THURSDAY, JANUARY 4, 1877

THE FARADAY LECTURE FOR 1875

The Life Work of Liebig in Experimental and Philosophic Chemistry. By A. W. Hofmann, F.R.S., &c. Delivered before the Chemical Society of London. (London: Macmillan and Co.)

IN this volume we have given us a sketch of the labours of Liebig in the domain of Pure and Applied Chemistry, and also an account of his manifold investigations in the direction of its Application to Agriculture and Physiology.

Prof. Hofmann has been induced to take the works of this great chemist as the theme for the Faraday lecture, not only from its being a subject in itself rich in most interesting matter, but, that from Liebig's studies on the relation and mutual bearing of the facts discussed by him, he was led to the conception of general laws elucidating chemical phenomena; thus standing beside Faraday as a fit representative of our century to future generations. Notwithstanding the great reputation Liebig now possesses, Prof. Hofmann seems to think that at the present time, we being almost contemporaneous with this great chemist, are not in a position to give to his works such appreciation as will be yielded them in the future; on this point Prof. Hofmann says:—

"As those who wander in a mountain chain cannot appreciate the sky-reaching grandeur of its lofty peaks as well as those who remotely from the plains beneath contemplate its snow-crowned summits, so we, the contemporaries of Faraday and Liebig cannot perceive the full dignity of their commanding forms—the philosophic pinnacles of this century—as they will hereafter appear to distant generations of posterity. In these days Faraday and Liebig will be looked up to with such reverence as it is ours to offer to the mighty spirits of the past—to such giant figures as those of Galileo, Kepler, Newton, and Lavoisier. And as that bright constellation shines on us from the misty darkness of the past, so will the names of Faraday and Liebig—stars of co-equal lustre—throw forward their bright beams on our successors through the far-reaching vista of ages yet to come."

Although expressing himself at the outset embarrassed by the richness of the subject, and consequently the difficulty of making any proper classification or selection of the many interesting investigations and discoveries to be discussed, Prof. Hofmann must be congratulated on the very successful result which has crowned his endeavours.

Commencing with a short review of the general work of Liebig with regard to the elaboration of apparatus and analytical methods for chemical research, Prof. Hofmann proceeds to speak of the great power Liebig had in imparting knowledge to others, and his influence over the mind of his pupils. He next draws attention to the resemblance between the labours of Liebig and Faraday in abstract science, and the abundant results they have produced in their applications to the useful arts.

In the field of agricultural chemistry, in his investigation of the laws regulating the growth of plants, we learn from Prof. Hofmann that Liebig first penetrated the doubt and uncertainty which had previously existed, establishing with certainty the relation which exists between the growing plant and soil and air in which it lives. Standing as a monument of his most exhaustive researches on this point, we have his two works: "Chemistry in its Application to Agriculture and Physiology," and "The Natural Laws of Husbandry," this latter work constituting the first perfect treatise on the philosophy of agriculture which had appeared up to that time. To Liebig is also due the knowledge we now possess, that for proper vegetable growth the plant must be supplied through the land with those constituents which are found in its ash; and, as a sequence following from this, the fact, that should the soil become deprived of such constituents, it will be unfit for further plant growth till the proper saline ingredients are returned to it. With the knowledge acquired on such points he was naturally led to the production of artificial manures as a means for the fertilisation of land impoverished and exhausted by the crops grown upon it.

Passing from Liebig's labours in agricultural chemistry to those in the higher branch of biology, we find his discoveries producing no less perfect and important results. Although many isolated researches, as those of Chevreul, Berzelius, Gmelin, and Tiedeman, had been already conducted on certain constituents of the animal economy, still we owe to Liebig the collection of these widespread attempts into a "focus" for the elucidation of the phenomena of animal life. Of Liebig's chemico-biological work perhaps the best instances we can refer to are his "Investigations into the Origin of Animal Heat," his "Theory with regard to the Nutrition of Animals," and his "Doctrine of the Origin and Function of Fat in the Animal Economy." In the first of these inquiries he reviews the ideas of Lavoisier and Laplace, and the experiments of Dulong and Despretz, pointing out the errors of experiment the two latter investigators had fallen into, and from his own minute calculations proving the sensible heat of the animal body to be explained by the processes of combustion carried on within the organism. From his inquiries into the chemical nature of food, Liebig was led to his theory that the vegetable stands in a position intermediate between the mineral and the animal. The animal being unable to assimilate inorganic compounds, the vegetable acts as a means for transforming the mineral molecules into those of a higher order fit for the proper maintenance of the animal organism. The facts necessary for the support of his theory are to be found in the identity in composition of the nitrogenous principles, animal and vegetable, albumin, casein, and fibrin; a fact previously pointed out by Mulder, but exactly determined through analysis either by Liebig or his pupils.

In the views promulgated by Liebig that it is in the animal organism, through the transformation of starch, sugar, &c., that the chief formation of fat takes place, he was led into a long and animated controversy with Dumas and Boussingault; but in this, as in other of his discussions, experiment has decided in favour of Liebig. Although the experiments of his opponents proved the existence of fat in vegetables, it was nevertheless in quantities quite insufficient to account for the amount found in animals when fed artificially on vegetable food alone. Like his investigations in agricultural chemistry, Liebig's discoveries in the biological branch yielded their proportion of practical applications, and from his investigations of the composition and nutrition of the animal body arose the methods now used for the preparation of condensed food and for its preservation without decomposition.

On examining the purely scientific work of Liebig brought before our notice by Prof. Hofmann, the reader is at once struck by the varied nature of the researches. In his experiments on the cyanogen group, resulting from his examination of the fulminates, we are led back to some of the earliest stages of Liebig's scientific career. In this investigation, published at the age of nineteen and detailing experiments extending over two years, we have accurate proof given us of the very early age at which he had recognised the natural tendency of his mind. His experiments proving the fulminates to be isomeric with the cyanates brought him in contact with Wöhler, already working on the same ground, this friendship being soon destined to exercise a most important influence upon organic chemistry.

Liebig's investigations upon alcohol and its derivatives are interesting, not only from the fact that it was from his earlier experiments on this body proceeded the discovery of chloral and chloroform, but also that in his endeavours to elucidate the constitution of alcohol he was led into a long protracted discussion with Dumas and Boullay, a discussion resulting in the victory of Liebig. It would be impossible here to give a detailed notice of the remaining investigations of Liebig touched on by Prof. Hofmann in his discourse; it will be sufficient for us to mention Liebig's researches on the group of benzoic compounds, his discoveries in uric acid and its derivatives, executed in conjunction with Wöhler, and his elaborate work on the constitution of the organic acids.

Many as Liebig's experimental researches were he still found time for literary labour. It would be almost sufficient to mention the work founded by him, in conjunction with his friends, Wöhler and Hermann Kopp, as early as 1832, a work then and now known as "Liebig's Annalen," a most invaluable collection of recent experimental discovery. Of his other larger works two more may be mentioned, his "Dictionary of Pure and Applied Chemistry," begun conjointly with Poggendorff and Wöhler, and his "Handbook of Organic Chemistry," a treatise translated into French and English by Gerhardt and Gregory respectively.

Examining the whole "Life Work of Liebig" as put before us in this admirable discourse of Prof. Hofmann, the reader must be at once struck with the enormous amount of work which it is almost impossible to believe could have been accomplished by one man during a lifetime. The number of his papers published in the records of the Royal Society alone is, we are told by Prof. Hofmann, 317, of which 283 are by Liebig himself, the remainder published in conjunction with other chemists. It is worthy of remark, however, that from the number and ability of the pupils he drew around him, Liebig was able to trust certain of his researches to their care, invariably, however, giving his assistants all credit for any ideas or discoveries of their own.

If Liebig was followed ardently by his pupils it was because he possessed the rare gift of inspiring them not only with admiration but with love. With the spirit which was equally characteristic of Faraday's genius, Liebig endeavoured to lead his followers beyond mere single spheres of thought to the conception of laws regulating wide ranges of phenomena, tending in their results to the material welfare of mankind.

We feel sure that this interesting account of the work of one so distinguished and widely known as Justus Liebig, will be read with great pleasure not only by chemists but by all who are interested in the progress of natural science. JOHN M. THOMSON

HUNTING-GROUNDS OF THE GREAT WEST

The Hunting-Grounds of the Great West, a Description of the Plains, Game, and Indians of the Great North-American Desert. By Richard Irving Dodge, Lieut.-Col. U.S.A. With an Introduction by William Blackmore. (London: Chatto and Windus.)

MR. WILLIAM BLACKMORE, well known to anthropologists in connection with the Blackmore Museum at Salisbury, hunted buffalo on the great plains of the Far West with Col. Dodge. The American colonel's camp-fire stories seemed to his English companion well worth preserving, and thus the present volume came to be written, and dedicated to Mr. Blackmore, who has prefaced it with an introduction on the Indian tribes of North America and the causes of their extinction. No doubt Mr. Blackmore was right in encouraging his friend to write his book, which contains much curious information not got up out of other books, but drawn direct from life in the Indian country, and told well in barrack-room fashion. The bold picturesque illustrations by Griset suit the contents well, and the volume in its red and gold binding might have been recommended as a gift-book, had the author had the discretion and good taste to exclude certain stories as to the relations of the sexes among Indian tribes, as well as several pages of revolting details respecting the fate of those who fall as captives into the hands of such tribes as the Comanches, which ought not to have found a place in it.

In pointing out that these contents must in great measure remove the book from popular circulation, we do not say that they should not have been printed somewhere, though a smart *ad captandum* volume was not the proper place. In fact they form part of a general description of Indian society, which students of the development of law and morals may read with considerable advantage. The necessary growth of some rule of female propriety in societies where the women are the absolute chattels of the men, is illustrated with remarkable clearness among the Cheyennes (see p. 301, &c.), and all the more plainly by contrast with the habits of their husbands, who, being no one's property, own no social restraint whatever. Again, however brutal the individuals of any tribe may be, there must be a social contract observed or the whole society would collapse. This also is well shown among the Cheyennes, by the fact that women obtain absolute protection by a merely symbolic form, which, if any man failed to respect, he would certainly be killed (p. 303). Again, the existing marriage law of the Cheyennes (p. 300) furnishes an instructive commentary on the story of King Gunther's marriage with Brynhild in the Nibelungen Lied, which is possibly a relic of Germanic custom in remote barbaric times. These are a few among many points in which modern savage society throws light on the ancient manners of nations now in the front ranks of culture.

The state of the savage mind as contrasted with that of the civilised man is well brought out in the following remarks by Col. Dodge as to what will and what will not astonish an Indian :—

"The Indian has actual and common experience of many articles of civilised manufacture, the simplest of which is as entirely beyond his comprehension as the most complicated. He would be a simple exclamation-point did he show surprise at everything new to him, or which he does not understand. He goes to the other extreme, and rarely shows or feels surprise at anything. He visits the States, looks unmoved at the steamboat and locomotive. People call it stoicism. They forget that to his ignorance the production of a glass bottle is as inscrutable as the sound of the thunder. A piece of gaudy calico is a marvel ; a common mirror a miracle. He knows nothing of the comparative difficulties of invention and manufacture, and to him the mechanism of a locomotive is not in any way more matter of surprise than that of the wheelbarrow. When things in their own daily experience are performed in what to them is a remarkable way, they do express the most profound astonishment. I have seen several hundreds of Indians, eager and excited, following from one telegraph pole to another a repairer, whose legs were encased in climbing boots. When he walked easily, foot over foot, up the pole, their surprise and delight found vent in the most vociferous expressions of applause and admiration. A white lady mounted on a side-saddle, in what to the Indian women would be almost an impossible position, would excite more surprise and admiration than would a Howe's printing press in full operation" (p. 309).

Both Mr. Blackmore and Col. Dodge lament over the wanton destruction of the buffalo in the hunting-grounds of the Far West, where they are killed by tens of thousands merely for the value of their hides. On the Arkansas River, where the hunters had formed a line of camps, and shot the buffalo night and morning when they came down to drink, Mr. Blackmore found their putrid carcases in a continuous line along the banks (p. xvii.). He reckons that in three years as many buffalo have been thus wastefully slaughtered as there are cattle in Holland and Belgium, and the map prefixed to the book shows the insignificant patches to which the buffalo ground, in 1830 extending across the whole middle of the continent, had shrunk by 1876. How recklessly the extermination was carried on may be judged from the description, at p. 137, of the "great buffalo-skinner's" method of using a waggon and horses to take the hide off the carcase at one pull, the ordinary method of careful flaying being found too slow. The destruction of the buffalo, driving the tribes of hunting Indians to starvation and revolt, has done much to hasten the extinction of this doomed race. But it is not the only cause of their destruction so swiftly going on. Every one who reads the details here given as to how the Indians carry on their war against the white settlers, must see that the whites will inevitably pursue the policy of killing them down till only a helpless remnant survives. But every candid reader will agree with Mr. Blackmore and Col. Dodge that it is the ill-treatment of the settlers, and the faithless disregard of Indian treaties by the American Government, that have made the warrior tribes into human wolves. It is evident that a humane while firm policy might have given the Indian tribes at least some generations of existence and well-being. We English have much to reproach ourselves with as to the treatment of indigenous tribes, but in Canada these have not fared quite so ill as in the United States. Indeed, Mr. Blackmore shows by American testimony that the comparatively prosperous condition of the Indian tribes in the British possessions is due to our more just and kindly management of them. But their prospects look hopeless enough in such districts as Idaho, in United States territory, where the legislature could put forth the following proclamation of reward to men who go "Indian hunting":—"That for every buck scalp be paid $100, and for every squaw $50, and $25 for everything in the shape of an Indian under ten years of age."

Col. Dodge's chapter on "Travel" contains an interesting description of the branching ravines which intersect the table-land of the western plains, where valley-systems, with their numberless tributaries, often approach one another so as to be only separated by narrow "divides." Such a region presents interesting problems of valley-excavation to the geologist, but extraordinary difficulties to the path-finder, who, though his destination may be but a few miles off in the straight line, has to find and follow the divide, often in a circuitous track of as many leagues, that he may avoid a score of deep ravines which cut the ground between. Going up divides is easy enough, for they all must reach the principal, or summit, divide ; but in going down, the one practicable divide has to be selected from hundreds which at the top look just as practicable to the waggoner, but only lead him, with his loaded wains, down upon the tongue of land in the fork of two steep ravines, where he must turn back and try again. Where there are buffalo, their trail marks the proper route, but otherwise the intricate maze can hardly be threaded except with the aid of an Indian guide or a perfect map. An account of these valleys, with a sketch like the author's, should find its way into every book on physical geography.

OUR BOOK SHELF

The Combined Note-book and Lecture Notes for the Use of Chemical Students. By Thomas Eltoft, F.C.S., &c. (London: Simpkin, Marshall, and Co., 1876.)

MR. ELTOFT is, we see from his title-page, engaged in teaching chemistry to two very large evening classes and also to the matriculation class at St. Bartholomew's Hospital, he has therefore very considerable experience as to the kind of instruction required by students going up for examination either to the University of London matriculation examinations, or to those of the Science and Art Department. His knowledge of the wants of the students has no doubt led him to the production of the "Note-book" we have before us ; and we do not doubt that the system here followed will save the student much trouble otherwise incurred in wading through his own notes, so often ill arranged, and missing the salient points of the lecture.

The first twelve pages of the book following the index are occupied with a mass of useful memoranda, as we should prefer to call them, such as notes on formulæ, atomic weights, nomenclature, use of numbers, brackets, and signs, &c., in formulæ ; the construction of constitutional formulæ, the base saturating power of acids, the density of gases, calculation of formulæ from analyses, and that tremendous crux with the ordinary student, the crith.

Of course the book is not intended for regular science students such as attend the Royal College of Chemistry and other science schools, but rather for those who take up chemistry either as a branch of general education or as an evening study, and for this purpose it seems to be well fitted; at the same time there is the danger of cram to be guarded against. The author evidently feels this and has endeavoured to provide against it in a somewhat original manner. Pages 102–121 are divided into double columns, the left hand one on each page containing the preparation or reaction formulæ of one of the non-metallic elements and their more simple compounds; the right hand column is left blank, and the student is requested to note the conditions under which each substance is prepared either from the lecture or from a text-book. This device would if conscientiously carried out by the teacher, probably prevent cram of a certain sort, and compel the student to know a little more than the mere formula of a reaction or preparation. At the same time we must confess that we must still regard this knowledge as only another form of cram which is infinite in its varieties and made to suit the idiosyncrasies of each individual examiner, and which will exist as long as any form of knowledge continues to be looked on as something to "pass" an examination in; and as long as examiners continue to look only to a set of answers given on a certain day in a certain time to a particular set of questions, and not to the general character and capacity of the student. We therefore think that Mr. Eltoft will meet with failure in his well-meant effort; we trust, however, that he will continue to persevere.

