Nature (Including index to vol. VII). Vol. VII, No. 158 November 7, 1872

London: Macmillan Journals, November 7, 1872

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NATURE

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME VII

NOVEMBER 1872 to APRIL 1873

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

London and New York

MACMILLAN AND CO.

1873

LONDON
R. CLAY, SONS, AND TAYLOR, PRINTERS
BREAD STREET HILL

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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

THURSDAY, NOVEMBER 7, 1872

THE LAST ERUPTION OF VESUVIUS

THE scientific results of the late eruption of Vesuvius promise to be as important to science as the phenomena were grand and awe-inspiring to the spectator. Not only has Prof. Palmieri published an account of the observations from his dangerous standpoint, in Italian and German, which will shortly make its appearance here in the English translation by Mr. Mallet, but M. Henri Saussure has also published in the Geneva *Bibliothèque Universelle* an account of an excursion made by him to Vesuvius about the middle of last May, shortly after the violent eruption of April. This account, given by such a competent observer, is so interesting and valuable, from all points of view, that it must be regarded as a most valuable addition to the literature of one of the most popularly-known volcanoes on our planet. For the better understanding of the geographical features we may refer our readers to the article in NATURE, vol. vi. p. 2.

Vesuvius, as Prof. Phillips has taught us, was formerly a mountain forming a vast circle, whose central part, occupied partly by a crater—which, without doubt, has been often displaced within the limits of the circumference—was not less than three kilometres in diameter, and the projecting part of which, occupied at present by the cone, formed then only a kind of plateau. The famous eruption of A.D. 79, which happened unexpectedly after a very long period of repose, entirely changed the form of the mountain. Very little lava seems to have been given forth during that eruption, which was characterised by tremendous showers of stones and ashes, and by rivers of mud. This it was that buried Pompeii and Herculaneum, the former being covered by fifteen feet, the latter by thirty or forty feet of *débris*, and which, at the same time, appears to have formed, by accumulation, the present mountain of Vesuvius, placed in the centre of the ancient circle, the work having been completed by innumerable successive eruptions.

The Vesuvius group, then, is at present composed of two distinct mountains—namely, the cone of Vesuvius, and the rest of the ancient circle which form, to the north and west, a vast amphitheatre, named *La Somma*. Between the two mountains is an elevated horse-shoe shaped valley, the middle part of which bears the name of *Atrio del Cavallo*, and the upper extremity, towards the east, that of *Canale del Inferno*. This elevated valley is depressed and widened towards the west, where it takes the name of *Gli Atri*, and ends by being lost upon the slopes of the *Piano* which form the buttresses of the two mountains, and which emerge by various ravines into the plains which stretch from San Sebastiano to Torre del Greco.

This description would be incomplete if we did not mention a knoll or hillock, apparently insignificant, but in reality of great importance from the part it plays in giving direction to the lava. This little eminence, named Monte de Canteroni, has the form of an elongated saddle-back; it runs east and west, parallel with the western extremity of the crest of La Somma, rising towards Vesuvius. It divides, as it were, in the direction of its length, the outlet of the elevated valley, and as it does not reach the foot of the cone of Vesuvius, it forms only an incomplete partition which divides the currents of lava flowing out of Atrio del Cavallo. At the lower or western extremity of this saddleback is situated the Observatory.

The greatest overflows are always those which make their way across the mass of the mountain; for when a volcano has acquired a certain height, the weight of the liquid column which issues from the vent becomes so considerable that the incandescent matter must rush from the fissures at a lower level. But, for a certain number of years, the centre of eruption of lava seems to have shifted towards Atrio del Cavallo, in the elevated valley situated between the two mountains.

In 1855 and the following years, eruptions made their way or had been thrown upon this point, and have transformed the elevated valley into a sort of sea of lava, which at present may be about 1,000 metres in breadth. The burning torrent makes its way to the west, but on leaving the valley of Atrio, it very soon encounters Monte de Canteroni, which divides the current into two unequal parts, giving to each a different direction, throwing back the principal stream on the left into Fosso Vetrana, and the small part on the right, upon the slopes of the Piano. The lava does not scoop out but only rolls along the ground, the eroded ravines which furrow the sides of the mountain becoming necessarily their natural channels. Thus the successive currents have followed very nearly the same channel, being superimposed on each other through a great part of their course. When the lava streams are of considerable depth, they often pass over small inequalities of ground, and leap to right and left when they strike against any considerable obstacle.

A good carriage road leads from Resina as far as the Observatory, across the cultivated slopes which are covered with houses. At less than a kilometre from the Observatory, the road traverses the lava of 1858, which has covered up the old route, and through which it has become necessary to reopen the way. Almost immediately after having passed the lava, the Observatory is reached, where Prof. Palmieri sojourned during the terrible days of the last eruption. This building, situated at a height of 600 metres, is a substantial freestone structure of two stories, surrounded by beautiful terraces which overlook the lava field on all sides, and the edges of which are enclosed by a handsome railing not much in keeping with the desolate aspect of the place. M. Palmieri has been compelled, from the want of trained assistants, to set up registering apparatus, and can obtain certain connected observations only during the time of his occasional stay at the Observatory. But for this circumstance, the last eruption would probably have been foreseen for some time.*

From the Observatory, the summit of Mount Vesuvius can be reached in two hours. The road skirts the immense fields of black lava which stretch between Monte Canteroni and the foot of Vesuvius, and which have been formed by the recent eruptions as they escaped from Atrio del Cavallo. The lava of April 26 M. de Saussure found already quite cooled on the surface. There would not appear to be a greater amount of incandescence at the bottom of any crevasse, although the matter certainly preserves its heat under the superficial stratum, as was attested by the great number of fumaroles encountered almost everywhere. These emanations escaped for the most part from little kilns, or swollen crevasses, which communicate by clefts with the deeper lava. Around some of these fires there prevailed a strong odour of hydrochloric acid, while other vents did not emit anything but steam or warm air. These are, indeed, the successive phases which mark these emanations of lava until they reach complete coolness.

At first, the whole surface of the lava-streams seems to exhale steam and hydrochloric acid, and the atmosphere is filled with a disagreeable odour which makes breathing uncomfortable. But very quickly the exhalations are localised around the little centres of fire, whose activity continues for many months, and emanations from which are gradually modified. Thus, as seen from Naples at the time of the visit, the whole of the lava appeared to be smoking, and it was possible clearly to distinguish the tracks of the whitish vapours which appeared to wander over the surface; but close at hand there was nothing to be seen but the fumaroles, between each of which there is plenty of space. The gas and the hot vapours which the lava emits are charged with numerous substances, and become the source of mineral deposits which fill the tourist with wonder. One of the most curious phenomena observed is the power of burning lava to retain an enormous quantity of water and salt, which it does not allow to escape until it begins to cool. The formation of salt is shown generally over the whole stretch of lava emitted in 1872. Soon after the surface cools it is covered with a light crust of salt, which forms in similar flowery patterns on the beds of cinders that cover the plains, the cinders themselves emitting everywhere hydrochloric acid. The first showers caused this deposit rapidly to disappear, and there remained on the 12th of May only scanty traces, except on the lower surface of the blocks, where the rain had not the power to dissolve it. But the salt continued to be deposited in the vents, from which were detached beautiful crystals and graceful concretions; it continued also to be formed upon the great deposits of cinders on the cone of Vesuvius, and, even on May 19, the summit of the mountain, as seen from the Observatory, appeared from this cause as if sprinkled with snow.

Next to salt, the substance which is formed in greatest abundance upon the lava is chloride of iron, which assumes the most varied tints according to its surroundings, but is in general of a beautiful yellow, often orange, and is easily mistaken for sulphur. A multitude of other substances are deposited around the smoke-vents, besides those which have been named. These are for the most part metallic compounds, especially chlorides, and more rarely sulphur compounds. There are chlorides of copper and lead, hæmatite and magnetic iron ore, gypsum, &c. The peroxide of iron, in particular, plays an important part in the life of these fumaroles; it appears to be formed by the decomposition of chloride of iron; the protuberances of the scoriæ are often covered with the substance, which gives them the richest and most brilliant variegated appearance.

The origin of these many substances has considerably occupied the attention of chemists, and has not yet been satisfactorily explained; but the form of the concretions, as much as the accumulation of substance, apparently foreign to lava, indicate that they are formed by sublimation.

When the summit of the cone was approached, fine ashes were found scattered about the transverse rents that are apt to be taken for ruptures caused by the concussions accompanying the eruptions. But violent fissures would rather have formed radiating or longitudinal rents, while these are perhaps only the effect of the settlement of the cinders which naturally tend to act in the direction of the greatest slope, and to give rise to fissures analogous to those which are observed in the centre of the Alps. It is to this same phenomenon that must be attributed the step-like structure, traces of which are met with on the external face of the summit of the mountain, and which is probably owing to the fact that the lower edge of the rents must be elevated by the settlement, while the upper edge remains unaffected, or is itself lowered in supplying the matter which afterwards fills the rents. On the outside face of the cone, these steps are scarcely more than three or four inches in height, but on the margin of the internal face of the south-west side of the crater are

* See description of the Observatory, NATURE, vol. vi. p. 145.

four large sharp-edged steps of more than a metre high, arranged stair-wise, the formation of which can scarcely be explained otherwise than by a deposit or a flow of ashes accumulated at the end of the last eruption.

A vast transverse funnel, much larger than it is broad, occupies the south-west part of the summit of the cone, and this gulf is itself divided at the bottom by a partition of rocks which divides it into two compartments. A third crater occupies the north part, and is separated from the first by a considerable wall of rocks. This latter crater opens into the great north fissure which descends into Atrio del Cavallo; it was opened during the last eruption at the expense of an adventitious cone raised in 1855, and appears to have been the most active, since it is upon its side that the mountain is rent as far as the base of the cone; however, it has not ejected any lava, this having found its way out by the bottom of the fissure. During the eruption the lava was raised as far as the summit of the mountain—it has filled to the brim the double crater on the south-west—yet two days after this the lava had escaped by the south side; for on the 24th of April it overflowed the crater and formed three streams on the south, the west, and the north-east, which flowed down the slopes of the cone, and lost themselves among the fields of lava underneath. After this event the lava fell back to the bottom of the craters.

The depth of the crater may be estimated at about 130 metres. The bottom appears to be full of *débris* and ashes, but shows no sign of incandescence, nor of any adventitious cone; no smoke ascends, and the volcano, after its convulsion, has apparently fallen into a complete sleep. The only signs of activity are seen in the numerous unimportant jets of white vapour which escape either from the bottom or from various points in the walls, and which appear to dissolve in the atmosphere. Nevertheless, as seen from Naples, Vesuvius always appears with a light smoke hanging over it, which is invisible on the mountain itself. On the side next Pompeii only, to the east and north-east the slopes are macadamised by bomb-like blocks of the size of the head. The crater must have projected from all sides a shower of such blocks, but over all the other parts of the mountain this deposit must have been covered by a thick bed of ashes; and since these blocks are seen only on the east, it is evident that at the time of the last eruption of cinders a violent wind must have blown them to the opposite side. The large blocks, if they have been thrown up to the height of 1,500 metres, appear to have fallen back at a short distance from the crater. Shot vertically, they fell so, while the ashes, on account of their greater lightness, have been carried to a greater distance.

The crater on the south-west is divided through and through by a narrow rent, which is doubtless the prolongation of that which on the 24th emitted, half way up, the lava which went in the direction of Torre del Greco. This rent divides the south crest, and may be traced upon the walls of the crater, where it looks only like a simple fissure; it re-appears more distinctly on the opposite side. Another disappears among the cracks of the rocks. This rent exhaled at the summit of the crater burning gases, which formed upon the sides abundant deposits. The south crest was sufficiently filled up by sand to enable one to cross it, but such a quantity of sulphurous vapours was emitted, that to escape being asphyxiated it was necessary to make several rapid leaps. On the west side of the crater the rent still gapes, and has not been filled up, notwithstanding the heat which escaped.

The eruption of April 26 which followed the rending of Vesuvius, reopening the same vent, suddenly made its way to the same point, shattering the manifold bed of lava, and ejecting to the surface immense blocks, probably torn from their beds far below. Of this *débris*, mixed with incandescent lava, there is formed an elongated ridge of about 50 metres high, from the base of which there sprung an enormous mass of lava that swept over the little cone of Atrio. The lava burst forth at first in all directions, even a little behind in ascending the valley. It filled all Atrio, without, however, encrusting anywhere the sides of the rocks of the Amphitheatre of La Somma, and flowed along the valley in the form of a current of about 1,000 metres broad. Subsequently encountering the ridge of Canteroni, it was turned to the right, though a part of it was separated by the upper extremity of this knoll, and diverted to the left on to the slopes of Piano, where it contorted somewhat the foot of the mountain, thanks to the lava of 1858, which, having changed the slope of the ground, prevented it from continuing its route. The principal stream continued to follow the valley of the Fosso de la Ventrana, running at the rate of about one kilometre and a half in two hours, passing under the Observatory, where the lava was seen to boil up at places and shoot forth into little eruptions, projecting jets of steam and scoriæ; then it was precipitated in a cascade of fire over a wall of rock, and continued its course by the same ravine as the stream of 1855, and for the greater part of its course overrunning the lava of that year. It passed, exactly as its predecessor did, between the villages of Massa and San Sebastiano, sweeping away likewise a portion of the houses, part of it at last lodging itself on the south of Cercola, while a branch of the current continued in the direction of San Giorgio.

The imagination is unable to comprehend how such a mass of matter could escape in a single day from a single fire, and spread itself over an area of seven kilometres. The elongated ridge formed in the Atrio, at the time of the eruption, upon the site of the centre of the outbreak, appears at present only like a huge bubble on the sea of lava. It is composed of recent black lava, strewed with enormous blocks of old bleached lava encased in the new. These blocks are, without doubt, the *débris* of subjacent beds which have been broken and driven back by the lava at the time of its outbreak; the mass of them encrusted with the same lava having formed a whole so solid that it could not be swept away by the general current. This ridge does not now overtop the surface of the lava more than fifteen to twenty metres, from which we may conclude that the bed of lava at this point has an enormous depth.

The general effects of the eruption of 1872 have been somewhat as follows, according to M. de Saussure:—

1. The mountain of Vesuvius has been divided by a rent running nearly from north to south-south-west.

2. The lava, rising in the rent, has rushed along the two sides, on the north to the very foot of the cone, on the south half-way down in much less abundance.

3. The summit of the mountain has been lowered and flattened.

An examination of the lava of 1872 does not appear likely to lead to any new results. Its mineralogical nature is essentially the same as that of the other lavas of all ages that have been found both on Vesuvius and in La Somma. It is composed of a leucitic rock strewn with crystals of augite, and destitute of vitreous felspar; whence the names of leucitiferous or augitiferous, as one or other substance prevails. The most ancient lava which forms the body and crevices of La Somma, is in general very pale; it often contains an abundance of leucite crystals of the size of a foot; but its composition is, qualitatively, essentially analogous to that of the actual black lava. The lava of 1872 differs considerably in its physical appearance from that of 1858. The last is much less scoriated; it has a fleecy surface formed of round embossments, shining and comparatively little roughened. We might liken it to black whipped cream, which has flowed along, forming arches, fibrous stalactites twisted cords, which look at places as if vitrified. The lava of 1872, on the contrary, is extremely scoriaceous, and assumes a form almost like madrepore. On account of the great shrinking of the material, it has been broken up into blocks, entirely separated from each other, and roundish, because the mass was as yet vitreous; porous, in consequence of the quantity of gas it enclosed, and full of the most curious irregularities resembling coral and vegetation, which render progress infinitely difficult. The difference of appearance, combined with a thin layer of gray cinders which adheres to the lava of 1872, enables one to distinguish at once between it and those of preceding years. It will be noticed also to the north of the Observatory that the current has filled all the bottom of the valley of Ventrana, while on the south it has only run into the crevices of the old lava, surrounding the knolls, separating, re-uniting, leaving here and there inlets, as rivers without any determinate bed do at low water. This difference of structure of the two lavas seems to result from the very rapid cooling of that of 1872.

