THURSDAY, NOVEMBER 25, 1875

THE OXFORD BOTANIC GARDEN

EVERYONE who knows Oxford remembers the quaint old Botanic Garden by Magdalen Bridge at the foot of the High Street. Nearly two centuries and a half have passed since St. James's Day, 1632, when the Vice-Chancellor and the authorities of the University walked in procession from St. Mary's Church to lay the foundation of the main gateway afterwards completed by Inigo Jones. The expense of this and of the high stone walls which surround the garden and protect it from the wind exceeded 5,000*l.*, a large sum even in those days, but which was provided by the munificence of Lord Danby, who afterwards bequeathed some property as an endowment.

The Oxford Botanic Garden is the oldest in Britain, and there are but two or three of earlier date in other countries. The space of this article would be insufficient to do justice to the place which belongs to it and to its successive professors in English scientific history. A few only of its traditions will be enough to show that it has always been a place for study as well as for instruction. Evelyn visited it in 1654, when "the sensitive plant was shown as a great wonder." Twenty years after (1676) Sir Thomas Millington, the Savilian Professor, first divined the fundamental fact of sexual reproduction in flowering plants. Five years later (1681) Bobart, "overseer of the physick gardens," experimentally demonstrated the function of pollen. At the beginning of the eighteenth century the Oxford Botanic Garden solved another great problem. Although Ferns bear no flowers, the world shared the opinion of Columna that they must have flower-produced seeds, because, amongst other reasons, "the book of Genesis said nothing about plants being destitute of them." Fern seed then came to be regarded as existent although invisible, and then by a not unusual transition as the cause of invisibility in its possessors. Morison (1715) disposed of these fancies by demonstrating that the asexual spores of Ferns were actually their means of reproduction. In 1736 the garden —then under the charge of Dillenius, the editor of the third edition of Ray's "Synopsis," and the author of the "Historia Muscorum"—was visited by Linnæus. Here he resided for some weeks, and many particulars have come down to us of discussions amongst the living plants, in which he endeavoured to convert Dillenius to his newly published Sexual System. Passing over Sibthorp and his splendid work on the Botany of Greece, it must not be forgotten that in the Oxford Botanic Garden Daubeny anticipated Draper in demonstrating (1836) that the light belonging to the red end of the spectrum is most effectual in promoting the evolution of oxygen by plants. There is something perhaps characteristic of the habits of forty years ago in his using port wine as one of his absorptive media.

It might be supposed that a place so venerable in its aspect, so interesting in its traditions, would be a source of some pride to the members of an ancient University, and that they would be anxious to give it the needful support to enable it to be as useful now as it has been in the past. Unhappily, the facts show the reverse of this. Notwithstanding the efforts of the present professor, the garden and its buildings have been for some time allowed by the University to sink into neglect, and it is now proposed—mainly at the instance of the Regius Professor of Medicine—to abandon the site altogether and create a new garden in the modern suburb of Oxford and in the vicinity of the New Museum.

It will, of course, be assumed by all who are unacquainted with the real state of the case that the present site is quite unfitted for its purpose; yet there is the very highest authority in such matters for saying that the facts are all the other way, and the Professor of Botany strongly opposes the removal. Soil and situation are all that can be desired, and far better than can be obtained in the "Parks," where the soil is poor and the ground is windswept. A moderate outlay compared with that which removal would entail would make the present garden an all but ideal establishment for the prosecution of every branch of modern botanical research, while, if half a mile distant from the professorial suburb, it is on the other hand ready of access to most of the colleges, where undergraduates reside.

The argument used in favour of the removal is the advisability of bringing together all the scientific institutions of the University. In pursuance of this policy an astronomical observatory has also been built in the Parks at considerable cost, although Oxford already possessed in the Radcliffe Observatory an institution of this kind. If it were profitable for students to rush in hot haste from astronomical instruction to the lectures of the Botany Professor, such a juxtaposition might be desirable. But this sort of omnivorous study is a thing to be discouraged. In the present state of science an hour now and again spent in a professor's lecture-room is of the slenderest value. Oral teaching must be supplemented by workroom study, and if Botany in its modern aspects is to be effectively studied in Oxford at all, students must be encouraged to give to it considerable portions of whole days rather than a mere sporadic attendance. This demand for centralisation does not make itself felt in the other studies of the University, and as regards proximity to the Radcliffe Library, the Botanic Garden already has a fair library of its own.

If the truth must be spoken, this unhappy scheme is one more phase of the feverish æsthetic activity which in modern Oxford seems to have taken the place of enthusiasm for learning. This is not the place to criticise the New Museum erected at vast cost for the scientific studies of the University, but we may challenge any impartial man of science to stand before that fanciful building, half municipal, half monastic in its aspect, and fail to see that it bears the impress of the fleeting artistic aspirations of a period rather than of the sober needs of scientific study. The same impulse which in building a laboratory must needs reproduce the abbot's kitchen at Glastonbury will now, if it have its swing, transform a botanic garden into a pleasure ground, in which the needs of study must once more be subordinated to artistic effect, and conservatories will be built not so much to grow plants as to show how such things can be constructed in the neo-Gothic manner. Forming part of the "Parks," and contiguous to a suburb of villa residences, it will immediately become a pleasant lounge, and the mem-

bers of the University will of course not be satisfied unless the time of the gardeners is pretty fully occupied with decorative floriculture. Comparing such a prospect with the old Garden, one turns to a place whose trim extent is ample for purposes of study, whose old-fashioned aspect is pleasing to the eye without much need of "bedding out," and which is supplied with substantial buildings well adapted for library, herbarium, laboratory, and museum, or which might be made so at comparatively little expense. It is true that the greenhouses are dilapidated and antiquated, but they could be reconstructed against one of the old walls, and this at a much less cost than they could be erected in the "Parks."

The hammer and the chisel resound throughout Oxford. The great court of Christ Church is to be surrounded with useless cloisters. The University Church, having been restored thirty years ago, is to be re-restored in a more critical manner. The beautiful old library of the Bodleian is in no small peril. The secret of all this is easy to read. A new distribution of the funds of the University and colleges is believed to be imminent. From one point of view it is desirable that these should be husbanded to the last penny, in order that new endowments for study and research may be adequate and comprehensive. From the other point of view it is only desired at Oxford *stare supra antiquas vias*, and the money must be got rid of before the time of redistribution arrives. Oxford, alas!—and those who regard her most lament it most—has grown careless that her life should pulsate with the life outside her. What new word in science ever now resounds from Oxford laboratories? Her energies seem lulled in the lethargy of a fastidious, almost feminine, culture. Her professors cannot be denied the possession of capacity and laboriousness, yet if perchance any new teacher is summoned from without to join their number, his friends lament him as one who has fallen away into an intellectual Capua.

To examine is the crown as to be examined is the commencement of an Oxford career. And those who are content that this should be the University's "measure of sufficiency" are only careful that buildings and appliances ancillary to examinations and studies preparatory for them should be after the newest fashion in taste and fitted to excite the admiration of relatives who visit Oxford at Commemoration-time. No one doubts that examinations are useful, and in Oxford, at least, no one will deny that Mr. Ruskin has not written on architecture in vain. But Oxford will not satisfy the hopes of those who look to its treasuries for things new as well as things old, till she has learnt to look upon examinations as by no means a sufficient *raison d'être*, and the wisdom of spending as little as possible upon the decoration, and as much as possible upon the efficient equipment of her workrooms and laboratories.

LOMMEL ON LIGHT

The Nature of Light, with a General Account of Physical Optics. By Dr. Eugene Lommel, Professor of Physics in the University of Erlangen. (London: H. S. King and Co., 1875.)

THIS book forms the nineteenth volume of the International Scientific Series. Nearly all the volumes have passed through more than one edition, and with few exceptions the works are of singular merit. They are, moreover, issued at so low a price that they cannot fail to have largely extended an interest in science and given the public a sound acquaintance with the special subjects upon which they treat. In the long list of the forthcoming volumes of the series, we are glad to find that some of the most eminent English and European men of science have consented to take a part.

In the present treatise, Prof. Lommel has given an admirable outline of the nature of Light and the laws of Optics. Unlike most other writers on this subject, the author has, we think wisely, postponed all reference to theories of the nature of the light until the laws of reflection, refraction, and absorption have been clearly set before the reader. Then in the fifteenth chapter Prof. Lommel discusses Fresnel's famous interference experiment, and leads the reader to see that the undulatory theory is the only conclusion that can be satisfactorily arrived at. A clear exposition is now given of Huyghens' theory, after which follow several chapters on the diffraction and polarisation of light-bearing waves. The reader is thus led onwards much in the same way as the science itself has unfolded, and this we think is the surest and best way of teaching natural knowledge.

Let us now look a little more closely at the book before us. It is evidently a translation, and as such the author's meaning must to some extent suffer, but on the whole the translator has done his work fairly well. We regret, however, to meet with some inaccuracies in the use of terms that ought not to have escaped revision. For example, on p. 228 we read: "The intensity (or energy) of light depends on the *liveliness* of the vibrations." The word *liveliness*, though used less objectionably in other parts of the book to express brilliancy, is here most likely to mislead the reader. For liveliness one may take to mean either extent and vigour or quickness of vibration; if the reader has the former meaning uppermost, he has of course gained a right conception, but if the latter, an erroneous idea is conveyed. The ambiguity of the word is fatal to its use in the passage we have quoted. Again, on p. 250 the word *fluids* is used when *liquids* should have been employed; the passage as it stands runs: "Glowing *fluids*, between the molecules of which the force of cohesion still acts, exhibit a continuous spectrum." This, of course, is not true of elastic fluids, as gases and vapours. The same error we notice also elsewhere, *e.g.* on p. 242. Again, on p. 261, the translator makes Prof. Lommel say: "When a telescope is used for the purpose of observing a diffraction image, *it* is formed in the focal plane of the objective." What is formed? Surely not the telescope Throughout the chapters on diffraction the term "elementary rays and elementary waves" is incessantly used; the more familiar term, "secondary waves," is not employed; we think it would have been well to have helped the general reader by a reference to the latter expression in a footnote or otherwise.

So likewise we find the term "fasciculus of rays" everywhere employed, where it is common for us to use the term pencil or group; it would have been pleasanter to have varied the expression occasionally by the use of one or other of its synonyms. On p. 249, "consistence of the chord" hardly expresses with sufficient exactness the word "density" for which it is used. Freshness

of expression is welcome, but not at the expense of accuracy.

Then, again, we wonder what was the object of the translator in tacking on to many words their German equivalent; if the meaning were doubtful to him, or could not be rendered, that would be all very well; but when a plain man finds in the text the statement that

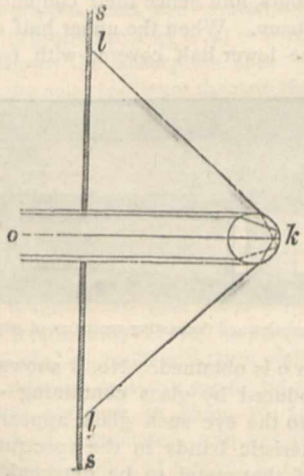


FIG. 1.—Refraction and internal reflection in a raindrop.

solid bodies are held together "by a powerful force which is termed the force of cohesion (Zusammenhangkraft)," he is apt to be a little frightened. The translator possibly felt that after the insignificance of our English term, it was necessary to give a powerful German word to express the powerful force. This, however, does not explain the occurrence of German expressions elsewhere in brackets.

These little defects are perhaps incidental to the first edition of a translation; of Prof. Lommel's work we have already expressed our high opinion. The explanations of phenomena are extremely clear and precise, and here and there appendices furnish elementary mathematical reasonings which, though wholly omitted from the text, are desirable in some places to give the reader a more complete knowledge. The chapters in which the undu-

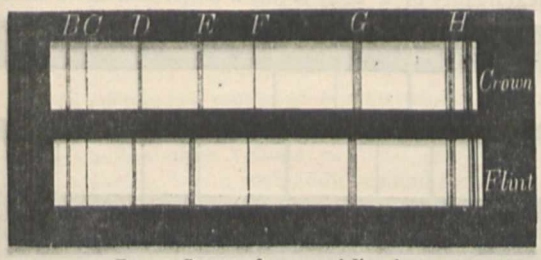


FIG. 2.—Spectra of crown and flint glass.

latory theory is employed to explain the phenomena of reflection, refraction, &c., seem to us extremely useful and clearly written. Nowhere, in an elementary book, have we met with so simple and elegant an explanation of the reason why the energy of a vibration is proportional to the square of its amplitude as that given by the author on pp. 227 and 228.

Here is a simple experiment to illustrate the formation of the rainbow, that we have not before seen in a text-book:—

"Upon a glass sphere *k*, filled with water and having a diameter of four centim. (1½ in.), a beam of solar light of equal or greater diameter than the sphere is allowed to strike horizontally, and there is then seen, upon a large screen *ss*, placed in front of the sphere, and perforated in its centre to allow the passage of the incident rays, arranged concentrically to the aperture and at a distance from it which is nearly equal to that of the sphere from the screen, a beautifully coloured circle, in fact a circular spectrum, the colours of which are arranged concentrically, and in such a manner that the red is outside and the violet on the inside. At a still greater distance from the centre of the screen a second similar but much fainter circle is observed, the colours of which however succeeded one another in the inverse order, the red appearing on the inside, and the violet at the outer periphery." (p. 122.)

The different dispersive power of bodies is instructively shown by comparing the spectra given by crown and flint glass (Fig. 2), wherein it is seen that although the total dispersion, that is the length of the spectrum, is exactly the same, the mode of dispersion is different. By the position of the Fraunhofer lines in the two spectra, "it is rendered evident that the less refrangible rays are more closely approximated in passing through the flint glass, whilst the more refrangible are separated further from one another than by the crown glass." (p. 139.)

The difference in the nature of the dispersion is subsequently shown (chapter xviii.) to be caused by a difference in the rate of propagation of the various undulations when passing through many solids and liquids. Hence "the proposition that all kinds of

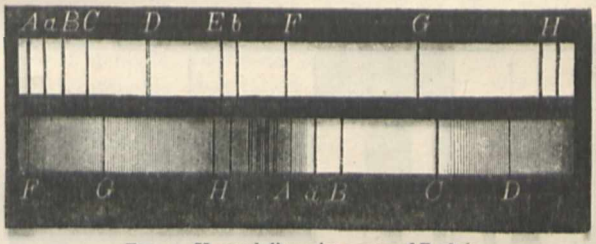


FIG. 3.—Unusual dispersive power of Fuchsin.

light are propagated with equal rapidity, which was shown to be true of the free ether of the universe, is found to be no longer admissible for the ether contained in the interior and occupying the interstices of the particles of natural substances." Very strikingly is the influence of the nature of the material particles on the velocity of propagation exhibited in those substances in whose absorption spectra one or more very dark lines appear. "If we introduce, for example, an alcoholic solution of the aniline colour 'fuchsin,' into a hollow prism, and look through it at a brightly illuminated slit, we obtain a spectrum in which blue and violet are less deflected than yellow and red. What is elsewhere the end of the spectrum here appears at the commencement; towards the middle it fades, and in the centre the green, being absorbed, is absent (Fig. 3). From this behaviour the conclusion may be drawn that in 'fuchsin' the blue and violet rays are propagated with greater velocity than the red and yellow. This phenomenon, which was discovered by Christiansen, and was shown by Kundt to be presented by a great number of absorbing substances, has been called the *anomalous dispersion of light*." (p. 244.)

The phenomena of absorption are treated very fully in this volume.