The rest of the book is divided into double pages, meant for notes on particular elements, the pages being divided according to a scheme in which specific gravity, in the state of solid, liquid, or gas, colour, melting-point, and boiling-point, are successively considered. Another space is reserved for the description of the experiment, a third for sketches of apparatus, and a fourth for tests for the identification of the body. These pages will no doubt teach the student to systematise his notes to a very considerable extent and indicate to him a detailed method of observation.

In conclusion, we note that Mr. Eltoft, in his short preface, expressly states that his "note-book" is "not in any way supposed to take the place of a text-book, but to act as an adjunct to it." We regard it in this light as an honest effort to assist the large class of students for whom it is intended, and we hope that the author will watch the effect of the book on the classes he is teaching, look on his present effort as experimental, and come forward again with the aid of his increased experience to still further improve his work.

R. J. FRISWELL

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.*]

Solar Physics at the Present Time

IN reference to Prof. C. P. Smyth's letter in NATURE, vol. xv. p. 157, I think it my duty to state that Prof. Smyth's remark on the priority of his exhibited results of observations of deep-sunk thermometers (as bearing on the question of transmission of waves of temperature into or from the interior of the earth) is perfectly correct.

It was only in the last summer that, having occasion to inspect some parts of Prof. Smyth's printed "Observations," I became acquainted with the extensive series of diagrams illustrating this matter. I have not yet been able to refer to his cited paper in the "Philosophical Transactions." G. B. AIRY

Royal Observatory, Greenwich, S.E.,
1877, January 1

Just Intonation, &c.

UNDER this heading your correspondent "A. R. C.," while explaining Mr. Colin Brown's "natural finger-board," writes thus:—"The vibration numbers of the diatonic scale being represented by—

$$1,\ \frac{9}{8},\ \frac{5}{4},\ \frac{4}{3},\ \frac{3}{2},\ \frac{5}{3},\ \frac{15}{8},\ 2.$$

If we build upon the dominant $\frac{3}{2}$, the vibration numbers will be—

$$1,\ \frac{9}{8},\ \frac{5}{4},\ \frac{45}{32},\ \frac{3}{2},\ \frac{27}{16},\ \frac{15}{8},\ 2,$$

and if we build upon the subdominant $\frac{4}{3}$ the vibration numbers will be—

$$1,\ \frac{10}{9},\ \frac{5}{4},\ \frac{4}{3},\ \frac{3}{2},\ \frac{5}{3},\ \frac{16}{9},\ 2."$$

Unless "A. R. C." proposes some new system of tuning, I submit that he is in error in the first steps of his two examples. The dominant of C is G, and from G to A is a minor, and not a major, tone. Also the subdominant to C is F, and from F to G is a major, and not a minor, tone. I do not pursue the analysis, not desiring to criticise oversights, but to draw attention to a not uncommon misconception of the figures in the above scale, and to the general adoption of a miscalculation as to the so-called "Comma of Pythagoras."

An eminent mathematician, not long deceased, derived our diatonic scale from the one note F, by the following process:—"F A C—C E G—G B D," thus taking the common chords of three different keys. Had he followed out his system of adding on a new scale from the Fifth of the preceding, he would have gone the round of the keys, and have derived them all from F, which would have been the *reductio ad absurdum.*

Nothing can be clearer than the history of the scale, and it carries with it conviction of its truth. The octave was formed out of two Greek conjoined tetrachords, such as B C D E and E F G A, the E being common to both. Then the lower A was added at the bottom, to complete the octave, and it was called "the added note" (*proslambanomenos*) because it did not form part of any tetrachord. The reduction from the eight notes of the two tetrachords to seven is attributed to a superstition in favour of the number seven. Thus came our A B C D E F G A—a minor scale with a minor Seventh—and from it came our truer major scale, by commencing on the third note, C, but carrying with it all the imperfections of the double root of the original. No improvement has been made in the scale since the days when Archytas, the friend of Plato, introduced the consonant major Third, and Eratosthenes the minor Third. Our present scale is therefore absolutely anterior to the Christian era; the ratios of its intervals given by Greek authors prove the identity irresistibly. Let us then look to the figures which represent our scale as "A. R. C." has justly given them. The large 1 and 2 refer to C as the fundamental note and its octave. The 3 to 2, the 5 to 4, the 9 to 8, and the 15 to 8 represent octaves of the key-note (2, 4, or 8); but the 4 to 3 (the interval of a Fourth) and the 5 to 3 (the interval of a major Sixth) refer to C only as the so-called "Twelfth" above F, and not to C as the octave. If we play either of these two notes, F or A, with C, we cannot use C as a consonant bass. We must take F, and thus we have the old tetrachord system, with its double root, running in our present scale. In all keys the tonic and the subdominant are both necessary basses. F and A belong exclusively to F; but B and D have no relation to F, not being aliquot parts of the F string. They belong to the scale of C, but more intimately to that of G. The F string exceeds the length of the C string by 3 to 2, because its sound is that of a Fifth below C; therefore any attempts to bring the sounds of our scale to a common denominator are fallacious, the first law of Proportion being that "Ratio can subsist only between quantities *of the same kind.*" Thus the "24, 27, 30, 32, 36, 40, 45, 48," cannot be accepted, because the 32 intended for the 4 to 3 of the scale, and the 40 for 5 to 3, represent other intervals. The 4 to 3 of C is the Fourth from C down to G, and the 5 to 3 of C is the major Sixth from E down to G. The 32 and 40 are not applicable to the interval of a Fourth from F down to C, nor to the major Sixth from A down to C.

And now as to the so-called "comma of Pythagoras," a strange name for the interval of 531441 to 524288! Can the modest inventor, who has concealed his own name, have supposed that the Greeks had musical instruments so very far beyond the compass of our seven or eight octave grand pianofortes? This interval is simply the excess of the twelfth power of 3 over the nineteenth power of 2. As powers of 3 are Twelfths, in music—octaves with Fifths, and not merely Fifths—and as octaves are powers of 2, this comma represents B sharp as topping C in its *nineteenth* octave. Happily any nineteenth octave is beyond our powers of hearing, even if we adopt a No. 1 with only one vibration in a second of time. We may therefore dismiss so disagreeable a sound to the so-called "Music of the Spheres," in compliment to Pythagoras, who is supposed to have been acquainted with music of that kind.

We are too generally prone to rely upon the labours of our predecessors, and hence this peculiar comma has been received without examination, as the overlapping of twelve Fifths over seven octaves, as stated by "A. R. C." After having traced what it really is, wishing to find the author of the miscalculation, I took up a newly-acquired copy of Koch's "Musikalisches Lexicon," which, although written in the last century, is still reputed as a work of authority, and has been re-edited by Arrey von Dommer (8vo, Heidelberg, 1865). I found a more curious mistake: instead of twelve Fifths, it is there stated to be twelve Fourths *or* Fifths; and Koch's way of proving it is by multiplying the ratios, not as fractions, but as whole numbers. For example, a Fifth and a Fourth we know to make one octave, but Koch multiplies 3 times 3 = 9 in one column, and 4 times 2 = 8 in the other (p. 24). As the twelve threes are in one column, he arrives by multiplication at the twelfth power of 3, and as the fours and twos are in the other column, he arrives at the nineteenth power of 2. It is desirable that this should be known as a caution against too-ready acquiescence in Koch's calculations.

WM. CHAPPELL

On "Comatula (Antedon) Rosacea," and the Family "Comatulidæ"

MAY I be allowed to point out to Mr. Stebbing that *Comatula* and *Antedon* are not precisely equivalent names, but that the genus *Antedon* represents only one of some five or six different types, to all of which "Lamarck's happily appropriate designation *Comatula*" is equally applicable; and that this is now generally used as a sort of family name, and only when strict scientific accuracy is not very important, as a generic name.

Johannes Müller, who laid the foundation of nearly the whole of our present knowledge of the zoology and morphology of the family, was the first to recognise that Lamarck's designation, *Comatula* included more than one type; in his well-known memoir, "Ueber die Gattung *Comatula*, Lamarck, und ihre Arten," he indicated two distinct varieties of *Comatulæ*, the one represented by the ordinary *Comatula rosacea*, with a central or subcentral mouth, and symmetrically distributed ambulacral furrows; and another, which he first recognised in the ordinary *Comatula solaris*, Lamarck, to which he gave the name *Actinometra*: in this type the mouth is marginal, and the furrows of the ten arms open at equal intervals into a circular furrow running round the edge of the disc, the centre of which is occupied by the anal tube. The first of these types is that to which de Freminville's name of *Antedon* is now usually applied. Müller, however, seems never to have been acquainted with this name, and adopted Leach's genus *Alecto*, which was constituted three years subsequently to *Antedon*; while *Comatula* did not appear till a year later. Recent observations have, however, shown that *Alecto*, as used by Müller, really includes many forms that are true *Actinometræ*, and the name has passed gradually into disuse, in its original application to the Crinoids; this was all the more necessary, as the name has been generally received as designating a genus established by Lamouroux in 1821, for a section of the Polyzoa.

Müller was in the habit of using a sort of trinomial nomenclature in his descriptions of the species of *Comatula*; thus, *Comatula* (*Alecto*) *europæa*, and *Comatula* (*Actinometra*) *solaris*; it will probably be advisable to continue this practice, and it is therefore somewhat unfortunate that Mr. Norman[1] should have transposed *Antedon* into a masculine name, for de Freminville, who first proposed it, used it as a feminine one, and described his first and only species as *Antedon gorgonia*, which is probably the same as *Comatula carinata*, Lam. Pourtales has already adopted *Antedon* as a feminine name, and we should probably do well to follow his example, especially if we employ Müller's very convenient system of trinomial nomenclature, for it is far simpler to write *Comatula* (*Antedon*) *rosacea*, than *Comatula rosacea* = *Antedon rosaceus*.

Besides these two types *Antedon* and *Actinometra*, there is, as Müller pointed out, another division of the *Comatulæ* represented by the recent *Comaster* of Agassiz and the fossil *Solanocrinus* of the Wurtemburg Jurakalk; these are distinguished from the ordinary *Comatulæ* by the fact that five small basals appear externally between the first radials. The five small ossicles lying between the second radials of *Antedon Dübenii*, Böhlsche, are possibly also external basals. It is unfortunate that Böhlsche was unable to make a further examination of this species, and so determine this very interesting point.

Müller considered *Solanocrinus*, or at any rate *S. costatus* and *S. scrobiculatus* as generically identical with *Comaster*, and pointed out that the differences in the form of the "knopf," or centrodorsal basin, which is elongated and more or less fusiform in *Solanocrinus*, and hemispherical in *Comaster*, could not be regarded as of generic value, for similar differences occur among different species of the recent *Comatulæ*; *e.g.*, between *C. Eschrichtii*, Müll. and *C. phalangium*, Müll. I have recently found that such differences may occur within the limits of the same species. Thus, of the two specimens of *Comatula* (*Antedon*) *macrocnema* in the Paris museum, one has a hemispherical centrodorsal basin, just like that of *Comatula* (*Antedon*) *Eschrichtii*, while in the other it is a short pentagonal or nearly circular column, on which the cirrhi are disposed in four alternating rows, precisely as in *Solanocrinus*. Götte, who has recently made some most beautiful observations upon the embryology of *Comatula*, opposes the view first suggested by Sir Wyville Thomson, and since adopted and strengthened by Dr. Carpenter, that the centrodorsal basin represents a coalesced series of the nodal or cirrhus-bearing stem-joints in the stalked Crinoids, but its condition in *Solanocrinus* and *Antedon macrocnema* seems to show unmistakably that Sir Wyville Thomson's determination of its homologies is the correct one, especially when it is remembered that, as Goldfuss says, young specimens of *Solanocrinus* are not uncommon, in which the articular surfaces of the segments composing the elongated "knopf" are visible, although in the adult animal they become so closely united as to be inseparable.[1]

Unfortunately we do not know the position of the mouth in *Comaster*, the only specimen yet known having been dissected by Goldfuss, who says little or nothing about the ventral surface; but in *Phanogenia*, a new genus of the free Crinoids established by Lovén, it is central, as in *Antedon*.

These four types, *Antedon*, *Actinometra*, *Comaster*, and *Phanogenia*, all currently regarded as belonging to Lamarck's genus, *Comatula*, differ very considerably from one another in many points, perhaps the most characteristic of which is the condition of the basals in the adult animal.

In *Antedon*, as shown by Dr. Carpenter, the primitive basals of the Pentacrinoid larva undergo a very remarkable metamorphosis into the small and relatively insignificant "rosette;" this is almost entirely inclosed within the circlet of first radials, with which it becomes more or less fused in the adult animal, and by which it is so concealed as very readily to escape notice; so that all the older investigators either denied the existence of basals at all, or like Goldfuss, mistook the first radials for basals. I have recently found that in *Actinometra solaris* (Müller's typical species), and in several other species of the genus, the basals are relatively very large, and take the shape, not of a "rosette," but of a five-pointed star, the rays of which lie on the dorsal aspect of the five sutures of the first radials with one another, while its centre is simply an open and very delicate calcareous network, more or less connected with that proceeding from the inner surface of the radial circlet. These basals are readily exposed by the removal of the flattened centrodorsal basin, the ventral aspect of which exhibits five stellate interradial depressions, into which the basals fit, but they never extend outwards so far as to be visible externally.

This last condition, of external basals, occurs, however, in *Comaster*, and in the Jurassic *Solanocrinus*. The centrodorsal basin of *Comaster* is hemispherical, and round its ventral margin lie five small triangular basals, not in contact with one another, but so widely separated that the first radials lying between them

[1] "On the Genera and Species of British Echinodermata," Ann. Mag., N. H., xvi. 1865.

[1] Further, in the singularly minute *Comatula alticeps* found by Philippi between the valves of a fossil *Isocardia cor* from the Sicilian Tertiaries, the centrodorsal, which he calls the "kelch stück," is elongated, egg-shaped, and visibly composite, bearing at least two, and very probably several more, alternating rows of cirrhi just like that of *Antedon macrocnema*. I have little doubt but that this species was a true *Antedon*, and an ancestor of our recent *Antedon rosacea* which is now so common in the Mediterranean.

articulate directly with the centrodorsal basin, while their infero-lateral angles are truncated so as to make room for the intervening basals.

The basals of *Phanogenia* appear to be in a condition intermediate between that of *Antedon* and *Actinometra*. Lovén describes them as internal and concealed, forming a small rosette with a central pentagonal opening, and marked on its ventral face by five sinuses, which receive processes from the sutures of the first radials.

We have thus a very interesting series of transitions from *Antedon* to *Pentacrinus;* firstly through *Phanogenia* and *Actinometra* to *Comaster;* thence to *Solanocrinus costatus*, in which the basals resemble those of *Comaster*, but the centrodorsal basin is elongated and visibly composite; and finally to *S. jægeri*, Goldfuss, in which the basals are so wide that they are completely in contact with one another all round, precisely as in *Pentacrinus;* this genus then only differs as far as the stem and basals are concerned, from *S. jægeri*, by the fact that its nodal cirrhus-bearing stem-segments are not fused together, but separated from one another by more or fewer of the internodal ones which do not bear cirrhi.

Solanocrinus thus constitutes, as already pointed out by Goldfuss, a very interesting intermediate form between the stalked *Pentacrini* and the ordinary free-living *Comatulæ*, which are only stalked in their young stages.

Besides the above-mentioned four generic types, or rather five, if Pictet be right in erecting *S. jægeri* into a separate genus, Lamarck's name *Comatula* also includes the beautiful little five-armed *Ophiocrinus* from the Philippines; unfortunately we do not yet know either the condition of its basals or the anatomy of its soft parts, and can therefore form no opinion as to its relations to the other members of the family.

As these five or six types are all equally entitled to the name *Comatula*, it becomes necessary in any systematic work on the family to give them distinct generic or sub-generic names, especially as in one or two cases the same specific name has been given to two or more types. Thus the *Comatula multiradiata*, Goldfuss, is a *Comaster*, while the *C. multiradiata* of Lamarck is an *Actinometra;* and again the *C. armata* of Pourtales is an *Antedon*, while *C. armata*, Semper, is an *Actinometra*.

For ordinary dredging work, however, on the British coasts, where *Antedon* is the only representative of the family, it is not so necessary to discard a common and better known name in favour of one which, although scientifically correct, and considerably older, has only recently come into general use, especially when, as Mr. Stebbing remarks, its meaning and pronunciation are alike difficult to determine; and though the designation *Comatula rosacea* may, scientifically regarded, be a somewhat loose one, it is now so well known that the use of it is not likely to lead to any serious mistakes in synonymy among working naturalists. P. HERBERT CARPENTER

Würzburg, Bavaria

WITH reference to the names Antedon and Comatula, will you allow me to say that the former has been applied to a genus of lamellicorn beetles since the year 1832? Comatula has been in use from nearly the beginning of the present century, and it is not only found in the works of Fleming, Forbes, Sars, Owen, G. H. Lewes ("Seaside Studies"), Carus, and others, but it must be a familiar word to many who have seen the splendid tank of those crinoids in the Naples aquarium. And now that we are bidden to change it "on the grounds of priority," may we inquire if the "grounds" of long custom (in this case more than sixty years) are to be invariably set aside? Dr. J. E. Gray, who had a sort of mania for change, tried in 1848 to restore de Freminville's name of Antedon. He went a step further, and, after Pennant, adopted Linck's specific name (so far as Linck had any idea of specific names, for they were unknown in his day) of "decameros," so that the advocates of *absolute* priority will have to take "*Antedon decameros*" as the designation of *Comatula rosacea*.