It is not easy to form a notion of the depth of this lava. In the lower parts the bed is about eight metres deep, with a breadth of about 800 metres; its borders form moraines of 45°, which indicate the small fluidity of the matter at the time it reached the place. In Atrio del Cavallo the moraine of the bed of lava which leans against the foot of the rocks of La Somma is less elevated, but the enormous waves in the middle of this surface argue in some places a considerable thickness.

The successive eruptions which have taken place in Atrio and which have piled up layer on layer, have enormously raised the level of the ground. A German geologist has conceived the idea of counting the layers which form the vertical dykes on the rocks of La Somma. At present the number would be hidden beneath more than a hundred feet of lava. The stream which debouches from Atrio has ended by considerably overtopping the Observatory; and that the latter has not been threatened this year results from the fact that the saddleback of Monte Canteroni, upon which it stands, rises in the direction of Vesuvius in such a manner that its eastern extremity (Croce del Salvatore) has hitherto performed the part of a buttress in dividing the burning stream and diverting the two currents into the ravines which slope rapidly to the right and left of the height. But a new outbreak will, without doubt, sweep away the eastern extremity of this crest, and a succeeding one would easily be able to send a stream of lava flowing as far as the Observatory. Foreseeing this danger, M. Palmieri has raised above the building a redan of a very sharp angle. This will form but a weak barrier, though it may be able to retard for a little the progress of the devastating element. Since several of the recent eruptions have happened on the Atrio side, it would seem as if the chief centre of volcanic action was tending towards that point, and there seems little doubt that one of the next eruptions will place the Observatory more or less in danger. Let us hope, however, that when that time arrives a worthy successor of Palmieri may safely chronicle what is going on, and that another De Saussure may be there to see.

WAGNER'S HANDBOOK OF CHEMICAL TECHNOLOGY

A Handbook of Chemical Technology. By Rudolph Wagner, Ph.D. Translated and edited from the eighth German edition, with extensive additions by William Crookes, F.R.S. (London: J. and A. Churchill, 1872.)

EVERY one who has studied chemistry from a scientific point of view must have been more or less struck with the fact that nearly all our manuals of chemistry have much of their space occupied with detailed descriptions of various manufacturing processes, and many must have asked why this is. It is not easy to see what utility there is in describing, in works professedly devoted to a scientific subject, such processes as those for the manufacture of chamois leather, wine, vinegar, china and earthenware, &c. &c.; and yet our largest and most ambitious manual, in common with its smaller companions, devotes scores of its pages to the consideration of such subjects. This fashion is much to be deprecated for many reasons: in the first place, these processes are utterly useless to the student, as, in the majority of cases, they illustrate no rule, elucidate no reaction. In the second, it is utterly impossible to do full justice to them in the space to which they must perforce be confined; and in the last, much valuable matter about the rarer elements and reactions is squeezed out of place altogether, or passed over with a mere mention.

This system has borne its natural fruit in the numberless questions bearing on manufactures which are to be found in all our chemical examination papers; and the result is, that many a man passes with credit on the marks gained by answering such questions, while others who, perhaps, have a much better knowledge of the science, fall behind in the race, because they have not devoted their time to Technology.

It is not difficult to see how this state of things arose. It is not so many years (we were almost going to say months), since chemistry was regarded by the public much in the same way that they now look upon the higher mathematics, as something very mysterious, very good for a learned man to know—but utterly useless and "unpractical" for all ordinary purposes. Such being the case, writers of manuals no doubt felt it incumbent on them to gild the pill by introducing such matter as tended to show that there was such a thing as a practical application of chemistry to the Arts.

However, that time has passed. Perhaps no science has of late become so widely popular, and certainly none has advanced so rapidly towards accuracy as chemistry. It is, therefore, time for it to throw aside the crutches upon which it was bound to support itself whilst struggling for recognition and public favour, and to march boldly forward, depending on itself alone. As a means to this end, it is with great pleasure that we welcome Mr. Crookes's translation of Dr. Wagner's work. He has given us, in the form of a handbook, what could only before have been obtained either by searching in special treatises, or by reading much more cumbersome dictionaries; and the existence of this book cannot but have its influence in setting free much of the space hitherto occupied in educational works on chemistry, by perfunctory descriptions of technological processes.

We most heartily join with Mr. Crookes in the hope he expresses at the end of his preface—"We cannot let this work pass out of our hands without expressing the hope that, at no distant date, chairs of Technology will be founded in all our universities, and that the subject will be included in the curriculum of every large school." Such an event could not fail to have the happiest effects on all; for, while it would set free the scientific student from a subject he does not require, it would enable those wishing to become managers of works or manufacturers, to study their special subjects in the best possible way."

The work consists of 745 closely-printed pages, with 336 illustrations, and a copious index. The subjects are treated at considerable length, and with extreme lucidity; this is especially the case with the portions devoted to metallurgical processes, where every step is carefully traced, and all the latest forms of furnaces, &c., are represented by woodcuts. We notice, however, that the section on electro-metallurgy is shorter than could have been wished, and that no mention is made of the process of depositing nickel upon iron, &c.

In the section on explosive compounds, we have full details for the preparation of picrates, nitro-glycerin, gun-cotton, &c., ; though the author, perhaps led away by his chemical enthusiasm for these bodies, has treated gunpowder somewhat shortly, and the very interesting results obtained by the use of pebble, pellet, and prismatic powders, we do not see noticed at all; in fact, this article is decidedly behind the times. The preparation of salt, sulphur, soda, ash, bleaching-powder, &c., are well and fully treated, though we do not see Deacon's process for the preparation of chlorine mentioned.

The articles on glass and earthenware are remarkably good and full, as are those on cements and lime, paper, sugar, and spirit. Since March 1868, two editions of the work have been issued, making eight in all. Of the eighth, and last, translations have been made into French and Dutch, and everyone will thank Mr. Crookes for the quantity of new matter he has added. In conclusion, it need only be said that the formulæ are throughout molecular, and that the metric system of weights and measures is used, except where English quantities were indispensable. We feel sure that this book will permanently take its place among our manuals, and that the editor and translator will, in future editions, correct any little faults and errors which are, in so large a work, unavoidable; while he will keep it fully abreast of the times.

R. F.

OUR BOOK SHELF

Ueber die Bedeutung der Entwickelung in der Naturgeschichte. Von Dr. A. Braun, Berlin.

Ueber die Auflösung der Arten nach natürliche r Zuchtwahl. Von einem Ungenannten, Hanover. (London: Williams and Norgate.)

THESE are two of the most recent of the numerous contributions which Germany has made to the literature of Darwinism. The first is an address delivered on the anniversary of the medical and surgical Frederick-William Institute in Berlin, and is a tribute to the enormous impetus given to physiological research by the promulgation of Mr. Darwin's theories. The writer, however, while fully adopting the principle of Evolution, leans to the views which have during the last few years greatly spread among naturalists, that any theory like that of natural selection, which does not recognise an inherent law of progress, is insufficient to account for the phenomena of the transmutation of species.

The second of these pamphlets is a more noteworthy production. The anonymous author also admits the principle of Descent by Evolution, but contends that the carrying out of this principle, so far from leading, as is generally supposed, to a multiplication of species and to a gradual rise to more and more perfect organic forms, must necessarily result in a gradual diminution in the number of species, a fusing together of form after form, and a descent to more lowly, instead of an ascent to more highly organised structures. With the origin of life he does not concern himself, but only with its future; and the succession of organised beings he compares not to a tree branching out into infinite ramifications, but to a river uniting in itself an infinitude of smaller streams. Whether the proposition is a serious one, or whether it is put forward as a *reductio ad absurdum* by a furtive opponent of Evolution, it is difficult to say; but the argument is carried out with considerable ability, and a strong point is made of the acknowledged degeneracy of many races of men from the condition of their ancestors, and of the gradual dying out of tribes and the consolidation of the human family into an ever decreasing number of types.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The National Herbarium

YOU will, perhaps, give admission to a few remarks on Dr. Hooker's instructive "Reply"* to my "Statement" of 16th May, 1872, bearing in mind that this "Statement" was called for in explanation of the grounds of my requirements and assignment of space in the Museum of Natural History, to be built at South Kensington, for the reception, uses, and applications of the National Herbarium, on the conviction that such would be continued and maintained in the metropolis.

Dr. Hooker had put in the van of his evidence,† and recommendations bearing on the reduction,‡ limited applications,§ and subordination to Kew ||, of the Herbarium at the British Museum

* See NATURE, vol. vi. p 516.
† Minutes of Evidence of Royal Commission on Scientific Instruction.
‡ Ans. to Q. 6,683. § Ans. to Q. 6,684 and 6,685 || *Ibid.*

as regards supply,* nomenclature, and government, a summary of the amount of botanical work represented by the 140 volumes having the Herbarium at Kew as their cause or conditions.

Seeing that—were this summary to be held as decisive, administratively, for carrying out his urgent desires—a Government impressed with its responsibilities for the application of public money, would place on retiring allowances the proportion of the staff no longer needed in the Metropolitan Herbarium—there was a motive in addition to my duty in response to the inquiry of the First Commissioner of Works, to sift the grounds of Dr. Hooker's attack on the Department of Botany in the British Museum. The anxieties of its officers were too well founded.

The argument from the amount of herbarium work at Kew since the practice of transferring there the dried plants collected in Government expeditions would be valid if such work could not be done elsewhere, or if such work had not been done in the Metropolitan Herbarium prior to the diversion therefrom of its legitimate supplies.

But the "Prodromus Floræ Novæ Hollandiæ," the "Observations Systematical and Geographical on the Herbarium collected in the Vicinity of the Congo," not to cite other works of Robert Brown, well known to botanists—and I may add the "Plantæ Javanicæ Rariores" of his successor, John Joseph Bennett, F.R.S.—are examples of "scientific work" at the London Herbarium, in relation to its legitimate supplies, which will bear comparison with the "scientific work which is turned out from the Herbarium at Kew."

The circumstance which, in the emergency threatening a Department of Natural History in the British Museum I was bound to submit to the consideration of Government, was that the works added to Botanical Science, for which before its supplies were intercepted by a "competing establishment" the National Herbarium in London furnished the materials for publication, were works of assigned duty. The officers of such Herbarium had no trusts or responsibilities in relation to the Royal Gardens, but gave their aid in naming the living Plants at Kew; leaving the officers in charge of those gardens free for the works and applications for which a Nation provides and supports its collections of living plants. Had Robert Brown been the director of such establishment, those who had the inestimable pleasure and benefit of his intimacy know that his devotion to the experimental and physiological duties of his office would have been the prime and paramount subject of his time and labours at Kew.

Permit me to exemplify my argument. In the "Report of the Royal Garden at Calcutta for 1870" (No. 585, 14th May, 1872) it is stated:—"At the beginning of the year the total stock of Ipecacuanha amounted to five plants in Sikkim and seven in this garden. These represented the only surviving offspring of a single plant received from Dr. Hooker of the Royal Gardens, Kew, in 1866.—At the request of the Right Hon. the Secretary of State for India, attention has for some years past been given in Edinburgh to the propagation of Ipecacuanha plants for this country, and during the past year the supplies raised there began to arrive. Five 'Wardian Cases' containing about 100 plants were received from Dr. Balfour of the Royal Botanical Gardens at Edinburgh." The Curator of these gardens, Mr. McNab, referring to the earlier introduction of living plants of *Cephaelis Ipecacuanha* into the Kew Gardens, and alluding to the slow and difficult method of its propagation by the adopted methods of cuttings, proceeds to describe the better method to which his experiments on living specimens led.† "The roots or rather rhizomes of the *Cephaelis* are peculiarly annulated (Pl. iv. fig. 2). A few of them were taken from one of the plants in the Botanic Garden during the month of August, 1869, and, after being cut into transverse sections of different lengths, were inserted in a horizontal position over the surface of a pot prepared with drainage and white sand. This pot was placed under a hand-glass in a warm propagating bed, and kept moist. A few weeks afterwards the root-cuttings began to swell, and showed signs of budding, chiefly on the upper cut surface, as in Pl. iv. fig. 3. In most cases only one bud was developed, but in some instances two or more were produced. When several growing plants are observed the root can be cut through so as to form independent plants." If this has not before found a place in the columns of NATURE it may be deemed worthy of one, for, as the physiological botanist in charge of the Edinburgh Gardens observes—"Understanding that the Government intend to introduce the cultivation of this plant in India," and "in order to meet the demand which in all likelihood will be made on nurserymen for plants of *Cephaelis*, it is well to know how it can be propagated independently of cuttings" (*Ib.* p. 318).

To give another instance. In an obituary notice of Dr. Fred. Welwitsch, the editor of a horticultural journal refers to the species of a plant which bears his name as follows:—"The *Welwitschia mirabilis* is about as remarkable a plant as the *Rafflesia Arnoldi* itself, and equally uncultivatable."* The simple fact is, the ill success at Kew. One cannot be sure till Edinburgh has had its chance.

As a popular premier once defined dirt, so a weed is a plant multiplying in a wrong place. We may hope for a reversion of the sentence on *Welwitschia* when "cones with ripe seeds" and "fine young plants" have found their way to a botanic garden whose officers are not diverted from experimental work, not trammelled and obstructed by that wasteful weed—an overgrown herbarium. The native conditions of existence of the Tumboa may then and there be imitated so truly, with ample provision for the descent of the tap-root, as to enable visitors to see the plant alive, and Mr. McNab may even succeed in giving other horticulturists the opportunity of multiplying specimens.

From such instances—and they might be multiplied—of legitimate successes, where a botanic garden is content to use the herbarium in the contiguous metropolis, and has not the low ambition of setting up a competing one in the garden itself, I infer an administrative advantage in maintaining the division of labour, which worked well in the days when the Government collections of live plants went to Kew, and those of dead plants to London.

I do not merely suggest, but affirm, that the nation loses part, perhaps much, of the benefit of the liberal grants and aids it affords to its garden of living plants through the uncalled-for and unnecessary accumulations there of collections of dead plants and the resulting herbarian work. Dr. Hooker evades the concluding argument of my statement, takes a personal stand-point, assumes the tone of an injured individual, and deems it unfitting to notice what he is pleased to call an "insinuation."

He who is most sensitive as to himself is often least mindful of the feelings of others. If Dr. Hooker will read his answer to Q. 6661 (op. cit., p. 434), he may, at least ought to, have some sense of the pain he inflicted on fellow-servants of the State and collaborators in science, on men at least his equals, and one of whom, in a recondite botanical problem, has shown himself his superior. Statements of a certain character may be made by one careless as to cost in few words and at small loss of time. It required the evidence occupying pp. 530, 531, of the published "Minutes" of the Scientific Commission to show the groundlessness of the insinuation conveyed in the answer to Q. 6661.

I will not now trespass further on your valuable space. But

* Ans. to Q. 6,785, "That the British Museum Herbarium and that at Kew should be under one control, and the former be continuously added to from Kew." In his Ans. to Q. 6,734, Dr. H. says—"The trouble of supplying the South Kensington Museum would be very trifling,"—which I think probable.

† McNab "On the Propagation of the Ipecacuanha plant," Transactions of the Botanical Society of Edinburgh, vol. x. p. 318.

* The *Garden*, Oct. 26, 1872.

the "Kew Question" has assumed proportions, and may have consequences, meriting for it a thorough ventilation; and I permit myself to believe that you may not be unwilling to receive further remarks on those points in my "Statement" to which Dr. Hooker has condescended to reply.

Sheen Lodge, Oct. 30 RICHARD OWEN

Physics for Medical Students

I AM and have been a "medical student" for many years, and hope to live in that capacity for some years more. I admit that I *ought* to know "the relation between the surface temperature of the body, the quantity of heat passing away from it, and the amount of heat generated in the body by the food given to a patient," but I do not know all this, and I have never discovered anyone who can tell me where I can learn it or how I can find it out by any efforts of my own.

