THE

Edinburgh

JOURNAL OF SCIENCE,

EXHIBITING

A VIEW OF THE PROGRESS OF DISCOVERY

IN NATURAL PHILOSOPHY, CHEMISTRY, MINERALOGY, GEOLOGY, BOTANY, ZOOLOGY, COMPARATIVE ANATOMY, PRACTICAL MECHANICS, GEOGRAPHY, NAVIGATION, STATISTICS, ANTIQUITIES, AND THE FINE AND USEFUL ARTS.

CONDUCTED BY

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VOL. V.

APRIL—OCTOBER.

WILLIAM BLACKWOOD, EDINBURGH:
AND T. CADELL, LONDON.

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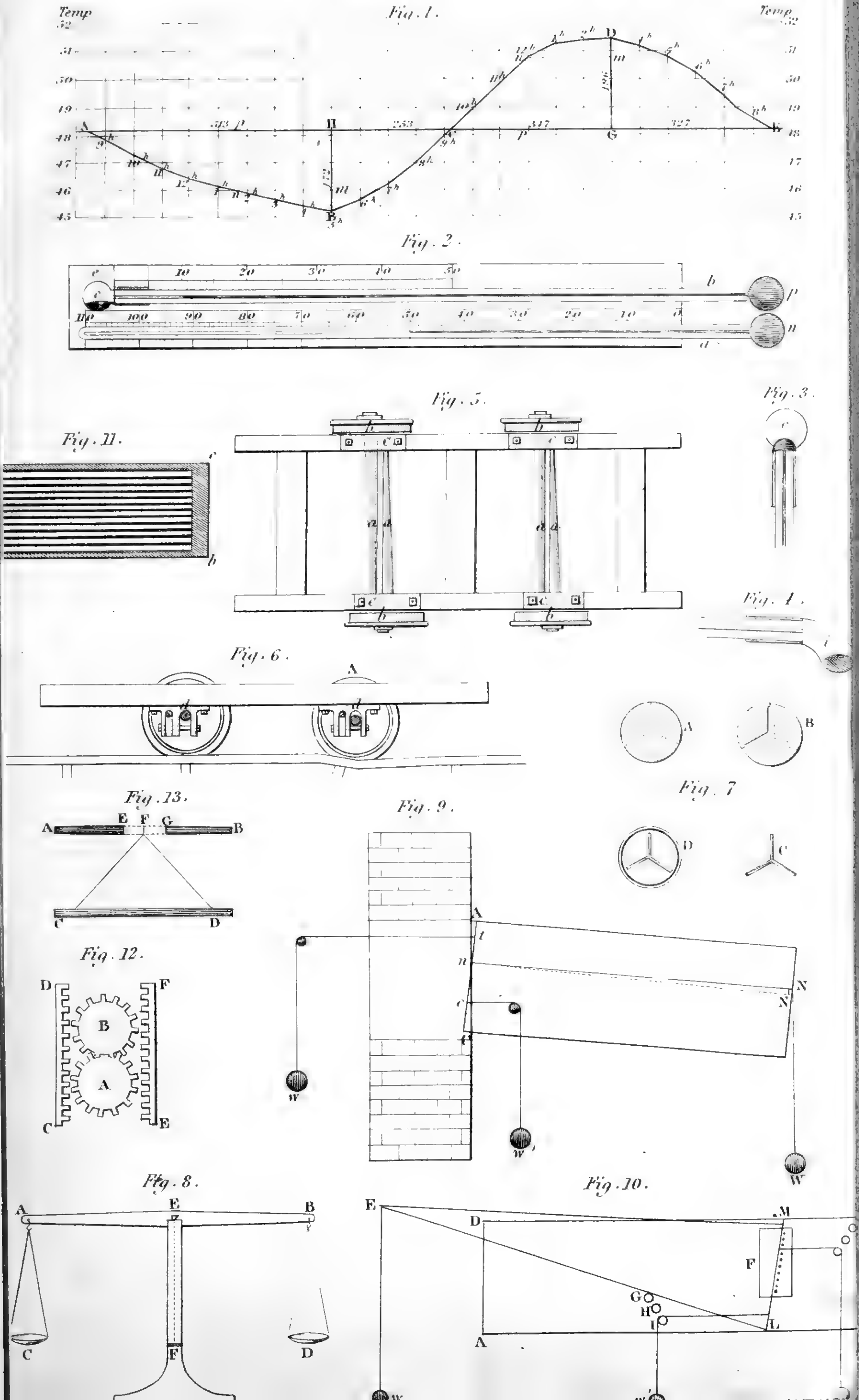
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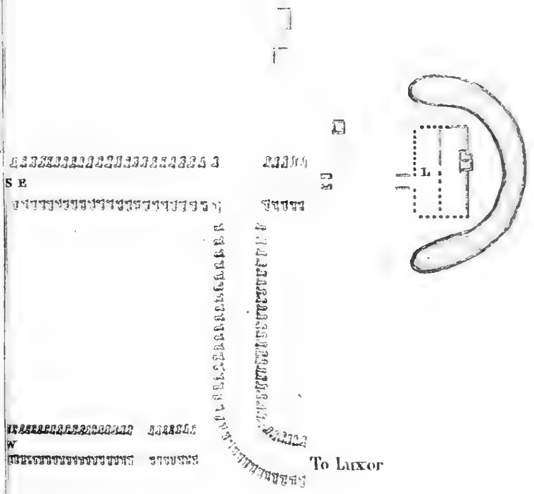

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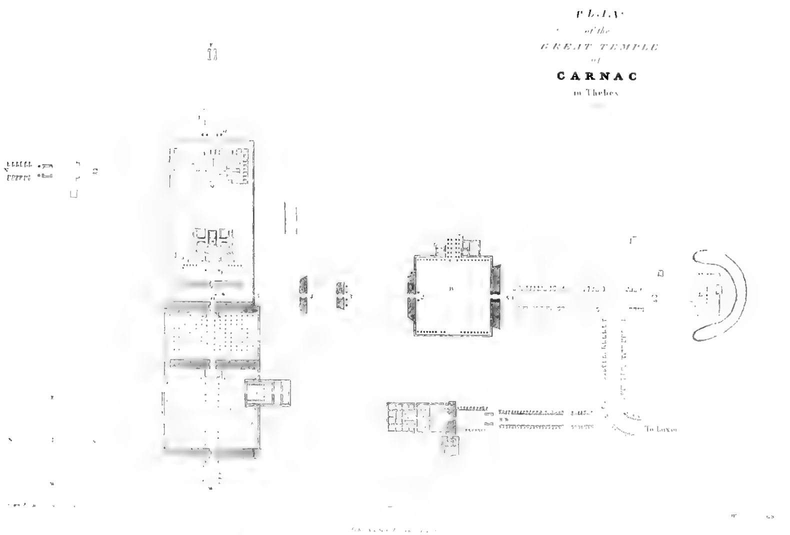

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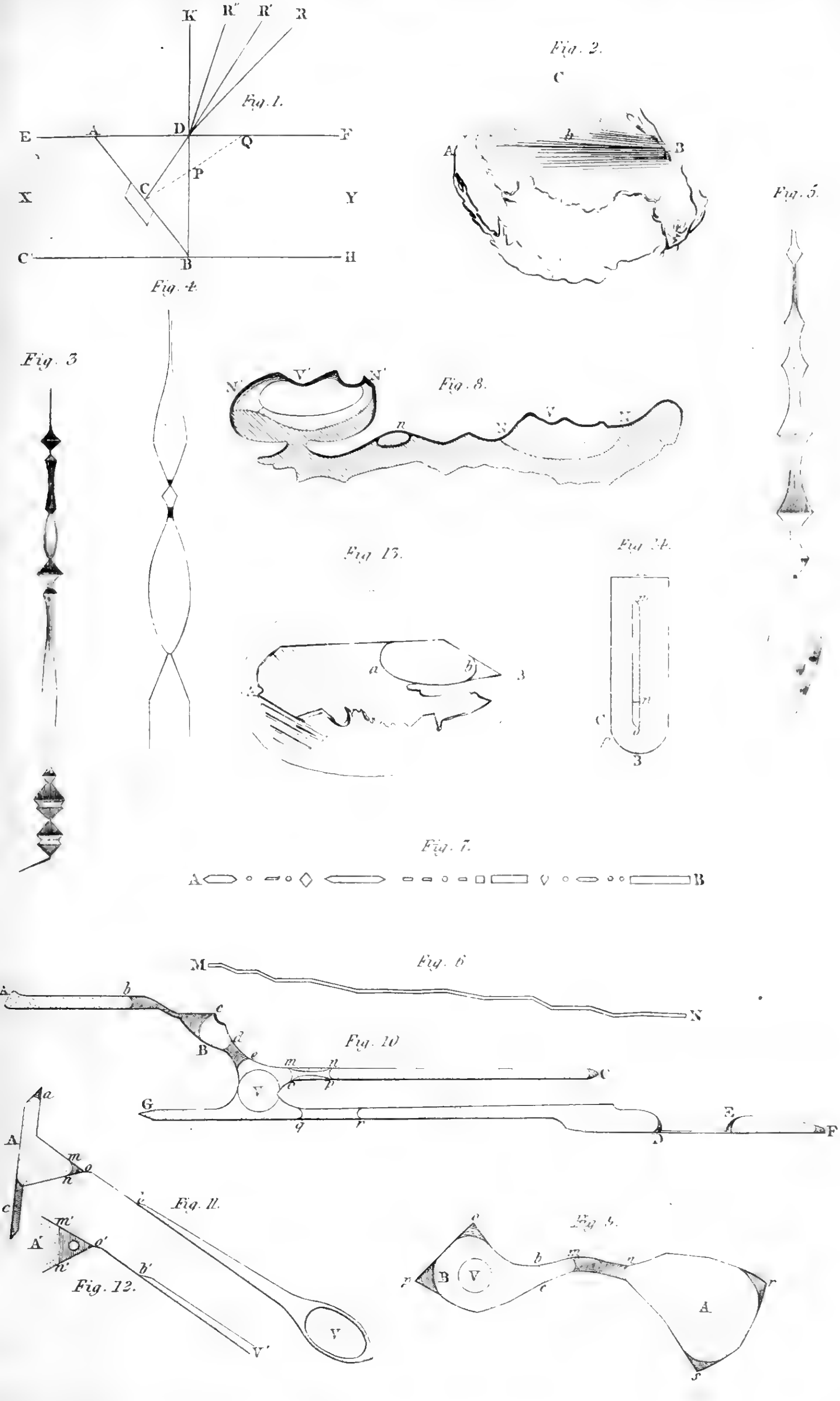

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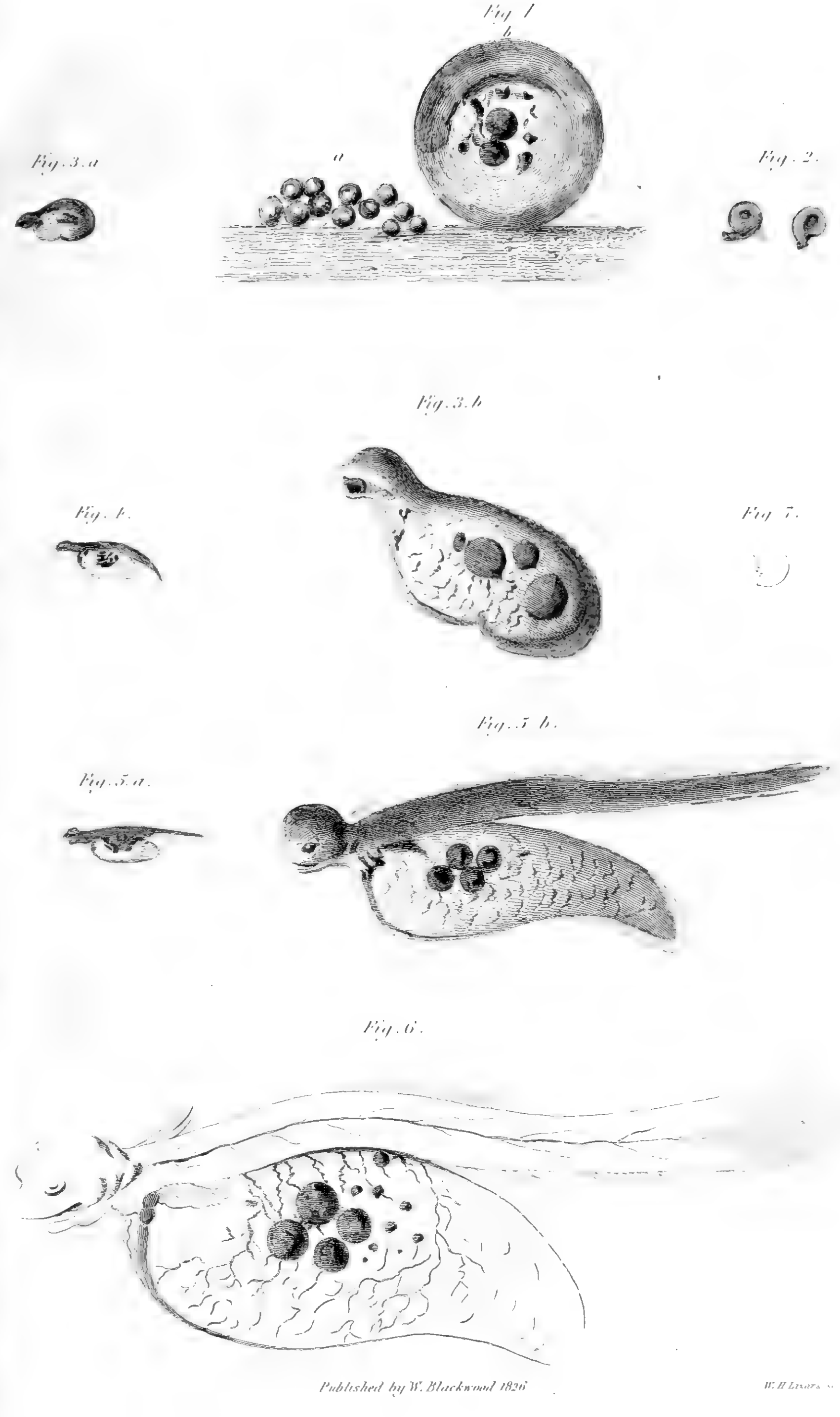

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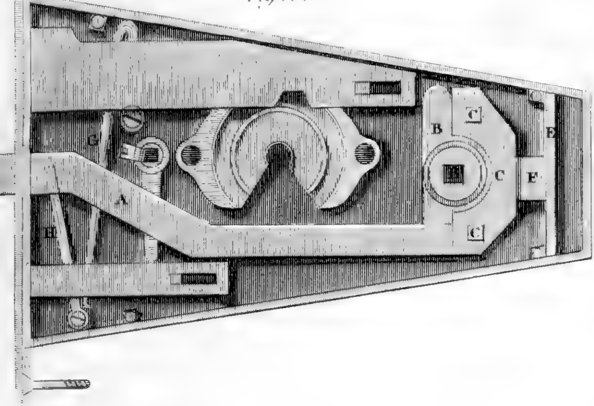

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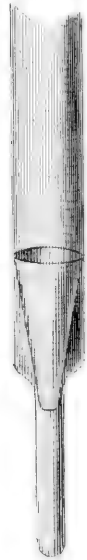

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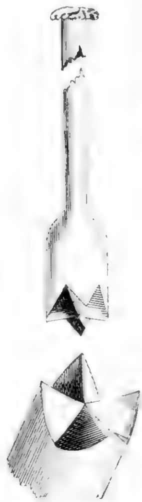

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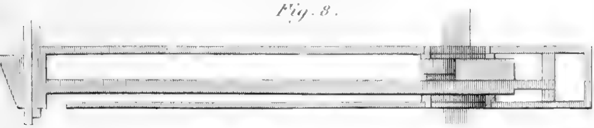

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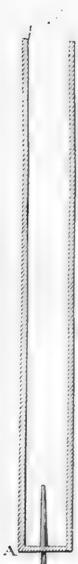

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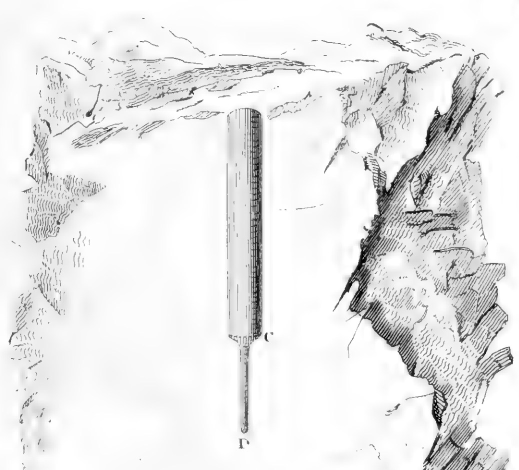

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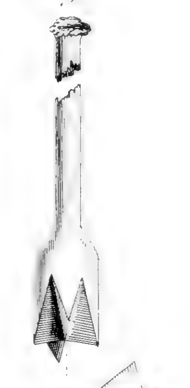

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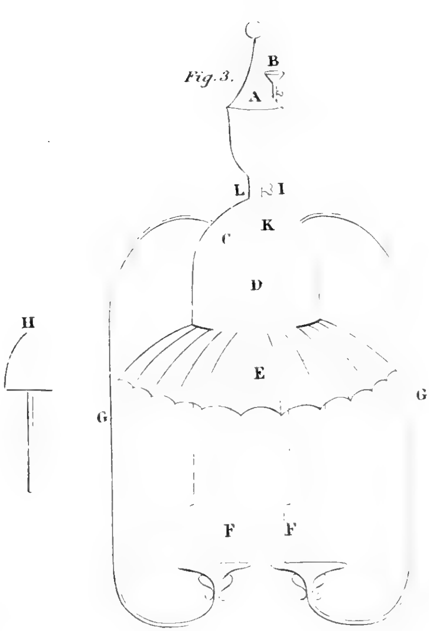
Fig. 3.



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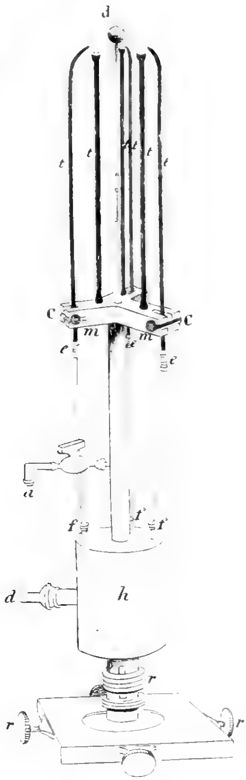

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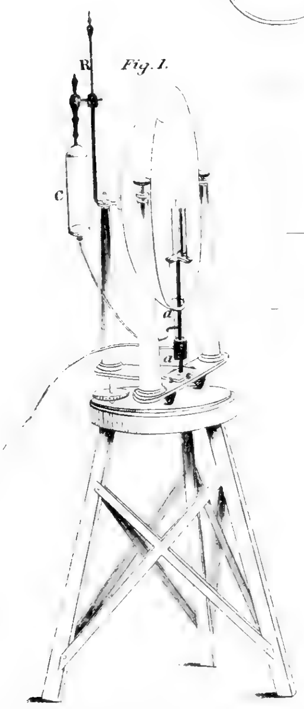

One Inch to Eighteen Inches

One Inch to four Inches

W. H. Lizars sc.

Published by W. Blackwood 1826.

THE

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Art. I.—*Biographical Memoir of* Mark Augustus Pictet, Professor of Natural Philosophy at Geneva, Corresponding Member of the Institute of France, and Fellow of the Royal Societies of London and Edinburgh, &c.