In Gemminger and von Harold's "Catalogus Coleopterorum," Antedon is derived from ἀντὶ and ὀδὼν, and consequently spelt Antodon; I do not see its application in either case.

I should be glad to see the "rules of zoological nomenclature" (Mr. Hughes means, I presume, those of the British Association) better observed if it led to the exclusion of such barbarisms as Butzkopf, Gatyghol, Sing-sing, Nabiroup, and others, which many of the readers of NATURE will probably be astonished to find in our modern scientific nomenclature. May we inquire if such a description as that of the celebrated "*Hister australis*," viz., "nigro-cyaneus, nitidus, subtus ater," which would apply to hundreds of species of Histeridæ, is entitled to claim the protection of the law of priority? I think we may sometimes fall back with advantage on the law of common sense, or that, at any rate, it may be allowed to supplement the law of priority. FRANCIS P. PASCOE

December 23, 1876

Sea Fisheries

MY chief reason for again intruding on you is for the purpose of supplying some omissions in Prof. Newton's quotations from Prof. Baird's first Report. In this Prof. Baird speaks of the destructive agency of the blue-fish. He states that about a million and a quarter of these fishes are caught annually on the New England coast, but that any one who has watched the blue-fish there must feel convinced that not one in a hundred of these fishes is caught; he allows twenty fish of other kinds as being devoured or mangled by each blue-fish daily, and then goes into a calculation of the thousands of millions of fish which must be destroyed by the blue-fish. I am writing this from memory, but I believe I am correct. Prof. Baird then says (I give this *verbatim*), p. 23:—"Indeed I am quite inclined to assign to the blue-fish the very first position among the injurious influences that have affected the supply of fish on the coast. Yet, with all this destruction by the blue-fish, it is probable that there would not have been so great a decrease of fish as at present but for the concurrent action of man."

This, the other cause of decrease, on which Prof. Baird lays great stress, is the numerous traps and pounds along the coast; but in Clause XII. of the same summary from which Prof. Newton quoted, I find the following:—

"As there is reason to believe that scup, and to a less degree other shore-fish, as well as blue-fish, have several times disappeared at intervals to a greater or less extent, within the historic period of New England, we cannot be certain that the use of traps and pounds within the last ten years has actually produced the scarcity complained of. The fact, however, that these engines do destroy the spawning fish in so great numbers renders it very probable that they exercise a decided influence."

Prof. Newton does not speak with his usual scientific precision when he refers only to the cod, and doubtfully to the mackerel, having decreased owing to the scarcity of the alewives—"cod, haddock, and hake" being mentioned in the same paragraph. Nor does it seem to me quite worthy of my friend, in discussing the probabilities of overfishing in the sea, to try to prove his case by bringing forward an instance of overfishing in the rivers leading to a smaller supply of food at a certain season for purely sea fish on the coast, and therefore a decrease in those sea fish.

Dogfish are "predatory and mischievous:" they plunder the nets, and they tear the nets in pieces.

Athenæum Club, December 29 E. W. H. HOLDSWORTH

[Pressure upon our space has necessitated a curtailment of this letter. This correspondence must now cease.—ED.]

The "Sidereal Messenger"

IN NATURE (vol. xv. p. 49), in a notice of Mr. Knobel's "Catalogue of the Literature of Sidereal Astronomy," attention is called to the rarity of the *Sidereal Messenger*. We have, in the library of this Observatory, only one copy of that periodical. I hope, however, soon to be in possession of a few copies of vol. i. If so I shall take pleasure in sending one of them to the Royal Astronomical Society. All of Prof. Mitchel's measures of double stars (about 300) are now in the hands of the printer and will be published before the close of the year. ORMOND STONE

Cin. Obs., September 12

South Polar Depression of the Barometer

MR. CLEMENT LEY, writing in NATURE (vol. xv. p. 157), thinks that the great depression of the barometer throughout the region round the South Pole as compared with that round the North Pole, is "mainly due to superior evaporation in the water hemisphere generally." This seems an inadequate cause, for evaporation must be small in the very low temperatures which appear to be constant at all seasons in high southern latitudes. I am convinced that the cause of the barometric depression round the South Pole is the centrifugal force of the west winds which revolve round the Pole, forming, in Maury's words, "an everlasting cyclone on a great scale." A similar cyclone is formed round the North Pole also, but less perfectly, and consequently the North Polar barometric depression, though decided, is much less than the South Polar. The reason of this difference I believe to be, that the North Polar cyclone is broken up by local air-currents due to the unequal heating of land and sea—a cause which scarcely exists in the South Polar regions, where almost all is sea or snow-covered land. JOSEPH JOHN MURPHY

"Towering" of Birds

IN connection with Mr. Romanes' valuable letter on this subject, the following note may be interesting. Rooks, I am informed, are sometimes killed by means of a paper cone containing birdlime, which is placed in a locality where these birds congregate. The rook inserts his bill and head into the cone; after a little time he rises vertically into the air and then falls dead. My informant—a traveller and sportsman of much experience—considered the upward motion to be due to the obstruction of sight, but the fact, I doubt not, will bear the same explanation as the towering in the case of a wounded grouse.

ARTHUR SUTHERLAND

IF it is of any importance to the question I may state that I have seen the following birds "tower:"—common snipe, fieldfare, wood-pigeon, pheasant, partridge, common Australian duck (*Anas superciliosa*), large Australian white cockatoo, Australian Nankeen night heron, and Australian piping crow. I have shot many thousands of Australian duck, and towering has occurred among them pretty frequently. In one case, the notes of which I have, the duck began to rise almost immediately, and rose to a great height. I was indoctrinated in the cerebral injury hypothesis, but I soon found that this was untenable, for I made a habit of plucking and examining the heads of all towering birds which I could recover, and there were some among them with no wound whatever on the head. One such instance would have been sufficient to dispose of the hypothesis; but I was unable to substitute another for it. The explanation given by Mr. Romanes meets the conditions as far as they have come under my observations. A. N.

THE SOCIETY OF TELEGRAPH ENGINEERS

THE Annual General Meeting of this Society was held at The Institution of Civil Engineers, 25, Great George Street, Westminster, on the evening of Wednesday, the 13th instant.

The Report submitted by the President and Council showed that during the past year the number of Foreign Members, Members, and Associates had gone on increasing until the total of all classes now exceeded 800. Many valuable papers, it was stated, have been sent in, or promised, for discussion during the current session, almost every available evening being already taken up. The result of the ballot for the President, Vice-Presidents, and Council for the ensuing year, was announced, Prof. Abel, F.R.S., being elected President.

A *Conversazione* was held at Willis's Rooms on the evening of Monday the 19th inst., when about 600 were present. Amongst these were to be found almost all the prominent members of the telegraphic profession, as well as most of the representatives of the leading cable companies and men whose names are known in connection with electrical or telegraphic engineering. A magnificent display of apparatus had been got together, including everything in the shape of a novelty which had been introduced in connection with this branch of science during the past year. Many interesting experiments were shown, and for the more especial gratification of the non-scientific portion of the assembly, Mr. Apps and Mr. Browning of the Strand exhibited respectively their attractive vacuum tubes and microscopical objects.

Prominent amongst the features of the evening were the experiments designed and personally exhibited by Mr. Robert Sabine. These may be divided into three classes—(1) Showing the circulation of mercury under the influence of oxidation and deoxidation; (2) Measuring time to the infinitesimal portion of a second; (3) Showing the potential at various points and the speed of waves of electricity through submarine cables. Full descriptions of these experiments—now publicly shown for the first time—have been contributed by Mr. Sabine to the recent numbers of the *Philosophical Magazine*. It was on the first-named that Sir Charles Wheatstone was engaged at the time of his death in Paris, and, based upon the results which he obtained, he had constructed a form of mercury "relay" constituting one of the most delicate portions of receiving telegraphic apparatus that could possibly be devised. The duration of impact, when an anvil is smartly struck with a hammer, was measured by means of the arrangement in connection with the second series of experiments. A condenser is charged from a potential of one volt, and then discharged through a Thomson's reflecting galvanometer, the deflection on the scale being noted. The condenser is again charged; a hammer in connection with one side of it is then brought on to the anvil which is in connection with the other side; during the moment of impact partial discharge takes place, the amount of current escaping being known when that which remains is next measured through the galvanometer. All the factors being thus known, the question of the time during which the hammer and anvil were in contact becomes a matter of simple mathematical calculation. The third series, owing to the difficulty of obtaining a sufficient length of Muirhead's artificial cable, was scarcely so successful as the other two, but yet sufficient was done to show the principle involved.

Prof. Dewar's electrometer, by means of which the electromotive force of the most minute fraction of any galvanic cell may be measured, and which is based upon the oxidation and deoxidation of mercury, was also shown.

Amongst the apparatus Sir William Thomson's new form of marine compass proved to be a centre of attraction. The adjusting "spider"—the most recent addition—was absent, but yet enough was exhibited to show that the mariner might to a great extent now render himself independent of solar observations. Eight small magnetic needles are employed, and the friction of the various parts is reduced to a minimum. Two soft iron balls are placed, one on each side of the compass, and adjusting rods are employed in addition to them. The liquid gyrostat, already described in NATURE, was also amongst Sir William Thompson's collection.

Hanging around the walls of the room were carefully executed diagrams, showing what are perhaps the most valuable observations of earth-currents that have ever been made. They were exhibited and are now presented to the Society by Mr. H. Saunders, of the Eastern Telegraph Company. Availing himself of a broken cable between Suez and Aden, Mr. Saunders succeeded in obtaining simultaneous observations at both stations, and saw that they are graphically represented; the coincidence between the two is striking to a degree. It is to be hoped that so interesting a record as this may be brought prominently forward in the form of a paper, and so elicit a discussion upon a subject which, although occupying the attention of many, still remains one of the most obscure problems in connection with electrical science. Closely allied to these were the specimens of the movements of the declination and horizontal magnetic force and of the earth-currents as observed at Greenwich and sent up specially for the evening by the Astronomer-Royal. They comprised the observations for a calm and a disturbed day, and served to show very clearly the correspondence which exists between magnetic and galvanic disturbances.

A form of grapnel designed by Mr. Andrew Jamieson, assistant to Mr. Saunders, did not fail to attract considerable attention. The toes, instead of being rigid, are hinged on to a spring which yields under a pressure of two tons, and thus serves to release the toes from any rocks or foreign matter with which it may be brought into contact, whilst a hold is still retained of the cable.

A telephone—showing clearly the principle of the apparatus—was exhibited by the Messrs. Wray, and musical notes were accurately transmitted by means of it through about 120 feet of wire. The battery employed for the purpose was the thermopile, designed by themselves, which was also shown. Although at first sight very similar to the well-known form of Clamond, the thermopile of Messrs. Wray has several modifications which are undoubted improvements. The extreme brittleness so fatal to many of Clamond's bars is here got rid of by the introduction, for a distance of about two inches, into the alloy, of a tongue which really is only a continuation of the sheet-iron. At first sight one would be inclined to think that this would tend to lower the electro-motive force of the couple, but the reverse is stated to be the case. The asbestos rings are replaced by a framework composed of circular plates of earthenware supported on three tie rods which serve to give stability to the structure and remove from each ring of bars the superincumbent weight of all the others over it. But perhaps the main improvement effected is the method of heating the bars ; instead of allowing the flamers to impinge directly on their ends, or admitting the products of combustion near them, an earthenware cylinder forms the centre of the pile. Around it and abutting hard upon it the bars are placed, and from a perforated chimney within the gas issues, and burning in blue jets, speedily raises the cylinder to a red heat, which is transmitted through to the ends of the bars.

THE PHYLLOXERA AND INSECTICIDES

SOME time ago we published in our columns a short account of the results of the investigations of various scientific men in France into the nature of the Phylloxera —that terrible scourge which is committing such widespread ravages among the French vineyards. Latterly we have received some reports communicated to the French Academy of Sciences dealing with the attempts which have been made during the last three or four years to arrest the mischief done by the insect, and ultimately to destroy it altogether, by means of some potent drug. It is obvious that the remedy to be employed must possess two qualities at starting, viz., it must destroy the insect and it must not damage to any great extent the vine. But, further, it is not sufficient that when put in close contact with the roots of a plant—as in a pot—it should prove fatal to the insect, it is necessary, if the remedy is to be of real practical value, that it should reach and destroy the Phylloxera on all the parts attacked by it in vines which are planted out in the open air. This is a real difficulty to overcome, as the remedy, be it in the form of solution or of vapour, cannot easily permeate the soil, sometimes clayey, sometimes sandy, on which the vine is growing, so as to reach and act upon the smaller root branches whose nutrition the Phylloxera diverts into itself.

M. Mouillefert, a professor at the School of Agriculture at Grignon, was the gentleman delegated by the Academy of Sciences to make the necessary experiments for the purpose of determining what agent was the most practically applicable to the destruction of the Phylloxera, and the account of the numerous substances employed by him with varying results fills no less than 200 pages of a memoir presented to the Academy of Sciences. It is not our intention here to do more than give a brief *résumé* of the results at which he arrived.

He divides the substances used by him into seven groups, the first of which was composed of manures of various kinds, such as guano, superphosphates, farm-muck, &c. ; the second of neutral substances, as water, soot, and sand ; the third of alkalies, as ammonia and soda ; the fourth of saline products, amongst which were the sulphates of iron, copper, zinc, potassium, and ammonia, alum, and sea-salt ; the fifth of vegetable essences and products, as decoctions of hemp, datura, absinthe, valerian and tobacco ; the sixth of empyreumatic products ; and the seventh of sulphur compounds. It was only with some of the substances contained in this last group that really satisfactory results were obtained, and it is to M. Dumas, the permanent secretary of the French Academy of Sciences, that the credit is due for suggesting the employment of the alkaline sulpho-carbonates of potassium and sodium and those of barium and calcium. All the other classes of remedies mentioned above were either without effect on the Phylloxera, or, in destroying it, also destroyed or damaged the vine.

The sulpho-carbonates, which were carefully studied by the great Swedish chemist Berzelius, are obtained by combining the alkaline mono-sulphides with the bi-sulphide of carbon, are either liquid or solid, and emit a powerful odour of sulphuretted hydrogen and bi-sulphide of carbon.

The alkaline sulpho-carb onates in the solid state are of a beautiful reddish yellow colour and deliquescent, but are not easily obtainable in that condition ; the sulpho-carbonate of barium can be easily procured, however, in a solid state, and presents the appearance of a yellow powder, but little soluble in water. The sulpho-carbonates decompose under the influence of carbonic acid, forming a carbonate, and evolving sulphuretted hydrogen and bi-sulphide of carbon. These two latter substances are gradually liberated and, as they have a very powerful effect on the Phylloxera, one can understand that the sulpho-carbonate, placed in the ground, may prove, by its slow decomposition, a powerful insecticide. In the case of the sulpho-carbonate of potassium, over and above its toxic effect, it has a direct invigorating influence upon the vine, as the carbonate of potassium is an excellent manure.

The employment of the sulpho-carbonates as a means for the destruction of the Phylloxera was suggested to M. Dumas by the clearly-recognised need that there was of some substance that would evaporate less quickly than the bi-sulphide of carbon ; he saw that it was desirable to apply the insecticides in some combination which would fix them and only allow them to evaporate gradually, so that their action might continue long enough in any one place to infect with their vapours all the surrounding soil.

But the task of eradicating the Phylloxera has by no means been accomplished by the mere discovery of the value for the purpose of these substances ; there is the further difficulty of applying them to the vine in cultivation. One thing seems very certain, that in order to render the sulpho-carbonates practically efficacious in killing the insect, it is necessary to use water as the vehicle by which they may be brought to all the underground parts of the plant, and that the best time of year for their application is the winter or early spring, when the earth is still moist and the quantity of water necessary to be brought on to the ground by artificial means is consequently less. Mixed with lime in the proportion of 2 to 1, these sulpho-carbonates give a powder which can be spread over the ground before the heavy rains, that is, between October and March, and which will probably prove itself very efficacious.

The conclusion at which M. Mouillefert arrives at the end of his report is that the efficacy of the sulpho-carbonates is proved, and all that is necessary is to bring to perfection their employment in agriculture, which can only be accomplished by the intelligence and practical knowledge of the vine-grower who is well able to discover the economic processes of culture which are conducive to their successful application.