Moreover, I have been unable to get a clear and satisfactory answer to the following simple questions, and have failed to find anyone who will explain to me accurately how I am to set to work to get the information so much desired:—"What is the quantity of heat generated in the body by the food, and how is it to be determined? How is the quantity of heat that passes away from the body in a given time to be estimated with anything approaching to accuracy?" If my friend and colleague Prof. Adams will be so kind as to give answers to these questions in NATURE, I can assure him he will confer a great favour upon many workers and thinkers in my profession, besides proving the value of such questions as that objected to by Mr. Heath for medical students. At this time we doctors are much in need of physical help. I have no doubt that physicists will be much astonished at our ignorance, but never mind that; we are quite ready to learn, and don't mind being laughed at or even spoken of with slight contempt by our physical friends if they will only help us. Nay, we will suffer anything from those who will instruct us so that we may be able to set to work upon living people who are "generating" and giving off heat, and determine with accuracy the different rate at which heat is "generated" and given off under different circumstances.

Prof. Adams asks whether "the production of heat in the human body by the consumption of food" is "carried on on principles entirely different from those of the production of steam in a boiler," and seems to regard it as one of the "mildest of questions" in heat that can be proposed for a medical student to answer. Will he answer his own question by asserting that the principles are the same in the two cases? Heat in the body, steam in the boiler—heat, steam; body, boiler!—or shall the question be revised before it is proposed to the student?

I have not the slightest doubt about the usefulness of a knowledge of physics to those who are working at medicine, and quite agree that the rising generation of medical students should be taught physics. But this is a very different thing from teaching people to fancy that living things are mechanisms, machines, galvanic batteries, or molecular apparatuses. I venture to think that some of the most distinguished physicists are too fond of deserting their own department for the purpose of trying to make people believe that there is an analogy between steam-boilers and human bodies, when no one has yet succeeded in proving that there is any true analogy whatever.

King's College, London LIONEL S. BEALE

IN the last number of NATURE Mr. Adams, of King's College, criticised the remarks made by Mr. Heath in his introductory address upon the character of the London University medical examinations, and of the first, the preliminary scientific, more especially. It scarcely needed a column and a quarter of close type for Mr. Adams to tell us that a medical man should be acquainted with physical laws and phenomena, and that in his opinion the mathematical question quoted by Mr. Heath was not too difficult to be fittingly placed in the examination paper. The former point is beyond question, and the latter is not to be settled by declaring the statement of the editor of the *Lancet* to be "shallow." As to the view that a medical man should be able to estimate precisely "the amount of heat lost through a blanket or a seal-skin coat," I will only say that it seems to me that a slight consideration of the physical and physiological conditions involved, and their variations in different instances, will suggest the hope that he will not waste his time in attempting such feats, simple as they may be deemed in physical laboratories. I will not take up space in commenting upon Mr. Adams' arguments and illustrations in support of his position, since they do but go to show that a medical man should have some knowledge of natural philosophy and its applications to the conditions with which he has to deal, and not that he should be driven to expend his time, already overcharged with much more that is of no possible use to him, upon mathematical processes which concern astronomers, chemists, and engineers. There is no doubt that to give a scientific character to medicine, exact quantitative methods must be applied to physiology and pathology, but it should be the work of men specially trained and devoted to the purpose. It has for some time past been commonly agreed that the medical student's education is such that he is urged to acquire a quantity of information with little regard to its use and digestibility. He has a great deal to learn in a short time. The chief part of his education consists, or should consist, in observing and comparing morbid conditions, and in learning or devising means for their relief and cure. Whatever time he spends upon what is not requisite, or has little direct bearing upon his art, implies time mis-spent and injury to the sufferers he will later attend. Prof. Huxley did not go too far in saying that the conduct of hose who impose useless knowledge upon medical students is mply criminal. F. LYNDON ATTWOOD

Junior Athenæum Club

NORTH POLAR EXPLORATION

IN the last number of the *Mittheilungen* Dr. Petermann publishes his 67th paper on the Geography and Discoveries of the Polar Regions, in which he gives an abstract of what has been done during the last three or four months.

The two projected Norwegian expeditions into the Siberian Seas, under the guidance of Captains Jensen and Mack, have at present been unfortunately frustrated; the former from a damage to the screw of the steamer, the latter from inability to penetrate the masses of ice. However, a projected scientific expedition for next year is exciting much interest at Tromsö. The French Expedition, under Ambert and Mack, has not yet put to sea, having been detained by the delay in settling the estate of Lambert, who left a large sum to be devoted to this purpose. This is much to be regretted, as Captain Mack has already distinguished himself by penetrating farther than any other discoverer into the Siberian Sea.

However, the much-talked-of and bold expedition under M. Octave Pavy, has, it is understood, at last left San Francisco, with what results remains to be seen. He expects to reach Wrangell Land by September 1, making his way farther northward in sledges, and hoping to come to open sea about May 1873. He will then proceed towards the Pole by means of a raft of somewhat novel construction, consisting of four hollow cylinders provided with a deck, and capable of holding all necessary provisions for Pavy and his small party for two years, by which time he expects to have reached the Pole, and returned to San Francisco. His companions are Dr. Chesmore, who has travelled much in Alaska; Captain Mike, who a few years ago attempted to cross the Atlantic in a vessel of somewhat similar construction to Pavy's; Watkins, a renowned Rocky Mountain hunter; and two sailors of whaling experience: in all, the expedition will consist of six men.

The latest news from the North American Expedition is contained in a letter from Dr. Bessels to Dr. Petermann, dated August 23, 1871, at which time the expedition had reached Tessinsak, the most northerly Danish settlement in Greenland, in lat. 73° 24′ N., and long. 56° 12′ W. Further details as to this expedition will be found in NATURE for September 19.

One of the most important and best fitted out expeditions is the Austrian one under Payer and Weyprecht, which left Tromsö in July, for the purpose of exploring the unknown region north of Siberia, to which they are prepared to devote three years. By the latest advices, about the end of July, the expedition was fairly on the road to its field of labour, and Count Wiltschek was to follow with a store of provisions, to be deposited near the Ice Cape, on the north of Nova Zembla, in case the expedition should be compelled to turn back.

Of the outfit and plan of the Swedish expedition we gave an account in NATURE for August 29. It left Tromsö on the 31st of July, and when last heard of was off the north-west point of Spitzbergen.

We are also favoured with a letter from Dr. Petermann, dated Gotha, October 11, from which we learn that the land on the east of Spitzbergen, which for the last 355 years has had a varying position on the map, has this year for the first time been reached by Captain Altmann of Hammerfest, and again on August 16 last by Captain Nils Johnsen of Tromsö, in his little sailing yacht the *Lydeana*, who landed and explored it. Captain Johnsen saw the island first when in N. lat. 78° 18′ 46,″ and E. long. 30°; in the maps of 1617 it was marked as Wiche Land, between 78⅓° and 75¼° N. lat. On the 17th of August he anchored near to the north point in 79° 8′ N. lat. and 30° 15′ E. long., for the purpose of landing and exploring the place. What Captain Altmann, looking from a distance, took to be three islands, Johnsen found in reality one, the high hills being connected by low lying land, with several outlying islets. On no part of the land has he found extensive snow-fields, and saw only one small glacier on the south-east coast, while, on the contrary, there are many large streams entirely free from ice. The greatest length of the land Captain Johnsen has found to be 44 geographical miles. Large quantities of driftwood extended here and there to about 100 feet from the coast, and rose to the height of at least 20 feet. The island abounds in the usual Polar fauna, the plentifulness of seals, especially *Phoca Groenlandica*, being noted by Johnsen. The reindeer on the island are spoken of as the largest and fattest which anyone on board the *Lydeana* had ever seen. The rocks seem to be principally of the quartz and argillaceous kind, and some fossils have been sent to Sweden and to Zurich. Captain Johnsen explored the east, south-east, and north-east coasts, and so far as his observations went, ice is to be found only on the north coast.

The fact of greatest significance in this latest news from these quarters is that for many months in the year the sea around Spitzbergen is almost entirely free from ice; a position long and sagaciously maintained by Dr. Petermann.

"Of interest," says the *Academy*, "in connection with this subject is an account of the finding of the relics of Barents' expedition of 1597 to Novaia Zemlia, by Captain Carlsen in 1871, prepared by M. de Jonge, and newly published under the auspices of the Dutch government at the Hague. The pamphlet contains the journal kept by Carlsen, and a minute description of the relics, accompanied by a photograph of these in a group, and charts comparing the Novaia Zemlia of Barents with the island as mapped from our present knowledge of it."

RESEARCHES IN GREENLAND *

WHEN I wrote to you last from Copenhagen, I anticipated that my season would be very short; and my anticipations were correct. The season, however, in Greenland has been long and brilliant. In the middle of May floe ice disappeared in Umenak Fiord, which was fully six weeks earlier than usual; and in April, in Godhavn men went about in summer attire. When I arrived (on July 6) the land was covered with flowers, the butterflies were beginning to appear, and almost all snow had vanished from the sea-level up to 2,000 ft. Since then, with the exception of a bad week in the Waigat, I have enjoyed the most exquisite weather that it is possible to imagine. In this arctic region it has only frozen on two nights, and during the daytime the thermometer has ranged from 50° to 70°. Until recently we have also had a high barometer; and, upon the whole, very little wind.

I have been upon Hare Island for three days, and have also been to Umenak, but the chief part of my time has been spent in the Waigat, where you would be surprised, perhaps, to find that a great deal remains to be done. I have found a great valley leading into the interior of Disco, and have gone up it a hard day's march. I have ascended one of the highest of the peaks on the Noursoak side of the Waigat, and looked down upon the great valley which occupies almost the whole of its interior. The lakes, as given upon Rink's map from reports of Eskimo, do not exist, but there is one very large lake which has a glacier or glaciers coming into it at perhaps 2,000 ft. above the sea. This valley is the most important one hitherto discovered in North Greenland. The river flowing down it has the character of a river, and not of a torrent; and, after descending through many windings a course of at least 100 miles, it pours into the sea a volume of water equal to that of the Rhone at the Lake of Geneva. At half a mile from the shore I found the water fresh.

In Umenak Fiord I ascended a mountain of about 7,000 ft. with five Greenlanders, and took my theodolite to the top. As you know the weight of the instrument, you will be partly able to appreciate this performance. The ascent, first over swamp, then over basalt *débris* which reposed insecurely upon solid basalt, and finally, at the top, up columnar basalt, was a sweet thing of its kind. The picture of your humble servant being lowered by a rope, dangling like a bundle from a crane, will, perhaps, to some people, be more interesting than the results obtained by the theodolite. These, however, were not unimportant. My peak, an isolated one, commanded a view of almost the whole of the Umenak district (which contains the highest mountains of Greenland proper), and a magnificent view of the "inland-ice." I found the general elevation of the mountains exceeded by about 2,000 ft. the height previously assigned to them. Of the altitude of the "inland ice" I shall write on a subsequent occasion.

A large part of my time in the Waigat was occupied by the measurement of a base line. This was the most important piece of work that I undertook, and it was successfully executed. I find the Waigat to have in some places scarcely half the width which our maps give it. I find its mountains to be about double the altitude that they have been supposed to be; and Hare Island I find to be twice the length represented upon the Admiralty Chart; Hare Island has some points of particular interest. I got from it a rather large collection of fossil plants, and went to its top (1,800 ft.). From the summit, at midnight, I distinctly recognised the mountain called Sanderson's Hope, near Upernavik, which was distant from me 140 miles!

I have made an excellent journey, full of interest. My collections are at least as valuable as those of 1867, though, as far as I know, they do not contain anything of the importance of the *Magnolia*. I have, however, even larger collections of fossil plants than before, and from localities which I did not visit in 1867. My stone implements are very numerous, and of good quality, and the natural history specimens are not few in number. Altogether I am very well content.

EDWARD WHYMPER

Written on board the brig Hvalfisken *as it proceeded out of the harbour of Godhavn, Sept.* 10, 1872.

* Copy of a letter addressed to Mr. R. H. Scott, F.R.S., and kindly forwarded by him to us.—ED.

THE HELVETIC SOCIETY OF NATURAL SCIENCES

THE 55th Session of this Society was held at the ancient city of Fribourg on the 19th, 20th, and 21st of August last, and of it we have again to tell of an overwhelmingly hospitable reception by "our hosts of Fribourg;" a well-attended opening address by the President, Dr. Thurler; sectional *séances*, at which many valuable papers were read, followed by fruitful discussions; a final general meeting to listen to something that would interest all, and then the dispersion. This Society appears to be satisfactorily accomplishing its professed aim of increasing the interests of the people generally in scientific studies, of establishing intimate and familiar relations between men of science engaged upon the same subject, and of fostering a harmonious spirit of labour all over the country. We give an abstract of the report contained in the *Bibliothèque Universelle.*

Prof. Volpicelli gave a paper on Atmospheric Electricity and the best method of studying it. Having made experiments, in calm weather, according to the methods both of Franklin and of Peltier (in the former of which a fixed uninsulated rod is used, connected with an electrometer by a wire, while in the latter a moveable metallic point with similar connection is sent up into the atmosphere), he found the results always contradictory as regards the quantity, and sometimes also as regards the quality, of electricity indicated.

On all the days in which the air was not much agitated, the time and circumstances being the same, the moving rod gave a greater quantity of electricity than the fixed; and the former often showed positive electricity, while the latter showed negative.

It has been shown that the earth is a body negatively electrified. It follows that any conducting substance is electrified positively when it rises in the atmosphere, and becomes negative, on the other hand, as it descends. The indications of the metallic rod shot into the air are therefore modified by the influence of the earth, and do not give a means of determining the electricity of the surrounding atmosphere. Franklin's fixed rod, on the other hand, is free from these disturbing influences.

That a conductor gives positive electricity as it rises in the atmosphere, and negative as it descends, may be proved by experiment. Suppose, *e.g.*, the fixed rod gives negative electricity; if a flame be applied to the point of it, the apparatus will indicate positive electricity. The flame produces an upward current of air, which, by its motion, and under the influence of the earth, gives a neutralising positive electricity, so that the point of the fixed rod becomes positively charged. (It is necessary that the flame should have a high calorific power.)

If the flame be now brought down to the ground, one or other of three effects will occur:—if the flame is not very strong, negative electricity will be indicated; if somewhat hotter, there will be no electricity at all; if very intense, the electricity will be positive. These effects are readily explained as the resultants of two opposing actions, the production of positive electricity by the ascending current of air, and the production of negative through the influence of the earth on the descending flame. The general inference Prof. Volpicelli draws is the preferability of Franklin's method to the other.

M. Müller, professor at Fribourg, gave an account of experiments on the lower Glacier of the Grindelwald, with reference to the optical properties of glacial ice. His experiments partly confirm the results obtained by MM. Grad and Dupré, that thin lamellæ of ice cut horizontally at the base of the glacier, give, in Norremberg's apparatus, systems of coloured rings with a dark cross. This property, moreover, appears only at certain separate parts of the lamella, and the system of rings is always more or less incomplete, which is sufficiently explained by the irregular structure of the ice of glaciers, in which, necessarily, there are only distant traces of the mode of original formation. Vertical sections gave no coloured rings.

M. Louis Dufour described some important researches on the Diffusion of Gases across diaphragms and the variations of temperature accompanying it. He studied the cases (among others) of hydrogen and air, of air and carbonic acid.

He distinguishes the diffusion at constant pressure, and the diffusion with change of pressure. The porous vessel containing the gas with slower diffusion contains also a very sensitive thermometer, and is enclosed in another vessel, in which the other gas circulates. A glass tube, passing through the stopper of the porous vessel, can be put in communication either with external air (pressure constant) or with a manometer. The whole is enclosed in an envelope of cotton. The thermometer is observed with a cathetometer.

1. Diffusion at constant pressure.—First of all, taking as example hydrogen and air, equilibrium of temperature is established between the air outside of the porous vessel and that inside; then hydrogen is made to circulate, and it is seen that the thermometer in the interior falls. A large number of experiments showed that there is always a rise of temperature on the side of the entering gas, and a fall of temperature on the side of the escaping gas. M. Dufour believes this change of temperature does not take place throughout the gaseous mass, but only at the surface of the diaphragm. He conceives that at the part where the gas enters there is condensation and compression, causing development of heat. In the opposite case there is expansion of the gas, and hence absorption of heat.

