiful, regular, characteristic figures. These may be had, *e.g.*, with finely-powdered manganese, or iron oxide, or sawdust, in petroleum, oil of turpentine, benzine, or sulphuric ether. The figures are rarely long stable; they show various internal movements, not essentially altering the character of the figure; and there is sometimes rotation.—M. Sohncke advances a new theory of crystalline structure, based on unlimited regular point systems; and Dr. Exner gives an account of his recent researches on galvanic expansion of metallic wires; which are noticed elsewhere in our columns.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, Jan. 15.—Dr. Mohn contributes an article to this number on the causes of the greater depressions of the barometer in winter than in summer. His present views on this subject are different from those given in his work on meteorology. He explains that in order that a barometric minimum may attain a great depth, the ascending current must develop itself with ease and rapidity. Therefore, besides high temperature and a large amount of vapour, the air supplying the ascending current must possess qualities unlike those of the surrounding atmospheric region, so that the ascended air may flow off easily at great heights. The easier barometric maxima can be formed, the easier the development of minima. In winter the strong continuous radiation over the Continent tends to create maxima; the cooling of the air over the sea is moderated by the quantity of vapour always present and by the ocean temperature, so that minima are formed. In summer opposite conditions prevail, but no nightly radiation comparable to that of the land in winter can occur, and thus only small depressions are observed. In a similar way the low pressure of the antarctic zone between lat. 70° and lat. 75° may be understood to be caused by the position of this region between two districts with high pressure, the one northwards about the tropic of Capricorn, the other the great Frozen Antarctic Continent. Between these two maxima lies an unbroken sea developing conditions favourable to the existence of minima.—The next paper is by Dr. G. Hellmann, on the daily period of rainfall at Zechen.

Journal de Physique, January.—The substances used in thermometers are generally such as are not in the neighbourhood of their change of state; but (as M. Duclaux here shows) by using liquids that are near critical periods, very sensitive instruments may be had. Thus, if we mix 10 c.c. of crystallisable acetic acid with 5, 10, 15 c.c. of benzine at about 20° we have, in each case, a homogeneous mixture; and in cooling the three liquids we come, with each, to a point at which it is troubled, and at length divides into two layers. The upper layer is found nearly always to contain one-third of acetic acid for two-thirds of benzine; while the lower contains two-thirds of acetic acid and one-third of benzine. There are few combinations of *two* liquids that show small variations so distinctly as this one (acetic acid and petroleum is another). But a good mixture may be had by taking 10 c.c. of amylic alcohol, 25 c.c. of alcohol at 50°, and adding enough water to produce a slight opalescence. The least fall of temperature divides the mixture into two layers of nearly equal volume. Such a mixture will serve to show, *e.g.*, the cold produced by solution of marine salt in water. By varying the quantity of water the mixture may be so made as to become troubled at any temperature desired; and so a series of minimum thermometers may be constructed. A little carmine may be used to make the changes more apparent.—M. Deprez, in this number, gives some useful directions on the construction of electro-magnetic registers; and M. Branly describes the electrometer he uses for measuring electromotive force, resistance, and polarisation.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, April 28.—Prof. Andrews, F.R.S., delivered a most interesting lecture on certain methods of chemical research (see p. 12).

Anthropological Institute, April 25.—Col. A. Lane-Fox, president, in the chair.—Dr. Comrie, R.N., exhibited his collection of weapons and articles of domestic use from New Guinea, and added several particulars to his previous remarks.—Mr. A. Tylor, F.G.S., read a paper on the origin of numerals. He held that inventive thought had always an object origin, and mentioned measures of length, as pace, foot, hand, &c., as having such a source. Also in the Ptolemaic hieroglyphics, a minute or second was shown by an eye-winking, answering to "the twinkling of an eye." Illustrations of the Abacus and mode of calculating by it were exhibited, and shown to be in principle the origin of the modern calculating machine. The dream of a universal language has been realised, as far as numerals and arithmetical figures are concerned, and this is due to their origin.—A paper by Mr. A. L. Lewis was read on some apparent coincidences of custom and belief in Chaldæa and other countries. He alluded, amongst other points, to the marks of finger-nails upon the terra-cotta deeds that had been discovered at Nineveh. They appeared to him to answer to the practice of touching the seals of legal documents with the finger. As regards the belief of the Assyrians in immortality, souls were either united with the sun, or descended to "Bit-Edie." Annwn, the country of the dead, in like manner amongst the Kymry was situated in the lower regions, at the going down of the sun in the west. The children of Anu, or the Sky, in Assyria, may be compared with "Cum Annwn," spirits, believed in by the Kymry. Amongst the Assyrian gods, Hed answered to the Lycian deity "Hu." Civilisation appeared to originate with the Turanians, the Semitic race merely succeeding to it.—The President, Mr. A. Smee, Mr. Distant, and others, took part in the discussion.