He ends by saying that "Science has accomplished its mission, and it remains for Agriculture to fulfil its part" in the eradication of the Phylloxera from the vineyards of France.

CAMBRIDGE (U.S.) OBSERVATORY

IN two previous articles (NATURE, vol. x. pp. 186, 206) we gave a sketch of the history of some of the principal observatories of the United States. Those which we then referred to are all more or less connected with the work of education. We shall now give some details of an observatory which has been enabled to make marked advances in independent research outside of its educational service; we refer to that of Cambridge, Massachusetts.

A look into the earlier annals of the observatory of Harvard repays the inquirer at the outset by revealing the interest in astronomical pursuits which was felt in the old Bay State many years before the founding of an observatory was practicable in the United States. In 1761 the *Province* sloop was fitted out at the public expense to convey a Harvard professor, Winthrop, to Newfoundland, to observe the transit of Venus of that year; and in the troublous times of 1780 the old "Board of War" fitted out the *Lincoln* galley to convey Prof. Williams and a party of students to Penobscot, to observe a solar eclipse. At so early a day was New England disposed to encourage scientific observations.

In 1805, Mr. John Lowell, of Boston, was consulting with Delambre in Paris on astronomical observatories, and forwarding his information to the Hollis professor, Webber, who even then indulged the hope of seeing an observatory founded. But it was only in 1839 that an observatory was erected on the Dana estate, and the

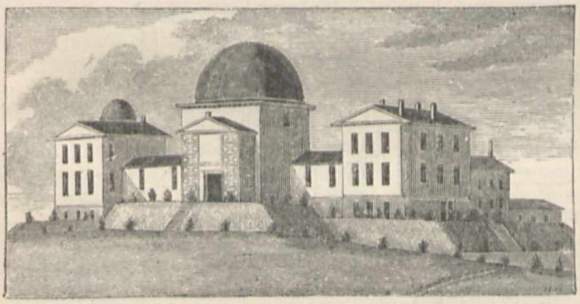

FIG. 1.—Cambridge Observatory.

observations which had been authorised by the United States Government to be made in connection with Lieut. Wilkes's exploring expedition were conducted by Prof. Bond until the year 1842.

A new issue now arose. The sudden appearance of the splendid comet of 1843 was, happily, the occasion of final success in the founding of the present institution. Cambridge was immediately appealed to for information about this strange comet. But the observers had no parallactic instruments or micrometers of the least value for its observation. While they were endeavouring to obtain data to compute the comet's orbit, a meeting of citizens was held, under the sanction of the American Academy, to take measures for procuring a first-class equatorial; the needed amount of $20,000 for the instrument was contributed in Boston, Salem, New Bedford, and Nantucket. The equatorial was ordered from Merz and Mähler, of Munich, and Harvard determined to erect a new observatory. The location selected was 80 ft. above tide-water, and 50 ft. above the plain where the soil was found favourable for the stability of piers for the instruments. In 1844 the buildings were occupied, and an equatorial of 44 in. focal length and $2\frac{1}{2}$ in. aperture, and a transit instrument loaned by the United States, were temporarily mounted for observations until the arrival of the great refractor. This was placed in position June 24, 1847. Among the earlier objects on which systematic observations were made with the new instrument were the nebulæ of Andromeda and Orion. "These nebulæ," said Prof. Bond, "were regarded as strongholds of the *nebular theory*; that is, the idea first suggested by the elder Herschel of masses of matter in process of condensation into systems." Orion's nebula had not yielded to either of the Herschels, armed even with their excellent reflectors, nor had it shown the slightest trace of resolvability under Lord Rosse's 3 ft. reflector. Bond announced, on Sept. 27, 1847, that the Cambridge refractor, set upon the trapezium under a power of 200, resolved this part of it into bright points of light, with a number of separate stars too great to be counted. With a power of 600, "Struve's Companion" was distinctly separated from its primary, and other stars were seen as double.

Within a few years yet more brilliant discoveries followed. Among them the inner ring of Saturn and its eighth satellite, the coincidence of which latter discovery on the same day (Sept. 19, 1848) at Cambridge and in England in no wise detracted from the honour due to each discoverer. It required, in those times, weeks before the discovery, indeed, could be mutually made known.

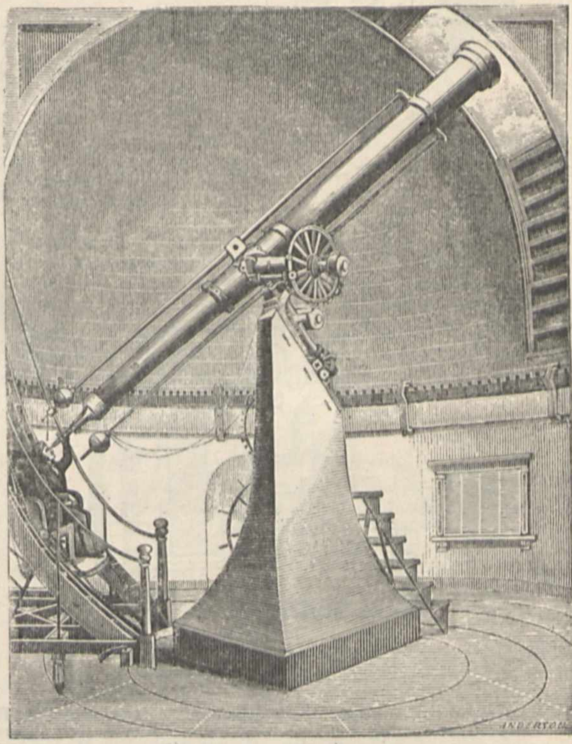

FIG. 2.—Cambridge Equatorial.

In 1850 Prof. W. C. Bond, with his sons, invented the spring governor, which gave an equable rotatory motion to the revolving cylinder of the chronograph. The observatory having been placed in 1849 on a permanent endowment by a legacy of $100,000 from Mr. E. B. Phillips, a young graduate of Harvard, and a fund for printing its results having been also provided by will of the Hon. Josiah Quincy, jun., the reports of the first systematic zone observations appeared in 1855 as Part II. of vol. i. of the "Annals." This zone catalogue comprises 5,500 stars situated between the equator and 0° 20′ north declination. The second volume, published in 1857, embraced chiefly observations of the planet Saturn made during a period of ten years. The second part of this vol. ii. is a zone catalogue of 4,484 more stars in the same zones as those observed before 1854. It was not printed until the year 1867. The splendid vol. iii., published in 1862, is a quarto of 372 pages, with fifty-one plates almost entirely illustrative of the great comet of the Italian astronomer Donati, which appeared in such different forms in America from those seen in England.

The Great Nebula of Orion was the other chief object of the observatory up to the death, in 1849, of Prof. W. C. Bond, the father, and thence to the death of the son, Prof. G. P. Bond, in 1865. The observations of this constellation form the latest as yet published volume of the "Annals," issued, in 1867, under the supervision of Prof. T. H. Safford, then director of Dearborn Observatory, but formerly in charge at Harvard as assistant in the observatory. For Mr. G. P. Bond's work, and especially for his observations on Donati's comet, he received a gold medal from the Royal Astronomical Society in 1865.[1]

Since the year 1866, in which the present director, Prof. Joseph Winlock, took charge of the observatory, its work has been yet further most successfully extended into new fields of research, by his own labours, and those of his able assistants, Messrs. Searle, Rogers, and Peirce. Besides what is known as routine work of all observatories,

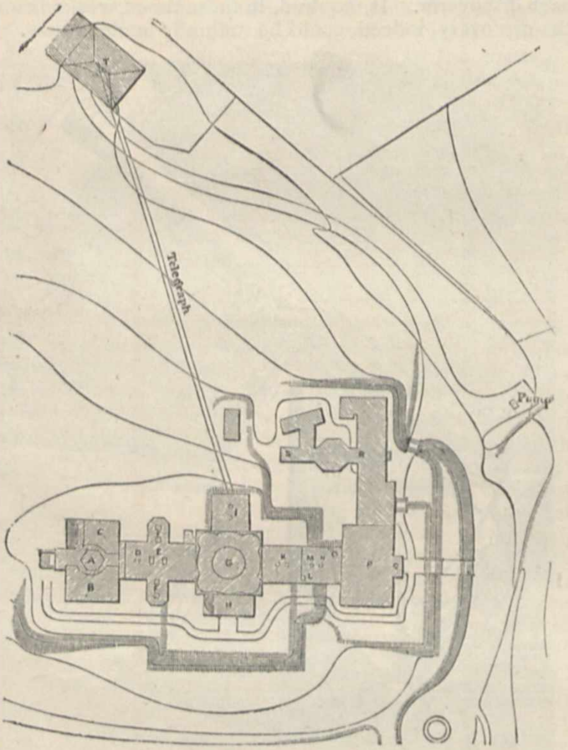

FIG. 3.—Ground plan of Cambridge Observatory. A, west equatorial; B, library; C, computing-room; D, west transit; E, new piers for new transit circle; F, collimator piers; G, east equatorial; H, grand entrance and stairs to east equatorial; I, prime vertical room and north clock; K, east transit; L, south clock; M, east clock; N, Chronograph; O, anemometer register; P, director's house; Q, front door; R, magnetic observatory; S, rain-gauge; T, anemometer.

spectroscopic observations of the sun and of stars and nebulæ, and the most careful photographs of the sun, have been frequent. Five hundred drawings of the sun were made between January 1872 and November 1873, and 500 careful drawings of solar prominences in the year 1873. To this work is to be added a great deal of labour given to the determination of longitude differences, and the observations, by Prof. Winlock, of the solar eclipse of 1869, at Shelbyville, Kentucky, and that of 1870, at Jerez, in Spain. The general reader, as well as the astronomer, cannot fail to be interested in the beautiful pictorial representations of these and of other astronomical phenomena which have been issued by subscription recently from Harvard.

[1] Mr. Bond was the first American, we believe, to be thus honoured with the gold medal of a foreign scientific society. Prof. Watson, of Ann Arbor, and more recently Prof. Simon Newcomb, of the United States Naval Observatory, have been the recipients of like honours; the former from the Imperial Academy at Paris, the latter last year, from the Royal Astronomical Society of London.

The great equatorial, made in 1847 by Merz and Mähler, of Munich, has an object-glass of 15 in. in diameter, and a focal length of 22 ft. 6 in. The power of its eyepiece ranges from 100 to 2,000; the hour-circle is 18 in. in diameter. The movable portion of the well-balanced instrument is estimated at three tons. Its original cost was about $20,000. The sidereal motion given to this telescope is now secured by clockwork from Alvan Clark, which is spoken of by the observers as the only known "driving-clock working with perfect steadiness." The telescope rests on a central granite pier, in constructing which 500 tons of granite were used. It is 40 ft. high, and rests on a wide foundation of grouting 26 ft. below the ground surface. Upon the top of the pier is laid a circular cap-stone 10 ft. in diameter, on which is the granite block, 10 ft. high, bearing the metallic bed-plate. This instrument is in the central "Sears Tower."

The meridian circle was mounted in the west transit-

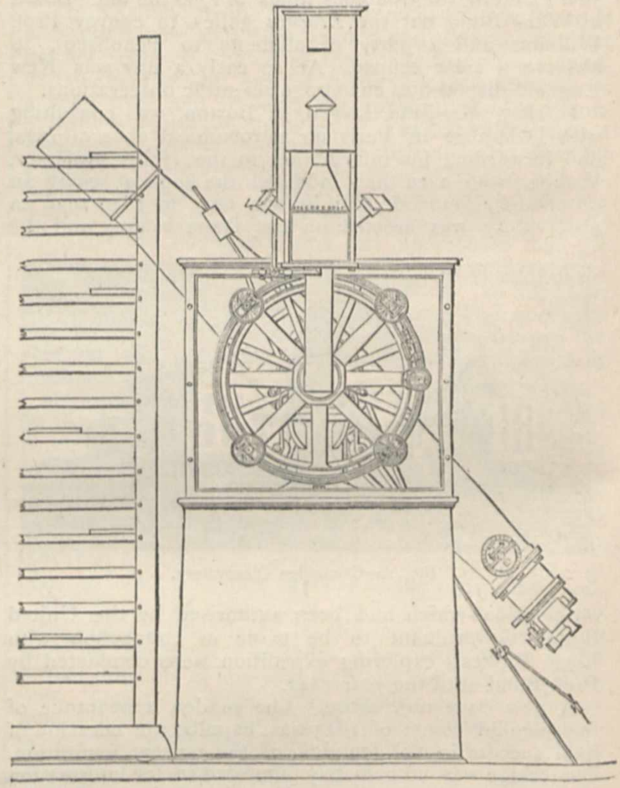

FIG. 4.—Cambridge Meridian Circle.

room in 1870. It has modifications, introduced by Prof. Winlock, not usually found in transit instruments, chiefly, that the graduated circles are directly above the piers, the bearings of the pivots being carried by iron standards; the axis friction rollers rest on rods rising from the base of the piers and counterpoised below the floor. The pivot circles and reading microscopes are protected by glass casing; the object-glasses of the transit and of each of its collimators, made by Clark, are each 8 in.

In the west dome is another Clark equatorial, made in 1870, with an object-glass of $5\frac{1}{2}$ in. In the east wing is the transit circle made in Prof. Bond's directorship, by Simms, of London. Its focal length is 65 in., its object-glass $4\frac{1}{8}$ in.; its circles are 4 ft. in diameter, read by eight microscopes to single seconds. Cambridge possesses a number of more modern instruments, constructed to meet the wants of astronomical investigations at this day.

The spectroscopes, photometers, and photographic apparatus are peculiar in form and power. The spectroscope used with the west equatorial in solar observations powerfully disperses the rays of light, which are carried twice through a train of prisms. In photographing the sun a lens of long focus is used, the light being thrown upon it by movable plane mirrors. This plan of Prof. Winlock's was adopted by the astronomers who went out under the U.S. Government to observe the Transit of Venus in December, 1875.

The photometer, or light measurer, made by Zöllner, has been used for three years by Assistant Prof. C. S. Peirce. The design is the accurate measurement of the magnitudes of all stars in Argelander's Uranometria between 40° and 50° north declination, determining these magnitudes on a scale of uniform ratios of light, so that the probable error of one observation shall not exceed the tenth of a single magnitude. The great object of this is, that throughout Europe and the northern part of the United States there will be constantly enough of accurately determined stars near the zenith to serve as comparisons for any star visible to the naked eye whose magnitude is to be estimated. The secondary object is the prosecution of inquiries with regard to the distribution of the stars in space, their magnitudes and variability.

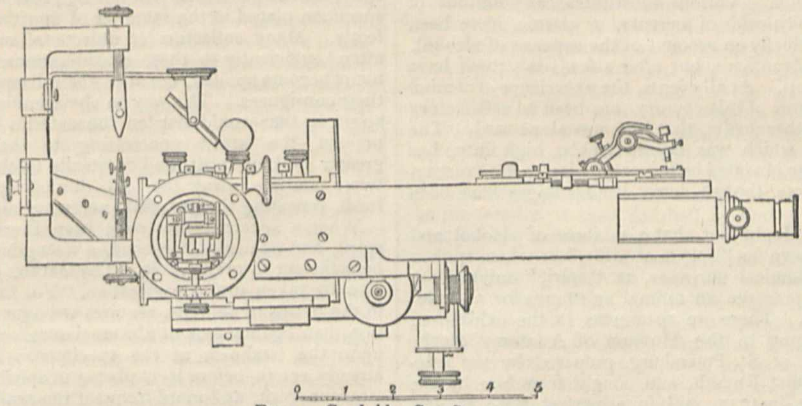

FIG. 5.—Cambridge Star Spectroscope.

The true time is daily given from this observatory to the State-house and other places in Boston, and by means of the telegraph lines to the whole of the New England States. It is received directly at noon each day without the intervention of any operator; the various lines being merely switched into the time line, the same click is heard at the same moment over the Eastern States.

Much more, however, than this is done for securing accuracy of time at any hour of the day. If anyone wishes to learn not only what the true time is, but whether his own watch is a good timekeeper, he may readily do so by a visit to the State-house in Boston. The arrangement for this, introduced by Prof. Winlock, is as follows:—The observatory clock is put in circuit at one end of a telegraph line, connected with which, at the State-house and other points, is an ordinary telegraph sounder. When the clock breaks the circuit by every second swing of the pendulum, a click of the armature of the sounder is heard at each of these points. The clock being so arranged that at every fifty-eighth second the break ceases, and at every even five minutes twelve breaks cease (no clicks being then heard), any person can, by listening to the sounder, compare his own watch with the standard clock. He can tell whether his watch is fast or slow by watching when the sounder ceases, the first click after the short pause being always the beginning of the minute, and the first click after the long pause the beginning of an even five minutes, as shown by the face of the clock in the distant observatory.