2. Diffusion with change of pressure.—In this case the phenomenon is complicated by variations in the temperature according to the pressure. When the diffusing gas enters the porous vessel, the thermometer indicates first a slight rise of temperature resulting from rapid increase of pressure; it then falls, and to a much greater extent ($\frac{1}{10}$ of a degree *e.g.*) commences again to rise gradually, falls a little again, in consequence of the escape of the other gas and the rarefaction produced; then continually rises. The effects are represented by a curve.

M. Dufour also studied the case of diffusion between dry air and moist air. He observed there was always diffusion between two quantities of air having different degrees of humidity; and, contrary to what one might expect from Graham's law (the vapour of water being lighter than air), the diffusion takes place from the dry to the humid. The laws of variation of temperature in this case conform to what M. Dufour observed in the case of two gases. The diffusion is readily indicated by a water manometer, and M. Dufour thinks the principle might be applied in hygrometry. It is evident that the general principle must have numerous applications in the organic world. M. Reichert described a thermo-regulator, in which the mercury of a thermometer which was placed in a heated liquid interrupted, on rising to a certain point, the passage of the heat-producing gas.

M. Mousson described a method for measuring the dispersion in the different parts of the spectrum furnished by a prism or any spectroscope whatever. The dispersion varies, it is known, in the different portions of the spectrum obtained with a prism, it is believed much less rapidly in the red, much more rapidly in the violet. The law according to which it varies changes according to the different prisms and different substances used. M. Mousson proposes a new simple process by means of which the law can be directly determined for each spectroscope. It consists in observing with the spectroscope the spectrum given by a network (*réseau*) of diffraction, of which the lines ought to be perpendicular if the edges of the prism are horizontal. There is thus obtained a curved spectrum, which is the graphic representation of the law sought.

Other papers in the section were by M. de la Rive on the rotation of the electric discharge in rarified gases under the influence of a magnet, and particularly upon the mechanical action which this discharge could exercise in its rotating movement. M. E. Hagenbach expounded the principal results of his beautiful researches upon Fluorescence:

and M. Volpicelli concluded the work of the section by a communication on Electrostatic Induction.

Geology is the branch of Natural History which is most cultivated in Switzerland. Notwithstanding its small extent, that country has the most varied field for observation in the mountain-chains of the Jura and the Alps; there are few important questions whose solution cannot be found in these mountains; and many Swiss names are found among those who have done most to advance that science. During the last year geological studies have received a great impulse in Switzerland by the subsidies which the Confederation vote for that purpose; each year the State grants a sum in aid of the researches of a certain number of geologists, and for the study of a new part of the territory. The works which result are published under the care of a special commissioner of the Society of Natural Science. As might be expected then, the Geological Section was very numerously attended, and the papers read on the subject were many and valuable. We learn from M. A. Fauzes' general lecture that the Society have taken similar steps for the study and preservation of Swiss boulders to those taken by the Royal Society of Scotland, whose report we gave in a recent number.

M. V. Gross brought under the notice of the members a series of objects belonging to the lacustrine dwellings of the Lake of Bienne, worthy of the attention even of those who have seen the richest collections of this kind. There was the bit of a bridle almost complete belonging to the station of Mörigen, which belongs to the age of bronze; at the present time only one similar fragment is known. Incrustations of iron upon a bronze knife tend to confirm what has already been conjectured, that at the first appearance of iron it was regarded as a most precious metal. The station of Lüschersz, of the stone age, has been discovered by M. Gross, and has furnished axes of nephrite and jade of a size not hitherto met with in lacustrine dwellings. It is known that these rocks are not found in Europe; and it is a question whether these lake-dwellers obtained them by commercial intercourse with Asia, or whether these rare articles were preserved as heirlooms in families from the period of their emigration from their ancient Asiatic home.

M. Ch. Vogt communicated to the section the results of his microscopic study of rocks. One of the questions which he wished to resolve is whether the microscope can enable us to know whether or not a rock has ever been in an igneous state. M. Vogelsang has discovered that the volcanic rocks present what has been called the "fluidal structure," a structure resulting from the disposition of minute crystals disseminated throughout the vitreous mass, and surrounding the larger crystals which have been previously formed in the lava. This fluidal structure is found in the porphyries, and proves their igneous origin. But on examining the siliceous deposits of the Geyser, M. Vogt found this same structure, and thus it does not belong exclusively to the igneous rocks, but also to those of aqueous origin, provided that they have been in a viscous state. In his study of volcanic rocks, M. Vogt has discovered that the trachytes, the basalts, and the lavas, present common characteristics.

M. Lebert brought under the notice of the section a magnificent series of specimens of amber, and expounded the results of his researches on that substance. The fluorescence of petroleum may be taken as a type of the same phenomenon in amber. For naturalists the most interesting of M. Lebert's specimens are fragments of the conifers which produced the amber, a piece enclosing a movable air-bubble in a drop of water, and a great number of other pieces enclosing insects in a perfect state of preservation.

M. François Forel exhibited a photograph of the fossil man of Mentone, which represents him in the position in which he was found. It would appear that this man was not buried under a landslip, but that he must have been interred by those who survived him. It is argued that, because it is very unusual to inter the dead in a dwelling for the living, we may conclude that this individual belonged to a nomad horde of the age of the reindeer, who did not inhabit the cavern, but passed it from time to time, and who buried this man in the place where he died. We may mention here that in the Zoological section Dr. Vonga read a paper on the same subject, he having been present at the exhumation of the body. He described the caves, and pointed out their probable mode of formation. The body lay upon its left side in the position of sleep. It showed a circular crack at the base of the skull, the thorax being broken at one place; the remainder is in perfect preservation. The cranium is very fine, all the teeth being preserved; the lower jaw is long, but the angle between the horizontal and the ascending branches is a right angle. Dr. Vonga attributed the remarkable preservation of the body to the properties of the pulverised earth which covered it.

Several members presented to the section their studies of various parts of the Alps, and M. E. Favre read a paper on a section of the Caucasus. In the centre of the latter chain a granitic formation is found. On the two sides palæozoic schists are presented, analogous to those of Grätz, and connected by veins of crystalline schist. They are less developed on the north side than on the other. Upon the northern slope the Secondary and Tertiary formations are in a very normal position, and have but little inclination; upon the other slope, on the contrary, there are many zones of eruptive rocks, and the Secondary formations are less disturbed. M. Favre also spoke to the section on the lower limit of eternal snow and the glacial phenomena which he has observed in this chain.

In the section of Zoology Prof. C. Vogt presented the results of his researches upon the *Phyllopodes*, especially the Branchiopods and the *Artemia*.

M. Vogt confirmed the observation of M. Joly, that among the *Artemiæ* collected at Cette during the months of July and August, no males were found, and that the females reproduced by parthenogenesis. This fact is so much the more singular that large numbers of males are found in other salt marshes inhabited by the same or analogous species.

M. Auguste Forel presented to the section some curious and interesting results of his researches into the nature and habits of ants. Different communities of ants, even when they are of the same species, are enemies to each other. A single community of ants may possess many nests, which are connected with each other by galleries and tunnels. A community of ants may be either simple or mixed; it is simple when it belongs to a single species, mixed when it belongs to two or more species living on good terms among themselves. There are in each community, at one time at least, workers, some males and females. If we consider the mixed communities, we can distinguish, amongst others, slave-ants, obtained by the workers of one species pillaging the ant-hills of another species, and carrying off the cocoons. These, when once hatched, become the auxiliary workers and friends of their captors, doubtless believing that they are of the same origin. The mixed community contains the three sexes of the species who plundered, but only the workers of the species pillaged.

The only paper apparently of importance in the Botanical Section was by Dr. Müller, of Geneva, on a new species of *Loranthus* from the Philippine Islands, which, from the position of the flowers, presents some very extraordinary but not yet well-established peculiarities.

Other papers of value were read in the various sections, and, considering that the meeting lasted only three days, the amount of work gone through appears extraordinary; but then no mention is made of any excursions.

ON THE WYANDOTTE CAVE AND ITS FAUNA *

THE Wyandotte Cave traverses the St. Louis Limestone of the Carboniferous formation in Crawford County, in South-Western Indiana. I do not know whether its length has ever been accurately determined, but the proprietors say that they have explored its galleries for twenty-two miles, and it is probable that its extent is equal to that of the Mammoth Cave in Kentucky. Numerous galleries which diverge from its known courses in all directions have been left unexplored.

The Wyandotte Cave is as well worthy of popular favour as the Mammoth. It lacks the large bodies of water which diversify the scene in the latter, but is fully equal to it in the beauty of its stalactites and other ornaments of calcyte and gypsum. The stalactites and stalagmites are more numerous than in the Mammoth, and the former frequently have a worn, or maccaroni-like form, which is very peculiar. They twist and wind in masses like the locks of Medusa, and often extend in slender runners to a remarkable length. The gypsum rosettes occur in the remote regions of the cave, and are very beautiful. There are also masses of amorphous gypsum of much purity. The floor in many places is covered with curved branches, and, what is more beautiful, of perfectly transparent acicular crystals, sometimes mingled with imperfect twin-crystals. The loose crystals in one place are in such quantity as to give the name of "Snow Banks" to it. In other places it takes the form of japanning on the roof and wall rock.

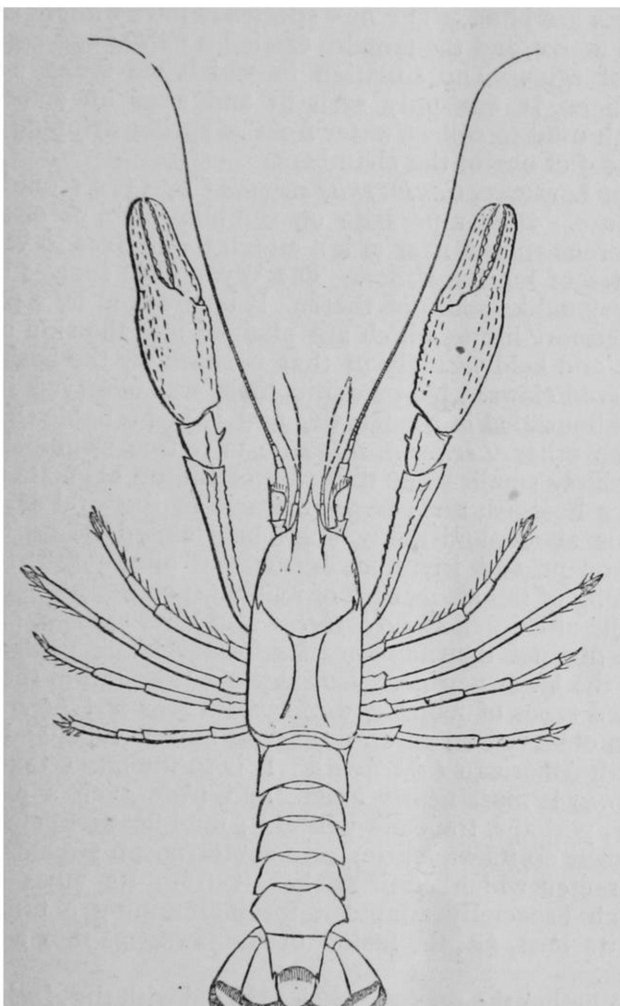

FIG. 1.—*Orconectes inermis* Cope, natural size.

In one respect the cave is superior to the Mammoth—in its vast rooms, with step-like domes, and often huge stalagmites on central hills. In these localities the rock has been originally more fractured or fragile than elsewhere, and has given way at times of disturbance, piling masses on the floor. The destruction having reached the thin-bedded strata above, the breaking down has proceeded with greater rapidity, each bed breaking away over a narrower area than that below it. When the heavily-bedded rock has been again reached, the breakage has ceased, and the stratum remains as a heavy coping stone to the hollow dome. Of course the process piles a hill beneath, and the access of water being rendered more easy by the approach to the surface, great stalactites and stalagmites are the result. In one place this product forms a mass extending from floor to ceiling, a distance of thirty or forty feet, with a diameter of twenty-five feet, and a beautifully fluted circumference. The walls of the room are encrusted with cataract-like masses, and stalagmites are numerous. The largest room is stated to be 245 feet high, and 350 feet long, and to contain a hill of 175 feet in height. On the summit are three large stalagmites, one of them pure white. When this scene is lit up it is peculiarly grand to the eye of an observer at the foot of the long hill, while it is not less beautiful to those on the summit. There is no room in the Mammoth Cave equal to these two.

FIG. 2.

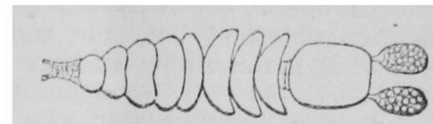

FIG. 3.

Cæcidotea microcephala Cope.—Fig. 2: The mandible and palpi of right side more enlarged. The outer palpus lies above the lateral plate, and its origin was not seen. Fig. 3: The same; magnified 6·5 times.

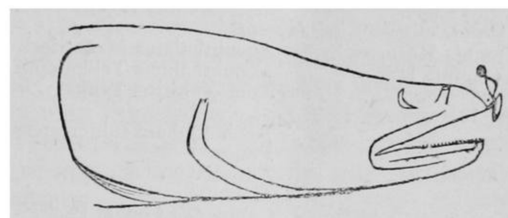

FIG. 4.—*Cauloxenus stygius* in position on the lip of *Amblyopsis spelæus*, enlarged.

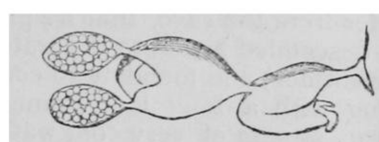

FIG. 5.

FIG. 6.

Cauloxenus stygius.—Fig. 5: Antennal processes and muzzle more enlarged. Fig. 6: The animal viewed from below, with an infero-lateral view of the cephalothorax.

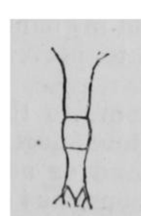

FIG. 7.

FIG. 8.

Erebomaster flavescens.—Fig. 7: Male organ from below. Fig. 8: The same; magnified 7·6 times.

An examination into the life of the cave shows it to have much resemblance to that of the Mammoth. The following is a list of sixteen species of animals which I obtained, and by its side is placed a corresponding list of the species obtained by Mr. Cooke and others, at the Mammoth Cave. These number seventeen species. As the Mammoth has been more frequently explored, while two days only were devoted to the Wyandotte, the large

* Reprinted from the *American Naturalist*, to the kindness of the editor of which journal we are also indebted for the loan of the cuts.

number of species obtained in the latter suggests that it is the richer in life. This I suspect will prove to be the case, as it is situated in a fertile region. Some of the animals were also procured from caves immediately adjoining, which are no doubt connected with the principal one.

Of the out-door fauna which find shelter in the cave, bats are, of course, most numerous. They are probably followed into their retreat by the eagle and other large owls. The floors of some of the chambers were covered to a considerable depth by the castings of these birds, which consisted of bats' fur and bones. It would be worth while to determine whether any of the owls winter there.

LIST OF LIVING SPECIES IN THE TWO CAVES.

WYANDOTTE.	MAMMOTH.
	Vertebrata.
Amblyopsis spelæus DeKay.	Amblyopsis spelæus DeKay.
	Typhlichthys subterraneus Girard.
	Arachnida.
Erebomaster flavescens Cope.	Acanthocheir armata Tellk.
	Phrixis longipes Cope.
Anthrobia.	Anthrobia monmouthia Tellk.
	Crustacea.
Orconectes inermis Cope.	Orconectes pellucidus Tellk.
Cæcidotea microcephala Cope.	Cæcidotea stygia Pack.
Cauloxenus stygius Cope.	Stygobromus vitreus Cope.
	Insecta.
Anophthalmus tenuis Horn.	Anophthalmus Menetriesii Motsch.
Anophthalmus eremita Horn.	Anophthalmus Tellkampfii Erichs.
Quedius spelæus Horn.	Adelops hirtus Tellk.
Lesteva sp. nov. Horn.	
Raphidophora.	Raphidophora subterranea Scudd.
Phora.	Phora.
Anthomyia.	Anthomyia.
Machilis.	Machilis.
Campodea sp.	Campodea Cookei Pack.
Tipulid	
	Myriopoda.
Pirostrephon cavernarum Cope.	Scoterpes Copei (Pack.).