A pretty mode is given by the author on p. 177 of showing how the absorption bands yielded by a coloured body, gradually thicken, but are not displaced, when greater depths of colouring matter are used. "To demonstrate this a number of gelatine discs coloured with

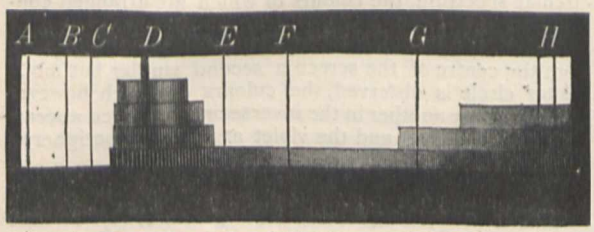


FIG. 4.—Absorption of colouring matter of litmus.

litmus may be used, which are placed between two colourless glass plates in a graduated manner. If these be placed before the slit, there will be seen in the aperture (Fig. 4) the graduated amount of absorption corresponding to the different thicknesses of the gelatine. In the case of the thinnest layer only a thick dark band is seen in front of D, whilst the thickest layer only permits the red end of the spectrum to be seen. The appearance of this spectrum explains why a layer of litmus gradually increasing in thickness first appears whitish, then blue, then violet, and finally purple red."

The next diagram (Fig. 5) represents the absorption

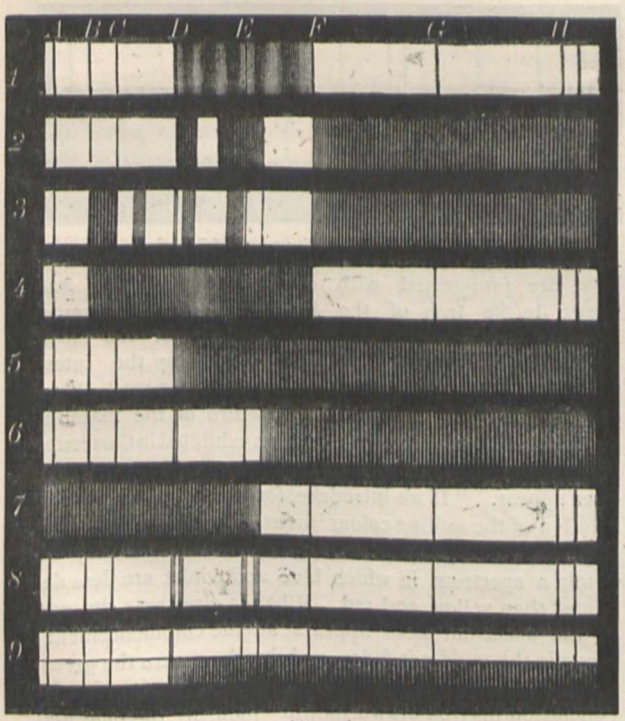


FIG. 5.—Absorption spectra.

spectra given by different bodies, the Fraunhofer lines being used as convenient standards of reference. The uppermost band, 1, is the spectrum as modified by transmission through a solution of permanganate of potash; the absorption by blood diluted with water is shown in 2, the violet end of the spectrum being cut out and two broad bands between D and E making their appearance; an alkaline solution of chlorophyll gives the absorption shown in 3; glass coloured blue by cobalt is shown in 4, and coloured red by oxide of copper in 5; solution of bichromate of potash is given in 6, and of ammoniacal oxide of copper in 7—these two are seen to transmit complementary colours, and hence their conjunction cuts off the entire spectrum. When the upper half of the screen is white and the lower half covered with red paper, the

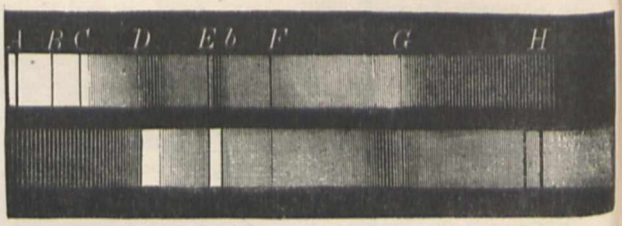


FIG. 6.—Absorption and fluorescing spectrum of napthalin red.

effect shown in 9 is obtained. No. 8 shows the absorption lines produced by glass containing didymium in combination; to the eye such glass appears colourless, but the characteristic bands in the spectrum enable the faintest trace of that metal to be detected. Conversely by heating the oxide of didymium to incandescence, bright lines appear in the spectrum of the emitted light in the place of the dark lines. As is well known, the oxides of didymium and erbium are rare examples of glowing solids giving a linear and not a continuous spectrum.

Concerning the production of these bright lines, Prof. Lommel remarks further on (p. 250): "The vibrations which the molecules of solid and fluid [liquid] bodies exhibit under the influence of the force of cohesion, do not prevent the simultaneous occurrence of those vibrations within each molecule to which the molecule is attuned owing to its chemical composition. As a general rule the latter are not visible, because the bright lines which correspond to them disappear upon the bright background of the continuous spectrum. The characteristic linear spectrum which discloses to us the chemical quality of a body is much better and more clearly

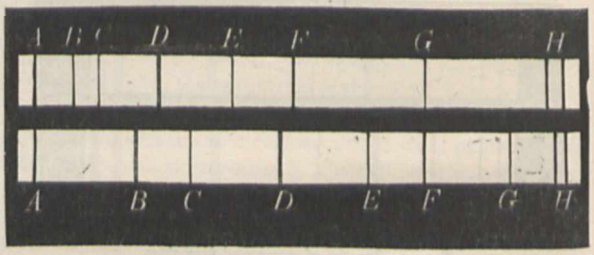


FIG. 7.—Comparison of prismatic with grating spectrum.

seen when its molecules, freed from the chains of cohesion, enter into the gaseous condition." We ought in fact to find the traces of its linear spectrum in a glowing liquid; if, for example, the metal sodium be heated to incandescence in nitrogen, the yellow portion of the spectrum should be more pronounced than the remaining regions; and if the glowing liquid metal could slowly pass into glowing gas, the extinction of the whole spectrum, except the characteristic D lines, should proceed imper-

ceptibly. From the law of continuity this must necessarily be the case in the transition of every solid into a gas, yet we are not aware of any definite experiments on this point.

The reciprocity of radiation and absorption is well illustrated by a comparison of the fluorescent and absorption spectrum of what the translator terms napthalin red; we presume rosaniline is meant. If the solar spectrum be projected upon a glass cell containing this liquid, the fluorescence exhibited in Fig. 6 (2) is seen. In the upper diagram is shown the absorption spectrum obtained by transmitting the solar spectrum through the same solution, and it will be clearer to the eye than it is in the diagram, that the three regions of strong fluorescence are in the same position as the three principal absorption bands. By employing a solution of proper strength, it will be found indeed that "every dark band in the absorption spectrum corresponds to a bright band in the fluorescing spectrum." (p. 190.)

The last diagram we give shows in an instructive manner the irrationality of the dispersion spectrum, by a comparison of the normal spectrum yielded by a diffraction grating with the ordinary prismatic spectrum (Fig. 7, 1). The last sentence in chap. 19, referring to this diagram, is badly translated, and certainly ought to be amended, for as it stands at present it is unintelligible.

We have said enough to show that Prof. Lommel's treatise is a useful contribution to the International Series, and is a book that can thoroughly be understood and enjoyed by any intelligent reader who may not have had any special scientific training. The familiar chromolithograph of different spectra which adorns the title-page of the volume has by this time lost its novelty and become wearisome. No book on chemistry, astronomy, or physics seems to be issued without it. Though the spectroscope is a wonderful and powerful instrument, yet the prominence of this subject is a little apt to throw equally valuable instruments into the background.

W. F. B.

DARWIN ON CLIMBING PLANTS

The Movements and Habits of Climbing Plants. By Chas. Darwin, M.A., F.R.S., &c. Second Edition, revised. With Illustrations. (London: J. Murray, 1875.)

THIS volume is a reprint of Mr. Darwin's well-known treatise on the habits of climbing plants, published in 1865 in the ninth volume of the "Journal of the Linnean Society," with such additions and corrections as the progress of knowledge since that time has rendered necessary. Although the subject had been investigated previously to that time by the German physiologists Palm and Von Mohl, it was Mr. Darwin's publication, describing many facts not previously recorded, that first introduced the remarkable phenomena connected with it to the notice of the general public. The phrase Climbing Plant is used by Mr. Darwin as a generic term for all those which, provided themselves with but weak stems that have no power of standing erect, avail themselves of the assistance of neighbouring plants for the purpose of raising their foliage and flowers to a considerable height from the ground. The plants included under this head are arranged in four divisions, according to the part that is modified in order to subserve this purpose: (1) Twining Plants (called in the first edition Spiral Twiners), in which the stem is the climbing organ; (2) Leaf-climbers, which climb by the aid of the petiole or some other portion of the leaf; (3) Tendril-bearers, by far the most numerous class, which are provided with tendrils specially contrived for this purpose; and (4) Hook and root-climbers, which climb by the aid of hooks on aërial roots, or merely scramble over other plants. In all these classes except the last, the mechanical means by which the climbing is effected is a sensitiveness and power of revolution possessed by the extremity of the stem or tendril, or by the petiole.

The origin of this peculiar power is one of the most interesting points of the inquiry. In some cases, as Passifloraceæ and Cucurbitaceæ, it is possessed by nearly or quite every species of the order; other orders, as Leguminosæ, include species belonging to two or three divisions of climbers, along with a large number which do not possess the power; while in others, as Compositæ, Rubiaceæ, Scrophulariaceæ, and Liliaceæ, it belongs to only a very few out of a large number of genera. From these facts, and the wide separation, on any system of natural classification, of the orders which contain climbing plants, Mr. Darwin draws the conclusion that "the capacity of revolving, on which most climbers depend, is inherent, though undeveloped, in almost every plant in the vegetable kingdom"—a conclusion which seems to us strongly confirmed by the fact that sensitiveness and a slight power of spontaneous motion are possessed by some parts of flowers where it is of no use for climbing purposes, as the flower-stalks of *Maurandia* and *Brassica Napus*; and by the remarkable observation of Fritz Müller—one of the most interesting additional notes in the present volume—that "the stems, whilst young, of an *Alisma* and of a *Linum*," which do not climb, "are continually performing slight movements to all points of the compass, like those of climbing plants."

These observations lead Mr. Darwin to a discussion of the nature of the difference between the so-called "spontaneous" power of motion of some plants and that possessed by animals, which he sums up as follows:—

"It has often been vaguely asserted that plants are distinguished from animals by not having the power of movement. It should rather be said that plants acquire and display this power only when it is of some advantage to them; this being of comparatively rare occurrence, as they are affixed to the ground, and food is brought to them by the air and rain."

In the present work Mr. Darwin makes ample reference to the light that has been thrown on the habits and movements of climbing plants by researches of a later date than the publication of the first edition, especially those carried out in the Würzburg Laboratory by De Vries and Sachs; and one of the most important of the additions is a paragraph wherein he expresses his partial dissent on one point from the conclusions of the last-named high authority. In his "Text-book of Botany," Sachs attributes all the movements of tendrils to rapid growth on the side opposite to that which becomes concave; these movements consisting of revolving nutation, the bending to and from the light and in opposition to gravity, those caused by touch, and spiral contraction. While

conceding this view with regard to all the other causes of movement, Mr. Darwin finds a difficulty in accepting it as regards movement caused by curvature from a touch, or what is ordinarily called sensitiveness. On this point he remarks that the movement of Revolving Nutation (Sachs's term for "the continuous self-bowing of a whole shoot successively to all points of the compass") differs from that due to touch, in so far that in some cases the two powers are acquired by the same tendril at different periods of growth; and the sensitive part of the tendril does not seem capable of nutation. A more important cause of hesitation is the extraordinary rapidity of the movement. Mr. Darwin has seen the extremity of a tendril of *Passiflora gracilis*, after being touched, distinctly bend in twenty-five seconds, and often in thirty seconds; and he doubts whether it is possible to believe in such rapidity of growth as would account for such movement. In reference to this we may simply remark that instances are on record of extraordinarily rapid growth—as in the case of the flower-stalk of *Vallisneria* to the extent of half an inch in an hour or more—even without any abnormal irritation.

The student will find in Mr. Darwin's work a *résumé* of everything known to the present date on this interesting and curious department of Vegetable Physiology.

OUR BOOK SHELF

Report of the Meteorological Reporter of the Government of Bengal for 1874; *and Administration Report of the Meteorological Reporter to the Government of Bengal for* 1874-75. By W. G. Willson, Officiating Meteorological Reporter. (Calcutta: Bengal Secretarial Press, 1875.)

THIS Report, drawn up by Mr. W. G. Willson, who has acted as officiating reporter during the absence of Mr. Blanford, keeps up the high character of the previous reports of this Office It contains not merely the dry details which form an integrant part of such reports, but also an able discussion of them both in their practical and theoretical bearings. As regards new observations, the most important are those from Sibsagar, situated in the north-east of the Assam Valley. The large barometric oscillation from 10 A.M. to 4 P.M., which on the average of the twelve months of 1874 amounted to 0·133 inch, will indicate their high strictly meteorological value. The hourly observations of the different instruments made on four days of each month at a number of the stations are a valuable piece of work, and the discussion of the results three or four years hence will be looked forward to with much interest by meteorologists. An admirable feature of these reports are the averages, corrected up to date in all instances, which are given with the discussion of each meteorological element, thus affording the means of an immediate comparison of the monthly results with the best averages that can possibly be had. Of these averages and comparisons we would direct special attention to those of the rainfall, which is of so great importance in Indian meteorology. Rainfall averages for different periods were prepared during the past year for the information of the Government of India. These have since been further amplified and corrected, and the present report gives the average monthly and annual rainfall for 146 stations, and incomplete averages for some months for other twenty-three stations. An example of the practical application of the rainfall discussions of the Office is given in the report. A forecast of the rainfall was called for by the Government from the Office in the latter part of July 1874, when considerable apprehensions were entertained regarding the prospects of the principal rice-crop of the year. A comparison of the peculiarities of the rainfall up to the end of July with those of past years, and the general similarity of the meteorological circumstances with those of 1872, induced Mr. Willson to submit the opinion that the rainfall in the latter months of the monsoon would turn out as favourable as in 1872, a forecast which fortunately was fully realised.

The inter-relations of the pressure, temperature, winds, and rainfall are particularly inquired into, and some of the results are of very high importance, of which those referring to the weather of January, April, May, and June may be specially referred to. From a careful examination of the observations, Mr. Willson infers that during the hot weather months there is an upper westerly current from the heated plains of Northern India blowing towards the cooler regions of Assam above the southerly winds of the delta; and that, if this be so, the vapour carried from the Bay of Bengal by the southerly winds in the hot weather months is mostly diffused upwards and thence transferred by the upper westerly current to Assam, where it descends, and, meeting the cold north-easterly surface winds, its vapour is precipitated in the copious rains which fall in Assam in this season. According to this view, the excessive rainfall of Assam in May 1874 is completely accounted for by the very unusual strength of the southerly sea winds over the delta in that month; by the abnormally low surface-pressure and high temperature over the plains of Northern India, and by the relatively high surface-pressure and low temperature over Assam. It will be seen that there is here indicated a further development of the important practical question of the prediction of the character of the coming season. As regards these and many other questions of meteorology, still more important observations and discussions may be looked for from the reports of the new Meteorological Department now being organised by Mr. Blanford for the whole of India, including British Burmah and the islands of the Bay.

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.*]

Oceanic Circulation

I HAVE, at Prof. Thorpe's suggestion (vol. xii. p. 514), compared the results obtained by the use of Prof. Hubbard's Table of the expansion of sea-water with that obtained from Muncke's, and find them almost identical. Both give 2 feet 6 inches as the amount by which the expansion of Column B * (lat. 23° N.) exceeds that of the Equatorial Column. Muncke's Table gives 3 feet 6 inches as the amount by which Column A (lat. 38° N.) exceeds that of the equatorial, while, according to Prof. Hubbard's Table, it is 3 feet 4 inches, being a difference of only 2 inches.

Dr. Carpenter objects † to my result on the ground that I have omitted the consideration of the inferior salinity of the equatorial column. Had I taken this into account, he thinks I would have found that it makes a difference in the opposite direction of about 1 foot in 1,026, which would more than neutralise the whole 3½ feet of slope derived from temperature. I do not know upon what grounds he believes that the difference in salinity is so great between the equatorial and Atlantic columns. Certainly the researches of the *Challenger* Expedition do not warrant any such conclusion. It is true that there is an excess of salinity in the surface-water of the North Atlantic, but it does not extend to any great depth. This superior salinity of the warm upper stratum of the North Atlantic, it may be observed, is an additional evidence that the water is of Gulf-stream origin.