Physical Society, April 29.—Prof. Gladstone, vice-president, in the chair.—The following gentlemen were elected members of the Society: Prof. F. Fuller and Capt. E. H. White.—The Secretary read a communication from Sir John Conroy, Bart., on a simple form of heliostat. The defect of Fahrenheit's heliostat, in which the beam of sunlight is deflected by a mirror moved by clock-work in a direction parallel to the axis of the earth, and then in the required direction by a fixed mirror, consists in the great loss of light. The author substitutes two silvered mirrors for the looking-glasses usually employed, and he has shown that the loss of light with this arrangement is less than when the light is once reflected from a looking-glass.—Mr. S. P. Thompson then made a second communication on the so-called "Etheric Force," and described some experiments which he has recently made in the Physical Laboratory at South Kensington on the subject. The name was given by Mr. Edison, the inventor of the motograph, to the sparks obtained when a conductor is presented to the core of an electro-magnet, the coils of which are traversed by an intermittent current. The results of the experiments conducted as originally described not proving satisfactory, various other arrangements were tried, and it was found that if the secondary current from an induction coil be used, instead of a current direct from the battery, the effects are much more marked. When the induced spark was diverted either wholly or partially into a short coil which was insulated very perfectly from the core inside, a spark about half an inch in length, which had a decided effect on the nerves could be drawn off from the core, and this was sufficient to illuminate a small vacuum tube; the spark, however, does not exhibit the usual signs of polarity. It was shown by observing the illumination thus produced with a rotating mirror, that the discharge is in reality a reciprocating one, each spark returning on its path after a minute interval of time. Under certain conditions it is also possible to charge an electroscope either positively or negatively by means of the spark, and Mr. Thompson has shown that the spark ignites a jet of gas but fails to deflagrate metallic wire or ignite gunpowder. From the above, and other

experiments which will be exhibited on a future occasion, the author concludes that the cause of the phenomena is obvious, and that the hypothesis of a new force is unnecessary.—Prof. McLeod referred to a paper on the same subject which appeared in the *Chemical News* of April 28, by Messrs. Houston and Thomson.—Mr. David Ross, B.A., inquired the tension of the Leyden jar arrangement used in the experiments, but Mr. Thompson pointed out that it would be very difficult of determination on account of the rapid change of the spark from positive to negative.

MANCHESTER

Literary and Philosophical Society, Jan. 25.—Mr. E. W. Binney, F.R.S., vice-president, in the chair.—On stannic arsenate, by Mr. William Carleton Williams, F.C.S., Demonstrator in the Chemical Laboratory of the Owens College.