There are few of the philosophers of the present age who have a greater claim to the admiration and gratitude of posterity, than that venerable individual whose life we are about to survey. Some there are, whose talents have placed them in greater affluence, and elevated them to higher dignities; others there may be, whose discoveries have shone with a more brilliant lustre, and illuminated a wider range of science; but there are none who possessed, in a more eminent degree, the genuine bearing of a philosopher—who laboured with more enthusiasm in exploring the mysteries of science—or who cherished a purer devotion in studying the laws, or in contemplating the wonders of the physical world. In a degenerate age, when the fair empire of science is assailed on one side by the despotism of intellectual pride, and overrun from the other by hordes of charlatans, it is refreshing to trace the progress of a powerful mind, uniting to the attributes of a philosopher the accomplishments of a scholar and a gentleman, and directing its energies to the interests of his country, and to the amelioration of his species.

The individual who possessed these qualities, was born at Geneva in 1752, and was descended from an ancient family, who had distinguished themselves in that interesting city.

After receiving a private education under his father's roof, young Pictet went to the upper schools, and after pursuing, as was then the custom, the study of belles lettres and philosophy, he entered the faculty, and was received advocate. A passion for the physical sciences, however, which no professional views could extinguish, had seized upon his mind; and he seems to have devoted himself, without hesitation, to the pleasures and the moderate prospects of a scientific life.

J. A. Mallet, who had gone to Paris to observe the transit of Venus in 1769, was at that time professor of astronomy at Geneva, and De Luc, Bonnet, Trembly, and De Saussure, were pursuing with ardour the natural sciences. With such men to direct and encourage him, M. Pictet entered upon his career under the most auspicious circumstances. From being the pupil, he soon became the assistant of Mallet, and he had the good fortune to accompany and assist De Saussure in those scientific travels through the Alps, which have immortalized the name of that distinguished philosopher. While De Saussure explored the geology and natural history of that interesting portion of the globe, M. Pictet carried on, under his direction, the measurement of heights, and conducted the experiments in electricity and magnetism. On his return from these excursions, he pursued his astronomical studies with Mallet, and carried on original researches of his own, respecting the variations of temperature in the lower strata of the atmosphere. These experiments were performed in the village of Cartigni, near that of Avulli, where professor Mallet had erected an observatory.

About this time some of the enlightened inhabitants of Geneva, among whom was M. De Saussure, founded the *Society of Arts* of that city. M. Pictet, though then very young, took an active part in that new establishment. In the first volume of its transactions, he communicated a paper, entitled *Considerations sur Meteorologie, et resultats d'observations faites à Geneve pendant l'année* 1778; and he also composed the preface to the second volume.

In consequence of the ill health of M. De Saussure, M. Pictet had occasionally supplied his place as professor of natural philosophy; but in 1786 this distinguished traveller, worn out with labour, and threatened with a serious indisposition, resigned his chair in favour of our author. This important situation he held during the whole of his life; and from the elegance of his personal appearance, the agreeableness of his elocution, and his talent for perspicuous and experimental illustration, he discharged its duties with the greatest success.

This was the period of the renovation of Chemistry, when a few superior spirits, throwing off the trammels of ancient systems, gave a new impulse to physical inquiry. The gaseous substances were discovered; water and air were decomposed; minerals were reduced to their elements, and new fields of research were laid open to the ambition of the philosophic inquirer. M. Pictet participated in the general ardour, and he published in 1791, his *Essai sur le Feu*, a work which added greatly to his reputation, and became the ground-work of many celebrated inquiries. Here he demonstrated the reflection of radiant heat, and the apparent reflection of cold. He discovered many new facts respecting the passage of heat through bodies; and he determined the distribution of heat in the lower strata of the atmosphere, and at different times of the day and the night. The last of these experiments have led to the explanation of the phenomena of Dew; while the former conducted M. Prevost to his beautiful theory of the moveable equilibrium of heat, which, though assailed in this country * by shallow reasoning and vulgar abuse, is now adopted by every philosopher in Europe.

When M. Pictet had thus laid the foundation of new and extensive researches, his career was interrupted by the political pestilence which had sprung up in Europe. The horrors of the French revolution were soon felt at Geneva, and this peaceful city was involved in all the calamities of faction and anarchy. The position which M. Pictet took amid these disasters, was that of a patriot and a Christian. He strove to reconcile the contending parties. He exposed his own life in order to protect the magistracy from the fury of a blinded populace; and he took up arms in defence of the

* *Supplement Encylopædia Britannica.* Article Dew.

established government. When Geneva and all her sacred institutions became the prey of her sanguinary assailants, M. Pictet did not abandon his fallen country. The spirit of the patriot rose in proportion as that of his country fell; and when his arm, and that of his fellow-citizens, was no longer able to smite or to save, he called forth all the gentleness of his nature to sooth the exasperated passions, and calm the troubled spirits of his countrymen. Amid the violent arrests and the bloody scenes which marked the revolutionary crisis, the house of our author was respected as the asylum of science and of patriotism.

During these convulsions, M. Pictet lost the whole of his fortune, and, by a series of distressing events, his income was reduced to the small honorarium of his professorship. This unexpected change of circumstances he sustained with the fortitude of a Christian. He introduced into his family the most severe economy, and attempted, as he then jocularly observed, to resolve the problem, of the least expence at which a man could live.

When this political storm had begun to abate, Professor Pictet conceived, along with his brother Charles Pictet, and his friend F. G. Maurice, the plan of a periodical work, to be published in monthly numbers, under the title of *Bibliotheque Britannique.* The original object of this Journal, which commenced in 1796, was to give an account of all the works, and of all the remarkable discoveries published in England, relative to literature, science, medicine, and agriculture. This work soon attracted general attention; and every exertion was made by the editors to sustain and extend the reputation it had acquired. By procuring, at a great expence, English journals, and works of all kinds; by giving spirited and faithful abstracts of them; and by liberal and candid accounts of all the new discoveries in science, this Journal has acquired a character, which we trust it will long retain. No jealousies mingled themselves with its criticisms; no malevolent passions warped its opinions; no ignorant charlatan was allowed to administer in its pages. A sincere and a just spirit seemed to preside over its management; and men of science of all countries were delighted to find, that there existed at Geneva individuals of high names, and profound knowledge, who appreciated labours, which, in their own country, had been overlooked from ignorance, or persecuted from malignity.

Such was the reputation of our author, that, on the 5th of May 1791, he was elected a fellow of the Royal Society of London; * and he received the same honour from the Royal Society of Edinburgh, on the 27th June 1796.

When the republic of Geneva was united to France in 1798, Professor Pictet was one of the fourteen citizens who were chosen to draw up the articles of this unequal contract; and he succeeded in procuring for his countrymen full liberty of worship, the possession of their ancient patrimony, and the management of their own establishments.

In the year 1801, Professor Pictet paid a visit to England, Scotland, and Ireland, where he spent three months examining the state of the arts and sciences, which at that time was but little known to the rest of Europe. He gave a detailed account of this journey in a series of letters to his colleagues, which appeared in successive numbers of the *Bibliotheque Britannique*, † and which were afterwards published in a separate volume.

In the year 1802, Professor Pictet was appointed a tribune by the First Consul, and in 1803 he became one of the secretaries to the Upper Body. Upon the suppression of the tribunate, he was nominated one of the five inspectors-in-chief of the Imperial University of France, a situation which was highly agreeable to him, and which he retained as long as Geneva was united to France. During his occasional residence at Paris, which the duties of this office imposed upon him, he was named a member of the consistory of the reformed church. In this situation, he was enabled to promote the interests of the reformed church in Geneva, by bringing it into correspondence with that of France; and he afterwards

* In the year 1791, Professor Pictet communicated to the Royal Society a paper, entitled, *Considerations on the convenience of measuring an Arch of the Meridian, and of the Parallel of Longitudes, having the Observatory of Geneva for their common intersection*, which was published in the *Phil. Trans.* for 1791, vol. lxxxi, p. 106.

† See Tom. xvii., xviii., xix., xx., and xxi.

added to this obligation, by his zeal and success in improving its psalmody and sacred music.

In 1814, when the Imperial Government of France sunk under the efforts of the allied sovereigns, Professor Pictet was one of the first to hail the deliverance of his country. The writer of this notice had the happiness to see him a few months after this event in the midst of his family and his fellow citizens, and to witness the delight with which he looked forward to the renewal of his former relations with our happy island.

The great changes which had now taken place in the relative position of the European governments, induced our author, in 1816, to give a new form to his Journal. He now adopted the title of *Bibliotheque Universelle*, under which he was enabled to give an account of the discoveries and productions of every part of Europe.

In the spring of 1818, Professor Pictet made a second tour to England and Scotland, with the view of placing his grandson, M. C. Vernet, in Edinburgh. The writer of this notice was fortunate enough to meet him on this occasion in the scientific circles in London, and to accompany him, and the celebrated Baron Cuvier, to several of the public works and institutions of the metropolis. We accompanied him also in his journey to Edinburgh, and had numerous opportunities of witnessing the respect and affection with which he was everywhere received.

On his return to Geneva in 1818, he directed his attention to the various public institutions, of which he was always the leading and the most active member. He was the Genevese president of the Helvetic Society of the Natural Sciences, which was founded by M. Gosse, after the separation of Geneva from France; and, during two years, he was never absent from any of its meetings. He was also the president of the Society of Arts at Geneva; and, in this situation, he was brought into contact with the most eminent artists of that city, to whom he gave the most important assistance in perfecting their inventions and improvements.

Meteorology was one of the favourite studies of our author. He was the first who conceived the idea of instituting observations on some of the highest mountains of Europe; and, several years ago, he established, at the convent of the Great St Bernard, a set of meteorological instruments, which have been used by the monks of that establishment, and the results of which are published every month in the *Bibliotheque Universelle.* After visiting this convent, he was struck with the rigour of their lengthened winter, and the diseases to which it gave rise; and, by setting on foot a subscription in different parts of Europe, he raised a sum, by which their convent was not only enlarged and repaired, but also warmed with stoves and pipes for conveying heated air.

Some years afterwards, he formed the project of erecting a meteorological observatory upon Mount Ætna, as the most southern part of Europe. In order to have this scheme carried into effect, he set off for Sicily in 1820; but the political disturbances which then agitated Italy, rendered it prudent to spend the winter in Florence, where he waited in vain for a favourable opportunity to set out for Palermo. This disappointment, however, enabled him to visit the most eminent philosophers in the north of Italy, with whom he made many interesting experiments, an account of which he has published in the *Bibliotheque Universelle* for 1821.*

In the year 1822, in the 70th year of his age, Professor Pictet assisted in the observations of the fire signals made upon Mont-Colombier above the Seyssel, and which, under the direction of M. Carlini, were employed to connect the observatory of Geneva with those of Milan and Paris.

Towards the end of the year 1824, he began, for the first time, to feel the influence of age. His physical strength was no longer sufficient for the numerous duties which he had been in the habit of performing; and, at this period, the death of his brother, to whom he was dearly attached, produced an effect upon his health from which he never recovered. He was seized with a violent disease, which baffled the skill of his physicians, and he died on the 19th April 1825, in the 73d year of his age, and less than four months after the death of his brother.

There perhaps never was a man who united, in such a

* See Tom. xvi. p. 176, 286, and 296; and Tom. xvii. p. 25.

remarkable degree, as Mr Pictet did, all the qualities which constitute perfection. Tall and handsome in his person, elegant in his manners, lively and gay in his conversation, he gained the affections of those who were unable to judge of his more solid acquirements. Those graces of his external nature, however, served only as the ornaments of his intellectual and moral frame. He was acquainted with most of the living languages. He was a musician, an astronomer, a mineralogist, a natural philosopher, and an elegant writer. Quick of apprehension, he did more in a day than others did in a week. He was at all times fit for labour, and, during fifty years of his life, he was the soul of all the improvements in the arts, in the schools, and in the philanthrophic establishments of his native city. To these qualities he added those of the most unaffected piety, and of unbounded charity. He was a Christian in heart and in practice. The death of such a man must, in any country, be a public loss; but in a small community like Geneva it is irreparable; and centuries may elapse before the high accomplishments and estimable qualities of M. Pictet are again united in the same individual. *

Art. II.—*On the Polarisation of Sound, in a different manner from that described by Mr Wheatstone.* By W. Weber. †

A pitchpipe sounds strongest when its broad side is turned to the ear, but the tone is nearly as strong when the pitchpipe is turned 90° round the axle of its handle, so that both the small sides of both branches become parallel to the *shell* of the ear, while it might be expected that the weakest undulations of sound would be conveyed to the ear by the vibration of these parallel-sided branches. These strong spreadings of the sound, in two directions, forming a right angle to each other, does not depend upon the form and position of the terminating planes

* For the principal facts in this biographical sketch, we have been indebted to the Eloge of M. Pictet, by M. Vaucher, in the *Bibl. Univers.* tom. xxix. p. 65.

† Translated from Schweigger's *Jahrbuch der Chemie und Physik*, b. xvii. heft. I. 1826, p. 108.

of the instrument. For, as in this case, the broad, as well as small sides of a common pitchpipe have smooth simple edges, as was the case with a triangular pitchpipe with which several experiments were made; the strength of the spreading of the tone shows itself by turning one of these edges to the ear in the same manner as when the side was turned into that position.

On the contrary, the tone will be weaker, if the broad and small surfaces of the branches of an usual pitchpipe, having carved edges, is directed to the ear; and, in a particular direction, (about the direction of the diagonal of a right angle which terminates the upper end of the branches,) the tone is extinguished altogether. This extinction of the tone, and the position in which it takes place, depends upon the relation between the breadth and thickness of the branch, but it is independent of the form and position of the terminating sides of the branch, in the same manner as the appearance of the increased strength of the sound was independent of the two right-angled arrangements placed under each other. For when, in the place of the edge of the common pitchpipe, sides are presented similar to those in the triangular pitchpipe, the vanishing of the tone takes place when one of these sides is turned to the ear.

In the same manner, the tone is heard when the two small right angles is turned to the ear, which terminate the end of the branch of the pitchpipe of the usual form. If we gradually turn the pitchpipe round one of these right-angled terminating edges, as if round an axle, so that one lateral surface of the pitchpipe begins to turn to the ear, the tone becomes weaker, and, in a particular position, entirely vanishes—again reappears in continuing to turn, and reaches its greatest strength when the lateral surface is completely parallel with the *shell* of the ear. This appearance does not arise from the varying influence of the two turning branches; since it takes place when one branch is entirely separated from the other branch, by being covered with a tube.

Table of the Changes of Position in which the Tone Vanishes, by changing the proportion of the breadth of the branch to its thickness.

Pitchpipe which gives the sound $\bar{a}$.	Breadth of the Branches.	Thickness of the Branches.	Distance of the Plates.	Angle of the Position at which the Sound Vanishes.	Number of Experiments.	Greatest Deviation of the Experiments from the Mean.
No. 1.	3.5 lines.	1.1 lines.	4.8 lines.	$144\frac{1}{4}$	8	$2\frac{1}{2}$
No. 2.	2.9	1.75	2.4	$139\frac{1}{2}$	8	4
No. 3.	2.5	1.5	4.1	134	10	4

With a pitchpipe whose branches were equilateral triangular prisms, the angle of the position in which the tone vanished, with the side of the pitchpipe parallel to its breadth, is $124\frac{1}{2}°$. These facts will appear more distinct in following some experiments of the celebrated philosopher Dr Chladni. After this accomplished acoustician proved the truth of what has been already stated, he proceeds to call our attention to the propriety of denominating these experiments Polarisation of Sound, rather than Wheatstone's Experiments; and devised this ingenious mode of satisfying with ease a whole assembly of these facts.

As M. Savart first called our attention to the strengthening of sounds by the mere presence of any organ-pipes tuned to accord, and as, by means of Chladni's instrument, in which iron rods gave the tone, much depended on the accurate tuning of the rods, Chladni has likewise made use of this means of augmenting the tone, by placing the vibrating rods over common small phials, which gave a tone by blowing on them.

Instead of the organ-pipes, Chladni used common wide-bellied medicine glasses of one or two ounce capacity, and tunes them, when, by blowing on them, they gave a deeper tone than the pitchpipe, by pouring water into them, (so as to lessen the air column in the glass exactly in the same manner as a closed organ-pipe is shortened,) so as to bring them into accord with the pitchpipe. As soon as this happens, the sound of the pitchpipe held over the glass becomes stronger. And if the pitchpipe, when struck, is now turned before the mouth of the small tuned ounce glass in a circle, (in the same manner as formerly before the ear,) the tone becomes four times stronger, and four times again vanishes, when it is, as formerly, placed in the diagonal position.

This experiment may be equally well performed with closed glass rods, as, according to Chladni's method, when tuned by water poured in; but the wide-bellied phials are most convenient. Moreover, it is easily seen, that, in this manner, the position of the vanishing tone corresponds correctly enough with the established position of the pitchpipe, and the angle of polarisation (if we may so express it) of the sound may be measured with exactness.

Perhaps the experiment corresponds with this, that a pitchpipe quickly turned upon the axis of its handle ceases to give out its tone to the air, which again appears when the turning is suddenly stopped.

Art. III.—*On the History of the Experiments on the Magnetism exhibited by Iron in Rotation.* By Samuel Hunter Christie, Esq. M. A. of Trinity College, Cambridge, Fellow of the Cambridge Philosophical Society; of the Royal Military Academy. In a Letter to the Editor.

Dear Sir,

As the article in the last number of your valuable *Journal*, giving an account of some of Mr Barlow's and my experiments "on the magnetism of iron as exhibited by rotation," contains statements which tend to convey very erroneous ideas respecting the discovery of the influence which the rotation of iron has on its magnetism, I feel that I cannot avoid making some remarks on that article, although it is with great repugnance that I notice circumstances connected with the subject.

That there is a considerable inequality in the magnetism of different parts of a piece of sheet-iron, every one must have observed on bringing it near to a magnetised needle, and the method adopted by Mr Barlow of combining two plates, so that the "opposite qualities" should come in contact, is that which immediately suggests itself for counteracting this inequality of action; but I am at a loss to see any connection between Mr Barlow's having so combined two plates, and the experiments in which I was engaged when I first discovered that the magnetism of iron is affected by rotation. I am not aware of Mr

Barlow having made any experiments with an iron plate to which your correspondent could refer mine as a repetition or even extension; but as he very pointedly so refers them, I am under the necessity of giving an account of the only connection between any experiments of mine on the magnetism of soft iron, and those in which Mr Barlow had been engaged. In the spring of the year 1819,* Mr Barlow informed me that he had found there was a plane passing through the centre of a sphere of iron, in which, if the centre of a magnetised needle were any where placed, the iron would in no case cause deviation in the needle. He did not, however, at the time, state to me from what experiments he drew this conclusion, but wished to have my opinion on the cause of the existence of such a plane, and likewise that I should witness some of his experiments. Previously to my doing this, I pointed out the nature of the deviations of the needle that ought to take place in different positions of the iron sphere, according to a particular view which I had taken of the subject, and the result in all cases perfectly accorded with those which I had predicted. I was immediately afterwards induced to make an extensive series of experiments with an iron ball, in order to ascertain how far the peculiar views which I had taken were correct, but quite unconnected with Mr Barlow's inquiry, which, at the time, was wholly practical. An account of these experiments is given in a paper in the first volume of the *Transactions of the Cambridge Philosophical Society.* In the first edition of his "*Essay on Magnetic Attractions,*" Mr Barlow has given a brief statement of my views of the subject at that time, and, by a reference to p. 113, you will see that, by adopting these views, Mr Barlow was then enabled to correct some of the laws which he had deduced. Your correspondent has thought proper to state, that I was adopting Mr Barlow's views, by conceiving an ideal magnetic sphere to circumscribe the needle. By referring to p. 21 and p. 28, first edition, p. 23 and p. 30,

* It was at this time that Mr Barlow's earliest experiments with an iron ball were made, and some time afterwards he proposed correcting the local attraction of a ship by means of an iron plate; but the account of this method was not published until 1820, instead of 1818, as stated in your *Journal.*

second edition, "*Essay on Magnetic Attractions*," you will find that Mr Barlow's ideal sphere was in all cases described about the centre of the iron ball, and that it was only when he adopted the views which I had suggested respecting the deviations of the dipping-needle being referred to the horizontal plane, and according to which views I required a magnetic sphere to be described about the needle, that he so conceived it to be described.