* Columns A, B, and C refer to Dr. Carpenter's section as given in my paper on the "Crucial Test" argument, read before the British Association at Bristol, and published in full in the *Philosophical Magazine* for September. A refers to North Atlantic column in lat. 38°, B to column in lat. 23°, and C to equatorial column.

† See NATURE, vol xii. p. 533.

Through the kindness of the Hydrographer of the Admiralty, I have been favoured with all the observations made in the *Challenger* of the specific gravities of the Atlantic at intermediate depths between surface and bottom. From these observations it will be seen that there is scarcely any sensible difference between the mean specific gravity of the equatorial and the two Atlantic columns.

The following Table shows the mean specific gravities of the three columns :—

Atlantic.			Equatorial.		
	I.	II.		III.	IV.
Depth in Fathoms.	Lat. 38° 3′ N. Long. 39° 19′ W. Specific gravity at 60°.	Lat. 20° 58′ N. Long. 22° 57′ W. Specific gravity at 60°.	Depth in Fathoms.	Lat. 1° 22′ N. Long. 26° 36′ W. Specific gravity at 60°.	Lat. 3° 8′ N. Long. 14° 49′ W. Specific gravity at 60°.
Surface	1·02684	1·02685	Surface	1·02616	1·02591
100	—	1·02738	50	1·02630	1·02658
150	1·02677	1·02658	90	1·02627	—
250	1·02641	1·02642	100	—	1·02643
400	—	1·02609	200	1·02607	1·02620
500	1·02608	1·02600	300	1·02618	1·02610
1500	1·02607	1·02620	400	—	1·02629
			1500	1·02618	1·02613
	1·026211 = mean of Column A.	1·02623 = mean of Column B.	Mean specific gravity of columns.	1·026181	1·026223
			Mean of the two.	1·026202 = Mean of Equatorial Column C.	

The mean specific gravity of the equatorial column as proved by the two soundings III. and IV. in the Table is 1·026202 ; and 1·026211 of sounding I. of the Table may be regarded as the mean specific gravity of the North Atlantic Column A, for the observations were made at a place on the same latitude, and only about two degrees to the east of that column. Consequently the specific gravity of Column A exceeds that of the equatorial by only ·000009, a quantity which does not amount to one inch in 1,500 fathoms ! Sounding No. II. of the Table, made at a place a few degrees to the east of Column B of the section, gives 1·02623, which may be regarded as the mean specific gravity of that column, and the more so as another sounding made in this region gives identically the same mean value. The difference between the Equatorial Column and Atlantic Column B in lat. 23° N. therefore amounts to only ·000028, or 3 inches in 1,500 fathoms. It must of course be observed that as the specific gravities in the table are not taken at equal intervals the mean of the figures does not represent the mean specific gravity of a column. The number of fathoms represented by each separate value must be taken into account in determining the mean value of a column.

My result is, therefore, not materially affected, even after I have thus taken into account difference of salinity, and computed the amount of expansion according to Prof. Hubbard's Table. The surface of the North Atlantic in lat. 38° to be in static equilibrium must be 3 feet 3 inches above that of the equator, and in lat 23°, 2 feet 3 inches above it.

It is perfectly true that according to the gravitation theory the ocean is never in a state of static equilibrium, but it must be observed that as the surface-flow according to this theory is from the equator polewards, it is the equatorial column that is kept constantly below the level necessary to static equilibrium ; hence, were I to make allowance for want of static equilibrium, I should make the slope greater than 3 feet 6 inches. Dr. Carpenter's objection that the force of my argument rests on the assumption that the sea is in equilibrium is based on a misapprehension of the problem, for in reality, by not making allowance for want of equilibrium, I give his theory an advantage which it does not deserve. Were the surface-flow from the North Atlantic to the equator, there would then be some force in his objection, for by leaving out of account want of equilibrium I would be making the slope greater than it should be. Dr. Carpenter states that his objection met the approval of General Strachey and Sir William Thomson at the British Association meeting. If it did, it shows that they must either have misapprehended my argument or his objection to it.

I have again to remind Dr. Carpenter that "viscosity" can have nothing to do with the question at issue. The water has to flow up the "gradient," and that by means of gravity. This is mechanically impossible, whether water be viscous or not.

It is needless to quote the opinions of Lenz, Arago, and Pouillet. They were not in possession of sufficient data to enable them to determine the question with certainty. The question, be it observed, is not "Can difference of temperature produce circulation?" Everyone will admit that were there no other agencies at work but equatorial heat and polar cold, a difference of temperature would soon arise which would induce and sustain a system of circulation ; but this condition of things is prevented by the equatorial waters being swept away by the winds as rapidly as they are heated. I submit that I have proved that this is the case in reference to the Atlantic. If I am wrong, let it be shown where my error lies. JAMES CROLL

Edinburgh, Nov. 10

Refraction of Light and Sound through the Atmosphere

THERE is in Upper Thibet a plateau called the "Kyan Chu Plain," on which phenomena of mirage are frequently seen. The plain is at a height varying from 15,000 to 16,000 feet. A cold wind comes down from the surrounding mountains, while an exceedingly hot sun heats the ground. While marching through this plain on Aug. 19 I saw the mirage in perfection. A mountain in front of us, at a distance of about five miles, appeared to be situated on the border of a lake of a deep and rich blue. A shepherd with a flock of sheep seemed to wade through the water, and the reflection of each sheep was most distinct and sharp. The effect was so complete that one of my companions proposed to leave the pool of water at the side of which we had encamped for breakfast, in order to go to the borders of the lake.

I measured the temperature of the air at various heights from the ground. The following readings were obtained :—

Height above ground.	Dry Bulb.	Wet Bulb.
5 feet	49°	32°
4 inches	55°	38°
1 inch	56°	39°

The ground at that place was stony, and no accurate measurement of its temperature could be taken. A few miles further on, however, a sandy ground was found to have a temperature of 90°.

The difference between the temperature of the ground and that of the air was painfully striking to me, as, owing to blisters, I had to walk with bare feet. My feet felt burning hot, while the remainder of the body was unpleasantly cold. The mirage was seen in its greatest perfection at about 9 o'clock A.M.

Such a condition of the atmosphere must, according to Prof. Reynolds, prevent any sound from being heard at a great distance, owing to its refraction upwards. Such was really the case. A rifle fired by the above-mentioned companion at a short distance remained almost unheard.

With regard to the question whether our better hearing at night is due to the absence of disturbing noises, or to the cause suggested by Prof. Reynolds, I wish to remark that the Upper Himalayas are particularly free from any disturbing noises, yet the increase in our power of hearing at night is most marked.

Sunnyside, Upper Avenue Road, N.W., Nov. 20 ARTHUR SCHUSTER

Evidences of Ancient Glacier Action in Central France

HAVING read with much interest Dr. Hooker's contribution to NATURE on "Evidences of Ancient Glaciers in Central France," I am tempted to send you a few remarks which may interest those who look out for glacial phenomena wherever they travel.

When travelling in Auvergne with Sir William Guise in 1866, we unfortunately missed the transported erratics in the Tranteine Valley, described by Dr. Hooker. We saw, however, examples of what we believed to be ice-borne erratics, on more than one occasion, and consulted M. Lecoq on the subject at his residence at Clermont Ferrand. He had observed travelled boulders in certain localities, but, as mentioned in the note-book of Sir William Guise, "attributed to transport by snow many of the effects generally assigned to glacial action."

I would also ask attention to a subject which appears to me of considerable interest with regard to the age of the most modern

of the lava currents of Auvergne. M. Lecoq had in his museum some fossil remains of the Marmot, the Mammoth, and the tichorhine Rhinoceros, and he distinctly told us that these relics of northern mammalia, which geologists are accustomed to associate with glacial times, were mostly found in cracks and fissures in the lava-streams near Clermont Ferrand. From this it would appear that the latest lava streams of Auvergne had become cold, consolidated, and fissured before the introduction of the bones and teeth of the northern quadrupeds into the fissures.

But if this prove to be true, on further investigation, I do not wish to imply that there have been no volcanic eruptions in Central France since the last outpour of lava currents, or the days of the Mammoth. On the contrary, I think the evidence is the other way. I have just returned from a visit to the extinct volcanos of the Haute Loire and the Ardêche, where I was accompanied by my friends Sir William Guise, Capt. Price, and Mr. Lucy; and I believe there is evidence of a certain amount of volcanic action in the Ardêche since the outpouring of the later lava-streams. There are outbursts of volcanic ash and scoriæ which form what are termed "chimneys," and which are blown right through the most recent lava-currents. Both near Montpezat, so admirably depicted by Mr. Scrope, and near the bridge at La Beaume, there are outbursts and eruptions through the basalts, which dislocate and throw off the basaltic columns. It is not improbable that some of these attempts at forming a volcano happened in the Ardêche during the fifth century, when the Archbishop of Vienne, Alcimus Avitus, in his homily on the "Rogation Days," speaks of "frequent shocks of earthquakes," and "fires often blazing," and "piled up mounds of ashes." Gregory of Tours also speaks of stags and wolves wandering about Vienne. These wild animals may have been driven from the forests of the Ardêche, by these last volcanic eruptions, as far as Vienne.

W. S. SYMONDS

Communication of Information among Bees

SOME two or three years ago a swarm of bees entered a very small hole under the slates near the eaves of the roof of my house in the Highlands, and established themselves for the summer but died out in the subsequent winter. I infer that there were no survivors among the bees to remember the circumstance (see Appendix to Kirby and Spence's "Entomology") and to account in any degree for what occurred this summer.

The house is of four stories, and stands in the garden, in which, about fifty yards from the house, on the other side of a hedge, are my beehives. For a few days, during which there were the usual indications of swarming being imminent in one of the hives, a great many bees found their way into the lower rooms of the house; there was a constant hum of bees in one of the chimneys, at the top of which there was always a group flying about. The top of this chimney is about thirty feet horizontally from the settlement of the old swarm, and fifteen feet above it; there was also occasionally a cluster of bees on the roof of a "semi-detached" lower building (the kitchen) on the other side of the house from the old settlement, but *as far as we saw* no bees visited the old settlement, and nothing indicated any intention of the swarm to go there, though we expected it to make for the house and probably for the chimney I have mentioned. In due time the swarm came off and rose unusually high, and I immediately made some smoke in the chimney to prevent their entering it. Presently the swarm settled on a low apple-tree and was snugly hived in the usual way in a straw "skep" about noon. Next day, however, about 10 A.M., the swarm left its "skep" and made for the old settlement without any hesitation, and there they established themselves in spite of all we could do.

Of course the whole proceedings may have been disconnected, but the impression left on my mind was that the queen, or her counsellors, had previously "prospected," and resolved to go to the old settlement as an eligible "location," and that the common bees learned somehow that "the house" was to be their destination, but that some of them fancied the chimney, others the roof of the kitchen, and others wandered vaguely in at various open windows, while the queen knew exactly where she wanted to go, but got confused the first day.

The manner in which the bees learned that the house was to be their destination may have been that the queen in her investigations had left strong traces of herself at the chimney and on the roof of the kitchen, which attracted the bees to these places, and a general odour of royalty about the house which induced the bees to come in at the windows; but it may have been that there was some "talk" in the hive about it. In connection with Sir John Lubbock's papers, the incidents may be worth your notice.

There has also been some question as to the distance bees go in search of "pasture." It may be worth noting that at Arisaig House, I am told, bees are to be found in the peach-house every spring at the time of the blossom, while, so far as I can learn, there are no hives within ten miles but my own, which are separated from it by an arm of the sea (Loch Ailort), a mile wide with islands, and a second arm of the sea (Loch-na-Nuadh), two miles wide without islands, the whole distance being about four miles from the hives to the peach-house.

University of Glasgow, Nov. 13 HUGH BLACKBURN

A New Palmistry

I HAVE lately consulted two standard works upon the proportions of the human figure to which Prof. Ecker does not refer in the suggestive paper of which I gave an abstract in NATURE (vol. xiii. p. 8), in the hope of finding some definite information as to the relative lengths of the "index" and "ring" fingers. In the first of these two works, Quetelet's "Anthropométrie" (Bruxelles, 1870), no mention whatever is made of the proportions of the several digits, whether of hand or of foot; while from the second authority, the "Proportionslehre" of Carl Gustav Carus (Leipzig, 1854), all the information that can be derived, meagre as it is, is purely inferential. In the skeleton of a hand represented at Fig. 4, Taf. iii. of this fine folio work, the "index" is considerably longer than the "ring" finger; and in the letter-press explanatory of this plate, a table is given of the lengths of the various factors of the digits, *e.g.* the metacarpals and the three phalanges, in "modul-minutes," constant lengths, each of which is equivalent to about seven millimetres. Now the length of the "index" is twenty-three, while that of the "ring" finger is only twenty "modul-minutes," the former thus exceeding the latter digit by about twenty-one millimetres, a difference much greater than any which has been recorded by Prof. Ecker. In the extended left hand of an *ideal* (sexless) figure, at Taf. iv. (*ibid.*), the "ring" and "index" digits are of the same length, the former being perhaps a shade longer.

Regiments and large asylums would be a fertile field for the further investigation of this interesting and highly suggestive subject.

J. C. GALTON

IN Mr. J. C. Galton's interesting article bearing the above title, in NATURE, vol. xiii. p. 8, no mention is made of the position of the hand at the time of making the observation as to the comparative length of the fingers. Perhaps Mr. Galton will kindly make it known whether Dr. Ecker has specified the position which he adopted. That the position makes some difference may be clearly seen in the following manner:—

Place the hand, back upwards, horizontally across the front of the chest, and observe the comparative length of the "index" and "ring" fingers. Then, by a motion of the wrist, moving the arm as little as possible, turn the hand outwards in the same plane, until the fingers stand at right angles to their first position, and again observe the two fingers. Naturally the "index" will appear to be longer in the first position than in the second, on account of the different condition of the muscles. Neither of these positions is likely to be adopted by anyone investigating the subject, but in any comparison of results *one and the same* position should be referred to as a standard, and this standard should specify whether the hand is held with the back or the face upwards. Dissimilarity between the two hands, as mentioned by Mr. Pryor, appears to be common.

F. T. MOTT

Leicester, Nov. 19

I HAVE made a collection of over fifty outlines of the fingers of European hands (right and left). At present I find that the tendency in the female hand is to a proportionately longer third than index, in *both* hands, than in the male. In all the hands I have examined, the third finger of the left hand (when longer than the index) is also proportionately longer than the same finger of the right. In this series I have found only one case of an index longer than the third, and only one in which they were equal (both males). These are all carefully drawn into a pocket-book, care being taken that the hand is perfectly free from any muscular strain, which alters the result very appreciably; and the race, sex, and general physical characteristics are noted on the sheet. The list at present includes some eminent classical

scholars, a distinguished artist, and numbers of persons of more than average culture ; yet there appears to be no correspondence between the mind and the length of the index finger.

R. A. N.

Extraordinary Tides

IN last week's "Notes" you say, speaking of the unprecedentedly high tide of the 15th inst., that "no one seems to have expected an unusual tide." Allow me to state, sir, that in the *Spectator* of Nov. 7th, 1874, I predicted this extraordinary tide. As a matter of fact, the tide was higher than that of March 1874, through the unusually swollen state of the river by floods and the N.W. gale.

No extraordinary tide can occur this side of March 1878.

4, Buccleuch Place, Dulwich B. G. JENKINS

Further Linkage Work

IN the interesting communication to NATURE, vol. xii. pp. 214-216, Prof. Sylvester gives account of the Hart and the Sylvester-Kempe "linkages." Of four points, three have work assigned. Problem : To employ the nondescript point.