Feb. 8.—Ordinary meeting.—Mr. Edward Schunck, F.R.S., president, in the chair.—Prof. C. Schorlemmer, F.R.S., read a communication from Prof. Sadtler, of the University of Pennsylvania, on some of the natural gases from the gas wells in Butler County, Pennsylvania, in the midst of the oil region.—Notice of a recent discovery of a prehistoric burial place near Colombier, in Switzerland, by Mr. William E. A. Axon, M.R.S.L.—Mr. Brockbank, F.G.S., exhibited a large collection of granites from the Ravenglass district, and from Criffel, which he had got together with a view to proving the origin of the large granite boulders recently found in the Glacial clay or till of this district.—On the formation of azurite from malachite, by Mr. Charles A. Burghardt, Ph.D.—On a direct-vision spectroscope of great dispersive power, by Mr. Arthur Schuster. This instrument is made by Mr. A. Hilger, of London. The following are its chief advantages :—1. The compound prism has a very great dispersive power. The nickel line between the two sodium lines is easily seen in the solar spectrum. 2. The cross wire is replaced by a very fine slit which can be illuminated from above to any degree of intensity. 3. The slit is moveable by means of a very fine micrometer screw ; the position of the slit can be read off to within 0·0001 inch. The measurement is made by bringing the line to be measured against the bright slit which comes down from the top to the middle of the field. The position of the lines can be easily measured to within the fifth part of the distance between the sodium lines.—On a new absorptiometer, by Mr. Arthur Schuster. In some recent researches Prof. Vogel found that the relative intensity of the red and blue part of the solar spectrum was subject to great changes. While working with the spectroscope at considerable heights on the southern slope of the Western Himalayas, I was struck by the same fact. The instrument which I have now the honour to exhibit before the Society is constructed in order to measure the relative intensity of the red and blue light in the solar or any other spectrum, by comparing the intensity of each ray with that given out by a standard lamp. The photometric principle involved in the measurement is that first used by Prof. Zöllner. The intensity of a certain part of the spectrum is brought to the same intensity as that of the standard light by a system of Nicol's prisms. Prof. Zöllner only compared the whole intensity of two sources of light and did not investigate the relative intensity of the different colours. Mr. D. Glau constructed another apparatus by which he could measure the relative intensity of different colours, but his instrument was constructed for an entirely different object, and is not suitable for the purpose for which the present instrument is made. The instrument, which I have called absorptiometer, because it is intended chiefly for the determination of the absorption of light taking place in our atmosphere, consists of a table similar to that of a goniometer table, but being able to turn round on a horizontal axis so as to give it any inclination to a horizontal surface. The telescope of the goniometer is replaced by a direct-vision spectroscope. Opposite the spectroscope a tube is fixed to the table containing two Nicol's prisms. One of the prisms is fixed, the other can be turned, and its azimuth read off on a graduated circle. The standard light is placed behind its tube. The intensity of the light falling unto the slit of the spectroscope is $\frac{A}{2} \sin \alpha$, where α is the angle between two of the principal planes of the two Nicol prisms, and A the intensity of the light which would fall into the slit of the spectroscope if the Nicol's were removed. A plane parallel piece of glass, acting as a mirror, is fixed unto the small table, the centre of which coincides with the centre of the large goniometer table. The parallel sides can be adjusted by means of three screws until they are vertical. This mirror reaches to such a height that the horizontal plane laid through the top of the plate would bisect the tube containing the two Nicols. The light which is to be examined falls through a tube containing one Nicol, and is reflected by means of the plane parallel mirror into the lower half of the spectroscope. If the ray of light is reflected at the angle of polarisation the intensity of this light can be reduced to nothing by means of the rotation of the Nicol. On placing the standard light in front of the tube containing the two Nicols and allowing the light which is to be examined to be reflected into the spectroscope on the mirror through the tube containing one Nicol, the mirror being placed at the angle of polarisation, we observe in the spectroscope the two spectra one above the other, and by turning the Nicols we can reduce the intensity of the brighter light to that of the weaker for any colour we like. The positions of the Nicols will enable us to find the relative intensity of the two lights for the different colours.