This standard motor clock is of course regulated with extreme care. It is customary, for the government of its rate of motion, to use shot of different sizes, which, according to the size, produce a change in the rate of the pendulum varying between 0·05 and 0·10 of a second per day. These are used as the astronomical correction for clock error may require. The time given by the standard clock thus regulated is that of the meridian near the State-house, sixteen seconds east of the observatory. Prof. Winlock considers that the use of the telegraph sounder gives a more satisfactory accuracy of time than can be given by other clocks which are put within the circuit and controlled, as is usual, by the standard clock; for in their case a variation in the strength of the electric current introduces an error in the beats of the pendulum, but the telegraph sounder must give the time with entire accuracy.

With so much before one at Cambridge of which interesting note could be made, one can do no more than attempt to trace its early and munificent endowment, its earliest discoveries under its first labourers, and the steady and recently very rapid advances not only in the highest objects of an observatory—exactness throughout extended series of observations—but in the exercise of professional skill in the invention and manufacture of the best appliances of the day for carrying on these investigations.

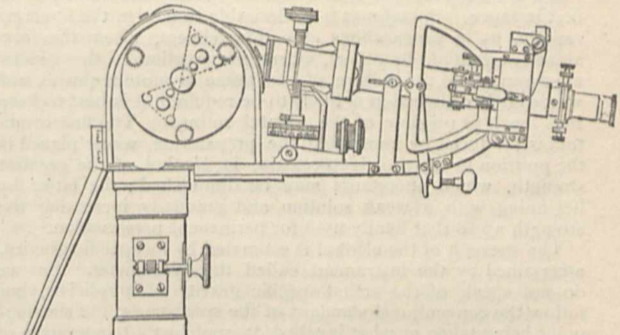
FIG. 6—Cambridge Spectroscope.

MUSEUM SPECIMENS FOR TEACHING PURPOSES[1]

III.

I NOW pass to the second great division of museum preparations, those that are preserved in a fluid medium; the only way in which the greater part of the structure of most animals, both vertebrate and invertebrate, can be kept from change and decomposition.

The first question for consideration is the best preservative medium. The one which has been most extensively used in all countries is alcohol. Various substitutes, as solutions of common salt, alum, bichloride of mercury, or arsenic, have been proposed and tried, chiefly on account of the expense of alcohol, and other slight disadvantages, but after a few trials these have generally been given up. At all events, the experience of alcohol in all the large museums of this country, has been so satisfactory compared to that of other media, that it is now alone used. The objection of expense which was caused by the high duty, has been in a great measure obviated by the permission to use "methylated" spirit, duty free, though some disadvantages have been thereby entailed.[2]

There seems little doubt but that a mixture of alcohol and water (commonly known as "spirits of wine," or when spoken of in relation to anatomical purposes, as "spirit" only) of the proper strength will preserve an animal substance for an indefinite length of time. There are specimens in the exhibition, (No. 3878 *a*), belonging to the Museum of Anatomy of the Academy of Science at St. Petersburg, prepared by the celebrated Dutch anatomist Ruysch, and bought from him by the Czar Peter the Great, in 1717, still in a perfect state of preservation. We have now in the Museum of the College of Surgeons many thousand preparations put up in the last century by John Hunter, and which appear to have undergone no changes beyond those which took place during the first few weeks of immersion in spirit, and which may be described as a certain amount of hardening and contraction of the tissues by coagulation of the albumen contained in them, and discharge of much of the natural colour.

The extent to which these changes take place depends very much upon the method with which the specimen is treated in the first instance. Sometimes it is desirable to harden the structure rapidly, as in preparations of hollow viscera, when the form alone is essential, in others, where preservation of the general appearance and the texture of the tissue is more requisite, and where further dissection is likely to be required, it is best to keep it as much as possible of the natural softness. The first condition is produced by immersing the preparation, when placed in the position in which it is to remain, in alcohol of the greatest strength, which afterwards may be diminished; the latter by beginning with a weak solution and gradually increasing the strength up to that finally used for permanent preservation.

The strength of the alcohol is estimated by its specific gravity, ascertained by the instrument called the hydrometer. But we do not speak of the actual specific gravity of physicists, but follow the conventional standard of the spirit-trade, the starting-point being taken at what is called "proof" at a temperature of 60° F., and the scale divided into degrees or "per-centages" above and below proof. By 1 per cent., or 1 degree under proof, is meant proof spirit with one-hundredth part (by bulk) of water. Spirit 10 per cent. under proof is a spirit consisting of 90 parts of proof spirit and 10 of water. On the other hand, by 10 per cent. over proof is meant that 100 parts (by bulk) of such spirit will require 10 parts of water to bring it to proof.

The "rectified spirit," as commonly sold, is about 60 or 65 per cent. above proof. This is only used for hardening preparations.

For ordinary use in the museum, proof spirit is strong enough, though to be quite on the safe side we generally use 10 per cent. over proof, diluting the rectified spirit with distilled water till it is reduced to the requisite strength, as ascertained by the hydrometer. This is the strength commonly used for all kinds of preparations, though it might be varied with advantage in some cases.

In estimating the preservative power of spirit, consideration should be given to the bulk of the specimen, and especially the amount of water contained in its tissues, as compared with the quantity of spirit used. For instance, if a large solid mass of animal substance is placed in a jar little larger than sufficient to contain it, filled up with proof spirit, the amount of fluid contained in the specimen will so dilute the spirit that decomposition, especially of the interior of the specimen, to which the spirit cannot penetrate, will not be prevented, whereas a smaller specimen placed in the same jar of spirit will be preserved perfectly. Many collectors of objects of natural history do not attend sufficiently to these considerations, and hence the specimens become spoiled, much to their disappointment or to that of their consignees. The way to obviate this is not to use stronger spirit, as that would harden the exterior of the specimen, and prevent the spirit penetrating to the centre, but to use greater bulk of spirit, and especially to change it, after a day or two, pouring away the old diluted spirit, and substituting fresh, repeating the process if necessary more than once.

When a specimen has once been thoroughly saturated with spirit, and its tissues hardened, a strength much below proof will be sufficient to preserve it. The nature of the specimen must also be taken into consideration. For instance, nerve tissue, as in the brains of animals, requires stronger spirit for its preservation than ligamentous or fibrous tissues. Much will also depend upon the freshness of the specimen. If decomposition has already set in before it is placed in spirit, it will require much stronger spirit, and more frequent renewals than if it is fresh.

With most preparations it is desirable to cleanse them well before mounting them in spirit. They should be left a few hours or days (according to the temperature) in water frequently renewed, and the blood should be washed out of the large vessels, by means of a stream of water directed through them. This will save to a large extent the discoloration of the spirit into which they are placed. When removed from the water they should be allowed to drain, and be gently dried with a cloth before placing in the spirit, but no part of them must on any account, at any time during the process of preparation, be allowed to become actually *dry*, otherwise dark stains which are quite irremovable will be produced. This precaution is most essential when they have been once in spirit, and are removed for examination or further dissection, as evaporation of the alcohol, and consequent desiccation of the preparation, takes place much more rapidly than that of water.

In most cases it will be requisite to change the spirit once or oftener, before all the soluble colouring matter is given off from the preparation, and it can be permanently mounted. The discoloured spirit need not be wasted, as it can be perfectly restored by passing through the still.

To succeed in making a good anatomical preparation, much patience, neatness of hand, knowledge of the subject illustrated, and some artistic talent are required. No pains should be spared to make it tell the lesson it is intended to convey in the most attractive and pleasing manner. Everything should be displayed as definitely and clearly as in a drawing, and there should be no appearance of negligence or want of finish in any part.

When an elaborate dissection is required, it must, at least in all its later stages, be carried on while the specimen is under spirit, fixed in a flat dish or basin. The small fragments of connective tissue which have to be removed then float out from between the fibres of the muscles and the vessels which are to be preserved and exhibited, and they are carefully snipped off with fine curved scissors. A dissection which looks clean and highly finished as long as it is in air, when placed in fluid, becomes at once cloudy and obscure, from the floating up of these little particles. Hollow viscera, as hearts or stomachs, are distended by injecting their interior with strong spirit, tying or plugging the apertures by which it could escape, and placing them for several days in a vessel with the same fluid. If all the requisite precautions are taken, they will then preserve their form, and the interior of their cavities can be exhibited, by cutting openings or "windows" through different parts of their walls. If from any cause a cavity cannot be made to contain spirit, it may be stuffed with cotton-wool or horse-hair during hardening. The preparation, when laid aside to harden, if not suspended, should be placed in a bed of cotton wool adapted to its form, otherwise it will become irremediably flattened on the side on which it rests.

[1] Lecture at the Loan Collection of Scientific Apparatus, South Kensington, July 26, 1876, by Prof. W. H. Flower, F.R.S., Conservator of the Museum of the Royal College of Surgeons of England. Continued from p. 186.

[2] Methylated spirit is decidedly inferior in transparency and in absence of colour to pure spirit, and even if bright when first used, is apt to become turbid after a time. In a large establishment this can be to a great extent remedied by passing the discoloured spirit through a still, but it would be very desirable to consider whether some other method could not be devised by which alcohol could be used for scientific purposes, without the necessity of paying the present heavy duty of sixteen shillings and sixpence a gallon.

Preparations are usually mounted in glass jars, open at the top, and with a foot below, and either circular or oval, *i.e.* flattened on two opposed sides. The form is selected according to that of the preparation. The ovals show off some preparations to greater advantage than round bottles, but have the disadvantage of being more expensive and being (especially when of large size) liable to crack spontaneously, and apparently without provocation, but probably in consequence of some alteration of temperature affecting the unequal tension of the outer and inner surface of the glass at the bent ends.[1]

The fine silk threads by which the preparation is to be suspended are brought over the edges of the jar, and passed beneath an ordinary thread tied round the groove, then returned and secured across the top of the jar. As threads fastened in this way occasionally are the means of causing leakage of the spirit, with which of course they are always saturated, some prefer to tie them to a piece of wood, or whalebone, fixed across the mouth of the jar. The only disadvantage of this is that it entails some additional trouble, and a reduction of the number of points of suspension which may be made use of in the other method.

There are two methods generally adopted for closing the upper end of the jars after the preparation is mounted in it. The oldest, and still very generally used, is by means of successive layers of bladder, tin foil, thin sheet lead, bladder again, and finally black varnish. The bladder must be macerated until it is partially decomposed, and then it will adhere firmly to the glass. This necessity makes the process a disagreeable and dirty one. The object of the tin foil is to protect the lead from the oxidisation which always takes place when the vapour of spirit comes in contact with it through the first layer of bladder, tin not being so acted upon. A layer of tin only would answer as well as the tin and lead, but if thick enough for the requisite strength, would be more expensive and less easily worked round the edges of the glass. The thin sheet of tin is gummed to the surface of the lead, and then they are cut together to the requisite size, and treated as one, the tin being of course placed downwards. The edges are firmly pressed down round the lip at the top of the bottle and into the groove, with pieces of box-wood shaped for the purpose. Much of the success in closing the bottle depends upon the care with which this is done. Then the second layer of bladder is put on, and tied firmly with twine, round the groove at the top of the bottle. When thoroughly dry the twine is removed, and the edges of the bladder neatly trimmed with a knife; it is afterwards coated with one or two layers of black paint and a layer of black japan varnish.

Bottles closed in this way often keep in the spirit for many years without any material alteration in its level, but there is generally a slight evaporation, so that they have to be watched, and whenever the spirit gets so low that the safety of the preparation is endangered, the old cover must be cut off, and the specimen remounted and closed in by the same process.

A more expeditious and cleaner process, which has also the advantage of admitting light to the top of the preparation and allowing it to be seen from above, is by the use of glass covers. The top of the bottle is ground smooth, and a cover of glass of thickness suited to the size of the bottle cut to fit it. Many practical difficulties have been encountered in carrying out this process, but they have been mostly surmounted by experiment and perseverance, and it probably will in time entirely supersede the bladder and lead plan.

One cause of difficulty was the frequent breakage of bottles so fastened, upon changes of temperature; in the other plan, the top, being somewhat flexible, yields with the varying state of expansion of the contents of the jar, but the glass top is perfectly rigid, and if the pressure is too great must either separate from the bottle or break. This occurs chiefly in large bottles where the bulk of spirit is great, and consequently its expansive power out of proportion to the strength of the glass. This can be obviated to a great extent by not filling the bottle completely, as then the layer of air at the top, being far more compressible than the spirit, acts as a sort of buffer between the bottle and the glass; but in large bottles we generally take the further precaution of a small safety-valve; a hole drilled through the cover, with a loosely fitting stopper to check too great evaporation, or the ingress of dirt. Through this hole the jar can be filled up with spirit, when required, without the necessity of disturbing the preparation, as in the old process.

A second difficulty with glass-covered jars was to find a cement to fix the top, at the same time easy of application and not dissolved or weakened by the spirit. Isinglass dissolved in strong acetic acid, pure gutta percha, a mixture of pitch and gutta percha, and other substances, have been successively used in the Museum of the College of Surgeons, but finally we have given them all up for a composition sold as "Rock marine glue."[1] It is applied in a melted state, the edges of the glass cover being also heated. A small gas jet fixed on a flexible tube greatly facilitates this process.

The suspending threads can either be fixed to a glass rod placed across the top of the bottle just below the glass cover, the ends of which are let into notches cut for the purpose on opposite sides of the inside of the upper rim of the jar, or they can be brought out between the top of the jar and the glass cover, embedded in the cement, and secured by a string tied round the top of the bottle till the cement is hard, when they can be cut off close to the outer edge of the cover, and the securing string removed. The preparation is then finished by neatly painting the edge of the covering glass and cement, and the neck of the bottle for a short distance below, with two or three coats of black varnish.

For displaying different parts of the preparation, especially canals or cavities, black and white hogs' bristles and variously coloured glass rods are used. Delicate preparations, which cannot be kept in position if simply suspended, are fastened by stitches to thin transparent plates of mica, or to opaque coloured slabs of wax, or cardboard. Black or blue are the colours generally preferred, as in greatest contrast to the usual colour of preparations, as shown in the beautiful series of dissections illustrating the anatomy of the frog (3,904 *c*) contributed by Prof. Huxley.

I have said nothing yet about injecting preparations, a process necessary in order to display the course and distribution of blood-vessels. There are two kinds of injections, fine and coarse; the former fills the capillary vessels, and for preparations intended to be seen with the naked eye, gives a blush of the colour used to the tissue, and is chiefly valuable as indicating the relative amount of vascularity of contiguous tissues. For microscopical investigations it is invaluable, and the methods employed and the materials used are fully detailed in all works devoted to microscopical manipulation. Coarse injection is intended only to show the vessels visible to the eye, and not to enter into the capillaries. Size, so generally used as a basis for fine injections, is not so satisfactory in this case, as if in any bulk it contracts in the spirit. The best material (introduced by Dr. J. B. Pettigrew, F.R.S., when Assistant in the Museum of the College of Surgeons) is fine plaster of Paris, coloured with vermilion or ultramarine, according as the tint of red or blue is required. It is mixed with water, as in taking casts, though of rather a more fluid consistence, and of course must be injected immediately, or it will set in the syringe. It has the great advantage of being used cold. It is rather brittle when set, and the vessels should be handled with care, but it may be made more tenacious by the addition of some glue or isinglass to the water with which the plaster is mixed.

The distinction between two different kinds of tissue is sometimes well shown by staining the preparation. Some good examples are exhibited by the Anatomical Museum of the University of Oxford. The head of a sturgeon (Nos. 3,837 and 3,838, prepared by Mr. Robertson) has been immersed for a short time in a solution of carmine, and the cartilage and connective tissue has received the colour, while the bones retain their natural white hue. The distinction between them, which otherwise would scarcely be perceptible in the bottle, is thus very clearly brought out.

The third and last great division of museum specimens for teaching purposes, illustrated by this exhibition, is that which comprises models and casts of natural objects, and under the same heading drawings and diagrams may be included.

As a general rule, models should never be used for teaching if actual specimens can be obtained and exhibited; but there are numerous cases in which the object is of so perishable a nature, that it cannot be preserved efficiently by any of the methods above described. Many objects are so scarce that it is quite out of the power of most museums to possess any representations of them, except as copies of the originals.

[1] The greatest desideratum in putting up wet preparations is a durable glass jar with flat sides, so that the distortion of the object caused by the refraction through the curved surface of the glass may be avoided. Built up cells do very well for small objects, but they are very expensive, and generally fail when tried on a large scale. The subject still offers a good field for experiment.

[1] It is bought from Rockhill and Co., 10, Blackfriars Road.

There are also others so small, that for lectures and demonstrations an enlarged model is of very great assistance.