Shortly after making the experiments to which I have referred, I had an instrument constructed, by means of which I avoided the preliminary laborious calculations for fixing the iron sphere and compass in required positions, but with this it became necessary to substitute a circular plate of iron for the heavy eighteen inch shell with which I had been previously experimenting. With this instrument, I commenced a series of experiments near the end of May 1821, and in endeavouring so to adjust the iron plate that, when its centre was on the magnetic meridian, the needle should not deviate from that meridian, I almost immediately (I think on the 4th June) discovered, that the simple rotation of iron had a considerable influence on its magnetic properties. I think your correspondent must allow that this discovery, so made, was quite independent of any experiments by Mr Barlow.

As I considered that the correction of the local attraction of a ship, by means of an iron plate, might be sensibly affected by the plate being turned in one direction or another, on applying it to the compass, previously to the sailing of the Leven and Baracouta in February 1822, these vessels being furnished with correcting plates, I communicated to Mr Barlow the discovery which I had made respecting the effects produced on the needle by the rotation of an iron plate, and suggested that the pin on which the plate was to be applied to the compass should be so formed that the plate could only be *slid* on. * At this time Mr Barlow witnessed several of my

* The necessity of a precaution of this kind, under many circumstances, if not under all, has been fully proved during the late voyage of discovery. Lieutenant Foster very obligingly undertook to repeat my experiments on the effects of rotation, with the correcting plate of the Hecla, in the high magnetic latitudes which the expedition was likely to visit, and at Port Bow-

experiments, and I stated to him that, independently of the deviation of the needle caused by the mass of iron, the deviations due to the rotation of the plate were very nearly the same in amount, as would arise from a polarizing of the iron in a direction perpendicular to the line of the dip.

Although, before the end of the year 1822, I had written all but the theoretical part, at the conclusion of my paper, on this subject, which was read before the Royal Society last May, and printed in the *Transactions*, being engaged about that time with other experiments, and otherwise much occupied, I was obliged to defer finishing the paper for a considerable time. In a note to a paper on the effects of temperature, on the intensity of magnetic forces, &c., read before the Royal Society in June 1824, and printed, I, however, stated, that I had discovered that a peculiar polarity was imparted to iron by simple rotation, and mentioned some of the effects produced by the rotation of an iron plate. It is, therefore, evident, that the *publication* of the discovery which I had made of the magnetical effects produced on iron by its rotation, took place at least nine months before we had any account of M. Arago's experiments, and six months before Mr Barlow undertook his, on the effects produced by the rapid rotation of iron. No one, you may be assured, is more disposed than myself to give to Mr Barlow all the credit which is due for his observations; but as he had, for nearly three years previous to making his experiments, been in possession of the facts which I had already observed, and found that the effects he observed were explicable on the same principle of polarization, which I had then pointed out, I think that his experiments must be allowed to be simply a variation of my original ones, whatever importance may be attached to such a variation of the experiment, and that I may justly lay claim to the discovery, that rotation has a considerable influence on magnetism, at least

en, where the dip is more than 88°, he found that, in one position of the plate, its rotation in opposite directions caused a difference of no less than 108° in the directions of the needle in the two cases, the same point, after rotation, being brought to coincide with a fixed mark in both. This was an extreme case, but several of the deviations due to the rotation of the correcting plate amounted to 30° or 40°.

as far as iron is concerned. It is certainly very unpleasant to my feelings to make this statement; but as you have, very erroneously I have no doubt, stated in your *Journal* that it was for his "discoveries respecting the effects of rotation on the magnetic forces," * that the Copley medal was adjudged to Mr Barlow, you must allow that I am called upon to do so in justice towards myself.

As it was considered that Mr Barlow's experiments naturally arose out of those which I had so long before communicated to him, it was agreed between us, that his paper should not be presented to the Royal Society till after mine; and your correspondent is perfectly correct in stating, that the publication of Mr Barlow's was, in consequence, delayed until May, although I must acknowledge I am at a loss to conjecture whence he derived his information. Although this arrangement was rendered nugatory by Mr Barlow's publishing an account of his experiments in the *Edinburgh Philosophical Journal* for July last, I feel fully convinced that it must have entirely proceeded from an oversight, that he allowed the publication to take place so long before the appearance of the paper in which these experiments are detailed in the *Transactions of the Royal Society*; and I likewise am persuaded, that he could have no intention of laying claim to the discovery of the influence which rotation has on the magnetism of iron,—although this early publication of his experiments, without the most distant reference to mine, has certainly such an appearance.

You will easily imagine, that, to enter into the preceding detail, must have been extremely repugnant to my feelings;

* The Editor must take to himself the whole blame of any error in this notice. As the Copley medal was always understood to be adjudged for the best paper in the *Transactions* during the year, and as Mr Barlow's paper on the magnetism of rotation, was the only one he published in the *Transactions* for 1825, we never doubted that the Copley medal was given for the discoveries contained in that paper. This idea was confirmed by the adjudication of another medal to M. Arago, which led to the belief that these two gentlemen thus divided the honour which attached to the discovery of the influence of rotation on the magnetic forces. Mr Barlow's discovery of the neutralizing plate, having been made long ago, we never supposed that the medal had any reference to it.—Ed.

but, at the same time, you will see that I could not avoid it, without a great sacrifice of proper feeling on such a subject. As you have, on all occasions, shown a laudable desire correctly to adjust such questions, you will, I trust, excuse me for troubling you with so much on this subject, and for requesting that you will occupy a portion of your valuable Journal, by giving the earliest insertion to these remarks, in order that the effects of inaccuracies of statement may be as speedily as possible counteracted. I am,

Dear Sir, yours very sincerely,

Royal Military Academy, S. H. Christie.
17*th February* 1826.

Art. IV.—*Observations on the size of the Teeth in Sharks, compared with the Fossil Teeth of an animal analogous to the present Shark, and described by Messrs Lacepede and Faujas St Fond, in the "Annales de Museum."* By Robert Knox, M. D. F. R. S. E., &c. Communicated by the Author.

The fossil tooth of a Shark discovered at Dax, by Mr de Borda, was examined by the Count Lacepede, and found to measure three inches and three lines in length from the base, and three inches in breadth. A comparison of this tooth, with others belonging to the common *Squaluss Carchariu* of Linné, led this distinguished naturalist to conclude, * that, in the former world, previous to the æra of a deluge, there must have existed sharks seventy-nine feet in length. Faujas St Fond adopted these measurements of Lacepede in the determination of the probable length of a shark, a tooth of which, in a fossil state, was brought to him from the quarries of Montrouge, in the environs of Paris, and he concluded, (*Annal. de Mus.* t. ii. p. 107,) that the animal to which the tooth belonged must have been about fifty feet in length, at the least.

The memoir of Mr F. St Fond is accompanied with a

* Tom. i. p. 205.

drawing of the tooth, and its various measurements, which are as follows:

Dimensions of the Fossil Tooth.

	In.	Lines.
The greatest breadth of the part covered with enamel, measured towards the base, is, - -	2	6
The length measured on the enamel of the concave part of the tooth, - - - -	2	3
Length measured on the convex face, - -	2	3

The jaws of a shark killed on the coast of Africa were presented to me by a friend; he, at the same time, informed me, that the animal from which these were taken measured twenty-seven feet. Now, the dimensions of these teeth are as follows:

	In.	Lines.
Greatest breadth as above, - - - -	1	$\frac{6}{8}\frac{1}{2}$
Length of the sides, - - - - -	2	$\frac{1}{8}$
Length of the centre, - - -	1	$\frac{6}{8}\frac{1}{2}$

I have found it difficult to calculate exactly the difference in length and breadth of these teeth, nor do I deem any nice admeasurements of much moment, for I think it evident that we cannot determine, with any precision, the dimensions of a fossil animal, by instituting a comparison between its teeth and those of similar species now existing. But, considering the tooth described by M. Faujas St Fond, as being $\frac{2}{8}$ of an inch longer, which is the case only in certain of its dimensions, we should have, for the length of the animal to which it belonged, about thirty feet, instead of fifty.

In this way the fifty feet shark of St Fond may probably be reduced to thirty, and the seventy-nine feet shark of Lacepede to forty-three; dimensions sufficiently large, it is true, to affect us with astonishment. It would be rash, however, to conclude, that because sharks approaching antediluvian dimensions are but seldom found in the present day, it therefore follows, that even they have partaken of the universal diminution in the size and bulk of all postdiluvian animals,—for we know that sharks, in those days, had at least one enemy less than at present, viz. man, the common enemy to all that lives.

ART. V.—*Results of the Thermometrical Observations made at Leith Fort, every Hour of the Day and Night, during the whole of the Years* 1824 *and* 1825. By DAVID BREWSTER, LL. D. F. R. S. Lond. & Sec. R. S. Ed. Corresponding Member of the Academy of Sciences of Paris, &c. *

IN the year 1820, I had occasion to suggest to the Royal Society the propriety of establishing registers of the thermometer in various parts of Scotland.

In a country embracing so many varieties of soil, climate, and elevation, and extending over nearly six degrees of latitude, it was an object worthy of a public body to determine the law of the distribution of temperature, even if such a subject had not possessed a separate interest in relation to the horticulture and agriculture of the country. The society did not hesitate in adopting this suggestion; and many intelligent individuals were found, who undertook to observe the thermometer twice a-day, and to measure occasionally the temperature of springs and wells. During the first year, viz. 1821, nearly sixty Meteorological Journals were regularly kept in different parts of Scotland. The number diminished considerably in subsequent years; but, notwithstanding this diminution, there is now in our possession a rich series of observations during *five* complete years, the results of which are nearly ready to be submitted to the Society.

In directing these observations, it became necessary to select two hours of the day most convenient for marking the state of the thermometer, and the mean temperature of which approached nearest to the mean temperature of the day. The hours adopted were 10 o'clock A. M., and 10 P. M., which had been previously recommended by the Reverend Mr Gordon. The observations were accordingly made at these hours, during three years; but it appeared to me, upon a more attentive consideration of the subject, that the thermometer should be observed at the two times of the day at

* The following paper is a brief abstract of the original memoir read to the Royal Society of Edinburgh on the 23d January 1826, which is illustrated with five Plates, and will appear in vol. x. Part ii. of the *Edinburgh Transactions*.

which the mean temperature occurred ; for if one of the observations was omitted, the other still possessed considerable value, as an approximation to the mean temperature. Unfortunately, however, there were almost no observations in existence from which the times of the daily mean temperature could be deduced. Professor Dewey of New York had observed the thermometer once every hour, during *five* days at a time, in the months of *March*, *April*, *July*, and *October*, of the year 1816, and during *eight* days of *January*, and *two* of *February*, in the year 1817 ; * and Mr Coldstream of Leith registered the temperature of twenty-four successive hours once every month, from July 1822 to July 1823. From this last series of observations, the mean temperature appeared to occur at half-past seven o'clock in the morning, and half-past eight in the evening ; and these hours were accordingly used in most of the registers for 1824 and 1825. It was very obvious, however, that these observations, though made with great care, were too limited to afford an accurate result ; and hence it became desirable to record the indications of the thermometer for every hour of a complete year.

As such a plan could only be carried on with effect at a military station, Leith Fort was considered the most eligible. Application was, therefore, made to Colonel Thackeray, commanding the engineers, and to Colonel Younghusband and Mr Street, of the artillery ; and, as these gentlemen entered warmly into the scheme, preparations were made to begin the register on the 1st of January 1824. A large and accurate thermometer was constructed by Mr Adie for the purpose, and it was placed in a situation as free as possible from all disturbing causes. Its height above the level of the sea is twenty-five feet, and its distance from the sea 200 yards.

The register commenced on the 1st day of January 1824, and has been regularly and zealously carried on by the non-commissioned officers of the Fort for two complete years.

In reducing these observations, Mr Foggo junior of Leith computed all the hourly, monthly, and annual means for the year 1824, and Mr C. Bell made the same calculations for 1825. These mean results are given in the following Tables :

* *Mem. American Acad. of Arts and Sciences,* vol. iv. Part ii. p. 392.

HOURLY REGISTER FOR 1824.

	Fahr.
The Mean Temperature of the Winter months, viz. *Dec. Jan. Feb.* is - - - - - -	40°.67
The Mean Temperature of the Spring months, viz. *March, April, May,* - - - - - -	45 .38
The Mean Temperature of the Summer months, viz. *June, July, Aug.* - - - - - -	57 .24
The Mean Temperature of the Autumn months, viz. *Sept. Oct. Nov.* - - - - - - -	47 .91
The Mean Temperature of the Year 1824, from 8784 observations, is - - - - -	47°.81

TABLE I.—*Containing the Daily and Monthly Mean Temperatures for* 1824.

Day.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	42.55	42.69	35.19	33.49	55.00	57.12	55.85	57.00	62.80	56.00	44.53	32.07
2	43.52	42.69	32.72	39.36	52.25	55.10	57.92	56.86	67.65	51.15	44.80	32.34
3	40.47	42.52	33.77	37.39	47.00	58.61	55.95	57.05	67.78	53.25	39.83	30.92
4	43.79	40.82	35.25	39.50	47.80	56.80	57.97	57.54	60.36	52.72	36.33	28.11
5	44.38	38.69	38.34	43.62	49.81	56.07	55.44	55.89	56 69	51.42	35.87	28.83
6	40.69	40.03	44.52	44.33	46.81	52.63	58.29	55.70	54.10	52.90	35.63	38.54
7	36.50	49.63	43.29	45.06	50.67	60.98	58.75	57.38	58.18	53.79	49.30	38.39
8	45.30	46.40	38.83	44.58	51.98	55.83	63.64	61.37	50.00	54.09	45.76	35.39
9	50.08	41.76	36.50	45.01	51.23	53.00	62.22	58.88	49.96	48.42	44.76	35.39
10	45.67	43.21	35.83	37.92	49.94	51.63	58.18	57.43	51.79	44.39	45.94	34.79
11	39.90	40.04	38.32	37.55	47.38	50.15	58.92	56.79	57.09	46.42	43.32	48.15
12	43.31	43.36	36.82	39.87	47.15	53.87	60.27	55.94	57.00	41.60	39.52	50.28
13	42.26	39.51	36.15	39.27	47.25	55.45	57.75	56.48	57.29	39.03	49.00	48.40
14	39.30	39.37	38.41	40.60	45.25	51.78	66.24	57.22	59.36	44.15	43.23	48.60
15	32.41	34.91	44.22	41.42	47.70	51.86	64.51	58.73	58.39	38.34	35.78	46 10
16	33.37	36.53	46.16	37.88	48.16	53.37	58.81	56.67	60.40	37.44	45.90	38.59
17	38.26	37.65	46.02	41.68	51.34	53.01	58.35	55.58	61.61	37.56	52.15	37.79
18	44.01	38.07	48.00	46.35	47.64	54.45	57.23	54.39	61.78	44.22	42.49	44.09
19	40.56	41.30	45.05	51 52	43.63	53.12	58.13	57.07	54.30	49.98	41.12	49.24
20	41.93	41.07	50.03	54.93	42.50	52.87	61.29	56.03	51.81	48.48	41.52	36.94
21	39.33	41.07	45.34	55.47	44.77	54.03	60.99	53.79	51.06	49.00	41.39	37.53
22	39.32	42.01	38.95	52.27	48.09	55.38	65.73	52.82	56.66	54.50	40.06	35.45
23	38.60	41.51	38.67	48.90	52.77	54 09	63.35	56.10	54 44	53.53	42.64	34.11
24	40.31	41.36	41.37	51 46	54.54	54.57	56.92	58.35	53.44	52.97	45.27	40.33
25	48.04	40.72	42.29	52.64	57.18	56.57	58 72	56.63	50.51	53.96	41.68	46.94
26	51.58	37.83	41.15	53.95	56.75	57.75	59.04	56.67	42.79	48.88	39.12	35.99
27	43.59	38.19	39.99	51.01	59.75	58.78	58.70	55.69	39.70	42.22	36.41	44.39
28	38.69	40.05	39.18	53.58	56.29	59.45	60.53	54.33	40.30	40.28	40.48	39.80
29	36.47	40.73	41.68	55.16	49.62	60.49	61.97	57.62	41.90	38.80	40.01	39.78
30	38.54		37.85	57.90	55.16	60.69	55.37	54.23	55.33	39.17	34.20	41.18
31	45.20		33.86		52.46		56.06	57.01		48.87		46.93
Means,	41.599	40.83	40.12	45.79	50.24	55.65	59.46	56.62	54.57	47.23	41.94	39.57

HOURLY REGISTER FOR 1824.

TABLE II.—*Showing the Mean Temperature of each hour for each Month of 1824, and for the whole Year.*

r.	Jan.	Feb.	Mar.	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Temp. of each hour for the whole year.
M.	41.19	39.9	38.3	42.63	46.56	52.6	55.4	53.3	52.3	46.17	40.4	38.69	45.62
...	40.8	40.03	38.3	41.6	46.03	52.3	55.2	53.2	52.1	46.17	40.4	38.71	45.40
...	40.8	39.95	38.07	41.00	45.3	52.1	55.1	52.9	51.4	46 07	40.5	39.02	45.18
...	40.28	39.68	37.9	40.08	44.7	51.8	54.9	52.5	51.1	46.2	40.47	38.9	44.93
...	40.07	39.62	37.65	39.8	44.9	51.8	55.2	52.7	51.2	45.6	40.45	38.8	44.82
...	40.1	39.44	37.45	39.9	45.7	52.7	55.8	53.3	51.6	44.8	40.50	38.9	45.00
...	40.23	39.27	37.77	42.2	46.9	53.1	56.9	54.5	52.1	45 3	40.7	38.8	45.64
...	40.3	39.02	38.3	43.1	48.3	54.3	58.2	55.5	53.4	45.9	40.8	38.8	46.32
..	40.64	39.93	39.13	45.9	49.8	55.2	59 7	56.8	55.0	46.6	41.3	39.0	47.41
...	41.15	40.74	39.47	47.3	51.1	56.2	60.56	57.9	55.6	47.5	42.1	39 3	48.24
...	41.54	41.35	41.13	48.2	52.3	57.3	61.5	58.7	56.5	48.5	43 1	40.4	49.21
...	42.3	42.22	42.23	48.9	53.3	57.8	63.2	59.5	57.5	49.3	43.9	41.0	50.09
M.	42.83	42.7	42.7	49.3	54 2	58.0	63.2	59.8	58.5	49.9	44.2	41.2	50.45
...	43.15	42.7	42.8	49.8	54.7	58.9	63.2	60.0	58.7	49.9	44.7	40.9	50.79
...	43.18	42.67	42.9	50.1	54.7	59.9	63.5	60.0	58 8	49.6	44.7	40.33	50.89
...	43.00	42.03	42.6	49.9	54.7	59.1	63.6	60.1	57.8	49.07	43.4	39.9	50.43
...	42.22	41.4	41.9	49.5	54.1	58.7	63.4	59.7	57.8	48.4	42.8	39.72	49.97
...	41.98	40.9	41.07	49.1	53.2	57.7	62.6	59.1	57.0	47.9	42.4	39.52	49.38
...	41.7	40.53	40.2	47.8	52.4	56.9	61.7	58.0	55.8	47.2	42.1	39.19	48.64
...	41.35	40.2	39.6	46.5	50.9	55.7	60.3	56.8	55.07	46.73	41.7	39.00	47.90
...	41.3	40.2	39.2	45.3	49.4	54.5	58.9	55.9	54.3	46.7	41.3	39.09	47.17
...	41.26	40.03	38.8	44.6	48.9	53.8	57.6	55.0	53.7	46.0	40.8	39.09	46.64
...	41.12	39.9	38.3	43.1	47.8	53.2	56.9	54.3	53.4	45.8	40.4	39.1	46.20
...	40.92	39.9	38.3	42.7	47.1	52.7	56.03	53.8	52.7	45.7	40.3	39.29	45.79

The Mean Temperature obtained from the last column in the above ble, is 47°588. It occurred at 9^h 13′ A. M. and at 8^h 26′ P. M.