First.—The Hart linkage yields the *Cissoid*, exactly as that curve is defined. Thus, with p circling, q resting, and s tracing straight line ; r traces cissoid. Second.—The Sylvester-Kempe linkage yields the *Hyperbola*, in that curve's simplest vector form. Thus, with r opposite, to p resting, and pq, ps in constant directions ; r traces the hyperbola whose assymptotes are these directions.

GEO. J. P. GRIEVE

Burntisland, N.B.

A Criminal Dog

I WAS so much pleased with the anecdote in NATURE (vol. xiii. p. 36) of the criminal dog who buried the cat he had murdered, that I told my wife ; but I did not mention the breed of the dog.

She said, "Was it not a retriever? because they always bury their food, so that it may become *high*." I could but answer that it was a retriever, and added that I was afraid she had hit upon the real reason for the act.

R. S. CULLEY

General Post Office, Nov. 12

OUR ASTRONOMICAL COLUMN

THE BINARY STAR 44 BOOTIS.—In No. 2,064 of the *Astronomische Nachrichten*, Dr. Doberck, of Markree Observatory, has given an orbit of this binary, and a comparison with measures to the present year. The elements are—

Peri-astron passage	1783·01
Node	65° 29′
Peri-astron from node on orbit ...	1° 18′
Inclination	70° 5′
Excentricity	0·71
Semi-axis major	3″·093
Period of revolution	261·12 years.

Dr. Doberck makes no reference to Sir W. Herschel's second measure in 1802, giving for the angle 62° 59′, or less than 3° in advance of his measure 1781, August 17, when the companion was first detected. The measure of 1802 was registered s.p. and "corrected by a subsequent observation to n.f.," as Sir John Herschel states in Memoirs R.A.S. vol. v. p. 46 ; but it is now pretty evident, from a projection of all the measures to 1875, that the quadrant was correctly registered s.p., and consequently the angle for 1802·246 should be 207° 1′ according to our present method of reckoning. The angle calculated for this time from the above orbit is 206° 55′, and this close agreement must be taken as very satisfactory evidence that Dr. Doberck has given us something like the true orbit, notwithstanding the difficulty of the case. It had been surmised that Sir W. Herschel's measures were to be increased 180°, Struve, in 1819, obtaining an angle of 228°, and Herschel and South, in 1821, 229°, but the position of the companion on the preceding side of the principal star, instead of the following side where it had been seen in 1781, was accounted for both by Sir John Herschel in his "Micrometrical Measures of 364 Double Stars," and by Struve in "Mensuræ Micrometricæ," by supposing motion in an orbit passing nearly through the eye of the observer, with the longer axis of the ellipse but slightly inclined to the meridian. Dr. Doberck finds an inclination to the tangent plane of the heavens, of 70°. Calculating from his elements, the following appear to have been the angles and distances from 1785 to 1800 :—

1785·0 ...	Position	74°·0 ...	Distance	0″·85
90·0 ...	,,	98 ·3 ...	,,	0 ·55
92·5 ...	,,	132 ·0 ...	,,	0 ·50
1795·0 ...	,,	162 ·7 ...	,,	0 ·53
1800·0 ...	,,	199 ·0 ...	,,	0 ·86

The calculated distance for epoch of Sir W. Herschel's measure in 1781 is 0″·89, and for that of 1802, 1″·05 ; the observed distances being only by estimation in diameters of the companion, giving "$\frac{1}{4}$ or $\frac{3}{4}$ diameter" of smaller star in 1781, and "barely $\frac{1}{2}$ diameter" in 1802, with power 460 in both years, are perhaps sufficiently well represented, though very admissible correction to one or two of the elements may diminish the distance in 1802 or increase that in 1781.

For comparison with future measures we have from Dr. Doberck's orbit—

1876·0 ...	Position	241°·45 ...	Distance	4″·887
78·0 ...	,,	241 ·71 ...	,,	4 ·928
80·0 ...	,,	241 ·97 ...	,,	4 ·971

THE MINOR PLANETS.—In No. 35 of the Circulars of the *Berliner Astronomisches Jahrbuch*, Prof. Tietjen notifies an arrangement which has been entered into by the Observatories of Leipsic, Leyden, Lund, Pola, and Vienna, for the more systematic and regular observation of the small planets. These Observatories have agreed to report to the editor of the *Jahrbuch*, every fortnight, the names or numbers of the planets which have been observed, with the dates of observation and the limits within which the planets whose positions are more uncertain have been sought. These communications will be so timed that they may arrive at Berlin on the 1st and 15th of the month, and will be there arranged, printed, and circulated. An invitation is extended to those Observatories where the small planets are occasionally, though not regularly, observed, to join in the proposed scheme. In the same manner the state of calculation as regards the various members of this group will be made known. The Milan Observatory has already engaged itself to calculation for No. 151.

Mr. Daniel Kirkwood, of Bloomington, Indiana, writes with reference to the resemblance which exists between the elements of certain minor planets, instancing as the most striking case that of No. 54, Alexandra, and No. 141, Lumen. An inadvertent application of the angle usually designated ω (or the distance of perihelion from node) in the wrong direction, renders the similarity between the orbits of these planets somewhat less striking than in Mr. Kirkwood's communication, but there is nevertheless considerable resemblance, as the following figures will indicate :—

	Alexandra.	Lumen.
Perihelion	294° 16′	341° 32′
Node	313° 49′	318° 59′
Inclination	11° 47′	11° 33′
Excentricity... ...	0·1987	0·2233
Mean distance ...	2·7093	2·7095
Period	1628·9 days. ...	1629·0 days.

THE ZODIACAL LIGHT.—Those who are interested in the observation of this phenomenon will do well to be on the alert during dark evenings in the winter months. The most conspicuous exhibitions of the light in this country during the last few years have occurred in the month of January, the long standing recommendation to

expect the most notable displays in the evenings about the vernal equinox having thus been by no means justified in the result. The light was perceptible for a short time last Sunday evening, without any yellowish tinge, and the position of axis somewhat doubtful from the indifferent state of the sky. Prof. Heis's observations in December from 1851 to 1870, place the mean position of the apex on the equator in R.A. 349°, or with about 82° elongation from the sun: this refers to the eastern arm of the phenomenon.

THE RAINFALL

THE extraordinary rainfall of the past year will make 1875 memorable in the annals of meteorology. With scarcely an exception every part of Great Britain has suffered from a plague of rain; from the Continent and from North America there come the same tidings of incessant rain and vast inundations. Even in a country so far distant as China we hear of unprecedented rains. The following statistics concerning a rainfall that occurred in China between last August 31st and September 1st will be read with astonishment. Our information is derived from the bulletins of the Meteorological Observatory of the Fathers of the Society of Jesus at Sikawei, on whose accuracy of observation we may doubtless depend. The readings show that between four and seven o'clock in the morning of September 1st the mean rainfall per hour was 32·7 millimetres, which makes the astonishing rate of 1·287 inch for each of those three hours. Well may the compiler remark, "We think there are few examples of such a figure, except in the case of waterspouts."

The total quantity that fell in the garden of the Jesuit Observatory during the twenty-four hours that elapsed between four o'clock on Tuesday, 31st August, and the same hour in the afternoon of Wednesday, 1st September, was 218 millimetres, or no less than 8·59 inches for the rainfall of a single day! After this the records of rainfall in Great Britain look insignificant. Nevertheless the fall has far exceeded the ordinary statistics. At Balbriggan, a town a few miles north of Dublin, the rainfall from 9 A.M. on the 13th inst. to 9 A.M. on the 14th inst. was two inches. This is the greatest fall in twenty-four hours which occurred in that town for the last ten years.

It is important to obtain statistics from the southern hemisphere. It is probable a vast drought must somewhere compensate for the floods of water poured over a large part of the northern hemisphere.

THE WORK OF THE CHALLENGER*

THIS report is dated from Hilo Hawaii, August 18, and describes the cruise of the *Challenger* from Yokohama to the Sandwich Islands. The *Challenger* left Yokohama on the 16th of June, and ran an easterly course between the parallels of 35° and 40° north latitude, as far as the meridians of 155° east. She then turned nearly directly southwards and reached Honolulu on the 27th of July. Twenty-four observing stations were established, at each of which most of the desired observations were made.

On the 17th of June, Prof. Thomson's Report goes on, we sounded in 1,875 fathoms with a bottom of bluish-grey clay and a bottom-temperature of 1°·7 C., forty miles to the south-east of No Sima Lighthouse. The trawl was put over, and it brought up a large quantity of the bottom, which showed the clay was in a peculiar concretionary state, run together into coherent lumps, which were bored in all directions by an Annelid of the Aphroditacean group. In many cases the Annelids were still in the burrows. Among the clay there were large lumps of grey pumice. The hyoid zoophytes were represented by a very remarkable species, apparently referable to the genus *Monocaulon* of Sars, a Corymorpha-like solitary polyp with adelocodonic gonophores; but instead of being of the proportions usual in its group, the stem in one of our specimens measured upwards of seven feet in height, while the polyp-head was nine inches in diameter across the proximal row of tentacles. We afterwards got another fine example of the same species at a depth of 2,900 fathoms (Station 248). The temperature of the surface of the sea stood during the day at nearly 23° C., considerably above the temperature of the air; and a serial sounding gave the isotherm of 10° C. at a depth of little more than 200 fathoms. We were therefore evidently under the thermic influence of the Japan current, which was found by observation to be running in an easterly direction at a rate of 1½ knots an hour. The thermometers registered a uniform temperature of 1°·7 C. from a depth of 1,000 fathoms to the bottom. About twenty Albatrosses of a nearly uniform brown plumage with whitish heads, probably the young of the common North-Pacific species in their second year's plumage, followed the ship.

On the following day there was a stiff breeze from the southward, and with a heavy sea. We sounded, however, successfully in 3,950 fathoms, our deepest sounding in the North Pacific position by dead reckoning lat. 34° 43′ N., long. 144° 2′ E., with a bottom of "red clay." The high surface-temperature continued to be maintained; and the position of the isotherm of 10° C., at station 239 at a depth of nearly 300 fathoms, indicates that up to this point, at all events, there was no diminution in the influence of the "Kuro-Siwa."

On the 21st the temperature-observations gave a singular result. The surface-temperature had fallen to 18°·2 C., and the belt of water above 10° C. was reduced in depth to considerably below 100 fathoms, while all the isotherms, at all events to a depth of 400 fathoms, rose in proportion. There seems to be little doubt, from a comparison of the American temperature-results with our own, that this sudden diminution of temperature is due to a cold surface-flow from the Sea of Okhotsk, probably through Pico Channel or Vries Strait. Very likely its effect may not be found to be constant; and at this season it possibly attains its maximum from the melting of the snow over the vast region drained by the Amoor and the Udi and Siberian rivers with a southern outflow.

On the 26th of June we sounded in 2,800 fathoms. Several forms were met with which apparently do not occur on the surface, particularly a number of species of a group which is so far as we know entirely undescribed. It seems to be intermediate between the Radiolarians and the Foraminiferas, resembling the former in the condition and appearance of the sarcode and in the siliceous composition of the test, and the latter in external form. The broken tests of these organisms are extremely abundant in the "red clay" soundings; a sufficient number of observations has not yet been made to enable us to say with certainty what is their bathymetrical distribution. From a zoological point of view the haul of the 28th was remarkably successful; there were one or two fishes, a *Scalpellum*, a number of annelids, particularly a prominent aphroditacean; Echinoderms of the genera *Pourtalesia*, *Archaster*, *Brisinga*, and *Antedon*; a fine species of *Cornularia*, several examples of *Fungia symmetrica*, and some *Actiniæ*. The general distribution of temperature remained much the same, the isotherm of 10° C. retaining its position near the 200-fathom line.

We trawled on the 2nd of July in 2,050 fathoms with a bottom of light brownish ooze with many *Globigerina*-shells. The bag brought up a number of lumps of pumice, and among them a very characteristic assemblage of deep-sea animals, the most interesting an undescribed

* Abstract of "Report to the Hydrographer of the Admiralty on the Cruise of H.M.S. *Challenger* from June to August 1875," by Prof. Wyville Thomson, F.R.S., Director of the Civilian Scientific Staff on Board. Read at the Royal Society Nov. 18.

species of *Hyalonema*, which occurred in considerable numbers and in an excellent state of preservation. The form of the sponge-body is almost spherical, with a comparatively small oscular opening, and the coil is much shorter than in *H. Sieboldi*, in the largest specimens not more than six inches in length. One remarkable point was, that in no case was there a commensal *Palythoa* connected with this sponge; the coil was always perfectly clean. The spicules of the network and of the sarcode closely resemble those of the Japanese species, but they all present marked specific differences in detail of form.

On the 12th of July the trawl was lowered at a depth of 2,740 fathoms. The net contained very few animals, and was greatly torn and frayed; but in a kind of packet formed by an accidental folding of the net, there were about a hundredweight of black mammillated concretions, which, when they were poured out on the deck, had very much the appearance of potatoes. The external surface of the concretion was slightly rough, and a number of small animal forms, particularly a minute rhizopod in a membranous tube, nestled in the crevices. The nature of these concretions will be discussed hereafter.

On the 14th of July we reached the point lat. 38° 9′ N., long. 156° 25′ W., whence we turned southwards towards the Sandwich Islands. For the last few stations the temperature of the water had been gradually sinking, and the influence of the Japan current dying out; the isotherm of 10° C. was now only 100 fathoms below the surface.

On the 17th of July we sounded in 3,025 fathoms, the bottom still "red clay;" and on the 19th in 2,850 fathoms. A serial sounding taken at the latter station to 1,500 fathoms showed a considerable rise in the temperatures near the surface, the isotherm of 10° C. having again sunk to a depth of 200 fathoms, and that of 15° C. corresponding with the 100-fathom line.

On the 24th, in 2,775 fathoms, the Albatrosses which had followed the ship, to the number of from fourteen to twenty daily since we left Japan, left us. In the evening of the 27th, the *Challenger* anchored in the harbour of Honolulu.

This cruise naturally divides itself into two parts: a section about 3,170 nautical miles in length, including the stations from No. 237 to No. 253, very slightly to the northward of east, between the parallels of 35° and 38° N. lat.; and a meridional section of 1,128 nautical miles, along the meridian of 155° W. long. The first of these sections corresponds very closely in relative position with the section in the Atlantic between Sandy Hook and the Açores, and the points of resemblance and difference between them, when fully worked out, must prove most instructive. The two sections cross the two great deflections to the northward of the equatorial current, in the Atlantic the Gulf-stream, and in the Pacific the "Kuro Siwa;" and the thermic influence of the two currents is fairly contrasted. The influence of the Gulf-stream, if not absolutely greater (and this is a point which it will be somewhat difficult to determine), is at all events much more concentrated and effective, owing to the continuity of the coast-line of the American continent, to the way in which the water of the equatorial current is driven into the Gulf of Mexico and superheated there, afterwards to be kept together and ejected in a defined stream through the Strait of Florida, and to the absence of periodical winds in the Atlantic. In the Pacific, on the other hand, the main flow of the equatorial current is weakened among the passages of the Malayan Archipelago; and although a large part of it is directed northwards by the broken barrier formed by the Fiji Islands, the New Hebrides, and Papua, it almost at once enters the region of the Monsoons, where it is thwarted for half the year; and it can only be regarded as comparable with that portion of the reflux of the Atlantic equatorial current which passes outside the West Indian Islands. It passes the south coast of Japan nevertheless as a very palpable and apparently a permanent current, exercising a very perceptible thermic influence to a depth of at least 300 fathoms.

In traversing the Pacific the influence of the Japan current appears to be gradually lost, while I am still inclined to believe that in the Atlantic the Gulf-stream is banked down against, and reflected from the western coast of Europe. It is a question of great complexity; but it seems to me that it is consistent with our experience that the temperature of the water of the ocean at any one place is due in a great measure to the temperature of the source of that water—not entirely due, for in passing through a long distance the temperature of even the greatest masses of water is certainly gradually altered by conduction and mixture.