What may be done in teaching natural history by means of models and coloured casts is admirably shown in Mr. Frank Buckland's museum in this building, where may be seen accurate representation of many of the species of Cetacea and larger fish of our seas, giving a more complete idea of their size, form, and colour, than has ever been produced by any other method. The reduced models of animals and men of various races exhibited by the Committee of the Pedagogical Museum of Russia are also interesting, and must be useful aids to school teaching. By what other means, for instance, could the singular form of such an animal as the Greenland right-whale be brought before a class of pupils? I would also call attention to the well-known anatomical models of Dr. Auzoux, of Paris (which by the way are not very fully represented in the present exhibition by Nos. 3,829 *a* to *d*); to the models illustrating the development of the trout, by Dr. A. Ziegler, of Freiburg (No. 3,839); to the enlarged models of blood corpuscles of different animals for illustrating their form and size, by Prof. H. Wolcker, of Halle (No. 3,893); to the models of Radiolaria in *papier mâché*, by V. Fric, of Prague (No. 3,865); to the numerous anatomical models of Strembitsky in the Russian collection, of Rammé and Todtmann, of Hamburg (Nos. 3,868–3,877); and of Tramond, of Paris (Nos. 3,923–3,925); to the casts of different parts of the human body dissected, by Steger and Honikel, of Leipzig (Nos. 3,840–3,842); and to the models by various exhibitors illustrating the structure of flowers and seeds.

With reference to such models, the importance of accuracy of execution cannot be too strongly insisted upon. With a cast of course there is not much chance of error, but for the accuracy of a model, especially when on a different scale from the original, we are entirely dependent upon the artist's skill and care. The only fault to be found with most of those in the exhibition is that they are rather too rough in execution to be pleasing to the eye, but it has been in most cases an object to produce them at such a low price, as would not be compatible with fine workmanship.

Although I have only been able in the time allotted to glance briefly at the various branches of the subject which I have been requested to expound, I trust that some suggestions have been given in this lecture which will be found of use to those who have the care of collections, and that I have succeeded in showing that the art of preparing, preserving, and displaying specimens in museums is one which deserves to be more fully cultivated than it has hitherto, as a most important adjunct to the diffusion of biological knowledge.

OUR ASTRONOMICAL COLUMN

THE NEW STAR IN CYGNUS.—Prof. Schmidt has published details of his observations of this star from November 24, the date of discovery, to December 15, and has also put upon record the dates, between November 1 and 20, when he had examined the constellation Cygnus, with the view to show that a star as bright as the fifth magnitude could not have escaped his notice, and therefore that the rise of the new one to the third magnitude must have been very rapid, as also appears to have been the case with T Coronæ in 1866. On the evening of its discovery the star was strong golden yellow, and writing on December 9, Herr Schmidt states it had always been of a deep yellow, but at no time exhibited the redness of its neighbour, 75 Cygni. The following are the magnitudes on different nights as determined at Athens by careful comparisons with ρ, π^2, τ, ζ and ϕ Cygni, and η Pegasi :—

	m.		m.		m.	
Nov.	24...3·0	Dec.	2...5·4	Dec.	11...6·7	
	25...3·1		3...5·6		12...6·7	
	26...3·1		4...5·8		13...6·8	
	27...3·2		5...5·9		14...6·9	Hardly visible to naked eye.
	28...3·8		7...6·3			
	29...4·7		8...6·5		15...7·0	Visible so, for last time.
	30...5·0		9...6·6			
Dec.	1...5·2		10...6·5			

On the evening of December 31 the new star was about 7m. and very decidedly orange. It has but slowly diminished during the last three weeks.

NEW VARIABLE STAR IN CETUS.—Mr. J. E. Gore, writing from Umballa, Punjab, on November 28, draws attention to a star entered on Harding's atlas as a sixth magnitude, about 1¼° distant from 59 υ Ceti, and 13′ *s.p.* Lalande 3590. On November 18, this star was only 8m., considerably fainter than a 7m. star shown by Harding, closely preceding υ.

This star is not in any of the catalogues, nor in Schjellerup's list in No. viii. of the publications of the *Astronomische Gesellschaft*. Reading off from Harding and reducing to 1877·0 its position is in R.A. 1h. 50m. 13s., N.P.D. 110° 59′.

DE VICO'S COMET OF SHORT PERIOD.—It was remarked in this column last week, that unless the orbit of De Vico's comet of 1844 has undergone some violent perturbation, a perihelion passage may be expected to occur during the year just commenced. It appears, however, that the chances of detecting the comet, should it arrive at its least distance from the sun during the first three months of the year are very small indeed, and hence, unfortunately if the comet is not found between July and December, it cannot be inferred with any degree of certainty that it has not passed its perihelion within the twelvemonth. The following places are calculated from Prof. Brünnow's last orbit for 1844, reduced to the equinox of 1872, supposing the arrival at perihelion to fall either on the date mentioned or thirty days before or after it. Δ is the comet's distance from the earth.

Time from Perihelion.	January 1·0.			February 1·0.		
	R.A.	Dec.	Δ	R.A.	Decl.	Δ
– 30 days	302°·1	– 21°·8	2·13	316°·4	– 18°·3	2·23
0 ,,	317·9	– 18·1	1·85	331·6	– 13·4	2·10
+ 30 ,,	335·1	– 12·3	1·58	347·0	– 7·2	1·94

Time from Perihelion.	March 1·0.			April 1·0		
	R.A.	Decl.	Δ	R.A.	Decl.	Δ
– 30 days	329°·2	– 14°·2	2·17	342°·2	– 9°·5	1·97
0 ,,	344·1	– 8·5	2·18	357·1	– 3·0	2·12
+ 30 ,,	358·6	– 2·1	2·16	11·1	+ 3·4	2·24

THE TOTAL SOLAR ECLIPSE OF STIKLASTAD, 1030, AUGUST 31.—The circumstances under which this eclipse occurred are given by Prof. Hansteen, of Christiania, in *Ergänzungs-Heft zu den Astronomische Nachrichten*, p. 42, with elements computed from the tables of Burckhardt and Carlini. Sir George Airy has also published elements of the eclipse, resulting from Hansen's calculations from his Solar and Lunar Tables, as an addendum to the paper on the eclipses of Agathocles, &c., in vol. 26 of the Royal Astronomical Society's *Memoirs*, having previously drawn attention to the circumstance that the eclipse of Stiklastad, from the narrowness of the belt of totality and its having been total at a well-defined point, might, in combination with the eclipse at Larissa, B.C. 557, May 19, be of much value in throwing light upon corrections possibly required for the lunar tables.

The following elements of this eclipse are founded upon the same system of calculation for the moon's places, to which we lately referred as having been applied to the Nineveh eclipse of B.C. 763, with the sun's place from Sir George Airy's paper :—

G.M.T. of conjunction in R.A., 1030, Aug. 31, at 1h. 20m. 40s.

	°	′	″	
R.A.	164	20	54·1	
Moon's hourly motion in R.A. ...		33	14·8	
Sun's ,, ,, ,, ...		2	15·3	
Moon's declination	7	37	23·3	N.
Sun's ,, ...	6	43	1·6	N.
Moon's hourly motion in decl. ...		10	20·8	S.
Sun's ,, ,, ,, ...		0	56·0	S.
Moon's horizontal parallax		58	18·1	
Sun's ,, ,, ...			9·0	
Moon's true semi-diameter		15	53·2	
Sun's ,, ,, ...		15	56·5	

Points on the central line would fall in long. 10° 22′ E., lat. 64° 0′ N., and in long. 14° 31′ E., lat. 61° 41′ N. Hansteen gives for the position of Stiklastad 11° 35′ E., and 63° 48′ N., which by the above elements would be only 10′ outside the northern limit of totality. On making a direct calculation for the longitude of Stiklastad, we find that the duration of totality could not have exceeded twenty seconds on the central line.

METEORS OF DECEMBER 11.—MM. Perrotin and Jean, at the Observatory of Toulouse, observed a considerable number of meteors on the night of December 11; between 11h. and 13h. 106 were counted, the majority of which, according to M. Perrotin, radiated from a point in about R.A. 115°, N.P.D. 57°, near Castor and Pollux, though closer to the former star than to the latter. The trajectories were very short, so that it was difficult to refer them to a chart. The sky was overcast on the following night.

NOTES

WITH reference to the closing of the Loan Collection, a circular has been issued by the Lords of the Committee of Council on Education, stating that, although in consequence of the funds at their disposal for the Collection being exhausted, they have found it necessary to close the Exhibition, arrangements are being made for the safe custody of all objects which may be left on loan to the Museum, pending the decision by her Majesty's Government on the offer made by the Royal Commissioners for the Exhibition of 1851, of a building for the establishment of a permanent Science Museum. The Lords of the Committee of Council on Education also inquire whether exhibitors are willing to leave the objects contributed till this question be settled. The closing of the Exhibition will not interfere with the delivery of the Free Saturday Evening Lectures.

ACCORDING to the will of Dr. C. A. Bressa, dated September 4, 1845, the testator left all his property to the Royal Academy of Sciences of Turin, the net interest to be given every two years as a prize for the most important discovery made or work published during the previous four years on natural and experimental philosophy, natural history, mathematics, chemistry, physiology, and pathology, as well as geology, history, geography, and statistics. This is to be given alternately to a person of any nation and to an Italian. Signora C. A. Dupêché had a life interest in the property, and it was not until July last that the legacy became free from all claims, and the first prize will be given in 1879, open to all, and of the value of 480*l*. In accordance with the spirit of Dr. Bressa's will, the Academy will choose the best work or discovery, whether or not it be presented by the author.

WE are informed that the valuable collection of fossils from the Red Crag made by the Rev. H. Cahnam, of Waldringfield, including, among the most important, the remains of *Halitherium* described by Prof. W. H. Flower, teeth of *Mastodon*, &c., has been purchased by Sir Richard Wallace, and most liberally presented by him to the Ipswich Museum.

THE Dutch Society of Sciences at Haarlem has offered a gold medal for the best answer to the following question :—What are the meteorological and magnetical periodic changes which may be considered to be in a well-established relation with the period of the solar spots? The answers must have a motto and be accompanied with a sealed letter containing the name of the author. They should be sent before January 1, 1878, to the Secretary, Prof. von Baumhauer, Haarlem.

RUSSIAN newspapers announce that the Helsingfors professor, Dr. Ahlquist, a well-known explorer among the tribes of North-western Siberia, will start, next spring, for further ethnological explorations among the Voguls and Ostyacks of the Obi and Irtysh. He will be accompanied by two assistants, the Senate of Finland having allowed a sum for the travelling expenses of the explorers.

AT a recent meeting of the Manchester Literary and Philosophical Society a letter was read from Mr. Joseph Sidebotham in which he calls attention to the fact of the growing use of the aniline colours for tinting photographs. He finds they are being *extensively* used in paintings and water-colour drawings, and the colours regularly sold for that purpose. Anyone who knows the speedy alteration by light of nearly all of these colours will protest against their use, and a statement of this with the authority of some of our chemists would probably have the effect of causing them to be discontinued by all artists who care to think that their works should last more than a single year.

ON the night of the Arlesey railway accident there were six Indian elephants on their way by train from Huddersfield to London. Two were large and the others quite young. The tarpaulin over the trucks in which they travelled was blown away in the gale, and the animals were thus exposed to the snow and sleet and cold wind of that night. They were also delayed long on the road in consequence of the accident. One of our contributors who saw them "unloaded" at King's Cross, and noticed that they walked very stiffly at first, has inquired of Mr. Harrington, their keeper, whether the cold journey has affected them. He has written in reply that they seem perfectly well, and he cannot see that the unusual exposure has had any effect on them. None of the animals have been more than a few years in England. As Mr. Harrington's letter is written nine days after the journey, no effects of chill are likely now to show themselves. The Indian (and perhaps the African) elephant may be better able to withstand sudden climatical changes than is generally supposed.

OUR Samoan Correspondent, the Rev. S. J. Whitmee, announces the publication of a new Dictionary of the Samoan language by himself and the Rev. G. Pratt. Mr. Whitmee is on his way to England, where he will probably arrive in spring. Intending subscribers—and we hope there will be a considerable number in this country—should address Mr. Whitmee at the Mission House, Blomfield Street, Finsbury, E.C. The price, it is hoped, will not exceed 10*s*.

WE have received reprints of the letters which M. Poliakoff has written during his recent journey for the zoological exploration of the Obi and Irtysh. They contain many valuable observations on the physical characters of the country visited, on its fauna, on the migrations of fishes up and down the Obi, and on the fisheries, on the migrations of birds, together with a variety of interesting occasional observations. We may hope therefore that the report on this journey will be a valuable addition to the zoo-geography of Western Siberia.

M. POLIAKOFF gives the following particulars confirming the law of Baer as to the deviation to the right of rivers running north and south. The bed of the Irtysh being cut in loose deposits, these deposits are constantly undermined by water on the right bank. Each spring a strip of the bank from 30 to 50 feet broad is destroyed by the waters. Sometimes it happens that a strip from 70 to 140 feet broad and about 150 yards long falls suddenly into the river. The course is then barred for a short time, and a great wave propagated up and down the stream, destroys the fishing-boats which happen to be at work within a distance of about ten miles from the spot. Large quantities of fishes are also found, after such a catastrophe, on the shores, suffocated in the muddy waters. The destruction of the right bank going on constantly, year after year, the villages are also constantly advancing to the east; one of them, Demiansk, has thus travelled about a mile in the course of 240 years. The left shore shows, therefore, a low tract of land covered with ponds and marshes, and yearly overflown, whilst the right shore faces the water with abrupt crags from 70 to 150 feet high. The same thing is also observed on the Obi. The hills of Bélogorie, a short way below the mouth of the Irtysh, have now the main bed of the river to their right, while some time ago it was on their left, there being now on the latter side only a secondary arm. These arms of the Obi—remains of its former beds—form on the left flat shore a series of elongated ponds and channels, connected with the main body of the river by a labyrinth of smaller watercourses.

IN the article in last week's number on Dr. Schliemann's Discoveries, *Amyclæ* was misspelt *Amychi*, Sir R. Colt Hoare's name was given as *Home; Arena* should be *Arma* Heroum, *Miomedia* should be *Nicomedia*, and *Caprea*, *Capreæ*.

THE first number of a new quarterly scientific journal, devoted to zoology, botany, geology, and mineralogy, will be published at Buda-Pest this month. It will be in German, though its first title is "Természetrajzi Füzelek" ("Naturhistorische Hefte"). Prof. Otto Herman is the principal editor.

THE death is announced of the Rev. Barnard Smith, the author of many well-known educational works in arithmetic and algebra.

A WELL-DESERVED pension of 50*l*. a-year has been bestowed upon Mr. Thomas Edwards, the "Scottish Naturalist," whose life Mr. Smiles has written.

DR. PETERMANN has been informed that the Portuguese Government has granted a subsidy of 20,000*l*. in aid of the proposed great scientific expedition for the exploration of Central Africa. The expedition is already organised and will start without delay, commencing its operations by proceeding up the Congo.

THE *New York Herald* of December 2 and 11, contains letters on our Arctic Expedition, by Dr. Hayes.

IN the last report of the Berlin *Akademie der Wissenschaften*, J. Bernstein describes an exceedingly simple and ingenious apparatus for determining the position of the nodal point of the eye of a living person. Experiments with his right eye gave 7·21–7·38 mm. as the distance of the rear nodal point from the vertex of the cornea.

THE Royal Museum at Berlin has received a valuable donation of about 8,000 ethnographical objects from Dr. Jagor. They are the results of extensive journeys through East Turkestan, Burmah, and portions of India, and afford a most complete picture of the domestic and military life of the widely diversified tribes inhabiting the less known parts of these countries.

THE gorilla in the Berlin Aquarium which excited so much interest among German naturalists, has lately recovered from a serious illness, and is now more than ever demonstrative and humanlike in his movements. With the approach of winter a soft silky fur has made its appearance. The weight of this young gorilla has increased from thirty-three to forty-three pounds during his six months' residence in Europe, a fact which would seem to show that confinement is, after all, not so unendurable for him as was supposed.

A SERIES of new rooms has been opened at the *Musée d'Artillerie* of Paris, in which a set of guns is arranged showing the various models used since the artillery was introduced for the first time in warfare 600 years ago.

THE *Annuaire du Bureau des Longitudes* is publishing for the first time two interesting tables;—first, the situation of the several radiant points of falling stars, second, the catalogue of all variable stars, with a calendar of their variations during the year 1877.

MR. M'LACHLAN gives a few details in the *Entomologist's Monthly Magazine* concerning Capt. Feilden's collection of the insects of the Arctic expedition, which he has seen. The greater number of the insects were collected near Discovery Bay in 81° 42′ N. latitude; some of the *Lepidoptera* are even from 82° 45′. The most interesting fact is the occurrence of five or six species of butterflies within a few hundred miles of the North Pole, especially when taken into consideration with the fact that Iceland and the large islands of the Spitzbergen group, although in lower latitudes, have apparently no butterflies. In *Lepidoptera* Mr. M'Lachlan observed four examples (2 ♂, 2 ♀) of the genus *Colias*, possibly two species (? *Boothii* and *Hecla*). Apparently three species of *Argynnis* or *Melitæa* (or both). A *Chrysophanus* apparently identical with *phlœas*. In the *Noctuidæ*, only one individual—an *Acronycta*. In the *Geometridæ*, one *Amphidasis* or *Biston*, and several Cheimatobioid forms with apterous females. Of the *Crambites*, one *Phycis*, perhaps our *fusca*. The *Hymenoptera* are represented by a *Bombus*, and one of the *Ichneumonidæ* of considerable size. In the *Diptera* there is one large fly, probably belonging to the *Tachinidæ*, and perhaps parasitic on the larvæ of some of the *Lepidoptera*. One species of *Tipulidæ*; and a considerable number of *Culicidæ*, and of what looks like a *Simulium*, which, however, do not appear to have annoyed the members of the expedition in these high latitudes. Of *Coleoptera*, *Hemiptera*, and *Neuroptera*, Mr. M'Lachlan saw none; but the bird-lice are naturally well represented.