The blind fish of the Wyandotte Cave is the same as that of the Mammoth, the *Amblyopsis spelæus* DeKay. It must have considerable subterranean distribution, as it has undoubtedly been drawn up from four wells in the neighbourhood of the cave. Indeed, it was from one of these, which derives its water from the cave, that we procured our specimens. We descended a well to the water, some twenty feet below the surface, and found it to communicate by a side opening with a long low channel, through which flowed a lively stream of very cold water. Wading up the current in a stooping posture, we soon reached a shallow expansion or pool. Here a blind crawfish was detected crawling round the margin, and was promptly consigned to the alcohol bottle. A little farther beyond, deeper water was reached, and an erect position became possible. We drew the seine in a narrow channel, and after an exploration under the bordering rocks, secured two fishes. A second haul secured another. Another was seen, but we failed to catch it, and on emerging from the cave I had a fifth securely in my hand, as I thought, but found my fingers too numb to prevent its freeing itself by its active struggles.

If these Amblyopses be not alarmed, they come to the surface to feed, and swim in full sight like white aquatic ghosts. They are then easily taken by the hand or net, if perfect silence is preserved, for they are unconscious of the presence of an enemy except through the medium of hearing. This sense is, however, evidently very acute, for at any noise they turn suddenly downward and hide beneath stones, &c., on the bottom. They must take much of their food near the surface, as the life of the depths is apparently very sparse. This habit is rendered easy by the structure of the fish, for the mouth is directed partly upwards, and the head is very flat above, thus allowing the mouth to be at the surface. It thus takes food with less difficulty than other surface feeders, as the perch, &c., where the mouth is terminal or even inferior; for these require a definite effort to elevate the mouth to the object floating on the surface. This could rarely be done with accuracy by a fish with defective or atrophied visual organs. It is therefore probable that fishes of the type of the *Cyprinodontidæ*, the nearest allies of the *Hypsæidæ*, and such *Hypsæidæ* as the eyed *Chologaster*, would possess in the position of the mouth a slight advantage in the struggle for existence.

The blind crawfish above mentioned is specifically distinct from that of the Mammoth Cave, though nearly related to it. I call it *Orconectes inermis*, separating it generically from *Cambarus*, or the true crawfishes, on account of the absence of visual organs. The genus *Orconectes*, then, is established to include the blind crawfishes of the Mammoth and Wyandotte Caves.

Dr. Packard has described an interesting genus of Isopoda allied to the marine form *Idotæa*, which Mr. Cooke discovered in a pool in the Mammoth Cave. He called it *Cæcidotea*. I obtained a second species in a cave adjoining the Wyandotte which differs in several important respects. I call it *Cæcidotea microcephala*. Both species are blind. The new species is pure white. It was quite active, and the females carried a pair of egg-pouches full of eggs. The situation in which we found it was peculiar. It was only seen in and near an empty log trough used to collect water from a spring dripping from the roof of one of the chambers.

The Lernæan, *Cauloxenus stygius* Cope, is a remarkable creature. It is a parasite on the blind fish, precisely as numerous species near of kin attach themselves to various species of marine fishes. The Wyandotte species is not so very unlike some of these. It is attached by a pair of altered fore-limbs, which are plunged into the skin of the host, and held securely in that position by the barbed or recurved claws. No parasitic male was observed in the neighbourhood of the female, and it is probable that, as in the other *Lernæopodidæ*, he is a free swimmer, and extremely small. The difficulty of finding his mate on an active host-fish must be augmented by the total darkness of his abode, and many must be isolated owing to the infrequent and irregular occurrence of the fish, to say nothing of the scarceness of its own species.

The allied genera, *Achtheres* and *Lernæopoda*, present very distinct distributions, the former being fresh water and the latter marine. *Lernæopoda* is found in the most varied types of fishes and in several seas; *Achtheres* has been observed on perch from Asia and Europe, and on a South American *Pimelodus*. It is to the latter that *Cauloxenus* is most nearly allied, and from such a form we may, perhaps, trace its descent; modification being consequent on its wandering into subterranean streams. The character which distinguishes it from its allies is one which especially adapts it for maintaining a firm hold on its host, *i.e.*, the fusion of its jaw-arms into a single stem.

Whether the present species shared with the *Amblyopsis* its history and changes, or whether it seized upon the fish as a host at some subsequent period, is a curious speculation. Its location at the mouth of the fish could scarcely be maintained on a species having sight: for if the host did not remove it, other individuals would be apt to.

I may here allude to another blind Crustacean which I took in the Mammoth Cave, and which has been already mentioned in the Annals and Magazine of Natural History as a Gammaroid. Mr. Cooke and myself descended a hole, and found, a short distance along a gallery, a clear spring, covering, perhaps, an area ten feet across. Here Mr. Cooke was so fortunate as to procure the *Cæcidotea stygia*, while I took the species just mentioned, and which I name *Stygobromus vitreus*. The genus is new, and represents in a measure the *Niphargus* of Schiodte found in the caves of Southern Europe. This genus has several species in fresh waters, which are of small size, and swim actively, turning on one side or the other.

Of Insects I took four species of beetles, all new to science; two of them of the blind carnivorous genus *Anophthalmus*, and two *Staphylinidæ*, known by their very short wing-cases and long, flexible abdomen. Dr. George H. Horn has kindly determined them for me.

One of them, the *Quedius spelæus*, Horn, is half an inch in length, and has rather small eyes; it was found not far from the mouth of the cave. Dr. Horn furnishes me with the following list of Coleoptera from the two caves in question:—

Anophthalmus Tellkampfii Erichs.	Mammoth Cave.	
,, Menetriesi Motsch, *angulatus* Lec.	Mammoth Cave.	
,, eremita Horn.	Wyandotte Cave.	
,, tenuis Horn.	Wyandotte Cave.	
,, striatus Motsch.	Mammoth Cave.	Unknown to me.
,, ventricosus Motsch.	Mammoth Cave.	Unknown to me.
Adelops hirta Tellk.	Mammoth Cave.	

These are the only true cave insects at present known in these faunæ. Other species were collected within the mouths of the caves, but which cannot be classed with the preceding, as cave insects proper.

Catops n. sp.?	Wyandotte Cave.
Quedius spelæus Horn.	Wyandotte Cave.
Lestev n. spa.	Wyandotte Cave.

And another Alæocharyde Staphylinide, allied to *Tachyusa*, also from Wyandotte Cave. No names have as yet been given to any of these, excepting the second. A monograph of Catops has already appeared containing many species from our fauna; and as the work is inaccessible at present, I have hesitated to do more than indicate the presence of the above species.

The cricket of the Wyandotte Cave is stouter than that of the Mammoth, and thus more like the *Raphidophora lapidicola* of the forest. There were three species of flies, one or more species of *Poduridæ*, and a *Campodea* not determined.

Centipedes are much more abundant in the Wyandotte than in the Mammoth Cave. They especially abounded on the high stalagmites which crown the hill beneath the Mammoth dome, which is three miles from the mouth of the cave. The species is quite distinct from that of the Mammoth Cave, and is the one I described some years ago from caves in Virginia and Tennessee. I call it *Spirostrephon cavernarum*, agreeing with Dr. Packard that the genus *Pseudotremia*, to which it was originally referred, is of doubtful validity. The allied form found by Mr. Cooke in the Mammoth Cave has been described by Dr. Packard as *Spirostrephon Copei*. It is eyeless, and is, on this account alone, worthy of being distinguished generically from *Spirostrephon*. This genus may be then named *Scoterpes*. I look for the discovery of *S. cavernarum* in the Mammoth Cave.

Two species of Arachnidans were observed, one a true spider, the other related to the "long-legs" of the woods. A species similar to the former is found in the Mammoth Cave, and others in other caves, but in every instance where I have obtained them they have been lost by the dissolution of their delicate tissues in the impure alcohol. The other forms are more completely chitinised, and are easily preserved; they are related to the genus *Gonyleptes*, found under stones in various portions of the country. Dr. Wood describes a species from Texas, and I have taken them in Tennessee and Kansas. In the Wyandotte Cave I found a number of individuals of a new species, at a place called the screw-hole. Though living at a distance of four or five miles from the mouth of the cave, this species is furnished with eyes. This species is described as *Erebomaster flavescens* Cope. In its relationships it may be said to stand between *Acanthocheir* and *Gonyleptes*.

Besides *Acanthocheir*, another blind Gonyleptid exists in the Mammoth Cave, which I found several miles from the mouth. It is blind like the former, but differs in having many more joints to the tarsi, approaching thus the true *Phalangia*, or long-legs.

Dr. Packard and Mr. Putnam have already discussed the question of the probability of the origin of these blind cave animals by descent from out-door species having eyes. I have already expressed myself in favour of such view, and deem that in order to prove it we need only establish two or three propositions. First, that there are eyed genera corresponding closely in other general characters with the blind ones; second, that the condition of the visual organs is in some cave type variable; third, if the abortion of the visual organs can be shown to take place coincidently with general growth to maturity, an important point is gained in explanation of the *modus operandi* of the process.

First, as to corresponding forms; the *Typhlichthys* of the Mammoth is identical with *Chologaster*, except in its lack of eyes. *Orconectes* bears the same relation to *Cambarus*; *Stygobromus* bears nearly the same to *Gammarus*; and *Scoterpes* is *Spirostrephon* without eyes and no pores.

Secondly, as to variability. I have already shown that in *Gronias nigrilabris*, the blind Silurid from the Conestoga in Pennsylvania, while all of several specimens observed were blind, the degree of atrophy of the visual organs varies materially, not only in different fishes, but on different sides of the same fish. In some the corium is imperforate, in others perforate on one side, in others on both sides, a rudimental cornea being thus present. In some the ball of the eye is oval, and in others collapsed. This fish is related specifically to the *Amiurus nebulosus* of the same waters, more nearly than the latter is to certain other Amiuri of the Susquehanna river basin to which the Conestoga belongs, as for instance the *A. lynx*; it may be supposed to have been enclosed in a subterranean lake for a shorter time than the blind fishes of the Western Caves, not only on account of the less degree of loss of visual organs, but also in view of its very dark colours.

Thirdly, it is asserted that the young *Orconectes* possess eyes, and that perhaps those of the *Typhlichthys* do also. If these statements be accurate, we have here an example of what is known to occur elsewhere, for instance, in the whalebone whales. In a fœtal stage these animals possess rudimentary teeth like other Cetacea, which are subsequently absorbed. This disappearance of the eyes is regarded with reason by Prof. Wyman as evidence of the descent of the blind forms from those with visual organs. I would suggest that the process of reduction illustrates the law of "retardation," accompanied by another phenomenon. Where characters which appear latest in embryonic history are lost, we have simple retardation—that is, the animal in successive generations fails to grow up to the highest point, falling farther and farther back, thus presenting an increasingly slower growth in this special respect. Where, as in the presence of eyes, we have a character early assumed in embryonic life, the retardation presents a somewhat different phase. Each successive generation, it is true, fails to come up to the completeness of its predecessor at maturity, and thus exhibits "retardation;" but this process of reduction of rate of growth is followed by its termination in the part long before growth has ceased in other organs. This is an exaggeration of retardation. Thus the eyes in the *Orconectes* probably once exhibited at maturity the incomplete characters now found in the young, for a long time a retarded growth continuing to adult age before its termination was gradually withdrawn to earlier stages. Growth ceasing entirely, the phase of atrophy succeeded, the organ became stationary at an early period of general growth, being removed, and its contents transferred to the use of other parts by the activity of "growth force." Thus, for the loss of late assumed organs we have "retardation," but for that of early assumed ones, "retardation and atrophy."

The mutual relations of this cave life form an interesting subject. In the first place, two of the beetles, the crickets, the centipede, the small crustaceans (food of the blind fish) are more or less herbivorous. They furnish food for the spiders, crawfish, *Anophthalmus*, and the fish. The vegetable food supporting them is in the first place fungi which, in various small forms, grow in damp places in the cave, and they can always be found attached to excrementitious matter dropped by the bats, rats, and other animals which extend their range to the outer air. Fungi also grow on the dead bodies of the animals which die in the caves, and are found abundantly on fragments of wood and boards brought in by human agency. The rats also have brought into fissures and cavities communicating with the cave, seeds, nuts, and other vegetable matters, from time immemorial, which have furnished food for insects. Thus rats and bats have, no doubt, had much to do with the continuance of land life in the cave, and the mammals of the post-pliocene or earlier period, which first wandered and dwelt in its shades, were introducers of a permanent land life.

As to the small crustaceans, little food is necessary to support their small economy, but even that little might be thought to be wanting, as we observe the clearness and limpidity of the water in which they dwell. Nevertheless the fact that some cave waters communicate with outside streams is a sufficient indication of the presence of vegetable life and vegetable *débris* in variable quantities at different times. Minute fresh water algæ no doubt occur there, the spores being brought in by external communication, while remains of larger forms, as confervæ, &c., would occur plentifully after floods. In the Wyandotte Cave no such connection is known to exist. Access by water is against the current of small streams which discharge from it. On this basis rests an animal life which is limited in extent, and must be subject to many vicissitudes. Yet a fuller examination will probably add to the number of species, and of these, no doubt, a greater or less number of parasites on those already known. The discovery of the little Lernæan shows that this strange form of life has resisted all the vicissitudes to which its host has been subjected. That it has outlived all the physiological struggles which a change of light and temperature must have produced, and that it still preys on the food of its host, as its ancestors did, there is no doubt. The blindness of the fish has favoured it in the "struggle for existence," and enabled it to maintain a position nearer the commissariat, with less danger to itself than did its forefathers.

E. D. COPE

SCOTTISH COAL FIELDS

THE "Journal of the Iron and Steel Institute" for August contains Prof. Geikie's paper read at the recent meeting in Glasgow "On the Geological Position and Features of the Coal and Ironstone-bearing Strata of the West of Scotland." The paper is meant chiefly for the benefit of those who are acquainted only with the British Carboniferous strata as seen in the English coal-fields, and to point out the geological position of the Scottish carboniferous deposits as contrasted with those of England. A geological map of Scotland shows that the Carboniferous formation is for the most part restricted to that broad belt of undulating low ground that extends from sea to sea, between the northern highlands on the one hand, and the southern uplands on the other. Throughout this area the strata are arranged in a series of great basins with intervening ridges. The chief basins, beginning in the east, the basins of Fifeshire, and Midlothian being first; second, the Lanarkshire and Stirlingshire basin; third, the broken and interrupted basins of Ayrshire and the south. This system is capable of being divided into four great series, which, beginning at the top, are as follows:—(1) the Coal Measures, (2) the Millstone Grit, (3) the Carboniferous Limestone (4) the Calciferous Sandstone series.

From Prof. Geikie's review of the more characteristic features assumed by the Scottish Carboniferous system, it is evident that the series which diverge most from those that are typical of the English area are the Calciferous Sandstones and the overlying Carboniferous Limestone series. In England, the strata that underlie the Coal Measures and Millstone Grit are composed almost exclusively of beds which have been amassed upon a sea bottom. In Scotland, on the other hand, we find the strata upon which the true Coal Measures and Millstone Grit repose giving evidence of numerous interchanges of land, fresh or brackish water, and marine conditions; while at the same time we are assured that during the accumulation of these underlying strata the eruption of melted matter hardly ever ceased in central Scotland.

NOTES

THOSE interested in the early history of geology will be glad to learn that a work is announced as ready for publication, with the title, "A Book about William Smith and the Somersetshire Coal Canal; being an Account of the Commencement of Stratigraphical Geology in England." The book is illustrated by a series of consecutive photographs of the districts along the north side of the Canal valley, and each photograph is accompanied by a geologically coloured key, which shows at a glance the outcrop of the various strata. This method is, as far as we know, quite original, and serves to show clearly the data with which Smith dealt in arriving at his discoveries.