HOURLY REGISTER FOR 1825.

	Fahr.
The Mean Temperature of the Winter months, viz. *Dec. Jan. Feb.* is - - - - - -	40°.312
The Mean Temperature of the Spring months, viz. *March, April, May,* - - - - - -	46 .121
The Mean Temperature of the Summer months, viz. *June, July, Aug.* - - - - - -	59 .306
The Mean Temperature of the Autumn months, viz. *Sept. Oct. Nov.* - - - - - -	49 .907
The Mean Temperature of the year 1825, from 8789 observations, is - - - - - -	48°.911

TABLE III.—*Containing the Daily and Monthly Mean Temperatures for* 1825.

Day.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	D
1	45.15	41.31	39.78	42.38	44.71	56.88	55.50	63.77	60.40	53.63	46.35	33.
2	39.83	41.81	37.29	45.89	46.09	58.41	57.81	63.56	59.19	60.36	42.08	36.
3	43.47	32.99	36.13	47.46	49.14	53.61	58.54	63.27	59.30	60.03	42.53	34.
4	37.35	28.72	36.20	49.74	52.73	50.52	59.56	59.60	57.07	58.81	40.36	37.
5	30 32	33.08	36.50	54.18	48.69	49.43	58.66	59.71	55.39	58.38	43.04	37.
6	39.26	34.99	38.24	47.26	52.59	52.35	59.24	58.21	55.99	57.57	41.52	40.
7	44.17	38.51	39.55	49.86	53.19	58.30	58.09	59.06	58.79	53.79	36.04	43.
8	39.80	38.81	44.20	52.11	54.63	57.46	57.05	59.88	55.45	54.48	36.82	44.
9	38.11	42.78	52.46	47.04	54.27	55.24	56.05	57.71	58.30	55.49	35.73	42.
10	35.55	47.11	52.48	48.55	50.77	59.59	55.25	59.37	60.26	56.79	32.37	43.
11	41.48	46.28	44.97	50.13	48.32	65.67	56.26	57.34	58.21	54.00	36.22	44.
12	39.91	46.06	44 18	41.03	48.75	62.71	61.09	56.41	60.55	57.80	33.73	43.
13	42.03	46.98	43 41	40.79	47.50	59.09	65.45	59.74	56.27	54.09	42.32	42.
14	44.75	41.82	37.83	48.62	48.91	60.14	69.94	56.78	56.30	53.57	40.82	38.
15	46.73	41.48	36.40	52.50	49.74	58.85	65.51	57.91	56.79	52.51	36.49	41.
16	43.99	41.79	36.04	50.49	49.05	63.52	66.77	56.88	61.21	54.65	44.12	46.
17	39.38	43.52	36.75	45.06	51.95	60.51	69.63	57.17	62.40	47.16	44.61	45.
18	41.22	41.26	39.07	40.54	53.55	58.45	66.63	59.01	62.59	46.75	45.56	47.
19	39.15	41.78	43.31	42.30	53.41	52.46	62.23	59.07	60.95	46.23	41.14	42.
20	40.09	43.73	40.58	50.49	50.41	52.70	60.02	65.40	59.87	40.24	45.56	42.
21	39.30	40.91	39.78	53.04	49.01	52.09	59.07	64.35	60.34	41.47	45.22	45.
22	37.02	42.63	42.55	46.81	52.14	53.16	59.83	60.41	54.95	42.47	40.76	40.
23	36.33	40.88	40.61	42.76	50.48	57.68	56.63	65.44	49.44	51.07	44.74	40.
24	38.03	40.17	38.12	42.37	46.01	57.59	57.10	57.88	63 49	48 97	43.30	39.
25	34.45	39.08	42.03	42.80	45.60	57.14	63.29	58.04	62.16	40.65	40.43	43.
26	41.30	37.69	42.81	45.28	48.55	52.44	61.01	57.23	56.29	39.26	44.80	35.
27	47.65	38.61	48.70	45.88	47.02	54.35	64.94	58.45	56.59	45.58	35.81	33.
28	38.83	36.75	45.39	47.35	45.18	54.70	60.22	59.21	53.00	52.41	36.44	35.
29	43.88		47.47	47.88	47.96	55.95	61.05	61.92	55.45	50.98	39.84	35.
30	47.62		44.78	48.51	50.17	55.05	68.53	65.35	54.66	51.90	34.63	32.
31	42.93		42.29		52.74		68.20	65.72		46.81		28.
Mean Temp. of each month	40.583	40.412	41.610	46.968	49.785	56.531	61.262	60.125	58.055	51.223	40.443	39.

TABLE IV.—*Showing the Mean Temperature of each Hour for each Month in* 1825, *and for the whole Year.*

Hour.	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Temp. of each hour for the whole year.
1 A.M.	39.073	39.437	39.604	43.350	47.016	52.575	56.935	57.355	55.358	49.984	39.325	39.194	46 648
2......	39.968	39.500	39.162	42.742	46.750	52.200	56.798	56.936	55.058	49.782	38.800	39.331	46 466
3......	39.823	39.598	38.516	42.050	46.460	52.133	56.087	56.661	54.792	49.685	38.975	39.105	46 198
4......	39.855	39.509	38.355	41.500	46.161	51.975	55.403	56.629	54.333	49.476	38.858	39.032	45 969
5......	39.814	39.089	38.275	41.317	46.210	52.067	56.121	56.565	53.992	49.516	39.050	39.016	45 968
6......	39.774	39.018	38.404	41.542	46.944	52.958	57.637	56.758	54.117	49.484	39.183	39.234	46 307
7	39.831	39.321	38.718	43.050	47.476	54.150	58.855	57.542	55.192	49.797	39.417	39.194	46 927
8......	39.927	39.518	39.524	44.725	48.597	55.250	60.032	58.887	56.442	50.451	39.383	39.468	47.738
9......	40.121	39.589	40.661	46.842	49.653	56.883	61.298	59.960	58.050	51.137	39.825	39.718	48.700
10......	40.508	40.473	41.605	48.892	50.702	58.117	62.693	61.170	59.342	52.484	40.825	40.089	49.784
11......	41.161	41.670	42.701	49.992	51.363	59.017	63.500	61.895	60.667	53.258	41.833	40.645	50.691
12......	41.748	42.241	44.404	51.142	51.863	59.508	64.484	63.008	61.500	53.766	42.258	41.016	51.461
1 P.M.	42.000	42.848	44.661	51.617	52.186	60.050	64.670	63.629	62.100	54.008	42.667	41.169	51.848
2......	42.032	42.821	45.226	51.817	52.540	60 500	65.468	63.826	62.575	54.137	42.708	41.532	52.150
3......	42 009	42.928	45.259	5 2275	52.686	60.533	65.798	63.830	62.258	53.855	42.808	41.250	52.174
4......	41.371	42.482	45.484	51.858	53.315	60.517	65.807	64.210	62.075	53.193	42.250	41.105	52.049
5......	41.153	41.562	45.210	51.175	53.645	60.450	66.250	64.387	62.042	52.557	41.517	40.652	51.774
6......	40.920	41.089	44.630	50.767	53.493	60.591	66.742	64.387	60.333	51.613	41.192	40.355	51.208
7......	40.475	40.705	43.556	49.275	52.484	59.867	65.975	61.927	58.875	51.065	40.667	39.798	50.449
8......	40.404	40.250	42.711	47.300	51.137	57.608	62.807	60.589	58.008	50.477	40.442	39.758	49.348
9......	40.258	39.625	41.718	46.117	49 637	56.242	60.742	59.476	57.283	50.202	40.350	39.532	48.488
10......	40.395	39.286	41.083	45.425	49.097	55.167	59.492	58.409	56.575	50.129	39.867	39.411	47 913
11......	40.283	39.170	40.523	44.733	48.508	54.225	58.581	57.779	56.042	49.742	39.492	39.153	47.407
12......	40.339	39.143	40.242	44.133	47.927	53.675	57.605	57.234	55.517	49.670	39.117	38.855	47.007

The Mean Temperature obtained from the last column of the above Table is 48°944. It occurred at $9^h\ 13'$ A. M. and $8^h\ 28'$ P. M.

The following are the Mean Monthly Results for 1824 *and* 1825.

January,	41°.091	August,	58°.372
February,	40 .621	September,	56 .312
March,	40 .865	October,	49 .226
April,	46 .379	November,	41 .191
May,	50 .012	December,	39 .775
June,	56 .091		
July,	60 .361	Mean of the year,	48 .360

The following Table shows the Mean Temperature of each hour of the day for 1824, 1825, *each result being the mean of* 730 *observations.*

Hours.	Mean Temp.	Hours.	Mean Temp.
1 A. M.	46°.134	1 P. M.	51°.149
2	45 .933	2	51 .470
3	45 .689	3	51 .532
4	45 .449	4	51 .239
5	45 .394	5	50 .872
6	45 .653	6	50 .294
7	46 .283	7	49 .544
8	47 .029	8	48 .624
9	48 .055	9	47 .829
10	49 .012	10	47 .276
11	49 .950	11	46 .803
12	50 .777	12	46 .398

Having given, in the preceding tables, the principal numerical results of the hourly Register for 1824 and 1825, we shall now proceed to consider some of the most important conclusions which may be deduced from them.

I. *On the Form and Character of the Annual and Monthly Daily Curve, or the Daily Progression of Temperature.*

The daily curve for 1824 is projected in Plate V. Fig. 27. of last Volume, from the numbers in the last column of Table II., and forms the lowest curve. The point of the curve for each of the 24 hours is the mean of 365 observations. The temperature is lowest between 4 and 5 o'clock in the morning; it then increases with great regularity till 3 o'clock in the afternoon, when it descends till it reaches its minimum at 5 o'clock in the morning. The period during which it performs its ascending motion is $9^h\ 40'$, and the period of its descending motion is 14^h 20′; the heat of the day, therefore, advances with more rapidity than the cold of the night.

The daily curve of 1825 is projected in a similar manner in Plate V., Fig. 27, from the last column of Table IV., and forms the upper curve of the plate. Each point of it is the mean of 365 observations. Its resemblance and general parallelism to that of 1824, cannot fail to strike the reader, and proves how nearly these observations have conducted us to the form of the daily curve.

The intermediate curve, which is laid down from the last column of Table VI., and is the mean of the two curves, is nearly free from the very slight inequalities in the afternoon branch of both curves, and may be considered as representing, with great accuracy, the mean annual daily curve for the latitude of Leith, and at the level of the sea.

In order to observe the variation in the form of the daily curve in different seasons, I have given, in several plates, their projections for every month in 1824 and 1825, and the mean of the monthly curves in 1824 and 1825; but we must refer for these plates to the original memoir.

By taking the means of the six Summer months, from April to September inclusive, and of the six Winter months, from October to March inclusive, and projecting them in the usual manner, we obtain an accurate type of the daily progression of temperature in Summer and Winter, each point of each curve being the mean of about 180 observations.

The summer curve descends regularly from midnight till 4 o'clock in the morning, when the coldest time of the day occurs, and it ascends with great regularity till 3 o'clock, when it commences a very rapid descent to its minimum, the total mean range being about 8°.61.

The winter curve, on the contrary, has a gentle rise from 1 A. M. till 2 A. M. It then descends till 6, when it commences its ascent, reaches its maximum at 2, and again descends, but more slowly than it rose, the greatest difference of temperature being about 3°86.

The difference of character in the curves of April and October deserves to be noticed. Although these months are considered as giving nearly the mean of the year, and therefore as resembling each other in temperature, yet there is a singular difference in the mode of its distribution. In October the mornings and evenings are comparatively warm, while in April these times of the day are remarkably cold. April, in short, unites the low temperature of a winter month with the great range of a summer month ; while October unites the temperature of a summer month with the low range of a winter one.

II. *On the Determination of the two times of the Day when the Mean Temperature occurs.*

I am not aware of any observations made in our climate, by which the hours, when the mean temperature of the day occurs, could be determined. It has generally been believed that it occurs at 8 o'clock in the morning ; and Professor Playfair not only considers this as nearly the hour of mean temperature for Edinburgh, but he regards the maximum as occurring "from 1 to half-past 2, or even 3 o'clock ;" and upon these principles he has selected his three periods, viz. 8 A. M., the time of maximum, and 10 o'clock P. M.

It appears, however, from Tables II. and IV., that the mean temperature of the 24 hours occurs at the following times :

	H. ′	H. ′
1824,	9 13 A. M.	8 26 P. M.
1825,	9 13	8 28
Mean of two years,	9 13	8 27

This very extraordinary agreement between the results of 1824 and 1825, shows how nearly we have approximated to the true form of the daily curve, and how much confidence may be placed in the general result. The following may therefore be regarded as the leading points of the annual daily curve.

	H.
Time of Minimum Temperature, a little before	5 0 A. M.
Time of the Morning Mean Temperature, -	9 13 A. M.
Time of Maximum Temperature, - - -	2 40 P. M.
Time of Evening Mean Temperature, - - -	8 27 P. M.
Interval between Minimum and following Maximum,	9 40

	H. ′
Interval between Maximum and following Minimum,	14 20
Interval between Morning and Evening Mean, -	11 14
Interval between Minimum and Morning Mean, -	4 13
Interval between Evening Mean and following Minimum,	8 33

The determination of the exact times of mean temperature throughout the year, furnishes us with the two best times of the day for recording the indications of the thermometer. These times are obviously $9^h\ 13'$ A. M. and $8^h\ 27'$ P. M.; for if any of the observations is accidentally omitted at one of the hours, the mean of the remainder will approach nearer to the mean temperature of the year, than if any other two hours had been taken, and similar omissions made.

There is, however, another advantage of this determination, namely, that the mean temperature of the year may be obtained with great accuracy by a single observation made every day at one of the times of mean temperature.

If we examine the annual curve, and also the monthly curve, it will be seen, that the ascending or morning branch is more regular in its progression than the descending or evening branch. On this account, we would prefer a single observation every day, made at the time of the morning mean, to a single observation made every day at the time of the evening mean.

It must be carefully observed, that the hours of mean temperature which we have now been considering, are only mean results for the whole year. If we wished to deduce the mean monthly temperatures from an observation made once a-day, it would not answer to take $9^h\ 13'$ A. M. and $8^h\ 27'$ P. M.; because the times of mean monthly temperature occur at different hours of the day throughout the year, as will appear from the following table:

	Mean of 1824 & 1825.			Mean of 1824 & 1825.	
	A. M.	P. M.		A. M.	P. M.
	H. ′	H. ′		H. ′	H. ′
January,	10 34	6 57	July,	8 55	8 40
February,	10 2	6 56	August,	9 0	8 19
March,	10 10	8 8	September,	8 52	8 18
April,	9 1	8 26	October,	9 25	6 48
May,	9 14	8 40	November,	9 39	7 41
June,	9 7	8 24	December,	9 56	6 15

III. *On the relation between the Mean Temperature of the 24 hours, and that of any single hour, or any similar pair of hours, &c.*

It was long the practice of meteorologists to observe the thermometer three times a-day, on the supposition that the mean of these three observations gave the mean temperature of the 24 hours. Observations of this kind are still continued in many parts of Europe. To the following short table of some of these, I have added the deviations from the mean temperature, as computed from the results of the preceding tables :

	Morning.	Afternoon.	Night.	Deviation from Mean Temp. of day.	
Edinburgh,	8^h	*Maximum.*	10^h	+0°.346	Professor Playfair.
Williamstown,	7	2	9	+0 .510	Professor Dewey.
	8	1	6	+1 .225	Proposed by the Phil. Soc. of New York.

As three observations made every day, are not convenient for many meteorologists, who are engaged in professional pursuits during the day, it became desirable to select those two hours, the mean of whose temperatures approached nearest to that of the whole day. The following times have been used in this country, and many of them give results that differ very considerably from the mean temperature of the 24 hours :

	Morning.	Afternoon.	Deviation from Mean Temp. of Day.
Hawkhill, -	8	2	+0°.982
Gordon Castle, -	8	2	+0 .982
Kinfauns, -	8	10	—1 .114
Ditto, -	10	10	—0 .122
Leadhills, - -	6	1	—0 .134
Isle of Man, -	9	11	—0 .838
Royal Society, London,	9	3½	+1 .453
————————	9	3	+1 .526
————————	9	2½	+1 .511
————————	8½	3	+1 .273
————————	8½	2½	+1 .258
————————	8	3	+1 .013
————————	8	2	+0 .982
————————	7	3	+0 .641
————————	7	2	+0 .610
Royal Society, Edinburgh,	10	10	—0 .120
————————	7½	8½	—0 .805
————————	9¼	8½	0 .000

I have given these examples principally with the view of showing the application of the results of the hourly register, and not with the design of contrasting the hours employed by different observers; for it yet remains to be determined how far the form and dimensions of the daily curve, as determined for Leith, are applicable to places in different latitudes, and situated at different heights above the sea. At Paris, for example, the mean temperature of the day occurs before 9 o'clock in the morning; at Tweedsmuir in Scotland, 1300 feet above the sea, it happens before $7\frac{1}{2}^h$ A. M., and at Salem Massachussets, before 8 o'clock A. M.; but it must be remarked, that the observations at 9 o'clock, and at $7\frac{1}{2}^h$ and 8^h, are compared with a calculated mean temperature, and not with the mean temperature of the whole 24 hours.

It is curious to remark, that, with the exception of the hours of 10 A. M., and 10 P. M., no similar pair of hours has been used by meteorologists. The following table will show how nearly at Leith the mean of every similar pair of hours approaches to the mean temperature of the day.

TABLE, showing the Difference between the Mean Temperature of every similar pair of hours, and that of the Day.

Hours.		1824.	1825.	Mean.
5 A. M.	5 P. M.	— 0.193	— 0.073	— 0.133
6	6	— 0.398	— 0.187	— 0.293
7	7	— 0.448	— 0.256	— 0.353
8	8	— 0.478	— 0.401	— 0.440
9	9	— 0.298	— 0.350	— 0.324
10	10	— 0.148	— 0.096	— 0.122
11	11	+ 0.117	+ 0.105	+ 0.111
12	12	+ 0.352	+ 0.286	+ 0.319
1	1	+ 0.447	+ 0.301	+ 0.375
2	2	+ 0.507	+ 0.364	+ 0.435
3	3	+ 0.447	+ 0.242	+ 0.344
4	4	+ 0.092	+ 0.065	+ 0.078

In some instances, meteorological registers have been kept, in which the thermometer has been observed only once a-day. These registers may now be rendered useful, by means of the following table, which shows the relation between the mean temperature of each hour, and that of the whole day.

Difference between the Mean Temperature of each Hour and that of the Day, for 1824 *and* 1825.

1h A. M.	— 2.133	1 P. M.	+ 2.882
2	— 2.334	2	+ 3.203
3	— 2.578	3	+ 3.265
4	— 2.818	4	+ 2.972
5	— 2.873	5	+ 2.605
6	— 2.613	6	+ 2.027
7	— 1.983	7	+ 1.277
8	— 1.238	8	+ 0.357
9	— 0.212	9	— 0.438
10	+ 0.745	10	— 0.990
11	+ 1.683	11	— 1.463
12	+ 2.510	12	— 1.868

From this table, it appears, that the mean annual temperature of any hour of the day never differs more than 3°½ from the mean temperature of the day for the whole year.

In order to obtain the mean temperature of the year from a register which contains observations made once every day, we have only to correct the mean temperature which the register gives, by applying, according to its sign, the correction opposite to the given hour. In place of taking the mean of the two years, it might be preferable to take the results for 1824, in cold years, and those for 1825, in warm years.