THE second International Congress of Americanists, organised for the Study of American Antiquities, will be held at Luxembourg on September 10–13, when all English students and *savans* will be cordially welcomed. Information and tickets may be obtained from Mr. Francis A. Allen, 15, Fitzwilliam Road, Clapham, S.W., one of the delegates for England.

THE December session of the *Deutsche Geologische Gesellschaft* was devoted to a long address from Herr Lohsen upon the Rammelsberg, in the neighbourhood of Goslar. The peculiar deposits of ore in this mountain he regarded as belonging to a much later epoch than that in which the surrounding slate was formed, while he explained the lens-shaped form of the cavities in which the deposits are formed as due to the enormous pressure of the overlying strata of sandstone.

THE recent death of Mr. James Drummond, of Comrie, deprives us of a local geologist. He had devoted much time and attention to the Comrie earthquakes, on which he had published many articles and a little book. His views were generally in disaccord with those of the observers appointed by the British Association, against whom he held out manfully.

THE large number of fossil plants brought home from Greenland and Spitzbergen by the two Swedish expeditions of 1870 and 1872 have been carefully examined by Dr. Oswald Heer, and they appear to throw important light on the geological development of the plant world. An account of his study of the remains from the chalk period appears in a recent number of the *Naturforscher*, and in the summary of his results Dr. Heer points out that the facts are against a gradual imperceptible transformation of plant types; from the upper chalk the dicotyledons appear suddenly in great variety, without any transition, whereas other forms at this period wholly disappear from the scene. Further, these researches make it very probable that a whole series of genera have had their origin in the Arctic zone, and have thence "radiated" southwards. Lastly, Dr. Heer shows that the facts at present known of plant palæontology do not point to any alternation of climate or repeated ice-periods in these regions (a view which has also been developed by Prof. Nordenskjöld).

DR. LAUDER LINDSAY has sent us a well drawn up programme of a subject for essays, to be substituted for the ordinary subjects set in schools. The subject is the Moral Education of the Lower Animals, and is intended to train the observing powers of the young, as well also to discover how far animals are capable of moral training.

AT a recent meeting of the Belgian Academy, M. Dupont announced the discovery of numerous vestiges of the age of polished stone in the neighbourhoods of Hastière-sur-Meuse. No less than fifteen burial caverns were discovered in the locality. Five of them have already yielded about fifty-five human skeletons and thirty-five sufficiently well-preserved skulls. Sixteen dwelling-places of the people who inhabited at that period the plateaux, are already explored, and have produced numerous flint weapons. These discoveries promise to throw much light on the pre-historic ethnography of the country.

THE Pennsylvanian Company, which was formed some time ago in order to convey the petroleum obtained in Pennsylvania from the wells to the seaports on the Atlantic, now intends to construct a tube of 4 in. diameter and of some 300 miles in length, connecting the wells with the sea. The practical possibility of the plan is proved by works, which, for a distance of 250 miles, are already in action and use. Baltimore was the first city with which these new canals were connected. The oil is forced through the pipes at a pressure of 900 lbs. on the square inch, and at intervals of fifteen miles large steam pumps, of 10-horse power, assist the motion of the stream. At Baltimore the canal ends in enormous tanks, and these are in direct communication with the refining works. The cost of the new canal and accessories is calculated at 1,250,000 dollars.

IN a note in the *Bulletin* of the Belgian Academy (vol. xlii., Nos. 9 and 10) Dr. Putzeys gives the results of his experiments on new anæsthetics belonging to the alcoholic series, viz., the bromides of ethyl, propyl, and amyl. Inhaled by frogs, rabbits, cats, and dogs, they were proved to possess the same properties as chloroform. The interest of the result is increased by the circumstance that many compounds of bromine from the fat series do not possess the same anæsthetic properties as the corresponding compounds of chlorine.

THE July number of the *Isvestia* of the Russian Geographical Society gives an interesting report by Col. Bolsheff on that part of the Pacific shores of Russian Mantchuria which lies between the 45° and 52° north lat., a country the interior of which remained very little known until now. Almost the whole of the land is covered with mountains, outliers of the Sikhotaalin, a ridge reaching in its highest point 5,173 feet, and abruptly falling to the sea with hills about 800 feet high. The high valleys, which sometimes have a breadth of seven miles, seem to be well suited for agricultural settlements. In the northern parts of the country, lead, silver, iron, copper, and gold, were discovered, this last seeming to occur in considerable abundance. The population is very thin, numbering but 550 souls, Chinese and Tazes, who carry on agriculture, and Gilyaks and Tunguses, living miserably by hunting and fishing. The settled Chinese and Tazes are also engaged in the collection of sea-weeds and sea-worms purchased in China, the Tazes being almost reduced to slavery by the Chinese. Various collections, especially botanical and entomological ones, were brought in by M. Bolsheff, and will be deposited at the Russian Geographical Society.

M. LIPPICH, of the Vienna Academy, has recently been investigating the influence of the mean distance of absorbent particles upon absorption. As such an influence must be especially prominent when the substances afford well-defined absorption bands, and, with considerable density, show no strong colours, he chose for his experiments the nitrate of didymium oxide, which has these properties in high degree. A pretty concentrated aqueous solution of this salt in a vessel 1 cm. thick was spectroscopically compared with a solution having concentration only 0·1, 0·05 . . . of the first. The solutions were in tubes of 10, 20 cm. . . . length severally. A Steinheil spectroscope was used, and the light sources were two gas lamps so regulated that both spectra showed the same brightness on the parts that were free from absorption. Even with the concentration-ratio 1 : 10, there were marked differences in the absorption bands. The very characteristic bands in yellow and yellow-green were, for the more concentrated solution, considerably broadened towards the red end of the spectrum, while the sharp limit towards the violet was the same for both solutions. The much narrower bands in the green showed quite a similar behaviour. In the other parts differences were observed with difficulty. Besides this difference in the breadth of the absorption bands, there were others in the distribution of the bright parts.

PROF. BERNARDIN, the indefatigable *conservateur* of the Commercial and Industrial Museum at Melle, near Ghent, has just published another of his useful lists under the title of *Classification de* 250 of *Fécules*. The arrangement is on a scientific system, the plants being classed under their natural orders, commencing with the Cryptogams and proceeding with the higher developed plants. The scientific name of the plant is placed first under each order and is in italics so as easily to catch the eye. The lists previously compiled by Prof. Bernardin are *Classification des Huiles Végétales*, *Nomenclature de* 550 *Fibres Textiles*, *Classification de* 250 *Matières Tannantes*, *Classification de* 100 *Caoutchoucs et Guttaperchas*, and *Classification de* 40 *Savons Végétaux*. These lists, when brought together, will prove serviceable to all those interested in the application of plants.

THE phenomenon of fluorescence, according to M. Lallemand (*Journal de Physique*) is much more general than has been commonly supposed; he knows of only two substances in which it is *nil*, viz., rock-salt and quartz. If it has not been remarked in the majority of liquids, and even of transparent solids which possess it, this is because all the spectral rays are capable of producing it, and the fluorescence, instead of being produced with a maximum of brightness and a proper colour at the surface of incidence, is manifested throughout the mass of the body traversed by the light and without a very pronounced proper colour. M. Lallemand distinguishes two kinds of fluorescence—one called *isochromatic*, or of equal colour, in which each simple ray excites an identical vibratory movement; this kind is produced by all the luminous rays of the spectrum in sulphide of carbon, benzine, alcohol, ether, &c., and in water itself in a slight degree; the other is that long observed in sulphate of quinine, and which is therefore called *quinic* or *hypochromatic* fluorescence. Each luminous ray here produces a fluorescence of less refrangibility, with this peculiarity, that a simple light produces often a complex fluorescence, containing rays of various refrangibilities, but always inferior to that of the exciting ray. It is generally the most refrangible and the chemical rays which develop quinic fluorescence of various intensities. A body may possess both kind of fluorescence at once, but the two parts of the spectra corresponding to them may be very unequal. In glass and crystal, *e.g.*, the red, yellow, and green rays develope a weak isochromatic fluorescence, the others produce quinic fluorescence.

M. GIFFARD, the celebrated aeronaut, and inventor of the *injecteur*, is constructing, at Forges-de-la-Seine, a small steamboat for service from Pont Royal to the Exhibition (1878) Pier, distance only three miles. The steamer will realise the extraordinary velocity of forty-five miles per hour, and run the distance in four or five minutes. The length of the steamer willbe thirty metres, and transverse section three and a half metres.

THE additions to the Zoological Society's Gardens during the past week include six Greek Partridges (*Caccabis saxatilis*) from Persia, Naran River, two Black-headed Partridges (*Caccabis melanocephala*), a Hey's Partridge (*Caccabis heyi*) from Hedyar, near Mecca, presented by Mr. F. M. Burke, Commander S.S. *Arcot*; a Yellow-lored Amazon (*Chrysotis xantholora*) from Central America, purchased.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, Ergänzung Band viii., Stück 1.—On the electric conductivity of water and some other bad conductors, by M. Kohlrausch.—The mica-combination of Reusch, and the optical rotatory power of crystals, by M. Sohncke.—On determination of the constants for absorption of light in metallic silver, by M. Wernicke.—The interference of refracted light, by M. Lommel.—The fundamental principles of Edlund's electrodynamics, by M. Chwolson.—Volumetric chemical studies, by M. Ostwald.—On the influence of the funnel-valve on electric spark discharges in air, by M. Holtz.—On an electrical fly-wheel like that of the radiometer, by M. Holtz.—Steam-jet air-pump, by M. Teclu.

Journal de Physique, December.—Measurement of the calorific intensity of the solar radiations and of their absortion by the terrestrial atmosphere, by M. Crova.—On various theories given to explain the movements of Crookes's radiometer (second paper), by M. Lippmann.—On the illumination of transparent and opaque bodies (concluded), by M. Lallemand.

THE *Jahrbuch der k.k. geologischen Reichsanstalt zu Wien* (vol. xxvi. part 2), to which are added Dr. Gust. Tschermak's *Mineralogische Mittheilungen* (vol. vi., part 2), contain the following papers:—Geological survey of the Dutch East Indian Archipelago, by Dr. Schneider.—The saline springs of Galicia, by Mich. Kelb.—Report on the volcanic events during the year 1875, by Dr. C. W. C. Fuchs. Of this we publish a detailed account in our "Notes."—On the green slates of Lower Silesia, by Ernst Kalkowsky.—On beryl from Eisvold, in Norway, by M. Websky.—Chemical analysis of the iodiferous saline springs of Darkau, by E. Ludwig.—On the volcanic formations of the Galapagos Islands, by F. A. Gooch.—On a perfect combination of pyrites and hæmatite crystals, by Dr. C. Hintze.—On some minerals from North-western Silesia, by F. Nenimar.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, December 18, 1876.—Prof. Abel, F.R.S., president, in the chair.—Prof. W. N. Hartley made a communication entitled "a further study of fluid cavities," in which he described the results of his examination of a large number of topaz and of rock sections, mostly granites and porphyries. The fluid contained in the cavities was almost invariably water, but it was very remarkable that the cavities often took the form of the crystals in which they were contained, and nearly always arranged themselves symmetrically with regard to the faces of the crystal.—A paper by Dr. H. E. Armstrong, F.R.S., on thymoquinone, one on high melting points with special reference to those of metallic salts, part 2, and another on the determination of urea, by Mr. G. Turner, followed this, after which Dr. G. Bischof called attention to the rapid corrosion of the so-called "compo" pipe employed by gas-fitters when used to convey water, especially when exposed alternately to the action of air and water.

Meteorological Society, December 20, 1876.—Mr. H. S. Eaton, M.A., president, in the chair.—Rev. C. C. Chevallier, T. Gordon, and Rev. T. H. Quelch were elected Fellows of the Society.—The following papers were read:—On observations with the psychrometer, by Dr. R. Rubenson (translated from the Swedish, and abridged by Dr. W. Doberck). This paper contains an account of the instructions issued to the Swedish observers in order to obtain trustworthy results from the psychrometer, or dry and wet bulb hygrometer. These instructions, however, do not differ from those followed by English observers at the present time.—Contributions to hygrometry: The wet bulb thermometer, by William Marriott, F.M.S. This paper contains the results of observations made with several wet bulbs in different positions and under different conditions, which were carried on in order to determine what a *wet bulb thermometer should be*. Ten thermometers were used as wet bulbs and three as dry bulbs. With three wet bulbs the water receptacles were placed at different angles; but it was found that the readings were not affected by the position of the water receptacle. Others were used with different thicknesses of muslin and conducting threads; but it was shown that the thermometers with the thinnest muslins always gave the lowest readings. Three pairs of dry and wet bulbs were used, one with a closed water reservoir six inches from the dry bulb, the other two having open reservoirs which were respectively three inches and one inch from the dry bulbs. It was found that the dry bulbs of the two latter read lower than the former in fine dry weather, but when the air was damp and during rain they generally read higher. The wet bulbs of the latter read a little higher than the former; this was mostly the case in damp weather. In conclusion, the author submitted for adoption certain regulations for the management of the dry and wet bulb thermometers, in order to secure comparable results.—Visibility, by the Hon. Ralph Abercromby, F.M.S. Visibility, or unusual clearness and nearness of distant objects, is a very trustworthy prognostic of rain in this and many other countries. The usual explanation that much moisture increases the transparency of the atmosphere is not borne out by observation. In this country great nearness occurs on a clear, brisk day, when hard masses of cloud shade the glare of the sky from crossing direct light sent from distant objects, and make clearness so great as to give the impression of nearness. The kind of rain which immediately follows nearness is in short sharp showers, but unsettled weather often follows later. The synoptic conditions of nearness in this country are either straight isobars or the edge of anticyclones, neither of which are associated with settled weather.—Description of a meteorographic model, a letter from the late Commodore M. F. Maury, Hon. Mem. M.S., to Capt. H. Toynbee, F.R.A.S.

Physical Society, December 16, 1876.—Prof. G. C. Foster, president, in the chair.—The following candidate was elected a member of the Society:—Mr. W. Baily, M.A.—Mr. Crookes described some of the most recent results he has obtained in his experiments on the radiometer, and exhibited many beautiful forms of the apparatus, most of which have been devised with a view to decide on the correct theory of the instrument. We shall refer to the subject of the paper in an early number.—Prof. Dewar exhibited a simple electrometer which he has designed, founded on the discovery of Leipman that the capillary constant is not really independent of the temperature or condition of the surface but is a function of the electromotive force. If a capillary tube be immersed in mercury, and dilute sulphuric acid be placed in the tube above the mercury, and a current from a Daniell's cell be so passed through the liquids that the mercury forms the negative pole, the column will be depressed to an extent dependent on the diameter of the tube. In making an electrometer, Prof. Dewar has increased the sensitiveness by connecting two vessels of mercury by means of a horizontal glass tube filled with the metal, except that it contains a bubble of dilute acid. The tube must have an internal diameter of two millimetres, and it is essential that it be perfectly clean, uniform in diameter, and horizontal. The instruments exhibited were constructed by Messrs. Tisley and Spiller, and Prof. Dewar showed that it is possible by means of them to measure an electromotive force equal to $\frac{1}{10000}$th of a Daniell's cell; forces capable of decomposing water must be measured by causing two currents to act against each other. The index bubble is brought to zero by uniting the mercury cups by a wire. The apparatus is very convenient, as it requires no preparation and is extremely simple in its action. He then showed an instrument arranged by Mr. Tisley for producing a current by the dropping of mercury from a small orifice into dilute sulphuric acid; if the vessels containing the mercury and the acid be connected by a wire a current is found to traverse it. He then exhibited a manometer suitable for measuring very slight variations of pressure, and he illustrated the use of it for proving Laplace's law that the internal pressure multiplied by the diameter of a soap-bubble is constant. It consists of a U-tube, one arm of which is about 15 inches long, and is bent horizontally and levelled with great care. If the shorter arm be connected with a tube on which a bubble has been blown and the diameter of the bubble be varied, the position of the extremity of the alcohol column will be found to vary in accordance with the above law.