THE Vice-Chancellor of the University of Cambridge, in resigning his office, referred to the progress made by the University in encouraging new branches of study. He commented upon the extension of the influence of the University over the studies in the kingdom, and the increasing desire on the part of those engaged in the work of education to be brought more closely in contact with the University. The yearly increase in the number of candidates for the Middle-class Examinations, and the institution of an examination for the higher grade schools, evidenced the fact of the extending influence of the University. The Vice-Chancellor referred to the munificence of the Chancellor, the Duke of Devonshire, in providing a school for Experimental Physics, and congratulated the University upon the approaching completion of the building of the Fitzwilliam Museum. The acquisition of the Leckenby collection of fossils to the Woodwardian Museum was a worthy proof of the liberality of the Colleges and members of the University, as well as a graceful acknowledgement of the services of Prof. Sedgwick. The donations of Lord Walsingham and Miss Walcott were likewise valuable additions to the collections in the above-mentioned museum. Among other bequests and donations, the Vice-Chancellor particularly alluded to the bequests of Sir John Herschel and the Rev. R. E. Kerrich, and especially to the generosity of the Earl of Portsmouth in presenting the MSS. of Sir Isaac Newton.

THERE has been a marked increase during the present term in the University of Cambridge in the number of students who take advantage of the privilege of being allowed to reside out of their college. Since the scheme was established in 1869, eighty students have been admitted, a considerable number of whom devote themselves to the study of natural science. The University payments for nine terms' residence, including the B.A. degree, do not greatly exceed 30*l*., and even with books and additional instruction the amount need not be much over 50*l*. The number of freshmen entered at the University this year is 622, as compared with 572 last year.

DR. BROWN-SÉQUARD, the eminent physiologist, has resigned the chair of Comparative and Experimental Pathology in the Faculty of Medicine in Paris, which he has occupied for several years. It is understood that this is preliminary to establishing his permanent residence in Boston, U.S.A.

AT a meeting of the Council of the Royal College of

Surgeons, held on October 31, Mr. John Birkett, F.R.C.S., Surgeon to Guy's Hospital, was elected a member of the Court of Examiners, in room of Mr. George Busk, F.R.S., who lately resigned the presidency of the college. Mr. Birkett, who is a member of several scientific societies at home and abroad, is also Examiner in Surgery at the University of London.

MR. JOSIAH MASON, of Birmingham, the founder of the Erdington Orphanage and the Birmingham Science College, now in process of formation, has received, through Mr. Gladstone, an offer of knighthood from Her Majesty, in recognition of his munificence in the causes of charity and education.

A CORRESPONDENT of the *Times* describes an interesting *fête* given on Sunday, Oct. 27, by the Municipality of Florence on the occasion of the inauguration of the new Florentine Observatory, placed on a very striking eminence from which in former times Galileo made most of his discoveries. Donati, the great star of the stars of Florence, and who was to have been the president and great attraction of the *fête*, was prevented from attending, as he had the day previously so hurt his leg by a fall that he was confined to his bed. The Municipio of Florence, Peruzzi at their head, had provided a splendid buffet, or *dejeûner à la fourchette*, for the whole of the guests invited, the music was excellent, and the view from the Observatory superb.

WE hear from Ceylon that there has been a deluge, which has done considerable damage; but the coffee districts are believed not to have suffered much. At Colombo a bank near the Pettah, or native suburb, had to be cut through in order to allow the water accumulated in the lake and its neighbourhood to escape into the sea. Mr. S. Green, of Colombo (a gentleman who takes great interest in science, and has sent home to England a great number of very interesting minute insects new to science, and who has a splendid telescope by Cooke, the best in Ceylon), says in a private letter:—"We have had heavy rains here, which have inundated a great portion of the Western Province. A great many native houses have been destroyed, and one or two lives lost. Many natives took refuge in the cocoa-nut trees around their dwellings; but some were found already occupied by snakes that had climbed the trees to escape the flood. They were very fierce, and maintained their position. A friend of mine going over the paddy-fields in a boat, saw several dead snakes floating on the water, and others swimming about."

THE *British Medical Journal* informs us that among other improvements about to be carried out at the Medical School of the Charing Cross Hospital, a Demonstrator of Anatomy is shortly to be appointed, with the annual salary of 150*l*. Preference will be given to gentlemen possessing a knowledge of Comparative Anatomy, as it is desired to associate a lectureship on this subject with the office of demonstrator.

THE following lecture arrangements are announced at the Royal Institution for the coming season:—Six Lectures on Air and Gas, by Prof. Odling, F.R.S.; Twelve Lectures on the Three Lectures on Oxidation, by Dr. Debus, F.R.S.; Four Lectures on the Artificial Formation of Organic Substances, by Dr. H. E. Armstrong; Four Lectures on the Chemistry of Coal and its Products, by Prof. A. Vernon Harcourt, F.R.S.; Six Lectures on the Comparative Political Institutions of Different Nations, by Edward A. Freeman, D.C.L.; Three Lectures on the Philosophy of the Pure Sciences, by Prof. W. K. Clifford; Three Lectues on Darwin's Philosophy of Language, by Prof. Max Müller, LL.D. The Friday Evening Meetings will commence on January 17. Friday Evening Discourses will probably be given by Wm. Spottiswoode, F.R.S., the Rev. Prof. T. R. Birks, Edward Dannreuther, Esq., Robert Sabine, Sir H. Rawlinson, F.R.S., Prof. Clerk Maxwell, F.R.S., James Dewar, E. J. Reed, C.B., J. Emerson-Reynolds, Prof. W. K. Clifford Prof. Tyndall, F.R.S., Lord Lindsay, Prof. Odling, F.R.S. and others. After Easter:—Three Lectures on the Limits of the Historic Method, by John Morley; Four Lectures on the Evidence for the History of Rome from Existing Architectural Remains, by J. H. Parker, C.B.; Six Lectures by Prof. Tyndall, F.R.S.; Four Lectures by Prof. Odling, F.R.S.; Three Lectures on the Development of Music in connection with the Drama, by Edward Dannreuther. In January the New Laboratories for research will be open for the inspection of the Members of the Institution.

THE following lectures are arranged to be delivered during the ensuing season at the London Institution, Finsbury Circus:—Educational Lectures, first course commencing Tuesday, Nov. 12; a lecture on the Nutrition of the Body, by Prof. Rutherford; second course commencing Jan. 27, 1873, eight lectures on Physical Geography, by Prof. Duncan, F.R.S.; third course commencing Monday, April 7, six lectures on Elementary Botany, by Prof. Bentley; two lectures on Fungoid Organisms in their relation to Mankind, by Prof. Thiselton Dyer, Mondays, March 24 and 31. Evening Lectures: Cavern Researches, by W. Pengelly, F.R.S.; Kent's Cavern, Torquay, Nov. 6; and The Cave Men of Mentone, Nov. 13; on Spontaneous Movements in Plants, by Alfred W. Bennett, Nov. 27; on the Paraffin Industry, by F. Field, F.R.S., Dec. 14; on Ancient Science, by G. J Rodwell, Jan. 15, 1873; on Fresco and Siliceous Paintings, by Prof. Barff, Feb. 5 and 12; on the Result of recent Meteorological Inquiry, by Robt. H. Scott, F.R.S., Feb. 26. On Dec. 11, 1872, Mr. Austen will read a paper, to be followed by discussion, on Peat as a Substitute for Coal. Prof. H. E. Armstrong will deliver a holiday course of four lectures, adapted to a juvenile auditory, on Air, Earth, Fire, and Water, commencing Dec. 30th.

MR. J. JENNER WEIR, F.L.S., delivered a lecture last evening at the Crystal Palace, on the Aquarium and its Contents. The West Kent Microscopical Society exhibited their instruments on the occasion.

THE following lectures will be delivered before the Bolton Literary and Scientific Society (Subject not fixed):—J. Glaisher, F.R.S., Nov. 19. On Coal and Coal Plants, by Prof. W. C. Williamson, F.R.S., Dec. 10. Where are the Bones of the Men who made the Flint Implements? by Wm. Pengelly, F.R.S. The Gulf Stream; what it does, and what it does not, by Dr. Wm. B. Carpenter, F.R.S., Feb. (day not fixed). An elementary course of six lectures on astronomy has been delivered by the Rev. J. Freeston; to be followed by one of eight lectures on geology and physical geography, by J. Collins.

THE birth of a hippopotamus is again announced to have taken place at the Zoological Gardens, Regent's Park, on Tuesday last.

A MDLLE. JACOBS is mentioned in the Dutch papers as having successfully passed her examination in physics and mathematics at the University of Gröningen. This lady will be the first female medical student in the Netherlands.

DR. DRUITT, well known as an author of standard surgical works, as a leading labourer in the cause of sanitary progress, and as the Editor of the *Medical Times and Gazette*, is compelled by ill health to retire for two years to a more genial climate. At a meeting attended by many of the leading members of the profession on October 31, it was resolved to initiate a subscription with a view to the public recognition of his eminent services.

THE Persian Government, the *School Board Chronicle* tells us, has engaged, through its representative at Paris, forty tutors fo a Lyceum to be established in Persia on the "model system" of France.

The meeting of Abbe Moigno's *Salle du Progrès* of October 25 was so crowded that great numbers could not obtain admission. He commenced on Monday last a series of scientific *soirées*, which he hopes may prove permanent.

Prof. C. A. White informs us that the report of his paper on the Geology of Iowa, read before the American Association for the Advancement of Science which we took from the *New York Tribune*, was incorrect in several particulars. There is no quartzite in the north-eastern part of the State, the Sioux quartzite occurring in the north-western corner; and the stoneless area of drift should have been stated at 13,000 to 14,000, instead of 20,000 square miles.

On the night of July 8 last, the object-glass of the Equatoria of the Alleghany Observatory was stolen, as also a few eyepieces belonging to the Transit. It is thought that the object of the thief is to try to extort a large reward for its return, but Mr. Langley, the director of the Observatory, has resolved not to offer a reward, nor guarantee immunity from punishment to the culprit. This he deems a duty to others who may have the charge of similar instruments.

The fifty-sixth session of the members of the Institution of Civil Engineers will be commenced on Tuesday, November 12, and will be continued thereafter on each succeeding Tuesday, with the exception of a short interval at Christmas, till the end of May. During the recess, the premises occupied by the Institution in Great George Street, Westminster—which were rebuilt and greatly enlarged in 1868—have been elaborately decorated. especially the theatre, and additions have been made to the library. The members have been specially urged to contribute, for reading and discussion at the evening meetings, well-authenticated accounts descriptive of executed works in foreign countries, in which it is thought British engineering literature is at present somewhat deficient. With regard to candidates seeking admission into the Institution, the members of all classes have been reminded that personal knowledge of the career and antecedents of every candidate is requisite, and only such should be recommended for election as are believed to be in every way worthy of the distinction, and willing and able to advance the interests of the society.

Among Messrs. Longmans' announcements for the present season are the following:—Electricity and Magnetism, by Fleeming Jenkins, F.R.SS. L. and E. Professor of Engineering in the University of Edinburgh, small 8vo.; Geometric Turning, comprising a Description of the New Geometric Chuck constructed by Mr. Plant, with Directions for its Use, and a Series of Patterns cut by it, by H. S. Savory, 1 vol. 8vo., with numerous illustrations; Notes on the River Basins of the British Isles, by Robert A. Williams, 16mo.; Physical Geography for Beginners, by William Hughes, 18mo.; Catechism of Zoology, by the Rev. J. F. Blake, M.A., fcap. 8vo.; Popular Lectures on Scientific Subjects, by Prof. Helmholtz, translated by E. Atkinson, 1 vol. 8vo.; Introduction to Experimental Physics, by Prof. Adolf F. Weinhold, translated and edited by Benjamin Loewy, F.R.A.S., with a Preface by G. C. Foster, F.R.S., 1 vol. 8vo.; Handbook of Hardy Trees, Shrubs, and Herbaceous Plants, based on the French work of Messrs. Decaisne and Naudin, and including the original woodcuts by Riocreux and Leblanc, by W. B. Hemsley, 1 vol. 8vo.; A General System of Descriptive and Analytical Botany, translated from the French of E. Le Maout, M.D. and J. Decaisne, by Mrs. Hooker, edited and arranged according to the English botanical system, by J. D. Hooker, M.D., with 5,500 woodcuts, from designs by L. Steinheil and A. Riocreux, 1 vol. medium 8vo.

The tenth part of the illustrated quarto publication upon the butterflies of North America, by Mr. William H. Edwards, has just made its appearance. This should have completed the first volume, but as better specimens have been obtained of several species heretofore figured, it is Mr. Edwards's intention to furnish these in a new supplemental number, with title-page and indices. This work, in addition to the numerous coloured figures and the elaborate descriptions of various species and their varieties, contains a synoptic list of North American butterflies, embracing 509 species, of which, previous to 1852, only 137 were known as belonging to North America. Sixty-one species were added between 1852 and 1860, and 311 since the latter year. There is every reason to believe that, with a thorough exploration of other regions of North America, many more will be found and added to this number.

The formation in Manchester of a Society for Promoting Scientific Industry is advocated by Mr. Frank Spence, of the Pendleton Iron Works. He says, in a letter to the *Manchester Guardian*, that the proposed society "will deal only with science in its practical applications—in the selection and perfection of all the instruments of production, not excluding the most important, and, just now, to many a manufacturer, most embarrassing of them all, the worker." He refers, as a precedent, to the Société Industrielle de Mulhouse, organised, in 1825, for "the advancement and propagation of industry, by the assemblage in a central situation of a great number of the elements of instruction, by the communication of discoveries and of remarkable facts, as well as by the initiation of original investigations, and by all the means which shall suggest themselves to the members in order to insure its prosperity and the happy results to which it may give rise." This is an attempt at a movement in the right direction.

Prof. Marsh, having completed the determination of the new species of fossil mammals and birds obtained during the Yale College expeditions of the summers of 1870 and 1871, has begun upon the reptiles, and has described five new species of a new genus, which he calls *Thinosaurus*. These were large carnivorous lizards, resembling the *Varanidæ*, or monitors, but differing in certain features pointed out by the professor. They are all from the tertiary beds of Wyoming. Other species belong to two new genera, *Oreosaurus* and *Tinosaurus*, together with a new species of a genus, *Glytosaurus*, previously indicated.

Dr. Hooker states that the rainfall for October amounted, at the Royal Gardens, Kew, to 6·46 inches. Of this no less than 3·09 inches was recorded in the last seven days of the month. The rainfall for October registered at the Royal Botanic Gardens, Regent's Park, seven miles distant from Kew, was 5·25 inches.

Les Mondes describes a curious experiment of M. R. P. Lafond. Take a chameleon top, and place on the centre one of the prismatic discs which can be bought with the article, and instead of producing the singular optical illusions usually obtained from these discs by means of the fingers (in the same way as the "checked action" of Wheatstone is produced), illumine the table with a large Geissler tube. The result is described as charming; the most varied combinations of colours and designs succeed each other, without any necessity for touching the discs and consequently destroying the movement of the top. Moreover—and this makes the plaything a veritable scientific instrument—we have here a beautiful demonstration that the light of the Geissler tubes is intermittent.

Harper's Weekly announces the early publication of an important work on American Natural History—the investigation of the Cetaceans of the western coast of North America, by Capt. C. M. Scammon of the United States Revenue Marine. This gentleman has for many years been directing his attention to the subject, and has collected a large amount of material in reference to the various species of whales and porpoises of the western coast, together with their zoological peculiarities and their habits.

CATALOGUE OF BRIGHT LINES IN THE SPECTRUM OF THE SOLAR ATMOSPHERE *

WITHOUT waiting to complete my entire report of the spectroscopic work at Sherman, I send for immediate publication, should you think proper, a list of the bright lines observed in the spectrum of the chromosphere during the past summer.

The great altitude of the station (nearly 8,300 ft.), and the consequent atmospheric conditions, were attended with even greater advantages for my special work than had been really expected, although I was never quite able to realise my *hope* of seeing all the Fraunhofer lines reversed; unless once or twice for a moment, during some unusual disturbances of the solar surface. Everything I saw, however, confirmed my belief that the origin of the dark lines is at the base of the chromosphere, and that the ability to see them all reversed at any moment depends merely upon instrumental power and atmospheric conditions.