The suggestions of Dr. Carpenter and Mr. Buchanan that the existence of a deep layer of warm water in the Atlantic might be connected in some way with the mean annual temperature of the area, and the absence of ocean-currents, are very suggestive; and I looked forward with great interest to an opportunity of testing them in the corresponding position in the Pacific. But there seems to be no trace of anything of the kind; as the influence of the equatorial reflux becomes weaker the temperatures fall uniformly.

To show that the conditions in the two oceans differ more in degree than in kind, I give in Plates I. and II. curves constructed from serial soundings along nearly corresponding lines in the Atlantic and Pacific. Curves A and B are added on Plate I. to show the position of the deeper belt of abnormally warm water, which makes its appearance near the coast of Europe.

Plate I.

North Atlantic Ocean.

No. of Station.	Latitude.	Longitude.	Depth in fathoms.
	° ′	° ′	
43	36 23 N.	71 51 W.	—
44	37 25 ,,	71 40 ,,	1700
53	36 30 ,,	63 40 ,,	2650
65	36 33 ,,	47 58 ,,	2700
69	38 23 ,,	37 21 ,,	2200
71	38 18 ,,	34 48 ,,	1675
80	35 3 ,,	21 25 ,,	2660
A A	In the Bay of Biscay.		2090
B B	Off the coast of Portugal.		1090

Plate II.

North Pacific Ocean.

No. of Station.	Latitude.	Longitude.	Depth in fathoms.
	° ′	° ′	
237	34 37 N.	140 32 E.	1875
240	35 20 ,,	153 39 ,,	2900
243	35 24 ,,	166 35 ,,	2800
245	36 23 ,,	174 31 ,,	2775
246	36 10 ,,	178 0 ,,	2050
248	37 41 ,,	177 4 W.	2900
252	37 52 ,,	160 17 ,,	2740

There seems to be little doubt that the enormous mass of cold water which fills up the trough of the Pacific is like the cold bottom-water of the Atlantic, an indraught from the Southern Sea. The more the question is investigated the less evidence there seems to me to be of any general ocean circulation depending upon differences of specific gravity. It seems certain that both in the Atlantic and in the Pacific the bottom-water is constantly moving northwards; and I am now very much inclined to refer this movement to an excess of precipitation over the water-hemisphere, a portion of the vapour formed in the northern hemisphere being carried southwards and precipitated in the vast southern area of low barometric pressure. I hope to enter fully into the discussion of this matter on a future occasion. The temperature of the water is greatly lower in the Pacific for the first thousand fathoms than in the Atlantic in the corresponding latitude of 35° N. There is one very remarkable difference between

the two basins. While in the Atlantic it seems certain that the temperature sinks gradually, though very slightly, for the last thousand fathoms to the bottom, it appears that in the Pacific the minimum temperature of 1°·7 C. is reached at a depth not greater than 1,400 fathoms, and that from that depth to the bottom the temperature is the same.

The soundings from Yokohama to Honolulu are remarkably uniform in depth, the twenty-two soundings on one line which are unaffected by the neighbourhood of land giving an average of 2,858 fathoms. The nature of the bottom is also very uniform; and, according to the nomenclature which we have adopted, it is in each case noted on the chart as "red clay." It is usually, however, somewhat greyer in colour than the typical "red clay," and contains a large proportion of the tests of siliceous organisms, a proportion which increases with increasing depth, and a considerable proportion of pumice in different states of comminution and decomposition. The clay contains scarcely a trace of carbonate of lime, although the surface swarms with ooze-forming foraminifera. In some cases the trawl came up half full of large lumps of pumice, which seemed to have been drifted about till they were water-logged, and to be softening and becoming decomposed; these pieces of decomposing pumice were often coated and pervaded throughout with oxide of manganese. Over the shale area the red clay was full of concretions, consisting mainly of peroxide of manganese, round, oval, or mammillated and very irregular, varying in size from a grain of mustard-seed to a large potato. When these concretions are broken up, they are found to consist of concentric layers having a radiating fibrous arrangement, and usually starting from a nucleus consisting of some foreign body, such as a piece of pumice, a shark's tooth, or a fragment of any organism, as for instance in one case a piece of a Hexactinnelid sponge, of the genus *Aphrocallistes*, which was preserved as a very beautiful fossil in the centre. The concretions appear to form losse among the soft clay; the singular point is the amount of this manganese formation, and the vast area which it covers.

We were particularly successful during this cruise in getting good samples of the fauna from great depths; and we found that the fauna of the North Pacific at depths of from 2,000 to 3,000 fathoms, although not very abundant in species, is by no means meagre. For each of six dredgings and trawlings at depths greater than 2,000 fathoms, we found along with a few fishes a fair representation of all the larger invertebrate groups; and in one dredging, No. 253, at a depth of 3,125 fathoms, we took a small sponge, a species of *Cornularia*, an *Actinia*, an annelid in a tube, and a Bryozoon. We were again struck with the wonderful uniformity of the fauna at these depths; if not exactly the same species, very similar representatives of the same genera in all parts of the world. I am glad to be able to report that everything is going on in a satisfactory way in the departments under my charge.

ACOUSTIC CLOUDINESS

WHEN the weight and number of the guns in action are taken into account, the following extract from "My Experiences of the War between France and Germany," vol. ii. pp. 285-9, by Archibald Forbes, will probably be regarded as the most extraordinary instance of "acoustic cloudiness" hitherto recorded. The complete reversal of the optical and acoustical conditions on two succeeding days renders the case very perfect. I am indebted for the extract to the obliging kindness of Mr. James Kenward, of Birmingham.

"The morning of the 6th presented a remarkable contrast in every respect to that of the preceding day. The latter had been cold to the chilling of the marrow, and so thick that nothing was to be seen half a mile away. The former was clear, bright, and warm as a morning in the end of March. Yesterday the air was charged with sound; to-day there reigned the stillness of an Arcadia that knows not war. Men looked at each other in blank amazement. Had Paris, forts, big guns, bombardment, and the no-bombardment on the eastern side alike been spirited away? Had the French reply shut up our pretty Spandau toys in one day? Or, on the contrary, had those pieces of finished mechanism stove in the forts and batteries bodily? And if we were going up to Montmorency, should we see the white flag on the top of Montmartre in token that all was over? Men were reticent in expressing speculations, but at the corners of the straggling lanes of Margency I heard the words 'Capitulation,' 'Parlementaire,' muttered as the feldgensdarmes and the orderly-men gossiped in little groups. Making the best of my way to head-quarters, I found head-quarters in ignorance and suspense. Nobody could interpret this strange, ghostly silence. There had come from Versailles on the previous night a telegram stating that the King was well pleased with the results which the day's bombardment had achieved. So it was plain the silence was not on our part due to coercion. 'Negotiations, then?' I suggested to my friendly interlocutor. 'No, that cannot well be,' was the reply, 'since in that case we should have received instant instructions to silence our Maas Army batteries, and this has not been the case.' 'Are they firing, then?' I asked, for it might be that I had been struck with sudden deafness. 'No, it would seem not, I can hear nothing. The silence is a puzzler, but we are sure to hear all about it within a few hours.' Determining to anticipate by personal investigation the information which was kindly promised me, I rode off to the front of Montmorency, whence there lay spread before the eye the wide panorama of the north side of Paris. Still all was silent as the grave. There was the white foreground, the ice-bound river, and the St. Denis chimneys smoking lustily according to their wont. Neither from the east nor the west came there the slightest sound of firing. A slight haze-bank hung over Le Bourget, which might have been snow, fog, or the filmy smoke of a cannonade; but, if the latter, it must have surely been audible. There I found three mounted officers, and we had a little talk about the position. They inclined to the armistice-negotiations theory, more especially as they had not heard a single shot since morning. As we spoke, there came a white jet of smoke out of the grey side of La Briche. No sound; for all the noise it made it might have been an escape of steam. But in a second or two we did hear something—the close swish of the shell, and then the explosion about fifty yards to the right. La Briche could not resist the temptation of the group. 'No negotiations, then, that is certain,' was the remark as we broke up and went our several ways.

"This action of La Briche rather intensified the puzzle, because it seemed to knock away the only explanation. I could not go to the south, but I could visit the batteries about Pont Iblon, and get at the root of the matter.

. . . . . .

"I came on to Gonesse alone. What was my surprise to find all the German batteries from Gonesse to Sevran firing away vigorously! They had been at it since eight in the morning. In Gonesse I learned that the firing on the south side was believed to have recommenced at the same hour, and was certainly going on. Yet at Margency and Montmorency we could not hear a sound. It was all owing to the air; it was to-day as non-conducting of sound as it had been the reverse yesterday. Even in Gonesse we could not hear the guns that were thundering, so to speak, at our elbows."

The condition of things here so graphically described discloses a state of the atmosphere precisely similar to that existing at the South Foreland on the 3rd of July, 1873. There, as here, the belching of the smoke from

the 18-pounder, the howitzer, and the mortar, resembled noiseless jets of steam, projected, "so to speak, at our elbows." JOHN TYNDALL

Royal Institution, Nov. 17

CHARLES BLACKER VIGNOLES, F.R.S.

THIS celebrated engineer died on the 17th instant at Hythe, at the age of eighty-three years. Although he won his fame mainly as an engineer, yet his services to science were of considerable importance. Mr. Vignoles was descended from an ancient French family which had taken refuge in England after the repeal of the Edict of Nantes. His father, Capt. Vignoles, was an officer in the 43rd Regiment of the Line, and his mother was a daughter of Dr. Charles Hutton, the celebrated mathematician and professor at the Royal Military Academy, Woolwich. When young Vignoles was only twelve months old, his father lost his life at the storming of Pointe-à-Pierre, Guadaloupe, when Sir Charles Grey, the commander of the British forces, gave the former a commission in the army. Thus his career has been an unprecedentedly long one. His grandfather, Dr. Hutton, undertook his education, and the pupil certainly turned out a credit to his teacher. For a short time before the conclusion of the great war which ended in 1815, Vignoles served under the Duke of Wellington on the Continent, and after visiting America about 1822, he returned to England and threw himself enthusiastically into the engineering profession. The railway movement was just then gathering strength, and Vignoles was associated with some of the earliest efforts to establish lines in this country. After the Liverpool and Manchester Railway Bill was thrown out of Parliament in 1824, he was, in 1825, selected by Messrs. Rennie to take charge of the new surveys which the Liverpool Committee ordered. From this time forward Vignoles was ever in the van of the railway movement, and had the foresight to predict, amid some incredulity and ridicule, to what gigantic results it would lead. In 1826 he was employed by Messrs. Rennie to make surveys for a line from Nine Elms, Vauxhall, Dorking and Shoreham, to Brighton; and in 1834 he escorted M. Thiers over the railways which had been built under his superintendence. The great French Minister's dictum was, "I do not think railways are suited for France." In England, in Ireland, on the Continent, and in America, Mr. Vignoles took a prominent part in the carrying out of great railway and other engineering works. Probably one of his greatest works was the magnificent suspension bridge over the Dnieper at Kieff, commenced in 1848 and finished in 1853, at a cost of 432,000*l*. A fine model of this is now in the Crystal Palace.

Mr. Vignoles became a member of the Institution of Civil Engineers in 1827, and was elected President in 1870, when he gave a very able address on the progress of engineering. In 1842 he gave a series of remarkable lectures as Professor of Civil Engineering at London University College. In 1855 he was elected a Fellow of the Royal Society; he was also a Fellow of the Royal Astronomical Society, and was for long a regular attendant at its meetings. The Eclipse party of 1860 was to a great extent indebted to him for all the local arrangements, and its success was mainly due to his exertions. He was also Honorary Treasurer of the Expedition of 1870, was on board the *Psyche* when she struck, and was afterwards indefatigable in aiding the necessary arrangements. In the early part of its career he took an active part in the meetings of the British Association, contributing several papers to the Mechanical Section.

As might be expected, Mr. Vignoles was a man of great energy and strong physical constitution. On the Thursday before his death he attended the annual inspection, in his capacity of Lieutenant-Colonel, of the Engineers and Railway Volunteer Staff Corps. On the Saturday following he was struck with paralysis, and remained unconscious till his death on the following Wednesday. He was buried yesterday at the Brompton Cemetery.

THE GERMAN COMMISSION ON ARCTIC EXPLORATION

FURTHER details concerning the work of this Commission appear in a recent number of the *Karlsruher Zeitung*.

The Commission cannot recommend another Arctic expedition. The task of special geographical discovery, to whose solution previous expeditions have contributed, must, since the polar regions have been opened up at many points, give place to the task of exploring in detail the region of which we now have a general knowledge, and on the results thus attained to construct a sure basis for wider researches. "Without such an established basis, every new Arctic expedition might, according to the circumstances, accomplish more or less good results, but for this a considerable expenditure of public means would be the less advisable, that we may have a sure expectation, by following a different course from that hitherto pursued, of accomplishing, more slowly perhaps, but all the more surely, the exploration of the Arctic zone, and at the same time solve very important problems in science."

The Commission unanimously agree that the exploration of the Arctic region should be undertaken. The last part of the Report, without pretending to be complete, discusses very important questions in all departments of science, the solution of which is to be obtained by Arctic exploration. The majority of meteorological and hydrographic problems, many questions in the regions of terrestrial magnetism and physical astronomy, a number of questions in the department of natural science, in other words, the discovery of the laws of periodical phenomena and of the variations from these laws, cannot be accomplished by an Arctic expedition of the kind hitherto sent out. Such an expedition cannot remain for any length of time at a number of points, and can therefore furnish observations bearing only on time and place, which do not in the least enable us to conclude what would be the condition at another time.

It is otherwise with those scientific problems in which the establishment of facts is of importance, as in the majority of problems in natural history, and in many of the other regions of natural science and geography. For such problems an expedition of the usual kind would accomplish very valuable results. For the solution of other problems the establishment of observing stations is desirable, from which, through as long a period as possible, observations of periodical phenomena should be undertaken. But in order to be able to generalise the results, corresponding observations should be made from time to time at intermediate stations and in regions lying in the neighbourhood. A German expedition would thus erect observing stations on particular points, and then would make such arrangements that, according to the special circumstances of the stations, or to accomplish special scientific objects, exploring journeys could be made from the stations as a basis, by land and water, in sledges, ships, or boats. This combined system of fixed stations and exploring journeys would give us at least the prospect, by the minute exploration of any particular region in which it might be employed, of enriching our knowledge with a plentiful supply of facts.

The problems indicated by the Commission for Arctic exploration can only be fully solved by means of a connected system of stations and exploring journeys in the Arctic region, and thus the way be opened up to the hitherto entirely unexplored portion. Explorations must thus be carried on by the three great water approaches,

which lead to the polar sea—between Greenland and Spitzbergen, between Spitzbergen and Novaya Zemlya, and through Behring Strait—and which have a physical connection, which is shown very distinctly in the isothermal curves. In this undertaking the co-operation of all States having an interest in these researches should be sought. Through the simultaneous action of different States a circle of observing points would be formed, which would sub-divide a common work having the same end in view, so that the combined labour of several nations would entail less sacrifice to each than has hitherto been the case. The Commission also recommends the above principles for the guidance of other nations, and thus an international alliance might be formed through which the highest scientific results would be attained. The Commission points out that one immediate result of the Second German Expedition is that the region between the west coast of Greenland and the east coast of Spitzbergen would be a suitable field for German research. As we have already stated (NATURE, vol. xiii., p. 33), they recommend a principal station to be established on the east coast of Greenland, with secondary stations on Jan Mayen Island and the west coast of Spitzbergen.

In the region indicated for observation, which can easily be reached from Central Europe, and whose exploration has for European States the greatest scientific and practical interest, German explorers have made a happy commencement, and established a claim for Germany to continue the work thus begun. The Commission urge Germany to set about at once fitting out an expedition for the occupation of the above region. They believe that if diligent preparations were made, the expedition might be ready to start in 1877. Finally, they recommend the appointment of a Scientific Commission to draw up full instructions for the guidance of the expedition in all departments.