IV. *On the average Daily Range for each Month.*

In a climate so variable as that of Scotland, the daily range of the thermometer is often very great, both in winter and in summer; but the average daily range which we propose now to notice, is the measure of the daily change of temperature for each month, and will, of course, bear some relation to the sun's declination, as appears from the following table.

	Mean of 1824 & 1825.				Mean of 1824 & 1825.		
	Hour of Min.	Hour of Max.	Daily Range.		Hour of Min.	Hour of Max.	Daily Range.
	H.	H.			H.	H.	
January,	6	3	2°.662	August,	4	4	7°.591
February,	6	3	3 .570	September,	5	2	8 .041
March,	6	3	6 .152	October,	6	2	4 .876
April,	5	3	10 .629	November,	2	3	4 .154
May,	4	4	8 .577	December,	5	2	2 .308
June,	4	3	8 .263		—	—	——
July,	4	5	9 .673	Whole year,	5	3	6°.138

V. *On the Parabolic form of the different branches of the Mean annual Daily Curve.*

Before concluding this Report, I was desirous of ascertaining if the different branches of the daily curve had a resemblance to any known curve. Their similarity to the parabola is very obvious, from Fig. 1. of Plate I., where they are distinctly projected; and I therefore calculated the following table, upon the supposition that AB, BC, CD, and DE, were parabolic branches of the following dimensions:

Branch AB,	Ordinate,	AH = 513
	Abscissa,	BH = 172 or 2°.872
Branch BC,	Ordinate,	CH = 253
	Abscissa,	BH = 172 or 2°.872
Branch CD,	Ordinate,	CG = 347
	Abscissa,	DG = 196 or 3°.266
Branch DE,	Ordinate,	EG = 327
	Abscissa,	DG = 196 or 3°. 266

The ordinates 513 + 253 + 347 + 327 are = 1440′ = 24 hours; and the abscissa BH = 2°.872, and DG = 3°.266, when reduced to the same scale as that of the ordinates, become 172′ and 196′, as one degree of temperature on the projection is equal to one hour. The abscissæ which represent the temperature were reconverted into degrees.

TABLE, showing the Differences between the Mean Annual Hourly Temperature for 1824 *and* 1825, *as observed, and calculated on the supposition of these being the abscissæ of Parabolas.*

Hours.	Difference.	Hours.	Difference.
H.		H.	
8 27′ P. M.	0°.000	9 13	0°.000
9	+0 .075	10	+0 .079
10	+0 .039	11	+0 .019
11	+0 .003	12	—0 .124
12	—0 .024	1 P. M.	—0 .008
1 A. M.	—0 .113	2	—0 .036
2	—0 .186	3	0 .000
3	—0 .138	4	+0 .183
4	—0 .016	5	+0 .219
5	0 .000	6	+0 .250
6	—8 .098	7	+0 .229
7	—0 .044	8	+0 .159

Hours.	Difference.	Hours.	Difference.
H.		H.	
8	—0°.184	8 27	0°.000
9	—0 .082		

These parabolic abscissæ were calculated by the following formulæ. By the property of the parabola, we have

$$\mathrm{BH} : \mathrm{B}m = \mathrm{AH}^2 : mn^2; \text{ and}$$

$$\mathrm{B}m = \frac{\mathrm{BH} \times mn^2}{\mathrm{AH}^2}.$$

But since AE is the line of mean temperature, *pn* the depression of the temperature below the mean at the point of time *p*, and $pn = \mathrm{H}m = \mathrm{HB} - \mathrm{B}m$, then, calling *m* the minimum temperature, and *y* the ordinate *mn*, we have the required temperature T at the time *p*, thus:

$$\mathrm{T} = m + \frac{\mathrm{HB} \times y^2}{\mathrm{AH}^2}.$$

For the *semi-parabola* BC,

$$\mathrm{T} = m + \frac{\mathrm{HB} \times y^2}{\mathrm{CH}^2}.$$

For the *semi-parabola* CD, M being the maximum temperature,

$$\mathrm{T} = \mathrm{M} - \frac{\mathrm{GD} \times y^2}{\mathrm{CG}^2}$$

For the *semi-parabola* DE,

$$\mathrm{T} = \mathrm{M} - \frac{\mathrm{GD} \times y^2}{\mathrm{EG}^2}.$$

Upon comparing the differences in the preceding tables, it appears, that the greatest is *a quarter of a degree of Fahrenheit*, and that they are most perceptible in the afternoon branch of the curve, between 4 P. M. and 8 P. M.

I have no hesitation, however, in saying, that the mean of a greater number of years will produce a close approximation to the parabola. In 1824, the afternoon branch is irregular. In 1825, which was a year of uniform character, the afternoon branch becomes more convex, and approaches closely to the parabolic branch; so that the mean of 1824 and 1825, which we have contrasted with the parabolic abscissæ, partakes of the irregularities of 1824, and thus occasions a flatness in the curve, and consequently the differences observed between 4 P. M. and 8 P. M.

Art. VI.—*Remarks on M. le Colonel Bory de St-Vincent's proposed species of the Genus* Homo. By a Correspondent.

"What a piece of work is Man! how noble in reason! how infinite in faculty! in form and moving how express and admirable! in action how like an angel! in apprehension how like a god!—the beauty of the world—the paragon of animals!"

Shakspeare, *Hamlet.*

The men of science in France are the most indefatigable of human beings; and, so far as regards some of the departments of Physical Science, have certainly outstripped, by their minute industry, most of their contemporaries in the other countries of Europe. In the different branches of Natural History, in particular, which seems to have attracted a more than usual portion of attention, the liberality of their government in fitting out exploratory expeditions, and the zeal and ability of their observers, has greatly increased the number of species; and the teachers of those branches of science at home have powerfully exerted themselves in examining the structure of these in every particular, and thrown light, in many cases, upon what was before not at all or but imperfectly known. While we award to the French naturalists, therefore, all the praise that is due to perseverance and acute observation, and give them the merit of a great many of the recent discoveries in Botany and Zoology, we do so with the most sincere feelings of respect and gratitude. But we are not very certain that their zeal and industry has always been accompanied by those higher qualities of mind, which enable their possessors to generalize isolated observations, and to form extended and philosophical views of those portions of nature which they are so successful in cultivating in detail.

In point of fact, the great characteristic of Frenchmen is Nationality. They chanced to give birth to Tournefort, his successors the Jussieus, and Buffon—and, of course, in a country which makes the most of every thing national, the simple and beautiful arrangement of the objects of nature proposed by the great Linnæus, had comparatively few followers in France. That this system was triumphant everywhere else, only whetted the eagerness of French patriots to support the fame of their own great men; and, accordingly, neglecting an arrangement which, though artificial, seems admirably calculated for the purpose in view, they have so far succeeded, as to plunge the study in a chaos of unintelligible systems and names—and to make it a greater difficulty to ascertain the identity of a single species through its thousand and one synonyms, than it would be to study a whole chapter of nature in the book of her ablest expositor.

In speaking thus of the tendency of the French systems, and those of their imitators in the rest of Europe and in this country—dazzled by the lustre of a few great names—we are far from undervaluing what is termed the NATURAL SYSTEM in the study of Botany, or in the other branches of Natural History. Linnæus himself was aware of its importance in a general view, but found the impossibility of applying it to the practical purpose of identifying and arranging genera and species in the speediest and simplest manner; and its advocates have many, and almost insurmountable, obstacles to get over, before they can turn it to this use.

Neither do we say that the discoveries in Natural Science since the time of Linnæus do not render some modifications of his system absolutely necessary. In many departments, the numerous and new objects that have been brought to light, rendered it necessary to adopt new genera and species to bring them under the Linnæan arrangement; and certain of the Linnæan classes, particularly *Insecta* and *Vermes*, and in Botany the class *Cryptogamia*, required to be re-modelled, as they have been in many instances, by able writers. But these modifications should be as much as possible assimilated to the terminology of the great institutional writer who first reduced confusion into order in arranging and naming the objects of nature, and whose system and language are still the common medium of communication among the learned in all parts of the world. Every additional and unnecessary term introduced into science, is a useless load upon the memory, and every change of nomenclature, not imperiously called for, tends rather to retrograde than advance its interests. From not attending to this, many of the petty proposers of systems and arrangements have already succeeded in making it extremely difficult, without immense labour, to ascertain the identity of species through their multiplied synonyms; and all distinctive characteristics are lost in the search of mere words without meaning, in the works of these minute philosophers.*

It is time for those who feel more interested in the knowledge of things than terms, to raise a barrier against the contagion of these encumbering nomenclaturists, who, by everlastingly quoting one another, or their own inedited manuscripts, have contrived to push themselves into ephemeral notice. Luckily in Britain, except among a very few, and those of no very overpowering genius or learning, this revolutionary frenzy has made but little progress. But every Frenchman who knows any thing of science must be an author, and not only so, but the author of a system in some particular department; and his presumption, in nine cases out of ten, being in an inverse ratio to his qualifications and his judgment, his book comes forth studded with a terminology composed of Greek and Latin compounds of the most unreadable and unpronounceable nature, and these are indicated as the classical and future names by which the objects of which he affects to treat are alone to be known. †

* M. de Rivière, in the *Annals of the Linnæan Society of Paris,* proposes a new language of Botany, in which each organ shall be expressed by a letter, and the number of organs by the place which the letter occupies in the word. This botanical notation he wishes the Society to promulgate, "and thus to do for the scientific world what the French Academy has done for the literary!"

† In a book published at Frankfort in 1825, on the *Natural History of Lichens,* M. Walroth, a German, has followed the French nomenclaturists even to unintelligibility. Not satisfied with the terms in use among former botanical writers, or even with those attempted to be introduced by modern reformers, he has created a set of barbarous terms, which he uses in his descriptions, and which even his French critics are not disposed to allow. For the use of philosophical recorders of aberrations of mind, we quote the following passage:

"*Patellaria fusco-lutea* (*Lecidea,* Achar. Syn. p. 42,) Blastemate acolyto verrucoso chlorogonimicio stephrophæno, facilè in massam chlorophænam fatiscente; cymatis plano convexiusculis marginem excludentibus, ex speirematum ubertate variâ nunc dilutè fuscescentibus intusque albidis, lividis intusque melunophænis."—*Bull. des Sciences Nat.,* Nov. 1825, p. 586.

The men of science in other parts of Europe have not been able to resist this revolutionary contagion. Never conceiving that to be able to view nature on the grand scale, and to form a simple and lucid mode of arranging its objects, requires a stretch of mind of which few men in an age are possessed, they take for granted the talent that is asserted, and the presumption with which statements are offered for their proof. The philosophical observer, not choosing to impugn doctrines or systems which might involve him in unprofitable controversies, remains silent; and the crowd, dazzled by appearances of learning, and never doubting, but that he who attempts to demolish an edifice, is able to rear a better in its room, acquiesce in the asserted talents of the innovator. It has, of course, become fashionable, in many parts of Europe, to view nature through French spectacles, in place of looking and judging through the medium of the eyes.

Having premised these observations, which we make in the utmost possible good humour, and with the highest feelings of respect for many of our French friends, we now proceed to give an instance of this disposition to fritter down science from the *Bulletin des Sciences Naturelles* of the Baron de Ferussac. In the number of that work for September last, and in an article extracted from a "Classical Dictionary of Natural History," conducted by M. le Colonel Bory de St-Vincent, under the title of MAN *(Homo,)* we have the human race, until now considered as one,* divided into no less than FIFTEEN SPECIES! M. Bory has been led to make this division from studying the subject deeply, and from materials collected during twenty years for a Natural History of that seemingly hitherto little known animal, MAN. "The originality of the plan

* "There is but one species of the genus MAN; and all people of every time, and every climate, with which we are acquainted, may have originated from one common stock. All national differences in the form and colour of the human body are not more remarkable, nor more inconceivable, than those by which varieties of so many other organized bodies, and particularly of domestic animals, arise, as it were, under our eyes. All these differences, too, run so insensibly, by so many shades and transitions one into the other, that it is impossible to separate them by any but very arbitrary limits."—*Blumenbach, Elem. Nat. Hist.*, trans. p. 35, 36.

and views of the author, and, above all, the perfect independence of its execution," are, according to the narrator in the *Bulletin,* the chief features of this new production; and the summary sketch of it which has been published, is (to use the phraseology of the same writer) "a kind of trial balloon," launched with the view of seeing how the wind sits for his "great work." Another French philosopher, M. Virey, had formerly separated the human race into *two* species; * more lately still, M. Desmoulins, with, it is said, a praiseworthy disregard of antiquated notions, and a "freedom from all prejudices which had hitherto restrained naturalists," raised the number of species to *eleven*; and now M. de Bory, determined not to be outdone even by the very great men we have named, extends the number to FIFTEEN!

But before proceeding to enlighten our countrymen by the characters or names of these fifteen species, we would beg leave to ask M. Bory, if he has any clear idea of what is generally understood among naturalists by the term *species?* If

* The most cogent reason for considering the African Negro as a distinct species, different from all the other inhabitants of the globe, was furnished to M. Virey, by M. Latreille, the celebrated entomologist. It is—shall we say it?—that the *Louse* found on the heads of negroes is BLACK, while that found on the heads of civilized Europeans is WHITE! (See *Nouv. Dict. d'Hist. Nat.* vol. xv. p. 152.) But if the said *Pedicularian* tribes be found, on investigation, to accommodate their complexion to the colour of the skin on which they lodge, this argument will have little weight in dooming the children of Ham to perpetual servitude as an inferior species. It may be worth M. Virey's trouble to examine if the *Pediculus* on heads in the south of France be not a brunette, compared with the fat and fair fraternity on the scalps in England. But if this pedicularian argument have any weight at all, we must go still farther; and as M. Bory seems to consider the Hottentots as the link in the chain which connects man with apes, we shall put it in his power to draw the connection closer, by the communication of a fact from Blumenbach. That excellent naturalist asserts, from his own knowledge, that the human *pediculus* is also found on the *Simia troglodytes,* and on the *Cercopithecus paniscus!* How far M. Bory may be successful in tracing the descent of some of his varieties from the ancient and no doubt respectable family of the Simias, we have no curiosity in learning—protesting as we do, on the part of the people of England, that in this particular we dissent from conclusions so disgusting to humanity, and so degrading to science.

it can be shown, from his own characters, that what he calls species are only what have been termed varieties by other naturalists, M. le Colonel Bory de St-Vincent may please himself with having discovered, in the five thousand eight hundred and thirty-third year of the world, fourteen new species of men, but will certainly not increase his fame among the philosophers of Europe by the discovery. A species, as defined by the best writers on natural history, is an individual family, different from every other family—capable of continuing in propagation or succession its determinate specific peculiarities, but incapable of continued reproduction or amalgamation with other individuals whose permanent characters are different. And though in systems collective species are, for the sake of arrangement, grouped into genera, and genera into orders, yet these last are merely conventional terms, the isolated individuals which form the species, remaining alone and distinct in the arrangement of nature.

The distinctions on which M. Bory relies for his specific characters are, in one or two cases, the facial angle—colour—height—and lank or crisp hair. The first of these, though at first sight imposing, is not constant, for it fades entirely on a change of circumstances, in two or three generations: *colour* is not more constant, and alone affords no room for a specific distinction; *height* or magnitude is no less deficient for this purpose; and *lank* or *woolly hair*, in the animal kingdom, is merely the continuation of a variety, perhaps at first accidental, as is seen in many species of domestic animals. In point of fact, M. Bory has not given one characteristic to his species, that has not been applied by other naturalists merely to designate accidental varieties,—not one boundary-line that could for ever prevent the natives of central Africa or China, transported to France, and intermarrying with the subjects of the most Christian King, from becoming, in a few generations, as much Frenchmen as M. de Bory himself. How much of the variety in the appearance of the human species is to be attributed to climate and food, geographical situation and mode of life, and how much even of man's physical configuration may be owing to moral causes, in fixing family or national distinctions, would require to be known, before a line could be drawn between the European and the Negro, which should for ever rank them as separate species. The few hundred years that have elapsed since the Spaniards discovered South America, have so amalgamated the natives with their conquerors, that in some districts the Indian and European features and forms are completely lost as distinctive characters in the common mass; and of the mixture of races whose fading distinctions have been noticed by Humboldt, a few centuries more will obliterate every trace.

M. Bory classes his fifteen species of men into two subgenera, viz. I. Leiotriques, or those with lank hair; and II. Oulotriques, or those with frizzled hair. Among the Leiotriques he distinguishes the following species:

1. *Homo Japeticus*, the first species, occupies a geographical space extending from the chains of mountains which unite near the parallel of 45° N.; and stretching from E. to W. from the west and southern shores of the Caspian to Cape Finisterre, projected into the Atlantic ocean. There are four varieties of the *Homo Japeticus*, viz. the Caucasian or Oriental race—the Pelagic or Southern—the Celtic or Western—and the German or Northern.

2. *Homo Arabicus*, the second species, consists of two races (why not species?)—the Atlantic or Western—and the Adamic or Oriental. This last, M. Bory conceives as proper to Abyssinia, where he thinks the garden of Eden and Adam's cradle are more likely to be found than in Mesopotamia.

3. *Homo Indicus.*—This species is confined between the shores of the Indus or Sind and Ganges on the north, and the border of the Indian sea on the South.

4. *Homo Scythicus.*—Confusedly known under the names of Turcomans, Kirguis, Cossacks, Kalmouks, Mongols and Mantchous; and inhabiting Bucharest, Songria and Davuria—all the vast Asiatic surface which extends from the Caspian sea to the sea of Japan.

5. *Homo Sinicus.*—Composed of the people called Coreans, Japanese, Chinese, Tonkinese, Cochinchinese, Siamese, and Birmans. These five species belong to the old continent. The three following are common to the new and old.

6. *Homo Hyperboreus.*—The Laplanders, Samoiedes, the people of the most northern parts of Scandinavia and Russia;

the Ostiacks, Tonguses, Jakous, Jukaghires, Thuschis, Koriacks, and some hordes of Kamtschadales in the old continent, and the Esquimaux in the new.

7. *Homo Neptunianus.*—This species occupies the eastern coast of Madagascar; the western shores of the New World from California to Chili; all the southern islands, and some of the Polynesian. They have no well-marked characters, but present varieties very distinct from one another. The races are, the Malays, the Sandwich Islanders, and the Papous.

What an excellent and well-marked species that amphibious animal a British seaman would have made under this title! We notice the circumstance, that M. Bory may have it in his view to incorporate this aquatic race, as a species more strongly marked than most of those he has mentioned, in his *magnum opus.*

8. *Homo Australasiaticus.*—Exclusively proper to New Holland.

The following species belong to the American continent:

9. *Homo Colombicus.*—Formed of the people inhabiting the territory of the United States, comprising Canada and the Floridas; Mexico from the eastern chain of the Cordilleras; all the islands of the Gulf of Mexico; the Terra Firma and the Guanas. This species, M. Bory adds, with a simplicity truly wonderful, and at once fatal to his distinctions, is almost entirely modified by the Europeans.

10. *Homo Americanus.*—This species occupies the interior basin of the Orinoco, the basin of the Amazons, Brazil, Paraguay, and the eastern sides of the mountains of Chili.

11. *Homo Patachonicus.*—Inhabiting Patagonia, but possessing no characteristic distinction (according to M. Bory) but their reported size, which is long since known to have been much exaggerated.

The last four species form the subgenera Oulotriques, or with woolly hair, including the negro races.

12. *Homo Æthiopicus.*—Inhabits central Africa, and the west coast of that continent from the river Senegal to St Helena, and nearly a similar extent upon the opposite coast, viz. between the tropics.

13. *Homo Cafer.*—This species is found to the south of the

Æthiopian race, or in the southern extremity of Africa, under the tropic, and upon the eastern side, and also some points of the island of Madagascar.

14. *Homo Melaninus.*—This species belongs to Van Dieman's Land and Terra del Fuego, which forms the extreme point of America; and is also found upon the projecting points of the coast or capes of the Island of Formosa, the Philippines, Cochinchina—in the greater part of the islands of Malacca, Borneo, Celebes, Timor, New Guinea, &c.