Entomological Society, December 6, 1876.—Sir Sidney Smith Saunders, C.M.G., vice-president, in the chair.—Prof. Eduard Grube, Director of the Zoological Museum of the University of Breslau, and Dr. Katter of Putbus, in the Island of

Rügen, were elected foreign members.—Mr. M'Lachlan (on behalf of Mr. W. Denison Roebuck, of Leeds) exhibited some locusts, a swarm of which had passed over Yorkshire during last autumn. He believed that they belonged to the *Pachytylus cinerascens*, an insect which was supposed to breed in some parts of Northern Europe.—Mr. W. C. Boyd exhibited living larvæ of *Brachycentrus subnubilus* in their quadrilateral cases, having been reared from the eggs. They were of a much larger size than those previously exhibited by him at the meeting of November, 1873, being more than half an inch long.—Mr. S. Stevens (on behalf of Mr. Edwin Birchall) exhibited a specimen of *Cirrhœdia xerampelina*, var. *unicolor*, *Agrotis lucernea*, var. *latens*, and what appeared to be a small variety of *Zygæna filipendulæ* with the pupa case and cocoon. They were all taken by Mr. Birchall in the Isle of Man.—Mr. Meldola referred to a request made by Mr. Riley, of St. Louis, Missouri, that entomologists should supply him with cocoons of the parasite *Microgaster glomeratus*, which were much wanted in America to destroy the numerous broods of *Pieris rapæ* which had been imported into that country. Mr. M'Lachlan had at a subsequent meeting stated that *M. glomeratus* was parasitic on *P. brassicæ*, but doubted whether it ever attacked *P. rapæ*; and Mr. Meldola now exhibited the insects he had found parasitic on these two species, that on *P. rapæ* being *Pteromalus imbutus* (one of the *Chalcididæ*), while on *P. brassicæ* he had observed *Microgaster glomeratus* and a dipterous species *Tachina augusta*. Specimens of all of these were exhibited.—Mr. Smith remarked that he had received a nest of *Osmia muraria*, sent to him from Switzerland, in which he had found in one of the cells a yellow larva, which ultimately proved to be that of a beetle belonging to the *Cleridæ* (*Trichodes alvearius*).—Sir Sidney Saunders exhibited a large box of insects of all orders, which had been collected in Corfu by Mr. Whitfield.—Mr. C. O. Waterhouse remarked on the "Catalogus Coleopterorum" of Gemminger and v. Harold, the concluding portion of which was now published. The total number of generic names given is 11,618, of which 7,364 are adopted genera, and 4,254 appear as synonyms. The total number of species recorded is 77,008. Dejean's first Catalogue, published in 1821, gave 6,692 species, while that of 1837 (the 3rd edition) gave 22,399 species, of which, however, only a portion were then described. Taking into consideration the number of species described during the publication of the Munich Catalogue, the number of described species at the present date could not be less than 80,000. Thus, since 1821, the known species of Coleoptera had increased twelvefold.—Sir Sidney Saunders exhibited several larvæ of *Meloïdæ* in their first stage, received from M. Jules Lichtenstein, of Montpellier, including (1) the primary larval form of *Sitaris colletes* found on *Colletes succincta*, feeding on ivy blossoms; (2) the same larval stage of *Mylabris melanura* obtained from the egg, and furnished with triple tarsal appendages like other larvæ of *Meloïdæ* in their primary form; (3) the exuviæ of the primary form of *Meloë cicatricosus* (from the egg), and also the second stage of the same larva, still bearing legs; (4) the primary larva of *Meloë proscarabæus* (?) differing from the foregoing in the structure of the antennæ, taken on an Andrena; (5) the corresponding larval stage of *Meloë autumnalis* (?), also differing as aforesaid, taken on *Scolia hirta*.—Mr. C. O. Waterhouse read descriptions of twenty new species of Coleoptera from various localities.

Geologists' Association, December 1.—Mr. William Carruthers, F.R.S., president, in the chair.—On the comparative ages of the English and Scottish coal-fields, illustrated by the geology of the Lothians and Fifeshire, and the structure and age of Arthur's Seat, Andrew Taylor, F.C.S. The author, after alluding to the early interest evoked by the geological problems which a study of Arthur's Seat suggests, proposed to bring forward some local sections bearing on the question of its age. A section, beginning with the Burdiehouse limestone quarries at East Calder, deals with upwards of 1,700 feet of strata. This area had undergone much disturbance; the trap-sheets were shown to fill the crevices, consequent on the subsidence, both in the main lines of shrinkage and in the parallel ones; nor does this shrinkage and contemporaneous emission of volcanic matter terminate in the lower strata. The structure of the Torbane hill mineral basin proves this. Another section was described at North Queensferry, through what was originally supposed to have been a compact mass of intrusive dolerite. During the earlier operations no igneous rock was touched; it was only towards the close of the work that the narrow plug became visible. The superposition of the beds cut through is —3. Sandstone, 2. Shale, 1. Freshwater (Burdiehouse) limestone. The freshwater limestone was found only in the plug of the tunnel, standing almost vertically, and having a white crystalline character. Below it occurred a bed of ozokerite, three inches thick. The shale near the plug lost its fissile laminated character, assuming a somewhat columnar form. Whilst the dolerite on the hill is visibly crystalline, at the plug it presents a compact aphanitic mass. We have here, as elsewhere, the association of ozokerite and bitumen with limestone.

PARIS

Academy of Sciences, December 18, 1876.—Vice-Admiral Paris in the chair. The following papers were read:—Note on the integration of total differential equations, by M. Bertrand.—Theorems concerning couples of segments taken the one on one tangent of a curve, and the other on an oblique of another curve, and making together a constant length, the curves being of any order and class, by M. Chasles.—On the secular displacements of the plane of the orbit of the eighth satellite of Saturn (Japhet), by M. Tisserand. If we consider on the sphere great circles representing the orbit of Saturn and his ring, and draw through their intersection two great circles suitably chosen, the orbit of the satellite will form with these two latter circles a triangle of constant surface.—Microscopic study of the volcanic rocks of Nossi-Bé, by M. Velain.—Method of methodic compression and immobilisation, by M. Chassagny. A solid inextensible envelope with a caoutchouc bag under it incloses the region to be compressed (*e.g.* a limb), and the bag is injected with air or water.—On a particular class of left unicursal curves of the fourth order, by M. Appel.—Manometer for measuring high pressures, by M. Cailletet (already noticed in connection with the *Journal de Physique*).—Researches on mannite with regard to its optical properties, by MM. Müntz and Aubin. Mannite, of whatever origin, presents the same optical properties.—On the keel of least resistance, by M. Béléguic.—Various notes on Phylloxera.—Calculation of three observations of the new star of Cygnus, by M. Schmidt.—Preliminary note on photographs of stellar spectra, by Dr. Huggins. He submitted a copy of the photographed spectrum of Vega (α Lyræ), in which are seven broad lines, two of them coinciding with the two lines of hydrogen in the solar spectrum.—Observations on the explanation of the phenomenon of the black drop at the moment of exterior contact of Venus and the sun, by M. van de Sande Backhuyzen.—Second note on the theory of the radiometer, by Mr. Crookes.—On an arrangement for reproducing Foucault's experiment (stoppage of a turning disc under the action of an electro-magnet), with the aid of the syren, by M. Bourbouze. The copper disc is fixed on the axis of the syren, and when the magnet is made the sound suddenly stops.—Practical method of testing an element of a battery, by M. Leclanché. He states some interesting effects of variation of temperature on a Daniell element.—Note on the presence of sugar in the leaves of beets, by M. Corenwinder.—Note on a rapid means of determination of lime in presence of magnesia, and on the application of magnesia to the defecation of saccharine juices, by MM. Bernard and Ehrmann.—On the fall of cold air which produced the disastrous frost in the middle of April, 1876, by M. Barral. This he considers strongly in favour of M. Faye's theory.—Absorption, by a meadow, of the fertilising principles contained in a liquid charged with manure and employed in watering, by M. Leplay.—On the quantity of rain that fell and was collected during the heaviest showers, from 1860 to 1876, by M. Berigny. The average of water which fell in ten to forty-five minutes, in the heaviest showers, was 0·51 mm. per minute, which would give 1·53 cc. for thirty minutes (an exceptional case occurred on August 2, 1866, when a shower furnished, in ten minutes, 11·62 mm. of water, equivalent to 1·16 mm. per minute).—Relations between the optical elements of Arthropoda and those of certain worms, by M. Chatin.—On the beds of fossil bones of Pargny Filain and of Dezanne.—M. Decharme described an experiment with coloured rings. Directing a current of vapour of bromine, iodine, or sulphydrate of ammonia against a metallic plate, he obtains, by chemical process, coloured rings similar to the thermal rings he got with a jet of flame.

BERLIN

German Chemical Society, November 13, 1876.—A. W. Hofmann, president, in the chair.—O. Pettersson has determined the atomic volumes of isomorphous mixtures of selenates and sulphates, notably of the alumns, containing both acids.—A. Horstmann published researches on the tension of dissociation, proving that the presence of one of the constituents of a substance liable to dissociation diminishes this tension.—V. Meyer described a simple apparatus to show the increase in weight by the combustion of a candle.—Friedrich Müller described simple apparatus for the lecture-room to determine the density of gases and the quantity of water formed by the combustion of hydrogen. The same chemist has determined the temperatures to which solutions of different salts are raised by a current of steam.—C. Hensgen has treated the sulphates of potassium, sodium, and lithium with hydrochloric acid gas at high temperatures, transforming them into chlorides. Sulphate of copper absorbs under similar circumstances 2HCl; heated in a current of air, this (molecular?) compound yields chlorine and water, and reproduces sulphate of copper. These experiments are interesting with regard to Deacon's process.—H. Iobst has found in coto-bark a new base, called by him para-cotoin.—C. Böttinger has treated racemic acid, $C_3H_4O_3$ with hydrocyanic and hydrochloric acids, transforming it into lactic acid as well as into a new acid of the formula $C_7H_{10}O_7$, or $C_7H_8O_7$.—C. Vogel showed absorption-bands produced by magnesia and alumina in solutions of purpurine; by their means traces of these substances can be recognised in the presence of large quantities of organic substances, as in milk, urine, tartaric acid, &c.—C. A. Martius reported on the Chemical Exhibition at Philadelphia.

November 27, 1876.—A. W. Hofmann, president, in the chair.—E. Baumann described phenylsulphate of potassium, obtained by the reaction

$$\underset{\text{Potassic phenate.}}{C_6H_5OK} + \underset{\text{Potassic pyrosulphate.}}{K_2S_2O_7} = \underset{\text{Potassic phenylsulphate.}}{C_6H_5SO_4K} + \underset{\text{Potassic sulphate.}}{K_2SO_4},$$

a well-defined crystalline salt easily decomposed into phenol and sulphuric acid. Conjointly with E. Herter Mr. Baumann proved the transformation of phenoles into phenolsulphates by the digestion in warm-blooded animals.—A. Atterburg described chlorides obtained from α and β dinitronaphthalenes, and expounded the probable reasons of their isomerism.—W. Thörner reported on some derivatives of phenyl-toluyl-ketone.—T. Hunats described citrate of methyl $C_3H_4(OH)(CO_2CH_3)_3$, acetyl-citrate of methyl $C_3H_4(OC_2H_3O)(CO_2CH_3)_3$, the product of the action of PCl_5 on the former, viz., $C_3H_4Cl(CO_2CH_3)_3$, monochloro-tricarballylate of methyl; and experiments trying in vain to produce ethyl-citrate of ethyl.—H. Willgerodt stated that α—dinitrochlorobenzol yields with acetamide (and alcohol) ortho-para-nitraniline (and acetic ether). With urea it yields another dinitraniline.—L. F. Nilson described double nitrites of platinum with K, Na, Li, Rb, Ag, Ca, Sr, Ba, Pb, Mg, Mn, Co, Ni, Fe, Zn, Hg, Be, Al, Cr, In, Y, Er, Ce, La, and Di.—C. Liebermann proved frangulic acid to be identical with emodine $C_{14}H_8O_4 + 1\frac{1}{2}H_2O$. The same chemist showed glass tubes profoundly attacked and rendered non-transparent by water at 200°.—A. Michael and Th. Norton, by treating resorcine with terchloride of iodine, have obtained teriodo-resorcine.

December 11, 1876.—A. W. Hofmann, president, in the chair.—E. Berglund, who obtained imido-sulphonate of ammonium, $NH.(SO_2.ONH_4)_2$, by treating chlorosulphuric acid, $ClSO_2.OH$, with ammonia, has found that by boiling the same with baryta, it yields the barium salt of amido-sulphonic acid, $NH_2.SO_2OH$.—S. Stein described levers, thermometers, and circular measures of rock crystal.—W. Thörner described an apparatus for distilling in vacuo, permitting the change of the receiver without taking the apparatus to pieces.—H. Landolt published interesting details of a projecting apparatus used by him for lecture-purposes.—F. v. Lepel communicated his observations on spectroscopic reactions of magnesium salts.—E. Glatzel described titanic sulphates derived from TiO_2 and Ti_2O_3.—E. Erlenmeyer has observed that an acid phosphate of lime, $CaH_4(PO_4)_2H_2O$, when treated with less water than is necessary for its solution, is decomposed into insoluble dicalcium phosphate, $CaHPO_4 + (H_2O)_2$, and free phosphoric acid. The same chemist recommends the following easy method for preparing cyanides, viz., to fuse ferrocyanide of potassium with sodium—

$$C_{12}N_{12}Fe_2K_8 + Na_4 = (CyK)_8 + (CyNa)_4 + Fe_2.$$

The same chemist, by oxidising normal oxycapronic acid, $C_6H_{12}O_3$, obtained normal valerianic acid.—E. Fischer has transformed diphenylamine into diphenyl-nitrosamine, and the latter into $(C_6H_5)_2N-NH_2$, diphenyl-hydrazine, isomeric with hydrazobenzol, but not transformable into benzidine.—C. Böttinger confirmed former observations that citraconic acid and its isomers treated with nascent hydrogen yield the same pyruvic acid.—A. Laubenheimer reported on orthodinitrochlorobenzol; one of the NO_2 groups having been replaced by NH_2, it yielded, by treatment with nitrite of ethyl, paranitrochlorobenzol.—H. Limpricht published detailed researches on various bromobenzolsulphonic acids.—G. Krämer to purify methylic alcohol transforms it into formiate. The impurity found in the pure alcohol of commerce is dimethyl-acetal. Conjointly with Grotzky he has found in impure methylic alcohol: aceton, dimethyl acetal, allylic alcohol, methyl-ethyl-ketone, higher ketones and oils which with chloride of zinc yielded cymol and xylol.—H. Bulk published simple contrivances to replace the ordinary suction-pump and separating funnel.—C. Liebermann and O. Burg have made researches on braziline, to which they give the formula $C_{19}H_{14}O_5 + H_2O$; the formula of haematoxyline being $C_{16}H_{14}O_6$. Brasiline, when oxidised, yields the colouring matter brasileine, $C_{16}H_{12}O_5$.—A. Frank gave a warning against the use of glass for sealed tubes, that yield more than 1 per cent. of soluble matter to water. He also mentioned that wine bottles are now in use that yield alkali to the wine, thereby spoiling their taste.

VIENNA

I. R. Geological Institution, November 26, 1876.—The Director, M. F. v. Hauer, referred briefly to M. F. Fötterle, vice-director of the institution, who died last summer; he then welcomed M. R. Drasche, who has recently returned from his travels in the Philippine Islands, Japan, and North America. The following papers were read:—Dr. Stache on the old eruptive rocks from the region of the Ortler Mountains; these bear a strong resemblance to modern andesites, and he showed their distribution on a large-scale map. The name of Ortlerite was proposed for one sort of these rocks, with a dioritic dark-coloured cement, a more basic nature, and of an older geological period; for the newer one, with a light-coloured trachytic and more acidic cement, the name of Guldenite was adopted. Many specimens which he presented contain various enclosures of other crystalline rocks.—Dr. E. Majsisovics presented the detailed geological map of South-Eastern Tyrol and the province of Belluno. The mapping was performed in the years 1874–1876, under the direction of the reporter, assisted by Dr. Hörnes and Dr. Dölter, since appointed professors at the University of Graz.—Dr. Tieze, on the country of Krasnowodsk, on the eastern coast of the Caspian Sea, which he had visited on his return from Persia. He stated that the supposition of a reappearance of the Persian-Armenic salt-beds in these parts, was erroneous. The large gypsum beds in Kuba-dagh belong to the mesozoic formations, and might be contemporaneous with the Jurassic gypsum-beds of Daghestan. The hills of Krasnowodsk may be regarded as a continuation of the Caucasian Mountains, and form the northern part of an anticlinal, whose southern part is partly formed by the Turcomanic Balkan.—Dr. Koch, on the occurrence of ice-crystals in loose gravel which he had observed at the Arlberg.—Dr. Drasche mentioned a similar occurrence that he had noticed during his travels in high mountainous regions of the tropical zone.

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