THE FAUNA OF THE CASPIAN SEA

OSCAR GRIMM has given in Von Siebold and Kölliker's *Zeitschrift* a brief account of his exploring expedition to the Caspian Sea last year, which will make naturalists look expectantly for the completion of his descriptions. The character of the fauna of the Caspian has interest for the evolutionist in natural history, as well as for the geologist. It will afford evidence not only of modification of animal life, but also of successions of change in physical geography. Two months were spent at Baku, and one month on board a steamboat in dredging from Baku to Krassnowadsk, thence to the Balchan Bay on the east coast, by the island of Tscheleki, southwards to Astrabad, and thence by Enzili and Lenkoran to Baku. Dredging was carried on up to a depth of 150 fathoms, and an enormous quantity of specimens was obtained, including six new fishes (Gobius and Benthophilus), twenty species of Mollusca, including four species of Cardium, four of Adacna, and three of Dreyssena; thirty-five species of Crustacea, principally colossal forms of Gammaridæ; and twenty species of Vermes. The eastern coast adjoining the sandy steppes was almost destitute of marine life, owing to the quantity of sand blown into the sea. The western part of the sea gives depths of 517 fathoms, and has a very abundant fauna. At one haul of the dredge in 108 fathoms, not far from Baku, there were taken 350 specimens of Gammaridæ, 150 *Idothea entomon*, fifty colossal Mysis, six species of fishes, and many large Mollusca.

One hundred and twenty species in all were taken, of which eighty are new to science. Many more might be expected to reward dredgings in the deeper parts of the sea. Those already known fall into two classes: (1) those derived from still existing or already extinct species, or but slightly differing from species living in the neares. seas; and (2) those which are identical with those of other seas. The latter are species possessing special tenacity of life, such as *Sabellides octocirrata*, *Mysis relicta*, and *Idothea entomon*.

Relationship is shown between the Caspian fauna and the faunas of the Aral and Black Seas, and the Northern Ocean. But the connection with the latter is more recent than with the Black Sea, for *Phoca*, *Coregonus leucichthys*, and other forms, not existing in the Black Sea, are common to the Northern Ocean and the Caspian. The geographical changes which Dr. Grimm conceives to have brought about these results will be better understood, and their probability may be more easily criticised, when the complete account of the Caspian Fauna is published.

*NEW FORM OF TUBE FOR OBSERVING THE SPECTRA OF SOLUTIONS**

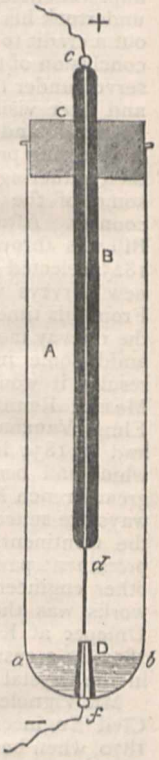
WE have the honour of presenting to the Academy an eminently useful spectro-electric tube;† it realises, in fact, a certain number of advantages, which are as follows:—

1. Constancy of spark permitting prolonged observation of spectra. 2. Suppression of the meniscus, and consequently of the absorption which it produces by partly concealing the spark. 3. Electrodes enclosed in a special tube, which preserves the solution from contact with impurities. 4. Possibility of collecting entirely the substance examined. 5. Possibility of arranging a series of spectroscopic tubes, enclosing solutions of the various bodies, thus permitting rapid demonstrations and comparisons.

The closed tube A of eleven centimetres in height, and 1½ centimetres in diameter, is traversed by a lower platinum electrode *f*; in the mouth of A is fixed a cork stopper C, pierced by an orifice through which passes a capillary tube B. B is traversed by a platinum wire *c d*, terminated at the upper end by a ring, and at the lower end by a point *d*, opposite *f*. *d* and *f* are the electrodes. The important part of the apparatus is a small capillary tube, slightly conical, one centimetre in height, moveable, and which covers the lower electrode *f*, topping it by ½ millimetre.

To work the apparatus, pour into the tube A the solution to be examined, taking care that the electrode *f* and the tube D are only immersed to half their height. Let *a b* be the level of the liquid; capillary force determines the ascent as far as the point D, on which is formed an immovable drop which is vaporised when an induction current is put on by *c* and *f*. The observations may then continue a very long time without intermission, allowing the spectra to be observed and drawn with the greatest ease.

This very simple apparatus has rendered us so great service in the course of our investigations, that we cannot too strongly recommend its use to chemists engaged in spectral analysis. Never-



A, Tube into which the liquid to be analysed is poured. B, Capillary tube in which is fixed the platinum wire *c d*, which forms the upper electrode. C, Cork stopper closing the tube A; it supports B, and permits its being moved with little friction. D, Small capillary tube, slightly conical, covering the lower electrode *f*. *d*, Upper electrode. *f*, Lower electrode. *a b*, Level of liquid.

* Paper read at the Paris Academy of Sciences, Oct. 26, by MM. Delachanal and Mermet. *Comptes Rendus*, t. lxxxi. No. 17, p. 726.

† See the description of the original apparatus in the "Annales de Chimie et de Physique," 5e series, t. iii., 1874.

theless, in some cases, as for example when it is desired to observe the spectrum of ferric solutions, it is preferable to employ the original tube ;* for the flow of the liquid causes solid particles to be given off, which tend to become fixed in the electrode.

SCIENCE IN GERMANY

(*From a German Correspondent.*)

IN the twenty-fifth volume of the "Zeitschrift für Wissenschaftliche Zoologie," just completed, Ehlers has given some interesting conclusions with respect to the distribution of the Chætopoda which were collected during the *Porcupine* expedition, by Messrs. Carpenter, Wyville Thomson, and Gwyn Jeffreys ("Beiträge zur Kentniss der vertical Verbreitung der Borstenwürmer im Meere"). He finds, in the first place, that of all Chætopoda occurring on the European coasts of the North Atlantic Ocean, only two families show representatives in the greater sea-depths at more than 300 fathoms, and he thinks, therefore, it is not certain that any forms belong exclusively to the deep sea. Further, the conditions of temperature of the water, as they determine the horizontal distribution of Chætopoda, seem also to be of influence with regard to their vertical distribution, seeing the deeper layers of water are also the colder. Accordingly the forms that live in the cold deep sea of that zone of the Atlantic Ocean correspond with those of the coast fauna of the Arctic regions ; and Ehlers thinks that they might even have a direct connection through currents which descend from the Arctic regions to the depths of warmer marine zones. It is also conceivable that the deep-sea forms, at a time when those regions of the Atlantic were warmer than they are now, were frequenters of the coast, and in proportion as the Gulf Stream heated the upper layers, they retired into the depths. For the most part they remain inferior to their Arctic congeners, perhaps because the conditions of existence in the depths are less favourable, and partly, doubtless, on account of the lack of plant life, and also the small amount of animal nutriment for the worms, there provided. Though in the greater sea depths the light is quite excluded, yet in the Chætopoda found there (with some rare exceptions) we miss neither the colours nor the eyes, which are met with in coast regions. Ehlers believes that these colours and eyes are preserved in the lightless depths, in consequence of new animals ever migrating down from the brighter layers of water, and so preventing the disappearance of these body-parts. There is, however, in the same "Zeitschrift" which contains Ehlers' work, a paper by the physiologist Ranke, on the eyes of leeches (*Hirudo medicinalis*), which may explain that phenomenon in the deep-sea Chætopoda in a different way ("Beiträge zur Lehre von der Uebergangs-Sinnes-Organen"). Ranke, on the ground of his observations on living leeches, considers that their very simply constructed eyes have also sensations of touch and taste; and, further, that they are not eyes proper, which, on occasion, also serve other ends ; they are, rather, neutral organs of sense, which can act in various directions, but in no particular one so specially as sense organs more highly organised, and therefore limited to one specific energy. This appears partly from the fact that organs quite similar to these so-called eyes on the head of the leech occur also in the whole of the rest of its body, quite in the same way as the so-called side organs of fishes and amphibia, which probably afford sensations of touch. We might, then, regard the eyes of the deep-sea Chætopoda as similar indifferent organs of sense, which, even where light fails, do not discontinue their functions. In an appendix to his memoir, Ehlers further describes how the tube-worms (Tubicola) construct their abodes. They use their feelers only for seizing and holding the building materials, then press these to the mouth or side of the abdomen, where they are coated with a cement secreted from numerous skin-glands in these parts of the body. So prepared, the piece has merely to be pressed on a firm bed, or the edge of a tube already formed, and there it adheres. In this way not only are new tubes constructed, but also any damages are repaired.

* See "Annales de Chimie et de Physique," Third Series, t. iii., 1874.

NOTES

THE following are the probable arrangements for the Royal Institution Friday evening meetings before Easter 1876 :—Jan. 21, Prof. Tyndall, F.R.S. : The Optical Deportment of the Atmosphere in relation to the Phenomena of Putrefaction. Jan. 28, Prof. Huxley, F.R.S. : The Border Territory between the Animal and the Vegetable Kingdoms. Feb. 4, W. H. Preece : The Applications of Electricity to the Protection of Life on Railways. Feb. 11, William Crookes, F.R.S. : The Mechanical Action of Light. Feb. 18, Dr. C. William Siemens, F.R.S. : The Action of Light on Selenium. Feb. 25, Lord Lindsay : The Transit of Venus. March 3, Earl Stanhope, F.R.S. : The Ancient Sun Worship, and the Remains of it in England. March 10, Prof. W. H. Flower, F.R.S. : The Extinct Animals of North America. March 17, Sir Henry Sumner Maine, K.C.S.I. : The Later History of the Fief and Manor. March 24, Prof. Odling, F.R.S. (subject not announced.) March 31, Edward B. Tylor, F.R.S. : Ordeals and Oaths. April 7, Prof. Jas. Dewar, F.R.S.E. : The Physiological Action of Light, Part II. The following lecture arrangements have been made :—Christmas Lectures (adapted to a juvenile auditory) by Prof. Tyndall, F.R.S. : Six lectures on Experimental Electricity. In this course the phenomena of frictional electricity will be so illustrated and its principles so explained as to enable the pupil to repeat the experiments, and to pursue the subject further, at school or at home. With this object in view the laws of the science will be elicited from facts obtained with the simplest apparatus. Prof. A. H. Garrod Twelve lectures on the Classification of Vertebrated Animals. Dr. J. H. Gladstone, F.R.S. : Eight lectures on the Chemistry of the Non-metallic Elements. Dr. W. Spottiswoode, Treas. R.S. : Four lectures on Polarised Light. R. P. Pullan : Three lectures on his Excavations in Asia Minor. W. T. Thiselton Dyer : Four lectures on the Vegetable Kingdom ; the Boundaries and Connections of its Larger Groups. Prof. G. Croom Robertson : Three lectures on the Human Senses. Edward Dannreuther : Two lectures on Wagner and his Trilogy (with pianoforte illustrations).

THE Stockholm *Nya Dagligt Allebanda* of the 4th inst. contains some account of the return voyage of the *Pröven* from the mouth of the Yenesei, after the departure of Nordenskjöld. The information is sent by Dr. Théel Kjellman, to whom, it will be remembered, Nordenskjöld gave over the command of the *Pröven*. The *Pröven* left Dickson Harbour, at the mouth of the Yenesei, on the 19th August, and set her course towards the north-east part of Novaya Zemlya. On the 23rd August she was found to be already in 75° 24′ N. lat., and 66° 24′ long. E. from Greenwich, and so a little to the south of Cape Middendorf, on the north-east coast of Novaya Zemlya. This peculiar circumstance can only be explained by a very strong north-westerly current going from the Ob and Yenesei out over the Kara Sea. At Cape Middendorf, where ice was met with which extended eastwards as far as the eye could reach, the expedition was becalmed for six days. During this time a considerable amount of dredging work was done, with abundant results. That animal life is here uncommonly rich at the sea-bottom may be inferred from the fact that when a swab was allowed to remain in contact with the bottom for a few minutes it was covered over with animals : sea-stars by hundreds, with

the most beautiful nuances of red, numerous, and colossal bush-like Alectos, Crustacea, and Mollusca stuck fast on its strands. On the 28th a start was again made, and a number of immense glaciers coming down to the sea were passed; the coast was rocky and very wild. The following day anchor was cast in Udde Bay. Marine vegetation was uncommonly abundant here, which is all the more interesting, as it has been stated that the Kara Sea is devoid of all plant life. Vegetation on land, on the contrary, was exceedingly scanty. Some small withered willows met the eye here and there. The fell-poppy (*Fjellvalmon*) alone yet bare flowers, but even these the autumn had almost destroyed. "The whole of nature produced the impression of indescribable desolation." On the 3rd September the *Pröven* sailed into the mouth of Matotschkin Strait, where the expedition remained till the 11th September. They then steered homewards, and after experiencing exceedingly tempestuous weather, the *Pröven* entered the harbour of Tromsö on the 3rd October. "We have," the letter concludes, "during this summer sailed over known and unknown seas more than 6,000 (English) miles; we have visited regions whither expeditions for more than three hundred years have attempted in vain to come; we have made rich collections in all departments of natural science. What more can man desire from such a journey?" In Petermann's *Mittheilungen* for December, along with some account of the expedition, is a map showing the route outwards and home of both parties. Nordenskjöld had reached St. Petersburg on the 17th instant.

In his will, dated Oct. 16, 1875, Sir Charles Wheatstone bequeaths all his scientific books and instruments, as well as his medals and diplomas, to the Corporation of King's College, London, together with a legacy of 500*l.* for the purchase of scientific instruments. To the Royal Society he bequeaths the portraits of the Hon. Robert Boyle, and of all the other scientific men in his possession, together with a legacy of 500*l.* to be added to the Wollaston Donation Fund.

It is stated that Prof. Huxley has accepted the invitation of the Senatus of the University of Edinburgh to take charge again of the Natural History Class during next summer session.

The *Challenger* arrived at Valparaiso on the 19th inst.

The following gentlemen have been appointed as a Commission to consider the claim of the Scottish Meteorological Society on Government, a claim which we may state has already been reported on by the Duke of Devonshire's Commission:—Sir Wm. Stirling Maxwell, Dr. Hooker, Col. Strachey, Messrs. Francis Galton, Brassey, D. Milne Home, Farrer, and Lingen.

Petermann's *Mittheilungen* for December contains a translation of Mr. Stanley's letters, with a clear map embodying the results of his circumnavigation of Lake Victoria Nyanza, and showing at the same time Speke's route of 1858, and that of Speke and Grant in 1861–62. In an introduction to the letters, Dr. E. Behm discusses the results obtained by Mr. Stanley. The *Daily Telegraph* of Tuesday publishes two letters from the late unfortunate M. Linant de Bellefonds, describing his sojourn at Mtesa's and his meeting with Mr. Stanley.

The same number of the *Mittheilungen* contains the first part of an elaborate and important paper by Oscar Loew, giving an account of Lieut. Wheeler's second expedition into New Mexico and Colorado in 1874, and pointing out the important scientific bearings of the results obtained. He pays a well-deserved tribute of praise to the enterprise of the U.S. Government, in accomplishing the survey of so large a portion of their extensive territories in so comparatively short a time.

An interesting letter appears in yesterday's *Daily News* from Mr. Smithurst, the engineer of the steamer which made the voyage up the newly discovered Baxter River in New Guinea, referred to in Sir Henry Rawlinson's address at the Geographical Society last week. The river seems to be a magnificent one, and could evidently be made navigable to a considerable distance inland. The exploring party found the banks to consist mainly of mangrove swamps, though, near the end of the journey, high clay banks with *Eucalyptus globulus* were found. Scarcely any natives were seen, though there were frequent signs of their being about. Mr. Smithurst refers to a very remarkable bird, which, so far as we know, has not hitherto been described. The natives state that it can fly away with a dugong, a kangaroo, or a large turtle. Mr. Smithurst states he saw and shot at a specimen of this wonderful animal, and that "the noise caused by the flapping of its wings resembled the sound of a locomotive pulling a long train very slowly." He states that "it appeared to be about sixteen or eighteen feet across the wings as it flew, the body dark brown, the breast white, neck long, and beak long and straight." In the stiff clay of the river bank Mr. Smithurst states that he saw the footprints of some large animal, which he "took to be a buffalo or wild ox," but he saw no other traces of the animal. These statements are very wonderful, and before giving credence to them we had better await the publication of the official account of the voyage. A very fair collection of rocks, stones, birds, insects, plants, moss, and orchids has been made, which will be submitted to a naturalist for his opinion. The dates of Mr. Smithurst's communication are from August 30 to Sept. 7.