15. *Homo Hottentotus.*—This is the most different from the Japetic species; and the anatomical characters of these degraded beings, according to M. Bory, lead evidently to connect man with the apes. The Hottentot race is confined to the southern and western extremity of the African continent.

Now, it appears to us that there is nothing very wonderful in this fanciful division of the human race into fifteen species—all of which, were the thing worth the trouble, might be shown to be merely varieties, and some of these not very strongly marked ones. His *Homo Colombicus* he himself states as a species risen up in North America without the intervention of a second Adam and a transatlantic paradise, by the intercourse of refugees from the different nations of Europe. The facial angle of Camper distinguishes two or three species—crisp hair marks the African negro—and height alone, the chief character rested on for the others, separates the Patagonian of five feet six inches or six feet, from the Esquimaux, whose stature only reaches, according to M. Bory, to four feet and a half. But all these varieties in the appearance of the human frame may, in our mind, be easily accounted for, without the necessity of referring them to separately created families or species as their source. M. Bory seems to have lost sight entirely of the effects of climate, soil, and food, those three great agents in increasing the variety of domestic animals,—the moral effects of education and civilization in moulding even the organic parts of our frame,—and a thousand other circumstances, which, with the important adjunct of time, are, gradually and unseen, perpetually working changes in the animated parts of nature. Take, for instance, our domestic animals—the plants which have been naturalized in our climate—our own indigenous plants, transported to a different soil—and it will be seen that varieties, as apparently wide of the original stock as it is possible to conceive any of the human species to be from one another, are not only introduced, but perpetuated. Size, and colour, and crisp hair, upon which the chief of M. Bory's distinctions are founded, have never been accounted as marks sufficiently discriminating to distinguish species. In the instance of the dog, how many varieties in the form of the head and the curl of the hair exist among domesticated individuals; among plants, how many varieties are found with crisp leaves, originating from accidental circumstances, but still by cultivation to be continued; and, even among the human race in our own country, what a marked difference in the relative proportion of the bones of the head and face, between the inhabitants of the hills and the valleys,—between the inhabitants of the sea coast and the inland peasantry,—between the natives of crowded manufacturing towns and those of villages.

But we go even farther than this, and appeal to any one capable of making an observation, whether there be not a still more marked difference between the inhabitants of the various countries of Europe—between those of France and England, for example: and this difference does not consist merely in the points of language or dress—but in the physical configuration of the bones of the head and face, and general contour of the whole body; and there seems to be as much reason for increasing the list of species by at least two more—the *Homo Bifstickius*, whose native country is happy England,—and the *Homo Gallicus* of the opposite shores—as there seems to be no good one for limiting the number to *fifteen*, when, by little exertion of thought or observation, the number might have been raised to fifty. In point of fact, the varieties of the human species are interminably mixed and endless; and the more the different races, in different geographical positions, mix together, the more is the apparent barrier between them broken down, so that it is impossible to draw any permanent line of distinction between the individuals of this widely-diversified species.

As to M. Bory's ideas of connection between the most degraded race of human beings and the highest in the scale of irrational creatures, or those whose form approaches to that of man, we believe, with Blumenbach, that there exist differences, both in anatomical structure, and in the more distinguishing qualities of Reason and Speech, which mark an incalculable distance between the Lord of Creation and every other class of organized beings. At the same time, as M. Bory has, we presume, satisfied himself by drawing the continuous, and, in his mind, connected line, from the *Homo Japeticus* to the Hottentot and the ape, there seems no good reason for his not following out the chain still farther, till he connects man with the races of reptiles, or ends the series in an infusory animalcule. We only object to our being included in this fancied chain of connection; for we feel, at this moment, too proud to be ranked in the unique Order BIMANUS, the superlative genus HOMO, the rational species *Sapiens*, and the happy variety whose country is Great Britain,—to listen with patience to details prompted by the vanity of system-making, even although their author be no less a naturalist than M. Bory de St-Vincent.

ART. VII.—*Remarks on Dr Knox's "Observations on the Habits of Hyænas," contained in the Fifth Number of the Edinburgh Journal of Science.* By W. H. WAYNE, Esq. Fellow of the Cam. Phil. Soc. Communicated by the Author.

IT had not been my good fortune to meet with the fifth Number of the *Edinburgh Journal of Science* till within these few days; and I am ignorant whether Dr Buckland has, or has not, made any remarks on Dr Knox's paper, in which he refers to a former one by himself, published in the "*Transactions of the Wernerian Society*," and to Dr Buckland's "comment" upon it. I have had no opportunity of seeing either of these, and may possibly repeat some things contained in one or other of them. If, however, these suggestions should appear worthy the *Edinburgh Journal of Science*, I shall feel honoured by their insertion.

To me it appears, that it was Dr Buckland's intention simply to prove the fact of an universal deluge, not "to fix its era;" and (having established this fact) to make it a standard whereby to estimate the relative antiquity of the numerous organic remains found in diluvial or alluvial formations.

With respect to Dr Knox's second observation, "That it is of little moment to a geological theory what are the habits of modern hyænas, since the antediluvian relics belong to a different species," I may be allowed to say, that where the similarity of their organization is so striking, we may, with some degree of confidence, expect a corresponding resemblance in their habits; and if, by the assumption of this probable coincidence in habit, Dr Buckland be enabled to account for the curious phenomena of the Kirkdale cave, I conclude such solution of the difficulties there presented a sufficiently strong presumptive proof, that the said similarity of habits *did* exist. I observe, too, that Dr Hibbert, in pp. 21, 22, adduces a similar argument to account for the locality of the remains of the *Cervus Euryceros.* If, however, Dr Knox do not consider this a sufficiently strong presumptive proof of the similarity of habits, still he can hardly maintain, consistently with his own argument, that a difference in the habits of post-diluvian, from those which Dr Buckland has thought proper to attach to his antediluvian hyænas, can render the "theory 'of the latter' absolutely untenable." All the Doctor asks us to grant is, that the hyænas, after having gorged themselves with the flesh, might (as is the common custom with dogs) secrete the bones. The circumstance which Dr Knox relates of having killed several hyænas, while engaged in eating the flesh, does not prove that they would not afterwards have conveyed away the bones had there been any.

But the quotations which Dr Buckland has adduced from Busquebius and Brown, (pp. 22, 23,) appear sufficiently conclusive with regard to the fact of their taking the bones to their dens. Busquebius, indeed, asserts, that it (speaking in the singular number) bears away the bodies, "*portatque cadavera ad speluncam.*" And Brown says, "that, acting in concert, they sometimes drag even a dead camel to an enormous distance."

"*3dly*, (says Dr Knox,) It is not improbable, that, in thickly inhabited countries, the habits of the hyæna may be much altered, as we find to be the case in all other wild animals. When much harassed, they become timid, and fly far from the abodes of men. I should be glad to offer this explanation in support of the supposed habits of the Kirkdale hyænas, but, unfortunately, the antediluvians had not discovered Britain."

I really do not see why Dr K. might not have adduced this "in support of the Kirkdale hyænas." No doubt their habits are altered by their vicinity to the abodes of man; but *how altered?* Surely not so as to induce them to congregate in places whence there was no escape in case of attack; but, on the contrary, they would probably become more vigilant, more wary, and would (as the Doctor intimates is the case in the neighbourhood of the Cape) have recourse to lurking-places *sub dio.*

That, however, under certain circumstances, hyænas do frequent dens, is sufficiently clear from Busquebius and Brown, as quoted above. See also "*Bingley's Animal Biography*," for some curious facts.

I come now to the fourth observation. "Hyænas do not congregate, they are solitary. Consequently, all that Mr Buckland has said about a *den of hyænas*, is simply the work of the imagination heated by a false theory;" and so it may be, for I can assure Dr Knox, that the "*den of hyænas*" is a phantom raised purely by his own imagination. Professor Buckland nowhere mentions any such thing as a "*den of hyænas*; 'tis true, he mentions the Kirkdale cave as one, which, "during a long succession of years, was inhabited by hyænas:" but he speaks not of them in the aggregate. Upon what other hypothesis can Dr Knox account for such an accumulation of the bones of hyænas? What less objectionable theory can be found? In fact, I see nothing at all improbable in Dr Buckland's supposition; for if we suppose the Kirkdale cave to have been occupied only a thousand years during that period between the creation and the flood; and again, which is possible, that one only at a time lived in it, say a male and female alternately, each during the space of ten years, and then died in it; that the female brought forth two young ones annually for six years, and that one only out of four died in the cave, or was dragged into it; and we shall have hyænas enough to account for the accumulation of bones in the Kirkdale cave.

Dr Knox asserts, too, that these bones "have never been fractured by hyænas, they have been broken by great external violence, and not by the agency of the teeth of living animals; and they do not differ in any respect from the bones found at Oreston and elsewhere, which bear no such marks of violence."

I confess I do not quite see the force of this remark. Is it meant that the bones at Oreston bear no marks of violence? This would be nothing to the purpose; or does it mean "no *such* marks of violence?" That is, the bones at Oreston bear certain marks of violence, whilst those at Kirkdale exhibit marks of violence proceeding from a different cause—from the agency, for instance, of the teeth of hyænas. But on this point, page 76 of the *Relic. Diluv.*, appears to me conclusive.

Dr Knox proceeds, "But the truth is, that we have evidence in the nature of the relics themselves, subversive of Mr Buckland's speculations on these subjects. 1st, The bones found in the cave at Kirkdale do not bear the marks of having been broken by hyænas, but of having been dashed to pieces, and exposed to the action of water."* Now this is merely a matter of opinion to be determined by a careful examination of the bones themselves; and this examination was a matter of too great importance for Dr Buckland to have overlooked; for it will be seen in page 7, that the doctor says, "in the interior of the cave, I could not find a single rolled pebble, nor have I seen, in all the collections which have been taken from it, one bone, or fragment of bone, that bears the slightest mark of having been rolled by the action of water." "On

* An ingenious friend, who examined some of the bones lately discovered, remarked, that one of them was so nearly worn through by the corrosion which it had undergone, that the effect could not possibly have been produced by the teeth of an animal, without the bone being broken. This fact merits particular attention.—Ed.

some of the bones, marks may be traced which, on applying one to the other, appear exactly to fit the form of the canine teeth of the hyænas that occur in the cave."

I have seen bones from the cave at Kirkdale, in the possession of Professor Sedgwick, and some also in the Institution at Bristol; and my conclusion was, that their fracture proceeded from the causes which Dr Buckland has assigned.

Another circumstance (and which Dr Knox has omitted to remark upon) tends greatly to confirm me in that conclusion; and that is, the presence of so considerable a quantity of *Album Græcum*,—this circumstance deserves particular attention. Again, at page 120, Dr Buckland says, the state of the bones at Bauman's Höhle " is totally different from that of the splinters in the den at Kirkdale, which latter are as obviously the effects of fracture by the hyænas teeth, as the former are of a violently crashing blow, imparted by a heavy mass of stone."

Art. VIII.—*Observations on the changes which take place on Mercurial Thermometers.* By H. H. Blackadder, Esq. F. R. S. E. Communicated by the Author.

It has been remarked, by various observers, that the most accurately constructed mercurial thermometers are liable, in the course of long use, to become inaccurate; and, in such cases, it is a lowering of the original height of the mercury that has been observed to take place. This change, to which mercurial thermometers are subject, has been attributed to a permanently increased capacity of the bulb, produced insensibly during the successive heatings and coolings to which it has been exposed. This explanation, however, appears unsatisfactory—for the change in question has been observed to take place in instruments, in the construction of which great care had been taken to extract the air from that part of the tube that is not filled with mercury. If the glass bulb were to suffer any permanent change in such instruments, during the frequent but moderate alternations of temperature to which they are exposed, we would have reason to expect that its capacity would not be increased, but diminished, as the approach to a *vacuum* in the space above the mercury would tend not to expand, but to contract the bulb. It is generally admitted, that no perfect *vacuum* has ever been produced. However this may be, we are certain that, in the most carefully constructed thermometers, some air is left in the interior of the instrument; for the means employed for introducing the mercury, and expelling the air, are not sufficient for wholly abstracting the latter from the inner surface of the glass. Let it then be admitted, that some air, more or less, has been left in the bulb and stem of the instrument; in the course of years, this air will be decomposed by the mercury, the oxygen, at least, will be absorbed, and, in becoming solid, will have its bulk greatly diminished. In this way, the lowering of the mercury from its original height may be accounted for;—but even before the included air has been decomposed by the mercury, some of it that has adhered to the inner surface of the bulb, and that part of the stem that was not left empty, will escape to the upper part of the tube during the frequent expansions and contractions of the mercury, and thus occasion a slight difference in the height of the fluid, from what it was when the instrument was constructed. In every instance the observed change has been small; and if the above explanation be the true one, the diminished height will, in each instance, be in exact proportion to the quantity of air that has been left between the surfaces of the glass and the mercury. Hence the most obvious and certain preventative would be, to allow a considerable space of time to elapse between the construction of the glass part of the instrument, and the adaptation of its scale.

ART. IX.—*On the Influence exerted by different Media on the number of Vibrations of Solid Bodies.* By M. FELIX SAVART.*

ATTEMPTS have frequently been made to determine the number of vibrations of solid bodies, when made to sound succes-

* Translated from the *Ann. de Chimie*, &c. Nov. 1825, p. 261–269.

sively in media of different densities, but hitherto all these attempts have been fruitless. This has arisen not only from our wanting a suitable method of causing bodies to vibrate in media of different kinds, but also from our not having acquired correct notions of the modes of vibrations of the bodies themselves;—for the action of the same medium on the number of vibrations of a body is different, according as the body is the seat of tangential longitudinal vibrations,—tangential transverse ones, or normal ones more or less oblique.

This action is nothing for very long and very thin bodies, which execute vibrations in the direction of their length, at least it seems to be so, if we judge by the impression produced on the organ of hearing; for a rod very long, and of a small diameter, affected with this kind of motion, appears to emit exactly the same sound in media of very different densities, such as air, water, acids, oil, and even mercury.

On the contrary, in the same circumstances, bodies which execute normal vibrations emit sounds which may differ much from one another. It may happen, for example, that the sound of a thin plate, which resounds in air, may become more grave by a third, a fifth, an octave, two octaves, &c. when it resounds in water, or in other liquids, either of greater or lesser density. We cannot determine any thing respecting this descent of the sound, because it depends on the relations between the dimensions of the plate. If its width and length become considerable at the same time that its thickness is smaller, the more will the number of its vibrations diminish by immersion in a denser fluid, such as water, for example. In order to verify this result, we must be able to impress upon a body normal vibrations, by a method which may be employed indifferently in all media. This may be easily done by exciting the motion with a small glass tube, which is rubbed lightly in the direction of its length, and which is fixed perpendicularly on one of the faces of a body which it is wished to make vibrate.

When the bodies execute tangential transverse vibrations, a kind of motion which we may produce by the method which we have pointed out for normal vibrations, the alterations produced in the number of vibrations by media of greater density are much less considerable than in the case of normal vibrations. If we operate on rods or plates of glass, the sounds produced in water, for example, differ the more from those produced in air, that the plates are more narrow, while their length and thickness are equal, so that we cannot determine, *a priori*, what will happen in each particular case. We can make the sound descend a half tone, a tone, &c.

From this it follows, that different media do not exercise any appreciable influence upon the vibration of the faces of a body which is the seat of tangential vibrations, and that, on the contrary, they exert a very great influence on the vibrations of those faces which produce normal vibrations, more or less oblique. Those bodies, consequently, which, like vessels, are formed of sides more or less oblique to the direction of the vibrations, ought to present, when sounding in different media, results very variable, and which it would be impossible to predict in the present state of the science. Thus the sound of a common drinking-glass is nearly an octave more grave when sounding in water than in air, whilst in large glasses on a foot, in the form of a cup, it may happen that the sound in water is only one-twelfth more grave than in air. We may conceive, indeed, that the descent of the sound will be as much greater as the vessel presents more thin portions, having the normal motions, as its sides are thinner, and as its diameter is increased. But we may conceive, at the same time, the great difficulty which there would be to determine rigorously the laws of this kind of phenomenon, so as to predict what would happen to any body whatever, when we wished it to sound in any particular fluid. And what adds much to this difficulty is, that the different media which surround a body influence its number of vibrations, not only because they are more or less dense, but because they vibrate along with it as a system, a circumstance which alone ought to have a great influence.

The modes of division of bodies which sound in different media are invariable when they are affected only by tangential longitudinal vibrations, but it is otherwise for normal vibrations. If, for example, we fix a small rod of glass at the centre of a disc of the same substance, and perpendicular to it, and if we produce a slight longitudinal friction on the small rod, the disc will execute normal vibrations, and it will present, when it sounds in the air, a circular nodal line, which will cut each of its radii nearly in the middle of its length; but in water this line will be transferred towards the edge of the disc, and it will approach it in proportion to the difference between the sounds of the body in air and in water. An analogous phenomenon occurs in rods: a rod, for example, which presents four nodal lines perpendicular to its edges when it sounds in air, still presents the same number in water, but then such of the lines as were less distant from the extremities of the rod approach to it still more, so that all the vibrating parts are lengthened. We may establish the accuracy of these results by projecting sand through liquids on bodies immersed in them. The nodal lines will be traced as distinctly as in air.

With regard to the different pressures exerted on the vibrating bodies, if placed at different depths, we have observed that, when the depth is such that the surface of the fluid remains fluid during the vibrations, the sound will continue sensibly the same, even to the depth that we can hold it with one hand, while it is made to sound with the other. It ought to be remarked, however, that when the experiment is made in a vessel, we must take care not to allow the vibrating body to approach too near its bottom or sides, because the reaction exerted by these parts, which are then agitated as a system, may alter the number of vibrations, and render the sound more intense.

I shall conclude this notice with an observation relative to preceding researches on the intensity of sounds propagated in different media. When a body executing normal vibrations sounds in water, for example, then, if we abstract all attendant circumstances, that is to say, if we attend only to the impression made on the ear, we shall conclude that the water transmits the sound with less intensity than air; but if we consider that the mode of vibration in water is no longer the same as in air, that the sound is become more grave, we are compelled to draw the conclusion, that circumstances being no longer the same in both cases, we can deduce no inference respecting the sensation we experience. Hence we cannot consider as exact the consequences which have been deduced from experiments hitherto made on the intensity of sounds propagated in different media, because the change in the mode of vibration of the sounding bodies has not been taken into account. From what has been above stated, it is easy to conceive, that the only way to render experiments of this kind comparable, would be to make them with long and thin bodies, to which are communicated a tangential longitudinal motion, the only case in which the number of vibrations cannot be influenced by the action of different media.

ART. X.—*Account of a Singular Phenomenon in Vision.* By Mr THOMAS SMITH, Surgeon, Kingussie. * In a Letter to the EDITOR.

SIR,

ON the 16th of February last, I was repeating with candle-light some experiments which I had made before with the light of day, to observe in what degree the sensation which a luminous object, seen by both eyes on corresponding points of the retina, differs from that which is produced, when it is seen by both eyes on points of the retina not corresponding. I held a slip of white paper perpendicular to the horizon, about a foot from my eyes, and directing them to an object at some distance behind it, saw, of course, two images of the white paper. I was surprised, however, to find that the colours of these two images were not the same, and neither of them white like the slip of paper; but that, on the contrary, they were complementary red and green, so that, when, by changing the direction of my eyes, I caused the two images to coalesce in the middle, the resulting colour was white like the paper viewed. For a moment I suspected that these appearances arose from a sudden morbid affection of my eyes, for, though I had often repeated the same experiment before, I had never observed that the colours of the two images were different. However, as in this experiment, the candle stood only a few inches from my right eye, so that it was strongly acted upon by the light, while the left eye was entirely shaded from it;

* Read before the Royal Society of Edinburgh on the 3d April 1826.

and as I was not ignorant that the action of strong light on one part of the retina appears to affect the sensibility of the surrounding parts, I thought of trying if that circumstance had any share in producing the phenomena. I therefore shifted the candle from the right to the left side, placing it so that it might be seen by the left eye, but not by the right. Instantly the colours of the two images were reversed, that which was green before being now red, and that which was red before appearing now green; the paper always appearing green to the eye on which the direct light of the candle fell, and red to that which was in the shade.