In this view, a catalogue of the bright lines actually observed is of course less important than it would be otherwise; still it is not without interest and scientific value, since the lines seen are naturally those which are really most conspicuous in the chromosphere spectrum, and this conspicuousness stands in important, but by no means obvious or even entirely simple, relations to the intensity of the corresponding dark lines, when such exist. There can be no doubt that a careful study of these bright lines and their behaviour would yield much valuable information as to the constitution and habitudes of the solar atmosphere.

In the catalogue, the first column contains simply a reference number: a ‡ refers to a note at the end of the catalogue.

The numbers in the second column refer to my "Preliminary Catalogue," containing 103 lines, which was published a year ago in the *American Journal of Science*. In this column a † indicates that some other observer has anticipated me in the determination and publication of the line. As I have depended for my information almost solely upon the *Comptes Rendus* and the Proceedings of the Royal Society (which give the observations of Lockyer, Janssen, Rayet, and Secchi), it is quite possible that some other lines ought to be marked in the same manner.

The third column, headed K, gives the position of the lines on Kirchhoff's scale, the numbers above G being derived from Thalen's continuation of Kirchhoff's maps. In this column an asterisk denotes that the map shows no corresponding dark line, a ? that the exact position, not the existence, of the line is for some reason slightly uncertain.

The fourth column, headed A, gives the wave-length of the line in ten millionths of a millimetre according to Angström's atlas. The numbers in this and the preceding column were taken, not from the maps themselves, which present slight inaccuracies on account of the shrinking and swelling of the paper during the operation of printing, but from the numerical catalogues of Kirchhoff and Angström which accompany their respective atlases. In the preliminary catalogue the numbers were derived from the maps; hence some slight discrepancies in the tenths of division.

The fifth column, marked F, contains a rough estimate of the percentage of frequency with which the lines were seen during the six weeks of observation; and the sixth column, B, a similar estimate of their maximum brightness compared with that of the hydrogen line C.

The variations of brilliance, however, when the chromosphere was much disturbed, were so considerable and so sudden, that no very great weight can be assigned to the numbers given. Nor is it to be inferred that lines which have in the table the same index of brightness were always equally bright. On some occasions one set of lines would be particularly conspicuous, on others, another.

With two or three exceptions, indicated in the notes, no lines have been catalogued which were not seen on at least two different days. In the few cases where lines observed only on one occasion have been admitted to the list, the observations were at the time carefully verified by my assistant, Prof. Emerson, so as to place their correctness beyond a doubt. Many other lines were "glimpsed" at one time and another, but not seen steadily enough or long enough to admit of satisfactory determination.

The last column of the catalogue contains the symbols of the chemical elements corresponding to the respective lines. The materials at my disposal are the maps of Kirchhoff and Angström, Thalen's map of the portion of the solar spectrum above G, and "Watts's Index of Spectra." Since the positions of the lines in the latter work are given only to the nearest unit of "Angström's scale," I have marked the coincidences indicated by it with a (w), considering them less certain than those shown by the maps.

In addition to the elements before demonstrated to exist in the chromosphere, the following seem to be pretty positively indicated—sulphur, cerium, and strontium; and the following with a somewhat less degree of probability, zinc, erbium, and yttrium, lanthanum and didymium. There are some coincidences also with the spectra of oxygen, nitrogen, and bromine, but not enough, considering the total number of lines in the spectra of these elements, or of a character to warrant any conclusion. One line points to the presence of iridium or ruthenium, and only three lines are known in the whole spectrum of these metals. The reversal of the H's deserves also especial notice.

No one, of course, can fail to be struck with the number of cases in which lines have associated with them the symbols of two or more elements. The coincidences are too many and too close to be all the result of accident, as for instance in the case of iron and calcium, or iron and titanium.

Two explanations suggest themselves. The first, which seems rather the most probable, is that the metals operated upon by the observer who mapped their spectra, were not absolutely pure—either the iron contained traces of calcium and titanium, or *vice versâ*. If this supposition is excluded, then we seem to be driven to the conclusion that there is some such similarity between the molecules of the different metals as renders them susceptible of certain synchronous periods of vibrations—a resemblance, as regards the manner in which the molecules are built up out of the constituent atoms, sufficient to establish between them an important physical (and probably chemical) relationship. I have prefixed to the catalogue a table showing the number of lines of each substance, or combination of substances, observed in the chromosphere spectrum, omitting, however, oxygen, and nitrogen, and bromine, since with one exception (line 230), neither of them ever stands alone, or accounts for any lines not otherwise explained.

The instruments and methods of observation were the same as those employed in the construction of the Preliminary Catalogue. Telescope, 9 $\frac{4}{10}$ inches aperture—spectroscope automatic, with dispersive force of 12 prisms.

The approximate geographical position of Sherman is long. 1h. 53·2m. west of Washington, lat. 41° 07′; altitude above sea-level 8,280 feet; mean height of barometer about 22·1 inches.

Table showing the number of coincidences between the bright lines observed in the spectrum of the chromosphere, and those of the spectra of the chemical elements.

Fe, Ti, $S_{(w)}$	1	Ti, $S_{(w)}$	3	*Unknown.*	52	Total.
" Ba, $S_{(w)}$	1	" Ca,	2			
" $S_{(w)}$ $Zn_{(w)}$	1	" Mn,	1	Fe,	64	110
" Co, Ce,	1	" Ce,	1	Ti,	23	43
" Ni, $E_{(w)}$	1			Ca,	10	29
Ca, Cr, Ce,	1	" Sr,	1	Ba,	8	13
" Li, Zn,	1	" Zn,	1	$S_{(w)}$	7	14
Ti, Ba, $S_{(w)}$	1			Mn,	6	12
Ba, La, $E_{(w)}$	1	Ca, Cd,	1	Ce,	5	11
		" Ce,	1	H,	4	4
Fe, Ca,	10	Ca, Co,	1	Na,	4	6
" Ti,	9	" Cr,	1	Cr,	4	10
" Mn,	4	" Sr,	1	Mg,	3	4
" Cr,	3			Sr,	3	6
" Ni,	3	$S_{(w)}$ $E_{(w)}$	1	Zn,	3	9
" Ba,	2			$E_{(w)}$	2	9
" Zn,	2	Mn, Zn,	1	Ni,	2	6
" $E_{(w)}$	2			Co,	1	5
		Cr, $E_{(w)}$	1	Cu,	1	2
" Ce,	1			La,	1	3
" Co,	1	Ce, Co,	1	Ru, Ir,	1	1
" Mg,	1			Cd,		1
" Na,	1	Na, Cu,	1	Li,		1
" $S_{(w)}$	1					
" La,	1	lines marked with an *	14			

The numbers in the last column denote the whole number of times that the symbol of each element appears in the catalogue, either singly or combined with others.

* Letter to the Superintendent of the U. S. Coast Survey, containing a Catalogue of Bright Lines in the Spectrum of the Solar Atmosphere, observed at Sherman, Wyoming Territory, U. S. A., during July and August, 1872; by Prof. C. A. Young, of Dartmouth College. Reprinted from advance sheets of the *American Journal of Science and Art*.

Catalogue of Bright Lines in the Spectrum of the Chromosphere.
1872.

No	PC.	K.	A.	F.	B.	E.
1‡	1†	534·0*	7055·?	100	12	
2	2†	654·3	6676·9	25	50	Fe, Ba$_{(w)}$
3	3†	C.694·1	6561·8	100	100	H,
4		711·4	6515·5	15	4	
5	4	718·7	6496·0	18	5	Ba,
6		731·7	6461·7	5	2	Ca.
7	5	734·0	6453·8	10	6	
8		740·9	6438·1	5	2	Ca, Cd,
9‡	6	744·3	6429·9	20	4	
10		750·1	6415·6	5	2	
11		756·9	6399·0	5	2	Fe,
12		759·3	6392·6	5	1	Fe,
13		767·?*	6373·?	5	2	
14	7	768·?*	6371·?	5	3	
15		778·3	6346·1	10	4	Ruth, Ir,
16‡	8	823·5	6245·4	8	5	Fe,
17‡	9	827·6	6237·3	8	2	
18		830·2	6231·5	·5	1	Fe,
19		836·5	6218·3	3	1	Ti,
20		839·2	6214·1	3	1	Ti,
21		845·7	6199·6	2	2	Fe,
22		849·7	6190·5	10	2	Fe,
23		859·7	6168·3	3	1	Ca,
24		863·9	6161·2	8	3	Ca,
25		{ 870·9	6148·1	3	2	Fe, E$_{(w)}$
26		{ 871·4	6146·8	3	2	
27	10	874·3	6140·6	25	10	Ba,
28		{ 876·5	6136·1	2	1	
29		{ 877·0	6135·6	2	1	Fe,
30		884·9	6121·2	5	3	Ca, Co,
31		890·2	6109·9	2	1	Ba,
32		894·9	6101·7	3	2	Ca, Li, Zn$_{(w)}$
33		903·1	6083·1	3	2	Ti,
34		912·1	6064·5	5	2	Fe, Ti,
35		933·8	6018·0	2	1	Ba,
36‡		949·4	5990·0	10	4	
37		992·0	5913·2	2	1	Fe,
38	11†	D_1 1002·8	5895·0	50	30	Na,
39	12†	D_2 1006·8	5889·0	50	30	Na,
40‡	†	1011·2	5883·0	2	1	Fe,
41‡	13†	D_3 1016·5*	5874·9	100	90	
42		1031·8	5852·7	8	2	Ba,
43		1135·1	5708·3	1	1	Fe
44		1151·1	5687·2	2	1	Na,
45		1154·2	5683·5	5	3	
46		1155·8	5681·5	2	1	Na, Fe, N$_{(w)}$
47		1165·7	5667·8	2	2	S$_{(w)}$
48		1167·0	5666·0	1	1	
49		1170·6	5661·5	15	2	Fe, Ti, E$_{(w)}$
50		1175·0	5656·7	8	3	S$_{(w)}$ N$_{(w)}$
51		1176·6	5654·4	2	1	Fe,
52		1187·1	5640·2	1	1	S$_{(w)}$
53		1189·3	5637·3	1	1	
54		1200·6	5623·2	2	1	Fe,
55		1207·3	5614·5	2	1	Fe,
56		1229·6	5587·6	2	2	Ca,
57		1231·3	5585·5	2	1	Fe,
58	14†	1274·2	5534·1	50	12	Ba, Fe, Sr,
59	15	1281·3	5525·9	40	5	Fe,
60		1287·5	5518·7	15	2	Ba,
61		1298·9	5505·8	2	1	Fe,
62		1303·5	5500·5	2	1	Fe, La,
63		1306·7	5496·6	2	1	Fe, E$_{(w)}$
64		1320·6	5480·2	2	1	Ti, Sr,
65		1324·8	5475·9	1	1	Ni,
66		1328·7	5472·3	3	1	
67		1337·0	5462·3	1	1	Fe, N$_{(w)}$
68	16	1343·5	5454·7	10	4	Fe,
69	17	1351·1	5445·9	10	4	Fe, Ti, Br$_{(w)}$
70		1360·9	5435·4	5	2	Zn, Br$_{(w)}$
71		1362·9	5433·0	2	2	Fe,
72‡	18	1364·3	5431·8	8	5	
73	19	1367·0	5428·8	8	3	Fe, Ti,
74	20	1372·1	5424·5	25	6	Ba, Ti, S$_{(w)}$
75	21	1377·4	5417·9	5	2	Ti, Mn,
76		1380·5	5414·5	2	2	Fe,
77	22	1382·5	5412·4	4	2	Mn$_{(w)}$
78		1384·7	5410·0	2	1	Fe, Ni,
79		1385·7	5409·0	2	2	Cr,
80		1389·4	5404·8	2	1	Fe,
81	23	1390·9	5403·1	5	3	Fe, Ti,
82		1394·2	5399·6	2	1	Mn,
83	24	1397·5	5396·1	4	2	Fe, Ti,
84		1401·6	5392·2	2	1	Fe, Ce,
85		1412·5	5380·2	3	2	Ti,
86	25†	1421·5	5370·5	10	3	Fe,
87		1423·0	5369·0	1	1	Fe,
88		1425·4	5366·5	1	1	Fe,
89		1428·2	5364·0	1	1	Fe,
90	26†	1430·1	5361·9	20	10	Fe,
91		1438·9	5352·4	4	2	Fe, Co, Ce,
92		1446·7	5345·0	1	1	
93		1450·8	5340·2	1	2	Fe, Mn, O$_{(w)}$
94	27	1454·7	5335·9	5	2	Ti, Zn$_{(w)}$
95		1461·5	5329·1	6	4	
96	28	{ 1462·8	5327·1	5	2	Fe,
97	29	{ 1463·3	5327·6	5	2	Fe,
98		1464·8	5325·1	6	2	
99		1471·9*	5318·0	1	1	
100‡	31†	1473·9	5315·9	90	50	Fe,? O$_{(w)}$?
101		1476·8	5313·1	3	1	
102		1497·3	5292·0	1	1	Cu, Br$_{(w)}$
103	32	1505·3	5283·4	20	10	Ti$_{(w)}$
104	33†	1515·5	5275·0	30	15	
105	34	E_1 1522·7	5269·5	15	4	Fe, Ca,
106	35	E_2 1523·7	5268·5	12	3	Fe,
107	36†	1527·7	5265·8	10	4	Fe, Co,
108		1530·2	5263·3	1	1	Ca, Br$_{(w)}$
109		1538·5*	5256·2	2	1	Sr,
110		1541·9	5254·1	1	2	Fe, Mn,
111		1547·7	5249·7	3	1	Fe, Z$_{(w)}$ Br$_{(w)}$
112		1551·6	5246·3	3	1	Fe,
113	37	1561·0	5239·0	4	2	Fe,
114	38	1564·2	5236·3	4	2	
115	39†	1567·5	5233·6	10	8	Mn, Zn$_{(w)}$
116	40	1569·6	5232·1	1	3	Fe,
117		1575·4	5227·5	1	1	Sr,?
118	41	{ 1577·4	5226·2	10	3	Fe,
119		{ 1578·1	5225·5	2	3	Sr, Br$_{(w)}$
120	42	1580·1	5224·3	2	2	Ti,
121		1589·1	5216·5	2	1	Fe,
122		1590·7	5215·5	3	2	Fe,
123		1592·3	5214·4	2	1	Fe,
124		1597·9*	5210·5	1	1	
125		1598·9	5209·5	1	2	Ti,
126	43	1601·5	5207·6	10	6	Fe, Cr,
127	44	1604·4	5205·2	10	6	Cr, E$_{(w)}$
128	45	1606·4	5203·7	10	6	Cr, Fe,
129	46	1609·2	5201·5	5	3	Fe,
130	47	1611·3	5199·7	4	2	S$_{(w)}$ E$_{(w)}$
131		1613·9	5197·9	1	1	Fe,
132	48†	1615·6	5197·0	15	10	
133		1617·4	5195·0	1	1	Mn,
134		1618·9	5194·1	2	2	Fe,
135		1627·2	5188·2	10	5	Fe, Ca,
136		1628·2	5187·3	1	1	Ti,
137		1631·5	5185·1	5	2	Fe, Ti,
138	49†	b_1 1634·1	5183·0	50	30	Mg,
139	50†	b_2 1648·8	5172·0	50	35	Mg,
140	51†	b_3 1653·7	5168·3	40	30	Fe, Ni, Br$_{(w)}$
141	52†	b_4 1655·6	5166·7	30	20	Fe, Mg,
142		1666·?	5160·?	1	1	
143		1671·5	5154·8	3	1	Na,
144	53	1673·7	5152·5	3	1	Na, Cu,?
145	34	1677·9	5150·1	3	2	Fe, Br$_{(w)}$
146		1689·5	5142·2	1	2	S$_{(w)}$
147		1701·8	5133·0	1	1	Fe,
148		1704·7	5130·8	1	1	Fe,
149		1707·9	5128·6	1	1	Ti,
150		1710·7	5126·7	1	1	Fe, Ti,
151		1712·2	5125·5	1	2	
152‡		1713·4	5124·4	1	1	Fe,