The long-standing Chancery suit of the King of Portugal *v.* Carruthers has at length been terminated by a compromise. The suit arose out of the will of the late eminent African explorer, Dr. Welwitsch, who had explored a portion of Central Africa at the expense of the Portuguese Government, and had made large and important botanical collections. These collections were left by will to the British Museum; but Dr. Welwitsch's right to so leave them was disputed by the Portuguese Government. The compromise finally arrived at is to this effect:—A declaration that the King of Portugal is entitled to all the collections; the King, as an act of grace and favour, paying the defendants 700*l.* in full discharge of all demands; that the study set (the best) and the next best set of the collections should be separated from the other collections; that the British Museum should have the second best set as a gift from the King, and that the King should have all the other sets, and should distribute them as he may think proper.

We learn from the *Gardener's Chronicle* that M. E. André, well known as a landscape gardener in this country as well as on the Continent, and also as the editor of the *Illustration Horticole*, is about to undertake a botanical exploration in Brazil, Peru, Ecuador, and New Granada.

M. Gabriel de Mortillet, the learned sub-director of the St. Germains Museum, has been appointed President of the Paris Anthropological Society for 1875-76.

Two new zoological gardens have recently been established and opened in the United States of America, at Philadelphia and Cincinnati, and both appear to be making good progress. The Superintendent of the former is Dr. Dorner, who was lately scientific secretary of the Zoological Garden at Hamburg, and has quitted Europe in order to inaugurate the new institution in America.

The meeting of Orientalists to be held in September next at St. Pete sburg is to be accompanied by an exhibition of Oriental manuscripts, coins, arms, implements, and other objects illustrative of the history and industry of the East. The meeting will be directed by an Imperial Commission, presided over by Prof. Gregorieff, the well-known geographer of Central Asia,

and including the names of Peter von Lerch, Victor von Rosen, and Daniel Chvloson. MM. Gregorieff and Lerch are ready to receive objects intended for exhibition.

At a meeting of the Fellows of the Royal Society of Edinburgh, held on Monday, the 22nd inst., the following were elected office-bearers for the session 1875-76 :—President, Sir William Thomson, LL.D. Vice-Presidents: Rev. W. Lindsay Alexander, D.D., the Right Rev. Bishop Cotterill, David Milne Home, LL.D., Prof. Kelland, Lord Neaves, David Stevenson, C.E. Secretary, Prof. H. Balfour. Secretaries to ordinary meetings: Professors Tait and Turner. Treasurer, David Smith. Librarian, Prof. Maclagan. Members of Council: Alexander Buchan, J. Matthews Duncan, M.D., Prof. George Forbes, Andrew Fleming, M.D., Prof. Geikie, Sir Alexander Grant, Thomas Harvey, LL.D., John G. M'Kendrick, M.D., Arthur Mitchell, M.D., Charles Morehead, M.D., Ramsay H. Traquair, M.D., Robert Wyld, LL.D.

The session of the Poitiers Meteorological Congress was opened on the 18th inst. M. Leverrier was present. The future Association is to be composed of sixteen departments: Loire, Loire et Cher, Loiret, Indre et Loire, Maine et Loire, Loire Inférieure, Vendée, Charente Inférieure, Deux Sèvres, Charente, Haute-Vienne, Vienne, Indre, Sarthe, Correze, and Creuze. The Gironde, which is to become the centre of another branch of the Association, sent three delegates. The proceedings are to be published, but the sittings were not public.

It is officially announced that it is the purpose of the U.S. Government to make a complete and representative collection of the mineral products of the United States, which shall illustrate the mineral resources of the country and its mining and metallurgical progress at the forthcoming International Exhibition to be held in Philadelphia.

In consequence of the time at the Manchester meeting of the Iron and Steel Institute being insufficient to allow of the reading and discussion of several papers that were upon the programme, a supplementary general meeting is being held in London to-day in the rooms of the Council of the Institution of Civil Engineers. Besides discussions on papers read at Manchester, Mr. G. J. Snelus will read a paper on fireclay and other refractory materials; Mr. William Hackney on the manufacture of anthracite coke in South Wales; Mr. C. J. Homer on the North Staffordshire Coalfield, with the ironstones contained therein. Suggestions will be submitted to this meeting for introducing such modifications in the rules and regulations as will in future admit of dealing fully with the various subjects that may be brought before each meeting of the Institute.

At its last sitting the French Geographical Society broached a scheme for inducing the several French Railway Companies to place at each station a map of the vicinity, with indications of the most notable historical or economical facts connected with the district. It appears that this is the universal practice on Brazilian railway lines.

A third and cheaper edition of the translation of Dr. F. A. Pouchet's work, "The Universe," published by Messrs. Blackie and Sons, has been issued. We reviewed the work in our first volume (p. 259), when we expressed our belief that it would do much to foster a love of pure science in the young. This cheaper edition, though a few illustrations and notes have been omitted, is still a handsome and beautiful work, well adapted for a present to boy or girl.

It is expected that the bulldings for the Yarmouth Aquarium will be completed by the 1st of June, 1876. Mr. Saville Kent has been appointed naturalist and manager of the aquarium.

Among recent additions to the Manchester Aquarium are nine examples of the Sterlet (*Accipenser ruthenus*) from St. Petersburg, a species that has hitherto, in this country, been on public exhibition in the living state at Brighton only. The fine Sturgeon obtained from Colwyn Bay for the Manchester tanks some six months since is still doing well.

It is said that the French National Library is to be opened every evening from 8 to 10. It is an important innovation which has been tried with success at the library of the Conservatoire des Arts et Métiers, and has existed for years at the Bibliothèque St. Génévieve, in the Quartier Latin, for the use of students.

Experiments have been tried with success for using locomotive engines on Paris tramways.

The International Medical Congress, which this year met at Brussels, will hold its next meeting at Geneva, in September 1877.

The Italian Expedition for exploring the interior of Africa will leave in January next, and will be absent three years.

The members of the Metropolitan Scientific Association lately paid a visit to the recent excavations in the Surrey Commercial Docks. One of the most important results of the visit was the discovery of what, on further examination, will doubtless prove to be a line of fault hitherto unsuspected, and if further inquiry confirm the accuracy of the engineer's section, another line of fault will have to be added to future geological maps of this district.

A movement has been set on foot at Philadelphia, the Society of Arts *Journal* states, since Mr. Cunliffe Owen's visit to that city, for the establishment of a Museum of Science and Art of a character similar to our own South Kensington Museum.

Mr. Serjeant Cox will publish, early in January, the first volume of a treatise on "The Mechanism of Man," being a reproduction, re-written, re-arranged, and greatly extended, of his work entitled "What am I?" which has been for some months out of print.

A paper was read at the meeting of the Psychological Society on Thursday week, by Mr. G. Harris, LL.D., F.S.A., vice-president, on "Caligraphy as a test of Character," in which, after remarking on the various modes in which character in each person is exhibited, and on the infinite diversities of handwriting, he adverted to the peculiarities which display character, and illustrated his theory by exhibiting a number of original autographs, including those of Napoleon I., Wellington, Nelson, Brougham, Horne Tooke, Southey, Cowper, Sheridan, Cobbett, Bulwer Lytton, and Charles Dickens, commenting on the contrast between the writing of the two latter. A discussion followed, in which Mr. Serjeant Cox, the President, Prof. Leone Levi, and others took part.

The additions to the Zoological Society's Gardens during the past week include an Arabian Baboon (*Cynocephalus hamadryas*) from Arabia, presented by Mrs. M. A. Moore; a Pampas Deer (*Cervus campestris*) from Uruguay, presented by Capt. Hairby; a Herring Gull (*Larus argentatus*) European, presented by Mr. P. Gipps; a Western Slender-billed Cockatoo (*Licmetis pasinator*) from W. Australia, presented by Mr. W. J. Irving; a Golden Tench (*Tinca vulgaris*), European, presented by Mr. S. C. Hincks; a Capybara (*Hydrochærus capybara*) from S. America, two Central American Agoutis (*Dasyprocta punctata*), two Yellow-winged Blue Creepers (*Cæreba cyanea*), two All-green Tanagers (*Chlorophonia viridis*), two Naked-throated Bell Birds (*Chasmorhynchus nudicollis*), two Yellow Hangnests (*Cassicus persicus*), a Sulphury Tyrant (*Pitangus sulphuratus*), a Silver Blue Tanager (*Tanagra cana*), a Blue Grosbeak (*Guiraca cyanea*), five Pileated Finches (*Coryphospingus pileatus*), from Brazil; five Darwin's Pucras Pheasants (*Pucras darwini*), from China, deposited.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for October contains but one paper communicated to the Society, viz., a lengthy communication on the chemistry of tartaric and citric acids, by Mr. R. Warington. The author has had considerable experience in the manufacture of these acids, having been for some years chemist to the factory of Mr. J. B. Lawes. The author's experiments prove that the citric acid of commerce contains one molecule of water corresponding to the formula $C_6H_8O_7$, H_2O. Some interesting results have been brought to light in the course of some experiments made with a view to determine the water of crystallisation in various samples of the acid. Thus in one determination a specimen of the powdered acid lost the whole of its water over sulphuric acid in a few days, at a temperature of 16°. In another experiment the powdered acid lost but a mere trace of water *in vacuo* over vitriol for some days, while the same acid heated to 100° lost its normal amount of water. Results of an equally contradictory nature were obtained with various other samples of the acid tried at subsequent periods. It has been proved also that a strong solution of citric acid undergoes considerable contraction when mixed with water.—The next section of the paper relates to the acidity and commercial value of the different lime, lemon, and bergamot juices supplied for the manufacture of citric acid. The nature of some of the acids existing in the concentrated juices is to be made the subject of further research; up to the present time, in addition to citric, formic, acetic, and possibly propionic, acids have been detected. It appears, however, that the organic acids other than citric which exist in the juice are chiefly non-volatile, and have soluble calcium salts. Phosphoric acid has also been found, and there is reason to suspect malic and aconitic acids, the latter being produced by the concentration of the juice. With regard to calcium citrate, it has been found that the amount of water contained in this salt varies according to the mode of preparation, a result demanding further investigation. The author next gives details of the method employed for analysing the citric acid liquors. With regard to tartaric acid, it is found that a strong solution contracts even more than citric acid when mixed with water. The author then proceeds to consider the qualitative reactions of tartaric, metatartaric, and ditartaric acids. Contrary to the statement given in books, it has been found that calcium acetate yields a crystalline precipitate of calcium tartrate, even in dilute solutions of tartaric acid. Free tartaric acid also is precipitated by calcium chloride in the presence of alcohol. The reactions with the acetates of lead and barium have likewise been studied. With regard to the amount of water in calcium tartrate, the author concludes that the salt has no definite composition at 100°. A very complete series of experiments upon the solubility of potassium bitartrate has been made, and the remainder of the paper is devoted to the materials used for the manufacture of tartaric acid, viz. lees, argol, and tartar, and the methods of analysis employed in their valuation. Mr. Warington deserves credit for thus contributing to the general store of knowledge from the experience gained in the chemical factory. A great deal of manufacturing chemistry is at present carried on without any regard to the scientific principles involved, and if manufacturers would only be somewhat more free in communicating apparently inexplicable facts to the scientific world, the advantage gained could not but be mutually beneficial. To quote the author's own words:—"A large amount of information is acquired in the laboratories of our great manufacturing concerns; most of this might be published without any injury to the individual manufacturer. Especially is this true of analytical methods, and the publication and discussion of these would do much to remove the disgrace to which science is often subjected from the wide discrepancies of commercial analyses." We cordially echo the hope "that the publication of these notes may lead to many similar communications."—The remainder of this part is occupied by abstracts of papers from British and foreign journals.

Poggendorff's Annalen der Physik und Chemie, No. 10, 1875. In this is given the remaining portion of Prof. Stein's article on the formation of sound; and from his analysis of the motions of tuning-forks he concludes that only displacements of the nature of condensation and rarefaction yield sound: that the strength of the tones depends, among other things, on the size of the sounding mass; and that only transversal or rectilinear excursions produce resonance. With these data he explains a number of phenomena; the disproportionate loudness of forks held near the ear, &c.—MM. Kundt and Warburg give the concluding part of their researches "On friction and heat-conduction of rarefied gases." After discussing the capability of their apparatus for determining coefficients of heat-conduction, they show that these coefficients are independent of pressure within 150 mm. to about 1 mm. for air and carbonic acid, and 150 mm. to 9 mm. for hydrogen. They tried to produce an actual vacuum in regard to heat-conduction, and by drying to 200° they reduced the conduction to a small fraction of its original value. The co-efficient for hydrogen (in accordance with Maxwell's theory and Stefan's experiments) they found to be 7·1 greater than that of air; while that of carbonic acid was 0·082 of that of hydrogen, which is considerably smaller than by Maxwell's theory.—M. Edlund gives an experimental demonstration that galvanic resistance is affected by the motion of the conductor. He made a current pass in two opposite directions from the middle part of a tube, through water that was sent through the tube; and with a galvanometer proved that the resistance was less where the galvanic current went *with* the liquid one.—There is another electrical paper, in which Dr. Bleekrode recommends ebonite as preferable to glass in many ways for the discs of "electro-machines." He gives a *résumé* of the various modifications of the Holtz machine that have appeared, and describes several observations with the ebonite electro-machines.—M. Glan has a paper on the change of phase of light polarised, through reflection, parallel to the plane of incidence.—M. Emsmann describes a curious phenomenon bearing on binocular vision; while M. Vogel gives an account of spectral observations on the Red Sea and Indian Ocean, and in the blue Grotto of Capri.

Transactions of the Royal Society of New South Wales for the year 1874.—This number contains the following, among other papers:—Description of eleven new species of Terrestrial and Marine Shells from North-west Australia, by Mr. John Brazier, C.M.Z.S.—Iron Pyrites, by Mr. J. Latta.—Nickel Minerals from New Caledonia, and Iron Ore and Coal Deposits at Wallerawang, N.S.W., by Prof. Liversidge.—Some of the results of the observation of the Transit of Venus in New South Wales (with diagrams), by Mr. H. C. Russell, Government Astronomer.—The Transit of Venus as observed at Eden, by the Rev. Wm. Scott.

Bulletin de l'Académie Royale des Sciences, tom. xl. No. 8.—The two original communications in the "Classe des Sciences" are a long article on arithmetical operations, by J. C. Houzeau, and a description of some fossil plants from the "Poudingue de Burnot" (Lower Devonian), by Dr. A. Gilkinet. The two species are *Filicites pinnatus* (Cœmans) and *Filicites lepidorachis* (Cœmans), which latter Dr. Gilkinet removes from the Ferns and places among the Lycopods, under the name *Lepidodendron Burnotense*. There are three plates of figures.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Nov. 19.—"On the Physiological Action of Vanadium," by John Priestley, Platt Physiological Scholar, the Owens College, Manchester. Communicated by Prof. Gamgee, F.R.S.

Thirty-one experiments are detailed, in which frogs, a pigeon, guinea-pigs, rabbits, dogs, and cats were made use of. From these experiments it is gathered:—

1. That vanadium is a poisonous substance.

2. That the symptoms of poisoning are, in general, similar, whatever the method of the introduction of the salt into the animal system.