At my request, several other persons, both old and young, repeated the same experiment, and, without knowing the result I had obtained, reported unanimously, that, of the two images of the white paper, that which was nearest to the candle appeared red, and the other green, or, as some termed it, blue, and that, when the images coalesced, the mixture of the two colours appeared white.

I varied the experiment, by employing slips of paper of different colours. When light red was used, the image seen by the eye, acted on by the light of the candle, appeared nearly white, and the other deep red. When faint green paper was employed, the shaded eye saw it nearly white, and to the other it appeared a stronger green.

As some persons may find a difficulty in attending to the two images while the eyes are directed to a distant object, that inconvenience may be remedied, and the same results obtained, by directing both eyes to the slip of paper itself, and pressing the side of one of the eye-balls. This, as is well known, produces two images of the object; and if the light is properly placed, one of these images will be seen red, and the other green.

When two candles were used, and so placed on each side, that the light of the one acted only on one eye, and that of the other on the other eye, the images of a slip of white paper appeared white, if the two lights were equal, and at equal distances from the eyes. But if the lights were unequal, or at unequal distances, the two images appeared of different colours; a fact which might perhaps furnish a method of measuring light, little, if at all, inferior to that of shadows. When an opaque body was interposed between one of the candles and the eye, the images which appeared white before, changed immediately to green and red; and if both eyes were then shaded from the light by means of opaque bodies, the images resumed their white colour

In making these last experiments, another new and interesting appearance presented itself to my observation. My two eyes being shaded from the direct light of the candles, when I removed both of the opaque bodies suddenly, and thus admitted the direct light of the candles into my eyes, I was surprised to find that the two images of the slip of white paper appeared immediately and distinctly *more luminous*. This phenomenon, in all the trials I have made, lasts only for a few seconds, the sensation being similar to that which would be produced by the paper being more illuminated by a sudden flash of light.

Satisfied with barely announcing to the Society these new and curious phenomena, I forbear to offer any attempt at an explanation of them. All I shall at present say, is, that they appear to me to be produced by an important function of the eye, which has entirely escaped the notice of the writers on Vision. I have the honour to be, Sir,

Your most obedient Servant,

KINGUSSIE, 28*th March* 1826. T. SMITH.

ART. XI.—*Description of the Great Temple of Carnac, in Thebes.* By Major-General STRATON, F. R. S. Edin. *With a PLATE.* Communicated by the Author.

THE first impressions conveyed by the great Egyptian temples are those of sublimity and colossal solidity. The beholder, on coming nearer to them, is delighted with the symmetry and just proportions of the constituent parts. On a close approach, while he is gratified with the accuracy and perfection of the details, he is astonished at the degree of perfection which the arts of statuary, sculpture, and design, had attained at periods so remote; and his surprise increases, as he finds colours, some of them, from their nature, the least durable, retaining in many places, after a lapse of thirty centuries, their original freshness and brilliancy.

The ancient Egyptians having borrowed nothing, their architecture is original; the talus, or slope, was applied to all parts having a heavy superstructure; and it is worthy of remark, that the modern houses, or cabins, usually formed of mud and straw, are generally built with their walls sloping inwards, in the form of a truncated pyramid. The ancient Egyptians considered security as the first principle of architecture. The ornamental parts, such as ceilings, cornices, and the capitals of columns, being imitations of the productions of nature, are varied almost to infinity. The capitals very frequently represent the lotus flower,* either in its natural order, or reversed; full blown, or in its progressive stages; or they represent the branch of the date or palm tree,† and sometimes of the doum tree.‡ Other capitals seem to be taken from the volutes of Papyrus, to which the Ionic order of the Greeks bears a strong resemblance. Some are not unlike the Tuscan and Doric, and all are more or less coloured, or decorated with branches of grapes, dates, &c. of good execution.

In all the Egyptian edifices, even those which have suffered the most from time, sufficient remains to enable a person, however little practised in the vestiges of antiquity, to fill up and form a correct whole. In the temple we are about to describe, the spectator is gratified to observe the trifling degree of dilapidation produced by time, the shocks of successive invasions, the irruptions of barbarism, and the ceaseless efforts at destruction of the more modern inhabitants.

There is little doubt that ancient Thebes occupied both banks of the river Nile. The gateways and propyla, parts of the hundred gates celebrated by Homer, from each of which might be sent two hundred horsemen and two hundred cars, might be traced to the number of fifty or sixty at

* Lotus, or water-lily—*Nymphæa albus,* called in the Arabic of the country, *Noufar.*

† *Phœnix dactylifera.*

‡ Doum of the Saide—*Borassus flabelliformis.*

this day, including the temples on both banks.* The courts were probably the places of assembly. They are from 100 to 400 feet long—the propyla from 70 to 100 feet high—and the gateways 30 to 80 feet in solidity. These masses are invariably built with a slope or talus. We shall give the temple of Carnac, situated on the eastern bank. This magnificent temple has many entrances, propyla, and gateways. In front of those gateways are statues of colossal dimensions: avenues of sphinxes conduct to them. One of these avenues is one mile and a quarter in length. Immense porticoes and colonnades, composing forests of columns, conduct to interior gateways. Many of these columns are 36 feet in circumference; and in front of some of the gateways are colossal statues of granite of the highest polish. The walls and columns are covered with sculpture and painting. We arrive at obelisks of granite, so deeply cut with hieroglyphics, figures, &c. that the modern workman would in vain attempt to imitate them.† Further on are obelisks of a greater size, backed by rows of colossal figures, holding the crook and flagellum across the chest. Then follow more obelisks, of great beauty and variety of sculpture. This suite of avenues, porticoes, gateways, and colonnades, and this combination of the arts in colossi, obelisks, &c. served to adorn the entrance to a small sanctuary, composed entirely of Thebaic granite, where the God of Generation and Abundance was worshipped. That nothing might be wanting, we find behind the sanctuary a court, most commodiously laid out in small but elegant apartments, for the use of the priests.

We commence the description in detail, by the west propylon, marked W on the plan, Plate II. An avenue of sphinxes leads to the gateway. These sphinxes have the ram's head, and lion's body, (called the Kriosphinx,)‡ and hold between their paws a small figure with the crook and flagellum:

* The lines of Homer are well known. See First Iliad, 382.

† The ancient Egyptians must either have had a temper for their tools unknown to us, or a process by friction, requiring great time and extraordinary perseverance.

‡ The Kriosphinx is supposed, by some authors, to denote the conjunction of the sun and moon in Aries.

The façade of the propylon is rustic, not unlike the rude architecture of the time of Justinian. It has four large openings pierced throughout the mass. From the top, which is easy of ascent, we have a splendid uninterrupted view of every part of the temple to the east and south. Behind us, to the west, is a luxuriant fertile plain in Dourra, (*Holcus Dourra*) rice, (*Oryza sativa*—Egypt. Arabic Rouss,) and interspersed with palm trees extending to the Nile. On the opposite bank, the eye takes in the long range of catacombs, (the ancient Necropolis,) the Memnonion, temples of Medinet Aboo, &c. and the two remarkable colossal statues. The prospect terminates with the sterile rocks, forming the valley of Biban el Moluk, the sombre valley of death, the last and dreary abode of the kings of this country. It is worthy of remark, that the modern inhabitant of Egypt has the same predilection for the solitude of the desert, as the abode of death. To resume the description of the temple: The inside of the portal is smoothed, but bears no sculptures. There is inscribed on it a list of latitudes and longitudes by the French savans who accompanied the army of Napoleon into Egypt. * The portal P is 22 feet wide; the propylon extends for 171 feet on each side. The mass is 41 feet in thickness. Passing through the portal, follows a spacious court C, having two rows of columns in the middle, each 28 feet in circumference, and on each side is a portico formed by a wall and columns, *b*, *b*, 20 feet in circumference. These columns are tapering in shape, and have for their capital the lotus flowers reversed, resembling a bell turned downwards. To the right hand, or south, is a suite of chambers *d*, having single or double porticoes. In the first, the square pillars forming the portico bear on their front large figures with the crook and flagellum across the shoulders. The walls bear sculptures of the hero, (always designated by his high cap, colossal size, and having a bird

	Long.			Lat.				Long.			Lat.		
* Dendera,	30°	21′	0″	26°	10′	0″	Edfou,	30°	33′	4″	25°	0′	0″
{ Carnac,	30	20	4	25	44	15	Ombos,	30	38	39	24	28	0
{ Luxor,	30	19	16	25	42	25	Syene,	30	24	19	24	8	6
Esneh,	30	14	12	25	19	39	Isle of Philoe,	30	33	46	24	3	45

Republique Françoise, An. viii. *Geog. des Monumens. Commission des Sciences et des Arts.*

with expanded wings hovering over him, which we shall call his winged concomitant,) holding by the hair a group of crushed or subjugated enemies; we count five. A deity facing the hero, to whom he appears to sacrifice them, holds out a large knife, as if offering fresh arms for further sacrifices of victims. Behind the deity, are prisoners with their elbows tied behind their backs.

The architraves and ceilings bear sculptures of hieroglyphics, bulls, birds, &c. The walls of these chambers to the south bear various presentations to Priapus. It is to be observed, that the god is inavariably represented with the left arm and leg only visible; the left arm holding the crook and flagellum, or the flagellum only appears behind his back. Behind him is an altar with a palm tree on each side, and between the god and the figure offering the presentation is a large lotus. Isis is sculptured on the walls, suckling Horus. The length across the court C, is 231 feet. In front of the second portal are two colossal figures facing inwards; the dress below the middle slants off, so as to fall lower behind than before; from the knee-pan to the foot measures 8 feet 6 inches.

On the façade are representations in bas relief of offerings to the god of Lampsacus. The hero is again sculptured, holding groupes of vanquished by the hair. This, as will be perceived by the plan, is a double gateway D G; the first or outer is 45 feet wide, and 41 feet 4 inches thick; the inner 17 feet wide, and 43 feet thick. This conducts to a court with 134 columns; those in the centre row are 36 feet, the others 28 feet in circumference; the first have for their capital the lotus turned downwards; the others a Bulge and Tuscan capital; they are painted blue, red, and yellow. The ultramarine and gold colours are here particularly brilliant. The capitals are connected by large blocks or slabs, so as to form a roof, except in the middle, which is open to the sky; the connecting slabs are latticed with long narrow apertures, so as to admit the light. Many of the blocks have fallen. Every column is covered from the pedestal upwards with sculpture and paintings of presentations to the god, of palm-branches, vases, libations of lustral waters, &c. &c.

The presenting figure is generally the hero, with his winged concomitant. The blocks forming the roof are sculptured with birds, grashoppers, &c. On the walls are offerings to the hero by kneeling figures. Offerings occur also to Sothis, (the human figure with the head of the ibis.) This forest of columns measures 167 feet 6 inches across. Passing through the next portal *e*, we come to a court with two obelisks of red granite O. Upon the faces of these obelisks are very deeply cut serpents, birds, bulls, the ibis, scarabæi, hares, owls, libations of lustral water, phallus often repeated, &c. The obelisks measure six feet two inches on two faces, and six feet eight inches on the other two. Passing through another portal *f*, we find a gateway flanked by an obelisk on each side F, measuring on the faces seven feet eight inches, and seven feet ten inches, and cut nearly as the two last described; they are of the same sort of granite. Behind are rows of colossal figures C′C′, holding the crook and flagellum. We now pass through a gateway of granite *g*, and find two more obelisks of granite, perfect, except the pyramidion. On these are sculptured the monarch, embraced by Isis Lunata; she has sometimes the right arm thrown round his shoulder, he having the left arm on her shoulder. There are other endearments; they look at each other, and the sculptor has thrown much tenderness of expression into the countenance of the female. There are also lotus flowers with green stalks, admirably executed. Next follows a granite portal eight feet wide, and seven feet ten inches thick, conducting to the sanctuary (Σηκοσ,) and having three feet of width on each side of the door, and twenty-six feet in length. It is built entirely of granite, the roof being composed of three large granite slabs, ornamented with gilt stars on a blue or azure ground. Here the god was adored as the grand creative principle, as the being supplying the wants of mankind, and giving animation to nature. The portal, as well as the walls of the sanctuary, are sculptured with presentations of vases, &c. to the god—with libations, holding up hands in adoration. He is figured twice on each of the four pannels of each wall, or thirty-two times in all. These sculptures are painted green. Behind is another chamber of granite, with a ceiling of gilt stars on a blue ground. The south wall has large figures of the god, with comparatively diminutive human figures at his feet, and adoring him. It is thus, throughout, by comparative size, that the Egyptians designated their gods, their heroes, and the different ranks of mankind. On each side are passages of black granite, marked on the plan with a deep shade. Proceeding onwards, we have a large court, 191 feet long; crossing it, there is a quadruple portico Q, 116 feet by 32; and to the right, or south, a range of apartments, perhaps for the priests, opening to the portico in front. The figures here are in relief, and represent offerings to the god, scenes of embracing, &c. In size, uniformity, and style of entrance, these chambers are really not unlike the cells of modern monks, though very differently decorated. The porticoes are all roofed with slabs, painted blue, and sculptured. Passing along the portico to the east end, we have another suite of small similar chambers P P, with a colonnade in front not entire, *m*. At the eastern entrance *h*, we trace the remains of a granite gateway; and at the distance of twenty feet two colossal figures on each side *a a*, various fragments of colossi, a colonnade, and, at the distance of 321 feet from the eastern wall, a propylon and portal, with sculptured figures E. The northern entrance N has a propylon and portal, avenue of sphinxes, having the lion's body, and human head*—the countenance is feminine. There are two colossi in front. On the cornice of the propylon is an immense globe, with expanded wings; there are also serpents sculptured and painted. This propylon is at the distance of 900 feet from the north wall of the temple, and in the intermediate space are various ruins, a gateway, &c. To the north of the propylon is a rich plain in dourra and rice, interspersed with palm-trees. We proceed to examine the figures sculptured on the exterior walls, commencing at the north-east angle *n*. We find the usual offerings and presen-

* This conjunction of the lion's body with the female human head, has been supposed to denote Leo and Virgo, and to be typical of the most interesting of all events to an Egyptian, the inundation of the Nile, which usually takes place when the sun is in Leo and Virgo, viz. from the 23d July, when the river begins to rise, to the 22d September, when it is at its height, or begins to decrease.

tations. Then follows a series of figures.—The Egyptian conqueror having his winged concomitant hovering above him, his standard and sacred tor is in his car, and in the act of drawing his bow on the enemy. His horses are scampering over, and treading on the foe. The fugitives are hurled down precipices pell-mell, or hastening to their strong-holds, while he drives furiously over the dead, the dying, and the wounded. The enemy are pierced in all parts by his unerring darts. Some, who have already reached their fortress, and climbed or ascended the wall, draw up others with arrows sticking in their backs, or assist their wounded comrades to save the remains of life, nearly extinguished by the hero's missiles; others are so grievously wounded, that, unable to make further efforts, they fall, pierced in every part, while endeavouring to scramble up. Those who have been fortunate enough to gain the inside of the fortress, are supplicating the mercy of the hero, and signify their surrender by extended arms, uplifted hands, and bent posture. The arms of the hero are the bow and quiver—those of the enemy the lance and javelin. The enemy wear a tight green dress, reaching to the middle, and below a red dress, reaching not quite to the knee. On the pannel above, is a groupe of prisoners—some are felling trees with axes—some assisting, others at a little distance, with ropes round the trees, to prevent their falling too suddenly. The hero returning from the chace, and having descended from his car, which is turned the other way, approaches them. The chief of the enemy, indicated by his larger size, (but comparatively small to the hero) turns to receive him. The enemy's chief is represented in a submissive attitude, crouched, and supplicating for himself and his people. The hero having his reins in his left hand, holds out his right to the chief, as if in token of granting his prayer. The beards of the prisoners have been allowed to grow. In the scene described, the enemy are on foot. Following the wall to the westward, we see the hero of colossal size, with his people represented small in comparison, putting the enemy to flight; they are drest as in the last scene, but are now in chariots. They are falling headlong in all directions.

The sculptor next gives us proofs of the athletic strength of the hero. His left side is advanced,—he carries before him two prisoners, whom he holds round the waist; he carries, in the same manner, two behind him, in his right arm; the legs and arms of the four thus carried dangle in the air; the iron grasp of the hero is finely pourtrayed by the small and compressed waists of the four figures. Behind are two rows of prisoners, five in each row, with their wrists bound, and tied across the body, whom the hero drags along by a cord: in front of the hero is his car, and the reins are girt round his body; he has a knife in one hand. The figures carried by the hero are much larger than those dragged by the cord, denoting the superior rank of the former. This groupe is highly executed, particularly the muscular action of the right leg of the hero. We see more groupes of prisoners, some having the wrists, others the elbows, bound with ropes. The hero presents them to a seated deity—another deity and Isis Lunata are standing behind;—the hero holds by the hair a number of the vanquished, who are on their knees: the hero makes offerings to the deity. The portrait of the hero is the same throughout, but his dress differs. In his car, and in the battle scenes, he wears a helmeted cap; when he holds the vanquished, or receives presentations, a very high cap;—and when he is seen making offerings, and presentations of lotus flowers in gratitude to the deity, he wears the low close cap of humility and devotion. In all, he has hovering over him his tutelary genius. The wall is here a good deal broken; we discover horses dead, wounded, dying or pawing in pain,—chariots upset, or dashed to pieces. The figure of the horses of the hero is peculiarly elegant and spirited. He has on his car quivers and bows; I also reckoned three human heads on the car. Similar scenes, but a little varied, occur; the hero holds a large figure whom he prepares to transfix, and crushes a smaller (inferior person) under his foot. The hero, in his car, with an uplifted long knife, prepares to make a blow at a person (of consequence from his size) who is by the side of his horses. The enemy are falling—the hero drives over them;—one man looks behind, with a scared aspect, and endeavours to save his cattle.

The south west propylon marked S. W. is imposing from its height; and the elegance and perfection of its sculpture are remarkable. An avenue of sphinxes conducts to it, which runs in a direct line for 323 paces, where it meets an interesting avenue, leading in one direction to the avenue of the south-east propylon, and bending in the other direction towards the great temple of Luxor, at the distance of a mile and a quarter. The avenue of sphinxes may be traced by fragments for two-thirds of the way. The sphinxes first mentioned have the ram's head, the others, the female human head. They hold between the paws a human figure, with the crook and flagellum. The south-west propylon is 100 feet high; over the portal is the winged globe and serpent, of admirable execution. This ornament is common to all the Egyptian temples. The jambs bear presentations to Isis Lunata, (with the disk or crescent) to Priapus; amongst others, of four bulls driven by a man, and held by a cord—a presentation of two bulls with globes on their heads to Ammon—a sacrifice of kneeling and supplicating figures to Isis and Ammon. He wears a blue, red, and white dress—Isis wears a striped checked dress of the same colours. The propylon is 37 feet 6 inches thick; the wall on each side of the portal extends only 10 feet 7½ inches, width of the portal 18 feet. We now enter a court *m*, 118 feet long, with sphinxes on each side, conducting through a pylone, having a portal of 12 feet wide, in a mass of masonry, extending 47 feet 2 inches on each side, and bearing offerings of lotus flowers, &c. There is a stair formed in the east end of the inside of this pylone, by which the summit may be attained, and whence a magnificent view is had of the temple. We enter a court *r*, with double rows of columns forming porticoes, roofed with blocks. They are covered with sculptures. Passing through a doorway, 6 feet 7 inches thick, and 8 feet 10 inches wide, there is a smaller court *t*, with a double portico on each side, which leads to a passage *v*, having rooms on either hand, and likewise underneath; two of them have a pillar. The passage leads to a small chamber *x*, 36 feet by 10 feet, almost buried in rubbish. To the west, is a small detached edifice *w*, the roof of which is supported by two columns, with the budding lotus for their capital, ornamented with lotus flowers and palm-branches, and surmounted by square blocks, bearing on each of their four sides the broad face of Isis in finely executed relief. The walls are sculptured with presentations, the ceiling with expanded wings. There are some adjoining chambers. At 315 feet east from the south west propylon, we find the commencement of another mass, and at 151 feet farther the gateway, or portal S E, constructed of granite highly polished, (marked with a deep shade on the plan,) bearing sculptures of offerings of jars, vases, &c. to the god, who wears here a very rich necklace or collar; there are other figures in magnificent costume, and artfully executed; the formation of the limbs, the feet, the dresses, drapery, and minor details, are exquisite. This leads to a court B, with a covered portico to right and left. At 120 feet to the right is an edifice *y*, with a double portico and side chambers: it has a granite entrance or gateway.