PARIS

Academy of Sciences, April 17.—Vice-Admiral Paris in the chair.—The following papers were read :—New researches on pyrogenous carburets and on the composition of coal gas, by M. Berthelot. Benzine is the most abundant carburet, after formène, in Parisian gas ; it is about 3 per cent. of the volume, and is, *par excellence*, the illuminating carburet.—On the direction of trees thrown down by tornados or trombes, by M. Faye. An observer in the central trajectory of the meteor (which turns from right to left in our hemisphere), and looking in the direction of the motion of translation, will distinguish, in the ravaged band, a right and a left region, and in the trombe an anterior and a posterior half. Then, in the right region, the trombe can throw down well rooted trees by the mere attack of its anterior part, but in the left region it overthrows them by the successive actions of its anterior and its posterior parts. The effects of a cyclone or tornado at sea are analogous.—On the carpellary theory according to the Amaryllideæ (second part, *Clivia nobilis*), by M. Trécul.—Memoir on the existence, the optic and crystallographic properties, and the chemical composition of *microcline*, a new species of triclinic felspar with base of potassium, by M. Des Cloizeaux.—Observations made at the Observatory of Toulouse with the large Foucault telescope, by M. Tisserand. It has been in use since the beginning of February ; the observations described are on the nebula of Orion and on the satellites of Uranus and Jupiter.—Researches on M. Winnerl's compensating balance for chronometers, by M. Caspari.—Conclusions from actinometric measurements made on the summit of Mont Blanc, by M. Violle. He obtains, for the effective temperature of the sun, the value of about 1,500° C., which gives, for the probable mean temperature of the surface, a number between 2,000° and 3,000°.—New researches on the effects of powder in arms, by M. Sarrau. He constructs new formulæ for the velocities and pressures, and deduces the laws according to which these quantities depend not only on the conditions of charging, but on the nature of the powder and the form of the grains.—On the ozone of atmospheric air, by M. Marié-Davy. Comparison by means of ozonoscopic papers are very uncertain. The author sought to associate the rapidity of action of iodide of potassium with the stability of arsenical action ; mixing pure iodide with equally neutral and pure arsenite of potash. From observations at Montsouris, March 15 to 31, it appears that the average proportion of ozone in the air by night was 0·76 mg. (per 100 cubic metres), and thus considerably less than that by day, viz., 1·13 mg. The volume of air operated on each time varied from 2 to 3 cubic metres.—The elephants of Mont Dol ; attempt at organogeny of the system of molar teeth of the mammoth (third communication), by M. Sirodot.—Note on the discovery of a human station, of the epoch of polished stone, near Belfort, by M. Ch. Grad.—Elements of the new planet Una, by M. Peters.—Elements and ephemerides of the planet (148) Gallia, by M. Bossert.—Generalisation of the theorem of Lamé on the impossibility of the equation $x^7 + y^7 + z^7 = 0$, by M. Genocchi.—Note on the foci of a plane curve, by MM. Gibert and Niewenglowski.—Researches on the elasticity of the air under small pressures, by M. Amagat. Under small pressure air still follows Mariotte's law. The opposite has been asserted by MM. Mendeleeff and Kirpitschoff, and that the departure from the law is in the same direction as that of hydrogen.—On the nerve terminations in the electric apparatus of the torpedo, by M. Rouget.—Undulations of the chalk in the north of France. Part III. Age of the undulations ; by M. Hébert.—Daubreite (oxychloride of bismuth), a new mineral species, by M. Domeyko.—On chronic caseous