3. That the symptoms of poisoning which appeared in one or other of the various classes of animals above mentioned are: paralysis of motion; convulsions, local or general; rapidly supervening drowsiness, or indifference to external circumstances; congestion of alimentary mucous membranes; discharge of sanguinolent fluid fæces; presence of glairy, fluid mucus in the intestines after death; certain changes in respiration, and, coincidently, a fall in temperature; drowsiness and feebleness of pulse. In addition the heart was always irritable after death; consciousness and sensibility to pain seemed unimpaired; and no diminution could be detected in the powers of muscle and nerve to respond to stimulation.

4. That the lethal dose for rabbits lies between 9·18 mgr. and 14·66. mgr. of V_2O_5 per kilog. of rabbits.

The author details a number of experiments undertaken with

the view to gain more exact information as to the action of the salt of vanadium upon particular functions. The methods of experiment and the precautions observed are fully described.

Chemical Society, Nov. 18.—Prof. Abel, F.R.S., president, in the chair.—The Secretary read a paper by Mr. T. M. Morgan, on ethyl-phenyl acetylene.—The second communication, on narcotine, cotarnine, and hydrocotarnine, Part 2, by Mr. G. H. Beckett and Dr. C. R. A. Wright, is a continuation of their investigations of this subject.—Mr. W. Noel Hartley then gave an account of the presence of liquid carbon dioxide in mineral cavities, in which he proves, from the physical properties of the liquid enclosed in a cavity of a quartz crystal in his possession, that it is carbon dioxide.—The last paper, by Mr. W. H. Perkins, was a preliminary notice on the formation of coumarin, cinnamic and other similar acids.

Meteorological Society, Nov. 17.—Dr. R. J. Mann, president, in the chair.—Sergeant James Conroy, R.E., Morris Jones, L.R.C.P., A. H. Leycester, Sir David L. Salomons, Bart., and James P. H. Walker, were balloted for and duly elected Fellows of the Society. The following papers were then read:—Some remarks on the reduction of barometric readings with a form of table for combining the corrections for index-error, temperature, and altitude, by William Marriott. Readings of the barometer to be of any scientific value must be corrected for index-error, temperature, and height above mean sea-level. There is not much difficulty in applying the first two, but it is a very troublesome thing to obtain the proper corrections for altitude if the station be more than 100 feet above sea-level. The author has found that a great number of observers make some very extraordinary mistakes in applying this correction, and gives a few as specimens. He attributes the difficulty in applying this correction to the unsatisfactory explanation accompanying the tables as given in the different manuals on meteorology and to the fact of the corrections being only given for two pressures, viz., 27 inches and 30 inches. He then submits a table which gives the sea-level pressure on the left hand and the reading of the barometer at the station corresponding to that pressure on the right hand, with the altitude correction between them. In conclusion he submits a form of table in which is combined the corrections for index-error, temperature, and height above sea-level, which is the means of saving much time, besides reducing the liability to error.—On a continuous self-registering thermometer, by W. Harrison Cripps. The thermometer consists of six coils of glass tubing, the first five being wound concentrically round an axis, each coil lying within the other, in such a manner as to form a spiral glass wheel 4 inches in diameter. The sixth coil is moved slightly away from the others, so that it shall form the circumference of a circle 5 inches in diameter, the centre being the axis around which the spiral tube is coiled. Pivots are attached to either end of the axis, which rest on two parallel metal uprights. The tubing is filled with spirit, and mercury and a small quantity of air are enclosed in the large coil. The thermometer works in the following manner: when the spirit contracts on cooling, the expansion of the included air keeps the column of mercury in contact with it; this immediately alters the centre of gravity, and the wheel begins to revolve in a direction opposite to that of the receding mercury. On applying heat, the mercury passes forwards and the wheel moves in the opposite direction. The thermometer is made to record somewhat in the same way as the recording aneroid barometer.—On a self-regulating atmometer, by S. H. Miller, F.R.A.S. After several years' experimenting with evaporating dishes of different forms under various conditions, the author has arrived at the conclusion that none of the contrivances which have come under his own observation are entirely satisfactory. After remarking upon the conditions which a good evaporator should fulfil, he proceeds to describe a self-regulating one which he has devised and which has now worked satisfactorily for several months. The apparatus consists of an open cylinder 8 inches diameter, surmounted by a brass rain-gauge rim which receives the water from which the evaporation takes. This vessel is surrounded by another cylinder 15 inches in diameter and closed at the top, which is divided into two compartments, upper and lower. The upper one is filled with water to keep the level in the inner cylinder always constant, and the lower one receives the overflow rainfall. The amount of evaporation is determined by weighing the apparatus.

Zoological Society, Nov. 16.—Mr. Osbert Salvin, F.R.S. in the chair.—Mr. Sclater exhibited the upper horn of a Two-horned Rhinoceros that had been shot in March last by Lieut.-Col. C. Napier Sturt, in the valley of the Brahmapootra. Mr. Sclater remarked that this seemed to prove conclusively the existence of a two-horned species of Rhinoceros in Assam, which would probably turn out to be the same as that from Chittagong, now living in the Society's Gardens.—Mr. Sclater read an extract from a letter addressed to him by Dr. N. Funck, director of the Zoological Gardens, Cologne, stating that the bird figured in Mr. Sclater's recent article on the Curassows as *Pauxi galeati* var. *rubra*, was the true female of *Pauxi galeata*.—Mr. H. Seebohm exhibited and made remarks on a series of rare and interesting birds and eggs from the tundras and deltas of the Petchora River, North-eastern Russia, collected there by Mr. J. A. Harvie Brown and himself during the present year.—Mr. A. H. Garrod read some notes on the Manatee (*Manatus americanus*) recently living in the Society's Gardens.—Dr. Günther, F.R.S., read a third report on the collections of Indian reptiles obtained by the British Museum, and gave descriptions of several species new to science.—A communication was read from Mr. E. Pierson Ramsay, containing a list of birds met with in North-eastern Queensland, chiefly at Rockingham Bay.—A second communication from Mr. Ramsay gave a description of the eggs and young of *Rallina tricolor*, from Rockingham Bay, Queensland.—A third communication from Mr. Ramsay contained the description of a new species of Pæcilodryas, and a new genus and species of Bower Bird, proposed to be called *Scenopœus dentirostris*, from Queensland.——A communication was read from Mr. Sylvanus Hanley, containing the description of a new Cyclophorus and a new Ampullaria, from Burmah.—A communication was read from Dr. J. S. Bowerbank, F.R.S., containing further observations on *Alcyoncellum speciosum*, Quoy et G., and *Hyalonema mirabile*, Gray.—Mr. Arthur G. Butler read a paper on a collection of butterflies from the New Hebrides and Loyalty Islands, and gave descriptions of some new species.—A second paper by Mr. Butler contained particulars of a small collection of butterflies from Fiji. Mr. Butler also read the descriptions of several new species of Sphingidæ.—A communication was read from Mr. W. H. Hudson, containing remarks on Herons, with a notice of a curious instinct of *Ardetta involucris*.—A communication was read from Dr. Otto Finsch, in which he gave the description of a new species of Crowned Pigeon from the southern end of New Guinea, opposite Yule Island. Dr. Finsch proposed to call this bird *Goura scheepmakeri*, after Mr. C. Scheepmaker, of Soerabaya, who had transmitted a living specimen of it to the Zoological Gardens, Amsterdam.

Entomological Society, Nov. 3.—Sir Sidney Smith Saunders, C.M.G., president, in the chair.—This being the first meeting of the session in the new rooms of the Society at 11, Chandos Street, Cavendish Square, the President delivered an inaugural address, pointing out the advantages which might be expected from the library and meeting-room being brought into juxtaposition on a more central site; and also from the library being open to members during three days in each week instead of one day only.—M. Oscar Lamarche, of Liége, was elected a foreign member.—Mr. W. C. Boyd exhibited mines of *Heliozela sericiella* in oak. He had succeeded in rearing the insects by confining them with a young oak plant, and thus was enabled to discover their habits, which had hitherto been unknown. The mines were situated in the footstalks of the leaves.—Mr. M'Lachlan exhibited a living apterous female of a terrestrial Trichopterous insect, *Enoicyla* (probably *E. pusilla*, Burm.) He had recently bred it, with others, from cases forwarded to him by Mr. Fletcher, of Worcester, the discoverer of the insect in this country. Mr. M'Lachlan gave an account of its structure and singular habits. The perfect insects emerge in November, and the males are furnished with ample wings.—Mr. Champion exhibited several rare Coleoptera captured by him in Kent and Surrey.—Mr. Phipson exhibited a *Calocala nupta*, with several *Acari* on a portion of one of the anterior wings, instead of on the body, as is usually the case.—The Rev. H. S. Gorham read descriptions of some new species and a new genus of *Endomycici*.—Mr. Arthur G. Butler communicated "a list of the Lepidoptera referable to the genus *Hypsa* of Walker's list, with descriptions of new genera and species."—Mr. Edward Saunders communicated a second part of his Synopsis of the British *Hemiptera Heteroptera*.—Mr. Charles O. Waterhouse read descriptions of some new genera and species of Heteromerous Coleoptera (*Heteropidæ*), chiefly from Terra del Fuego. The specimens had been brought to this country by Mr. Charles Darwin, and had been described many years ago by Mr. Water-

house, sen., but the manuscript had been unfortunately lost, and the insects had remained unnoticed till the present time.

BERLIN

German Chemical Society, Nov. 8.—A. W. Hofmann, president, in the chair.—J. Landauer described a blowpipe-apparatus consisting of two bottles, one of which contains air, while the other, filled with water, is placed above and is connected by a tube with the air-bottle. The water replacing the air produces the blast.—T. Grabowsky has found amongst the products chlorine forms with acetone, a liquid of the formulæ $C_6H_7Cl_3O$, and another liquid $C_6H_7Cl_3O$ (trichlorinated oxide of mesitylene).—The same chemist has studied anew the transformation of chloral into chloralid and solid chloral.—P. Griess has obtained betain by the action of iodide of methyl on glycocol.—S. P. Sadler appears to have transformed glycerine into tartronic acid by means of diluted fuming nitric acid.—V. von Richter reverted to a reaction formerly observed by him, through which nitrobromobenzol and cyanide of potassium form cyanobromobenzol, and consequently a bromobenzoic acid, of which the acid group CO_2H is *not* corresponding in position to the nitro-group of the original compound. He has repeated the experiment with bibromo-nitro-benzol, and finds corresponding exchanges to take place in their case. He also described the formation of certain di-tri- and tetra-bromo-benzols.—F. Beilstein and A. Kurbatow, by adding chloride of antimony to nitrobenzol and passing chlorine gas into it, have obtained a good yield of meta-chloronitrobenzol and higher chlorides.—T. A. Roorda Smit prepares acetate of ammonium and acetamide by means of carbonate of ammonium. The same fluids, nitrobenzol and sulphite of ammonium, yield anilosulphite of ammonium $C_6H_5NHSO_3NH_4$. The same chemist has found thioanilide, $C_6H_5NH-S-NHC_6H_5$, a yellow oil, amongst the products of the reaction of chloride of sulphur on aniline.—Ira Remsen communicated researches on the action of potassium on succinate of ethyl and on the action of ozone on carbonic oxide.—The President then read to the meeting an autobiographical sketch by F. Wöhler, not intended for publication, of which the following is an extract:—His father, as well as a friend of the family, encouraged his pleasure in collecting natural objects, and experimenting. In 1814 he was sent to the grammar-school of Frankfort. He was backward particularly in mathematics, partly because he was constantly occupied in collecting minerals. Dr. Buch in Frankfort was his first serious instructor in chemistry. Buch published remarks on selenium conjointly with Wöhler. Hagen's old treatise, based on the phlogistic theory already used by his father, was his first guide, but was soon exchanged against more modern views and books. His room was changed into a chemical laboratory; he learnt to engrave on copper, and collected antiquities; but his great pleasure was the construction of a Volta-battery of 100 couples and the reduction of potassium by means of it, as well as by heat alone. He was fond of bodily exercises, such as swimming and shooting. In 1820 he went to the University of Marburg, but was offended by one of the professors, who forbade his making chemical experiments while he was studying medicine! He therefore continued his studies in Heidelberg. The great physiologist Tiedemann became his friend, and he published researches on the change that organic acids undergo through passing the human body. He obtained a prize for this paper, and used it for his dissertation as Doctor of Medicine. He still had the intention of entering into the practice of a profession. He worked in Gmelin's laboratory, but never heard any lectures on chemistry. The sketch does not enter into his life in Sweden, described in a former paper. After returning from Sweden his friendship with Liebig commenced in Frankfort, to cease ouly with Liebig's death. In 1825 Leopold von Buch proposed him as teacher of chemistry of the newly founded School of Industry (Gewerbeschule) at Berlin. He accepted the place, and was named Professor in 1828. He derived great benefit from living in friendly intercourse with Magnus, H. and G. Rose, and Mitscherlich. He remembers with enthusiasm the influence of Humboldt and his eloquence. Humboldt was president of the Association of Natural Philosophers at Berlin, and the contrast between his never-ceasing flow of language and the silence of Berzelius is humorously described in the following anecdote. During an excursion of the Association, Wöhler had to take his seat, as he says, on account of his thinness, in a carriage nearly filled already by the stoutest members of the Association, viz. Humboldt and Berzelius. The former held forth with his usual readiness, when Berzelius suddenly broke out in Swedish: "Mr. Wöhler, what eloquence! I cannot stand it any longer!" Fortunately Humboldt's all but universal knowledge did not comprise the Swedish language. In Berlin Wöhler published his text-book (Grundriss) of chemistry, at first anonymously. Soon afterwards he left Berlin for Cassel. In 1829 he visited France together with Magnus; in 1835 England. In 1836 he was named successor of Stromeyer as Professor of Chemistry in Göttingen.

PARIS

Academy of Sciences, Nov. 15.—M. Frémy in the chair.—The following papers were read:—On meridian observations of small planets at the Greenwich and Paris Observatories during the third trimestre of 1875, by M. Leverrier.—On the density of pure platinum and iridium and their alloys, by MM. Sainte-Claire Deville and H. Debray. The numbers obtained (about 21·5 for platinum and 22·4 for iridium) are higher than those found hitherto.—Researches on the composition of dissolved acids and salts, by M. Berthelot.—Memoir on measurement of the affinities between liquids of organised bodies by means of electromotive forces, by M. Becquerel. He studies the electromotive force obtained from the white and the yolk of an egg, from the arterial and venous blood of dogs, and from each of these with albumen, the reactions between plant liquids, and between them and animal liquids, the electro-capillary effects of sulphurous liquids in contact with liquid exuded from the skin, &c.—Examples of the contemporaneous formation of iron pyrites in thermal springs and in sea water, by M. Daubrée.—On the carpellary theory according to the Amaryllideæ (Part 1, Alstræmeria), by M. Trécul.—Fifteenth note on the electric conductivity of moderately conducting bodies, by M. Du Moncel.—M. Janssen presented four cases of natural history specimens from the Japanese Government.—On the representation of figures of geometry of n dimensions by correlative figures of ordinary geometry, by Mr. Spottiswoode.—On the development of the fruit of Coprini, and the supposed sexuality of the Basidiomycetes, by M. van Tieghem.—Theory of hail, by M. Cousté.—On the employment of nickel deposited electrically to protect the magnets of compasses against oxidation, by M. Duchenin.—Application of the principle of analytic correspondence to the demonstration of the theorem of Bezout, by M. Saltel.—Observations of the planet Jupiter, by M. Flammarion. He notes (*inter alia*) the appearance of white elliptic spots followed by shadows. Some sketches are given.—On some combinations of titanium, by MM. Friedel and Guérin.—Solution of platinum in sulphuric acid during the industrial process of concentration, by M. Scheurer-Kestner.—On the presence of a new alkaloid, ergotinine, in spurred rye, by M. Tanret.—On the *rôle* of carbonic acid in the phenomenon of spontaneous coagulation of blood, by M. Glénard.—Reply to MM. Mathieu and Urbain's last note on the same subject, by M. Gautier.—On the embryogeny of the flea, by M. Balbiani.—On larval forms of Bryozoa, by M. Barrois.—Note on the storms of November 6 to 11, 1875, by M. Marié-Davy.

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