No.	PC.	K.	A.	F.	B.	E.
153		1715·2	5123·2	1	1	Fe,
154		1717·9	5121·0	1	1	Fe,
155		1719·4	5119·9	1	1	Ti,
156‡		1727·3	5114·9	1	1	Ni,
157		1734·6	5108·8	2	2	$Ti_{(w)}$
158		1737·7	5107·0	1	1	Fe,
159		1750·4	5098·1	1	1	Fe,
160		1752·8	5096·5	1	1	Fe, $S_{(w)}$
161		1765·0*	5087·0	2	1	$E_{(w)}$
162		1771·5	5083·5	1	1	$Zn_{(w)}$
163	55	1778·5	5077·9	1	2	Fe,
164		1823·6	5047·8	2	2	Fe,? $Zn_{(w)}$
165		1833·4	5041·2	2	2	Fe, Ca,
166		1834·3	5040·1	2	2	Fe,
167		1848·9	5030·1	4	3	$S_{(w)}$
168		1856·9	5023·5	3	1	$S_{(w)}$
169	56†	1867·1	5017 6	30	15	Fe, Ni,
170	57†	1870·6	5015·0	30	10	$Ti_{(w)}$
171		1905·1	4993·3	2	1	Fe, $N_{(w)}$
172‡		c.1961 0	4956·7	1	2	Fe,
173	58†	1989·5	4933·4	30	8	Ba,
174	59†	2001·6	4923·1	40	12	Fe, $S_{(w)}$ $Zn_{(w)}$
175	60†	2003·2	4921·3	30	8	$S_{(w)}$
176	61	2007·2	4918·2	20	3	Fe,
177		2016·0	4911·2	3	2	$Zn_{(w)}$
178	62†	2031·1	4899·3	30	6	Ba, La, $E_{(w)}$
179	63†	2052·5?*	4882·9	10	4	Ce,
180		2067·8	4869·4	5	1	
181	64†	$F_1$2080·0	4860·6	100	80	H,
182		2087·6	4854·7	5	2	Fe, Ni, $E_{(w)}$
183		2094·0	4848·1	3	2	Ca, $O_{(w)}$
184		2116·?*	4826·5	1	1	
185		2121·2	4822·8	10	2	Mn,
186		2142·4	4804·4	3	1	Ti, $S_{(w)}$ $O_{(w)}$
187		2171·5	4778·7	3	2	Co, $N_{(w)}$
188		2229·1	4730·8	1	1	Fe,
189‡		2251·3*	4712·5	2	2	Ce, $O_{(w)}$
190		2309·5	4666·3	3	1	Fe, Ti,
191		2314·3	4663·3	2	1	
192		2323·0	4656·0	2	1	Ti,
193	65	2358·4	4629·0	15	8	Ti, $N_{(w)}$
194		2359·5*	4628·2	2	1	Ce,
195		2369·7	4620·3	1	1	
196		2410·2	4589·4	1	1	
197		2412·8	4587·5	2	2	
198	66	2419·3	4583·2	15	6	
199		2429·5	4576·0	4	2	
200	67	2435·5	4571·4	10	4	Ti,
201	68	2443·9	4564·8	10	3	
202	69	2446·6	4563·2	10	5	Ti.
203		2452·1	4559·5	8	2	
204		2454·1	4558·1	8	1	
205	70	2457·9	4555·3	10	5	Fe, Ti,
206	71	2461·2	4553·4	10	5	Ba,
207		2463·4	4551·8	1	1	Ti, $S_{(w)}$
208	72	2467·6	4548·9	10	8	Ti,
209		2480·8	4539·2	2	1	Ce,
210	73	2486·6	4535·5	2	2	Ti, Ca,
211	74	2489·4	4533·2	5	5	Fe,
212		2490·5	4532·1	3	2	Ti, Ca,
213	76	2502·2	4524·4	3	2	Ba, Fe,
214	77	2505·6	4522·0	3	3	Ti, $S_{(w)}$
215		2517·0	4514·0	2	1	
216		2518·4	4513·0	1	1	
217		2527·0	4506·0	2	1	
218	78	2537·1	4500·3	15	6	Ti,
219	79	2552·4	4490·9	20	8	Mn,
220	80	2555·0	4489·4	15	3	Fe, Mn,
221	81	2566·3	4480·9	5	2	Mg,
222‡	82†	f.2581·2	4471·2	100	25	Ce,
223	83	2585·4	4468·5	20	5	Ti, $O_{(w)}$
224		2620·8	4446·3	1	1	Ti,
225	84	2625·2	4443 0	10	2	Ti,
226		2633·0	4436·7	1	1	Mn?
227		2639·6	4433·5	1	1	
228		2651·5*	4426 0	2	3	
229		2653·2	4425·0	2	2	Ca,
230		2664·9	4418·0	2	1	$O_{(w)}$

No.	PC.	K.	A.	F.	B.	E.
231		2665·9	4417·5	3	1	Ti,
232	85	2670·0	4414·7	1	1	Fe, Mn, $O_{(w)}$
233		2680·0	4407·7	1	1	Fe, Ca,
234		2686·8	4404·2	1	1	Fe,
235		2696·0	4398·5	1	1	Ti, Ce, $O_{(w)}$
236		2698·2	4396·5	1	2	
237	87	2702·5	4394·6	15	3	
238		2715·2	4388·5	1	1	Fe,
239	88	2718·5	4384·7	8	2	Ca, Ce,
240		2720·2	4383·5	1	1	
241	89	2721·6	4382·8	1	1	Fe, Cr,
242		2725·8	4380·4	1	1	
243		2728·0	4379·1	1	1	Ca,
244	90	2733·7	4375·5	5	3	Fe,
245	91	2736·9	4374·2	8	3	$E_{(w)}$
246		2762·0	4359·1	1	1	Cr,
247	92	2775·7	4351·8	3	1	Cr,
248	93†	2795·7	4340·1	100	65	H,
249		2798·0	4338·2	10	2	Cr,
250		2805·4	4335·1	2	1	La,
251		2823·4	4324·0	1	2	
252		2830·7	4320·1	1	1	Ti, $O_{(w)}$
253		2843·0	4313·5	1	1	Ti,
254	94	G.2854·2	4307·2	3	2	Ca, Fe,
255	95	2867·7	4302·1	3	2	Ca, Fe,
256	96	2874·2	4298·0	1	1	Ca, Fe,
257	97	2894·5	4289·4	1	1	Cr, Ca, $Ce_{(w)}$
258	98	2928·5	4274·6	2	1	Cr, Ca,
259	99	2961·2	4260·0	2	1	Fe,
260	100	2996·2	4245·2	30	3	Fe,
261		3018·0	4235·5	30	5	Fe,
262		3022·8	4233·0	15	5	Fe, Ca,
263	101	3040·0	4226·3	3	3	Ca, Sr,
264	102	3061·8	4215·3	40	7	Ca, Sr,
265		3155·5	4178·8	1	1	
266		3187·0	4166·7	1	1	Ca,
267	103†	h. 3363·5	4101·2	100	50	H,
268		3431·0	4077·0	25	2	Ca,
269		3526·0	4045·0	3	2	Fe,
270		3703·3	3990·?	2	1	
271		3769 5	3970·?	2	1	Fe,
272‡		$H_1$3778·5	3967·9	75	3	Fe, Ca,
273‡		$H_2$3882·5	3932·8	50	1	Fe, Ca,

Notes

1. The position assigned to this line, first observed by Respighi (a fact of which I was ignorant when the Preliminary Catalogue was published), rests upon two series of micrometric measurements, referring it to four neighbouring dark lines—the probable error is about $\frac{1}{20}$th of a division of Kirchhoff's scale.

9. No. 6 in P C. Position there given, 743?

16 and 17. Nos. 8 and 9 of P C. Position given as 816·8 and 827·6, by a mistake in identifying lines upon the map.

40. I have never myself seen this line reversed. Prof. Emerson, however, saw it several times. It was first reported by Rev. S. J. Perry, in NATURE, vol. iii. p. 67.

41. The position of this line has been independently determined by three series of micrometric comparisons with neighbouring lines. My result agrees exactly with that of Huggins.

72. Erroneously given in P C, as 1363·1, which line does not reverse, or at least was never seen reversed at Sherman.

100. The principal line in the spectrum of the corona. The corresponding line in the spectrum of iron is rather feeble, and on several occasions when the neighbouring lines of iron (1463, &c.) have been greatly disturbed, this has wholly failed to sympathise. Hence I have marked the Fe with a ?. Watts indicates a strong line of oxygen at 5315 A.

152 and 156. Observed only on one day, but verified by Prof. Emerson.

172. Called little C by Mr. Stoney.

179. Given by Lockyer as K 2054. Its position is a little uncertain; it seems to coincide with neither of the dark lines at 2051 and 2054, but lies between them, a little nearer to 2051.

189. Rather a band than a line.

222. The position of this line, which, however, like 189, is rather a band, was determined by two series of careful micrometrical measurements.

It was first discovered in 1869 by Rayet, and has since been named "f" by Lorenzoni, who, ignorant of the previous work of several other observers, has claimed its discovery.

272 and 273. These lines were both reversed (by a narrow bright stripe running down the centre of the broad hazy band) as constantly, whenever the seeing was good, as h or C itself. The observation was difficult, however, and required the most scrupulous exclusion of foreign light, and a careful adjustment of the slit in the plane of the solar image formed by these particular rays.

They were also found to be regularly reversed upon the body of the sun itself, in the *penumbra and immediate neighbourhood of every important spot.*

SOCIETIES AND ACADEMIES

Cambridge

Philosophical Society, Oct. 18.—The following were elected officers of the Society:—President: Prof. Humphry. Vice-Presidents: Prof. Cayley, Prof. Adams, Prof. Liveing. Treasurer: Dr. Campion. Secretaries, Messrs. Bonney, J. W. Clark, and Trotter. New Members of Council: Prof. Babington, Prof. Stokes, Mr. Hort, Dr. M. Foster. The following communications were made to the Society:—"On the form suggested by M. Tresca, and adopted by the Commission Internationale du système métrique, for the Mètres Internationaux," by Prof. Miller, F.R.S. "A Method for Drawing in Perspective;" and "A Method for Levelling" (communicated), by Mr. J. C. W. Ellis. The nature of these papers does not admit of a brief abstract.

Paris

Academy of Sciences, October 21.—M. Faye, president. In opening the meeting the President announced the death on that morning of M. Babinet, Member of the Academy, Physical Section.—M. Yvon Villarceau then read a note relative to a letter from M. Magnac on the use of chronometers at sea which he presented to the Academy. The note and letter related to the compensation and rating of chronometers, and in conclusion drew attention to the great and continuous care which ought to be devoted to this subject by the Transit of Venus Expedition of 1874.—M. Pasteur then read an answer to M. Fremy's two notes read at the meeting of the 7th October. M. Pasteur's observations were in support of his theory of the wine ferment coming from the husk of the grape. He concluded his observation as follows:—"I declare both the theory of the transformation of albuminous matters into ferment cells by contact with atmospheric oxygen, and that of hemeorganism, or the generation of ferment cells from fruit cells, to be erroneous."—Next came a vigorous reply from M. Chevreul to certain "allegations contained in a report, by M. A. Gruyer, on the International Exhibition of London, 1871." At the conclusion of the reply MM. E. Bequerel and Milne-Edwards made some remarks on the subject, when the matter dropped. —A note from M. R. Clausius, on the mechanical equation from which the 'viriel' theorem results was then read, and was followed by a note from M. A. de Caligny on the theory of the several systems of navigation locks, a long paper relating to various kinds of locks, sluices, floodgates, &c..—This was followed by the continuation of M. P. A. Favre and C. A. Valson's paper on crystalline dissociation. The authors find that potassium and ammonium alum are partially dissociated when rendered anhydrous, and that chromium-potassium alum, when rendered anhydrous and then washed, loses potassic sulphate. They also attribute the change from violet to green of solutions of chrome alum, when heated, to this cause, and state that there is nothing to prove that this is not the case with all alums.—M. C. Sédillot then presented a note on the phenomena of fermentation and their connection with pathological physiology. The note related to certain recent studies on zymology by M. F. Monoyer.—M. Tresca then asked the Academy to open a sealed packet deposited by him with it on September 9, 1870, and which contained the particulars of the secret place where he and General Morin had deposited the standard metre and kilogramme during the events of that time. He wished the Academy to open the depositary, and to place the standards in the hands of the Government.—M. Ed. Bureau then read a note on the value of characteristics deduced from the structure of the stem for the classification of the *Bignoniaceæ.*—The concluding portion of M. Max Marie's paper on the extension of the method of Cauchy to the study of double integrals, &c., followed.—A note from Ed. Jannettaz on the coloured rings produced in gypsum by pressure, and their connection with the ellipsoid of thermal conduction and with cleavage, was referred to the physical section, and M. C. Dareste's studies on the osteological types of osseous fishes was sent to the section of zoology. The commission for the Montyon prize for medicine and surgery received a memoir on the three "psoric acariens" of the Horse by M. P. J. Mégnin.—A communication from MM. Chevallier on the manufacture of amorphous phosphorous matches was sent to the commission on the unhealthy arts.—A suggestion for the use of the tension of liquid ammonia as a source of motive power in aerial navigation by M. Pollard was submitted to the commission on aerostation; and the *Phylloxera* commission received a note relative to a remedy for that pest from M. Chatelain.—M. Yvon Villarceau then communicated a letter on the elements and co-ordinates of the planet No. 123 from M. Stephan, and also an extract from a letter from M. de Magnac on the determination of longitude by chronometers.—M. Chasles presented a note from M. H. G. Zeuthen on quartic equations, of which one part is reduced to a direct double.—A letter from M. P. Volpicelli on the probable nature of the Saturnian rings, and on a meteor observed at Rome on the 31st of August, was then read.—M. Th. du Moncel read a note on the accidental currents which arise in telegraphic wires, one end of which remains isolated in the air, after which M. Pasteur presented a note, by M. Feltz, on the action of crystallisable sugar on Barreswil's cupro-tartaric reagent. The author's experiments tend to show that cane sugar acts on the reagent in the presence of an excess of alkali; hence he distrusts all determinations made where both sugars are present. This paper was followed by a note from MM. Béchamp and Estor on the role of the microzymes during embryonic development.—M. Tarry then read a note on the aurora and magnetic storm of the 14th and 15th October.—M. E. Fournié demanded the opening of a sealed packet relating to cerebral physiology deposited by him on the 22nd of July, 1872, and after a note from M. G. Bandiera on a means of separating essence of citron from turpentine had been submitted to M. Dumas, the session adjourned.

BOOKS RECEIVED.

English.—The Expressions of the Emotions in Man and Animals: C. Darwin (Murray).—The Causation of Sleep: James Capper, M.D. (Thin, Edinboro').—Underground Treasures; how and where to find them: James Orton (Worthington and Co.).

Foreign.—(Through Williams and Norgate.)—Ueber die Auflösung der Arten durch natürliche Zuchtwahl.—Ueber die Bedeutung der Entwickelung in der Naturgeschichte: Dr. A. Braun.—Sachs-reglster zu dem Repertorium: J. Schotte.

DIARY

THURSDAY, November 7.

Linnean Society, at 8.—On the "Piopio" of New Zealand (*Keropia crassirostris Gmel*): T. H. Potts.—On the buds developed on leaves of *Malaxis*: George Dickie, M.D.

SUNDAY November 10.

Sunday Lecture Society, at 4.—On A Bar of Iron: John Hopkinson, D.Sc.

TUESDAY November 12.

London Institution, at 4.—On Nutrition: Prof. Rutherford. (Educational course.)

THURSDAY, November 14.

London Mathematical Society, at 8.—Remarks on some Recent Generalisations of Algebra: the President.—Sur les Fonctions Circulaires: M. Hermite.—Investigation of the Disturbance produced by a Spherical Obstacle on the Waves of Sound: Hon. J. W. Strutt.—On the Mechanical Description of a Cubic Curve: Prof. Cayley.—A Series of Models of Cubic Surfaces to Illustrate their Different Forms: Prof. Henrici.

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