amygdalitis, by M. Bouchut.—M. Chapelas gave a *résumé* of observations of falling stars during March 1876.

April 24.—M. Peligot in the chair.—The following papers were read:—Discovery of two new planets, 162 and 163; note by M. Leverrier.—On coal-gas and pyrogenous carburets, by M. Berthelot.—On the pyrogenous decomposition of nitrate of ammonia, and on the volatility of ammoniacal salts, by M. Berthelot.—Reply to a part of the criticisms of M. Hildebrandsson (in letter of March 20), by M. Faye.—On the vegetation of plants without chlorophyll, by M. Boussingault. The author affirms that if solar radiation ceased, plants without chlorophyll, as well as plants with it, would disappear from the globe. M. Pasteur asserts that some lower plant forms might continue.—Researches on sugar beet (second year of experimentation), by MM. Fremy and Deherain. Similar saline solutions act quite differently on the roots, according as the latter are immersed in them, or in porous substances impregnated with them. An excess of nitrogenised manure diminishes the saccharine richness of all beets, but those of excellent race retain so much sugar that their cultivation is advantageous.—Experiments made to explain the round alveoli very frequently presented by the surface of meteorites, by M. Daubrée. These bodies, entering the air with high velocity, become incandescent and superficially fused. The part which, at a given moment, is in front, accumulates and compresses the air strongly, so that this is thrown into gyration, and bores a cavity. The mechanical action is generally accompanied by chemical action.—Note on cellular grainage for preparation of the grains of silkworms, by M. Pasteur.—On the triturators and crushers of the Anduze system, by M. Resal.—On the means of substitution of vines in countries where they have been destroyed by phylloxera, by M. Marés. He recommends the wider separation of the stocks.—M. de Baer was elected Foreign Associate in room of Sir Charles Wheatstone. The other candidates were Sir W. Thomson, M. Bunsen, and Mr. Stokes.—Note on an operation of gastrotomy performed in order to extract a solid body (fork) from the stomach, by M. Labbé. The young man (eighteen) retained the fork in his stomach for more than six months, suffering, at intervals, extreme pain. M. Labbé first tried caustics (for extraction), but at length resorted to the knife. He attributes his success (1) to carefully determining the points of operation; (2) fixing the stomach against the abdominal walls before opening it; (3) using a thick layer of collodion, which rendered motionless the abdominal walls and the digestive tube, producing strong compression. In about five days the man was almost in his normal health again.—On the exchanges of ammonia between natural waters and the atmosphere, by M. Schlœsing. Having previously studied the exchanges in rain, dew, fog, he here deals with snow and hoarfrost. The aqueous vapour and ammonia of the air, after having probably a common origin, the sea, are precipitated together, but in very different proportions, as the air is cooled to zero. Under zero the association is broken; water alone continues to be precipitated, and the ammonia remains in the atmosphere, which is then never entirely without it.—On various compounds of titanium, by MM. Friedel and Guérin.—On electric variations of the muscles, and the heart in particular, studied by means of Lippmann's electrometer, by M. Marey. The phases of electric variation of a muscle are similar to those of the work which it furnishes.—On electrical fuses, by M. Ris. He conceived the idea of rendering induction fuses conductive by incorporating with the detonating mixture (having a chlorate of potash base) a small quantity of pulverised spongy platinum. Such fuses are inflammable either by induction currents or by battery currents, and they can be tried without alteration of the elements composing them. If the quantity of platinum be small the resistance of the fuse is considerable, and may reach 50,000 ohms. By increasing the platinum, the fuse is brought towards the condition of those appropriated to currents of quantity.—Fauna and flora of the peat bogs of Champagne, by M. Fliche.—Note on a new process of titration of astringent matters, by M. Jean. Solutions of various astringent principles, with a carbonated alkali added, absorb a solution of iodine with an energy comparable to that of arsenite of soda. This absorption is in direct ratio of the quantity of astringent matter used, and one part by weight of dry tannic acid absorbs four parts of iodine. This is the principle of the method.—Hatching of the winter egg of phylloxera in the Gironde; characters of the insect, by M. Boiteau.—On the chemico-legal investigation of arsenic, by M. Brame.—On the temperature of ebullition of spirituous liquids by M. Salleron. Salts and solid substances dissolved (sugars, tartrates, gums, &c.) falsify considerably the indications of the ebullioscope.—General theorem on the symmetric functions of any number of variables, by M. Jung.—On the cyanide-cyanate of chloral, by M. Cech.—Sulphur in coal-gas, by M. Verigo. The gas in Odessa, he found, contained about 2 grammes of sulphur per 100 English cubic feet. He notes some of its effects, *e.g.*, a metallic part of a ball-shaped lamp, exposed some time in a gas-lit warehouse, had its surface corroded and covered with a greenish substance. The solution, from washing with distilled water, contained sulphuric acid, and gave, on evaporation, crystals of sulphate of zinc. The metallic alloy of the ball consisted of copper and zinc.—On the fructification of some silicified plants, from the beds of Autun and Saint Étienne, by M. Rénault.—New meteorological researches on the circulation of the lower layers of the atmosphere in the North Atlantic, by M. Brault.—In studying the map of the North Atlantic for July to September, one perceives four chief meteorological points that are, in some part, the keys of the situation. These are, on the one hand, the Gulf of Mexico and the Sahara; on the other, the Azores and the maximum region of calms. The two former are the more important, and they are points of convergence of winds. About the Azores turns an immense cyclone.—Process for taking impressions of plants, by M. Bertol.—Geological and anthropological note on Mount Vaudois and the Cravanche Cavern, by M. Voulot.—Experimental researches on pulmonary respiration in the large domestic mammalia, by M. Sanson. Equidæ eliminate more CO_2 per unit of time than Bovidæ, races of less weight more than those of great, males more than females, young more than old. Alimentation does not affect the respiratory function once it is sufficient to maintain the healthy state; nor does muscular work, after it is done. The quantity of CO_2 eliminated is directly proportional to rise of temperature, and inversely proportional to rise of pressure.

GÖTTINGEN

Royal Academy of Sciences, January 8.—The following, among other, papers, were read:—On the organs of vegetation of the Marattiaceæ, by Dr. Holle. By the bilateral arrangement of the vascular bundles Marattia and Argiopteris diverge from the typical ferns, and agree with Ophioglossæ and Osmundaceæ.—A new microscopical drawing apparatus, by Dr. Holle. The principle of this is to bring into view not the pencil itself or its reflected image, but the entire image thrown by lenses. The eyepiece of the microscope serves also as eyepiece of a telescope bent twice at right angles and having two mirrors. The first (transparent) is immediately under the eyepiece, the second under the object-glass of the telescope. The former is very thin (0·2 mm.) that the images of the drawing pencil, cast by the upper and under sides of the glass plate, may fall on each other. The other mirror is thicker; and between the two is a lens which again reverses the reversed image of the pencil. The microscopic image can thus be seen directly and without fatigue of the eyes. The drawing hand is immediately to the right, and so in the most convenient position. The image is unreversed.—Development of formulæ for Abel's theorem, by M. Goran Dillner.—Some remarks on the representation of mountain deities in classic art, by M. Wieseler.

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