At 135 feet, is another mass of masonry 2, which is, in a great measure, dilapidated. There are fragments of a granite gateway, and of two colossi, whereof there remains a hand and body. Passing through an open space of 240 feet, we come to a third mass 3, having two colossal seated statues on each side, measuring from the head to the navel (they are partly buried) twelve feet four inches, from the shoulder to the elbow seven feet two inches, from the elbow to the fingers seven feet one inch. These statues have the serpent twisted on the forehead. The façade is sculptured with the hero holding the vanquished by the hair of the head; we reckon five pairs of hands. Traversing a space of 133 feet, which includes the thickness of a fourth mass 4, we proceed for 181 feet, which brings us to an opening in the wall 5, a little to the eastward of the forest of columns.

The sphinxes leading to the south east, or granite-gated propylon, have the bull's head; we reckon fifty-eight on one side, and 49 on the other; they stand on high pedestals, and are painted. Proceeding south, we come to a gateway leading to an open space, with fragments of statues and ruins. A pond encloses, on three sides, a small eminence L, where we have seated rows of figures with the female form and lion's head; they sit in chairs with backs. We reckon thirteen in one row, and eleven in another—they are all of black granite—the hands rest on the thigh; one hand holds the sacred tor; they wear bracelets; the breasts are exposed, the thighs, legs, and feet are closed.

The chain of rock and mountain which bounds the plain, is here, at least, six or seven miles distant; the whole of the intervening flat receives the benefits of the inundation of the fertilizing Nile.

	feet	in.
The width of the avenue formed by the sphinxes, is generally about - - - - -	41	0
The distance between the sphinxes, - -	5	0
From the shoulder to the insertion of the tail of the sphinx,	12	0
Length of the tail, - - - -	11	0
Breadth across the chest, - - - -	4	0
From the shoulder to the knee, - - - -	5	1
From knee to knee in their recumbent position, -	3	6
Breadth across the paw, - - - - -	1	11
In some avenues, the interval between the sphinxes is,	11	0

The length of the temple from the western portal *p* to the eastern propylon E, is upwards of 1500 feet.

ART. XII.—*Observations on the Position and Revolution of the Magnetic Poles of the Earth.* By CHRISTOPHER HANSTEEN, Professor of Astronomy in the University of Norway.

As we had the satisfaction of first introducing the English reader to the important researches of Professor Hansteen, contained in his valuable work on the magnetism of the earth,* we are desirous to keep our readers in the current of his very interesting and important inquiries.

In the work now quoted, Professor Hansteen computed, by means of the observations which he then possessed, the positions of the four magnetic poles of the globe, and from these results he calculated the following table, which shows the position of these poles during the first half of the present century. In this table,

* *Untersuchungen uber den Magnetismus der Erde.* Christiania, 1819.

N is the *strongest* pole in the *north* hemisphere, and its revolution round the north pole of the earth is performed in 1740 years.

S is the *strongest* pole in the *south* hemisphere, and its revolution round the south pole of the earth is performed in 4609 years.

n is the *weakest* pole in the *north* hemisphere, and its revolution is performed in 860 years.

s is the *weakest* pole in the *south* hemisphere, and its revolution is performed in 1304 years.

Year.	Pole N, Strongest Pole in North Hemisphere.		Pole S, Strongest Pole in South Hemisphere.		Pole *n*, Weakest Pole in North Hemisphere.		Pole *s*, Weakest Pole in South Hemisphere.	
	Distance from the *North* Pole.	Long. West from Greenwich.	Distance from the *South* Pole.	Long. East from Greenwich.	Distance from the *North* Pole.	Long. East from Greenwich.	Distance from the *South* Pole.	Long. West from Greenwich.
1800,	20° 7′	93° 33′	20° 53′	134° 8′	4° 35′	131° 43′	12° 10′	130° 28′
1810,	20 15	91 28	21 1	133 21	4 42	135 54	11 57	133 14
1820,	20 22	89 24	21 8	132 35	4 48	140 6	11 44	135 59
1830,	20 30	87 19	21 16	131 47	4 54	144 17	11 31	137 45
1840,	20 38	85 15	21 23	131 1	5 0	148 28	11 19	140 31
1850,	20 46	83 10	21 31	130 14	5 0	152 40	11 6	143 16

Since this table was computed, Professor Hansteen has obtained many new sets of magnetical observations, and particularly those which have been made during the British voyages of discovery to the Arctic Regions. These he has diligently compared, and thus obtained new determinations of the position and times of revolution of the magnetic poles of the earth. The results of these we shall now lay before our readers in a very abbreviated, but, we trust, intelligible and useful form.

1. *On the Position, &c. of N, the strongest Magnetic Pole in North America.*

By combining four observations on the declination of the needle, made on board his Majesty's sloop Brazen in Hudson's Bay, in 1813, and which Professor Hansteen inspected in the Marine Chart Office at the Admiralty in London, he obtained the following results:

	Distance of the Pole N from the Pole of the Earth.	Long. West of Greenwich.
1813,	21° 44′	91° 35′
	23 40	92 18
	22 9	93 22
	23 47	92 21
Mean,	22° 50′	Mean, 92° 24′

By placing this result beside former determinations, we have,

	Distance of N from Pole.	Long. West of Greenwich.
1730,	19° 15′	188° 6′
1769,	19 43	100 2
1813,	22 50	92 24

Hence we have,

Motion of the Pole N to the East.	Annual Motion.
From 1730 to 1769,	12′.44
From 1769 to 1813,	10 .41
Mean motion,	11′.425
Period of complete revolution,	1890 years.

These results have received a very remarkable confirmation from the observations both of the variations and dip made during the voyages of Captain Ross and Captain Parry. In August 1819, Captain Parry was north of the magnetic pole, and from his measure of the dip, viz. 88° 37′, on the 11th September 1819, the expedition must have been about 3° north of the magnetic pole; but they were then in 74° 27′, consequently the pole must have been in 71° 27′, or its distance from the pole of the globe must have been 18° 33′. We may therefore conclude, that the position of the strongest pole N in the northern hemisphere is well determined.

2. *On the Position of S, the strongest Magnetic Pole in the Southern Hemisphere, south of New Holland.*

By combining the observations made by Captain Cook in 1773 and 1777, and those made by Fourneaux in 1773, Professor Hansteen has obtained the following results, from which two of the most discordant are rejected:

Distance of the Pole S from the Pole of the Earth.	Long. East of Greenwich.
20° 26′	138° 7′
20 58	135 12
21 30	132 47
19 47	136 31
19 53	136 25
20 27	138 29
19 39	138 11
21 48	134 21
Mean, 20° 33′.5	Mean, 136° 15′.4

But, in the year 1642, Professor Hansteen found these positions, from the observations of Jansen Tasman, to be,

Distance from Pole,	18° 55′
Long. East of Greenwich,	146 59

Hence, in 131 years, the pole S has moved *westward* 10° 14′, or 4′.69 per annum.

Its period of complete revolution will be 4605 years.

3. *On the Position of n, the weakest Magnetic Pole in the North Hemisphere in Siberia.*

By combining a number of observations made in 1805 at Tobolsk, Tara, and Udinsk in Siberia, Professor Hansteen obtained the following results:

Distance of *n* from the Pole of the Earth.	Long. East from Greenwich.
4° 27′	116° 27′
4 50	115 51
Mean, 4° 38′ 30″	Mean, 116° 19′

But, in 1770, Professor Hansteen found the positions of this pole to be,

Distance from Pole in 1770,	4° 14′
Long. East of Greenwich,	91 29 30″

Hence, in 35 years, the pole *n* has moved 14° 35′ 30″, or 25.′128 per annum.

Hence it appears, *that the magnetic pole n has* a motion from west to east, and that its period of complete revolution is 860 years.

4. *On the Position of s, the weakest Magnetic Pole in the Southern Hemisphere south of Terra del Fuego.*

By combining the observations made by Captain Cook and Fourneaux in 1774, Professor Hansteen has obtained the following results:

Distance of the Pole *s* from the Pole of the Earth.	Long. West from Greenwich.
12° 36′	122° 52′
12 44	122 21
13 15	120 42
12 46	124 7
12 47	123 48
Mean, 12° 431′	Mean, 123° 17′

But, in 1676, from observations mentioned by Halley in the *Phil. Trans.*, No. 148, Professor Hansteen found the position of this pole to be,

Distance from the Pole in 1670, - -	15° 53′
Long. West from Greenwich, - -	94 33½

Hence, in 104 years, the pole *s* has moved *westward* 28°43½′, or 16′.57 annually; and we have its period of complete revolution, 1303 years.

From these determinations, it appears that *the two magnetic poles in the northern hemisphere, N and n, move* eastward, *while the two S, s, in the southern hemisphere move* westward.

As the poles N and S are nearly about the same distance from the terrestrial poles, and, therefore, almost diametrically opposite, and as they are also much stronger than *n* and *s*, Professor Hansteen properly assumes, *that N and S are the terminating points of one magnetic axis, and n and s those of the other axis.* Therefore, says he, these two magnetic axes cross without intersecting one another, or passing through the centre of the earth. The centre of both lie much nearer the surface in the South Sea than in our hemisphere.

In answer to the question which naturally arises respecting the cause of these remarkable phenomena, Professor Hansteen makes the following observation: It is possible that the illumination and heating of the earth, during one revolution about its axis, may produce a magnetic tension, as well as it produces the electrical phenomena, and that the change of position in the magnetic axis may be explained from a change of position in the earth's axis to its orbit.

Professor Hansteen next proceeds to show how the changes in the variation and dip of the needle may be explained by the motion of the magnetic poles; and he begins with the observations made at Paris, where the variation was as follows:

Years.	Declination of the Needle.	Years.	Declination of the Needle.
1541	7° 0′ East.	1667	0° 15′ West.
1550	8 0	1670	1 30
1580	11 30 Maximum.	1680	2 40
1603	8 45	1683	3 50
1630	4 30	1700	7 40
1640	3 0	1800	22 12
1659	2 0	1807	22 34
1664	0 40	1814	22 54 Maximum.
1666	0 0 No Variation.	1824	22 23¼

Now it appears that, in 1580, the Siberian pole *n* was about 40° east of Greenwich, or north of the White Sea, while the North American pole N was about 136° west of Greenwich, or about 30° east of Behring's Straits. The pole *n*, therefore, lay *nearer* Europe than now, and the pole N was *more remote.* Hence the former exercised a predominant action, and the needle turned towards the east. In the mean time, the pole *n withdrew* itself towards the Siberian Ocean, and as *N approached* Europe, its action increased, and the needle turned westward till 1814, when it reached its greatest declination, and since that time it is evidently returning eastward. On the very same principles we see the reason why the eastern declination was less before 1580.

The variations of the needle in the *Southern hemisphere* are explicable in the same way. At the Cape of Good Hope, and in the different bays of the adjoining sea, the variation was easterly in 1605. The following are the variations since the time of Vasco de Gama:

Years.	Declination of Needle.	Years.	Declination of Needle.
1605	0° 30′ EAST.	1724	16° 27′ WEST.
1609	0 12 WEST.	1752	19 0
1614	1 30	1768	19 30
1667	7 15	1775	21 14
1675	8 30	1791	25 40 MAXIMUM.
1702	12 50	1804	25 4

Now, in 1605, the South American pole *s* was $76\frac{1}{2}°$ west of Greenwich, nearly south of Terra del Fuego, and the New Holland pole S was about 150° east of Greenwich; the pole *s* was, consequently, much *nearer* the Cape than it is now, while the other pole S was *more remote* from it. The effect of *s*, therefore, was *greater*, and of S less than at present, so that the *south* pole of the needle moved more towards the *west*, and its *north* pole more towards the *east*. But as *s* went farther off, and S approached the Cape, the south pole of the needle turned more and more towards S, so that the declination became westerly.

To obtain an example from the dip, Professor Hansteen gives the following observations at Paris:

Years.	Dip.	Years.	Dip.
1671	71° 0′	1798	69° 26′
1754	72 15	1806	69 12
1780	71 48	1814	68 30

Though the dip thus *diminished* at Paris, yet it *increased* in Eastern Siberia and Kamtschatka. Both these changes are the results of the motion of the Siberian pole *n* towards the east, in which it is removed from Europe, and approaches to Kamtschatka. In all South America the dip *decreases* in consequence of the motion of the Terra del Fuego pole *s* towards the west.

ART. XIII.—*On the Solar Eclipse which will happen on the 29th of November* 1826; *being the principal results of a calculation for Edinburgh.* By MR GEORGE INNES, Aberdeen.

SIR,

I SEND you for insertion in the *Journal of Science*, the results of a calculation for Edinburgh of the solar eclipse which will happen on the 29th of November 1826. The elements have been found from the solar tables of M. Delambre, and the lunar tables of M. Burckhardt.

Although the moon's apparent semi-diameter exceeds that of the sun, yet, owing to the moon's great south latitude, the eclipse will not be total any place of the globe, as the central path of the penumbra will pass beyond the north pole. For the same reason, at those places where the eclipse will be visible, the parallaxes in latitude will not be very different; and, therefore, also, the digits eclipsed will be nearly the same at all places in Great Britain; but the times will be affected by the parallaxes in longitude, which will vary with the situation of the place.

The elements are as follows:—

	D.	H.	′	″
Ecliptic conjunction, *mean time* at Edin.	Nov. 29	11	12	47, 11 A.M.
Equation of *mean* to *apparent* time,		+	11	31, 26
Hence the *apparent time* is	29	11	24	18, 37 A.M.
Longitude of the sun and moon from true equinox,		246°	46	21, 83
Sun's right ascension,		244	55	41, 04
—— declination south,		21	27	34, 47
—— horary motion in longitude,			2	32, 09
—————— right ascension,			2	41, 06
—————— declination,			+	25, 65
—— semi-diameter,			16	15, 15
—— horizontal parallax,				8, 93
—— latitude,				0, 00
Obliquity of the ecliptic,		23	27	36, 86
Horary decrease of the equation of time,				0,895
Moon's latitude north increasing,		1	12	27, 81
—— equatorial horizontal parallax,		1	1	23, 66
—— horizontal semi-diameter,			16	43, 80
—— horary motion in longitude at conjunction,			38	5, 80
—————— for the hour preceding,			38	5,865
—————— for the hour following,			38	5,735
—— horary motion in latitude at conjunction,		+	3	25,833
—————— for the hour preceding,		+	3	26,054
—————— for the hour following,		+	3	25,613
Angle of relative orbit of the moon with the ecliptic,		5	30	36, 4
Horary motion of the moon from the sun in the relative orbit,			35	43, 62

Table of the Principal Results obtained in calculating for Edinburgh.
Reduced Lat. 55° 42′ 10″; *Long.* 3° 10′ 21″ W.

	For the Apparent Conjunction,		For the Beginning.		For the End.	
	D. H. ′ ″	D. H. ′ ″	D. H. ′ ″	D. H. ′ ″	D. H. ′ ″	D. H. ′ ″
Instants assumed,	29 10 49 18,89	29 10 50 18,87	29 9 45 19,86	29 9 46 19,84	29 11 54 17,92	29 11 55 17,90
Sun's longitude,	246° 44 53,11	246° 44 55,65	246° 42 10,88	246° 42 13,42	246° 47 37,88	246° 47 40,41
Moon's longitude,	246 24 8,39	246 24 46,49	245 43 29,71	245 44 7,76	247 5 24,70	247 6 2,79
——— latitude,	1 10 27,56	1 10 31,00	1 6 46,35	1 6 49,61	1 14 10,62	1 14 14,04
Sun's right ascension,	244 54 7,09	244 54 9,77	244 51 15,29	244 51 17,97	244 57 1,57	244 57 4,25
Right ascension of the meridian,	227 13 50,44	227 28 52,82	211 11 13,19	211 26 15,57	243 31 30,37	243 46 32,75
Altitude of the nonagesimal,	22 42 12, 3	22 36 16, 1	29 4 22, 6	28 58 26, 3	16 32 10, 0	16 26 53, 3
Longitude of the nonagesimal,	187 32 43, 5	187 47 24, 8	172 15 44, 6	172 28 15, 3	207 59 17, 6	208 25 34, 6
Parallax in longitude, +	20 14,90	20 6,90	28 31,25	28 24,21	11 0,47	10 51,01
Parallax in latitude,	56 17,13	56 19,56	53 20,42	53 23,48	58 28,81	58 30,39
App. diff. long. of the sun and moon,	29,82	2,26	30 9,92	29 41,45	28 47,29	29 13,39
Moon's apparent latitude N.	14 10,43	14 11,44	13 25,93	13 26,13	15 41,81	15 43,65
——— apparent semi-diameter,	16 47,15		16 45,99		16 47,53	
——— appar. motion from sun in 60″	27,56		25,09		23,82	
Errors from instants assumed,	— 29,82	— 2,26	+ 0,69	+ 25,78	— 15,31	+ 8,51
Times obtained,	Appar. Conj. at 10 H. 50′ 23,79″		Begins at 9 H. 45′ 18,21″		Ends at 11 H. 54′ 56,46″	

The final results in view are as follows:

		Apparent Time. D. H. ′ ″
Begins at Edinburgh, - -	Nov. 29	9 45 18,21 A.M.
Greatest obscuration, - - -		10 49 15,91
Apparent conjunction, - - -		10 50 23,79
End of the eclipse, - - -		11 54 56,46
		D.
Digits eclipsed at greatest obscuration, -		6 57 52,56 on

the north part of the sun's disc.

The moon will make the first impression on the sun's limb 39° 54′ 30″ from his zenith to the right hand.

I am, Sir,
Your most humble servant,
Geo. Innes.

Art. XIV.—*Observations relative to the Sound which accompanies the Aurora Borealis.*

That the phenomena of the Aurora Borealis were accompanied with a whizzing sound, resembling the discharge of electricity from a pointed conductor, was, for a long time, considered as an undeniable fact in science. During the late expeditions, however, to the Arctic Regions, and during Mr Scoresby's numerous voyages to Greenland, the Northern Lights were not heard to emit any sound; and since that time it has been very generally supposed, that preceding observers must have been mistaken.

We do not mean to array, in opposition to this opinion, the body of evidence which has been recorded in favour of the opposite one. It may be sufficient to state, that Gmelin speaks of the hissing noise of the Aurora Borealis in the most pointed terms, and represents it as not only frequent but very loud in the north-eastern parts of Siberia, and that M. Cavallo distinctly heard more than once a sort of crackling noise accompanying the coruscations of the Aurora when they were strong.

At a later period, and during the brilliant Aurora which appeared at Edinburgh on the 5th December 1801, the same noise was distinctly heard by Dr Brewster, who, at that time, published the following description of it:

" The whole northern part of the horizon was covered with a thin transparent luminous cloud, which emitted almost as much light as the moon when three days old. This luminous cloud sometimes appeared settled, and totally free from all manner of motion or agitation. At other times the agitation was extremely great, and the coruscations or streams of light which were perpendicular to the horizon, flew with the utmost rapidity from east to west, and from west to east. One of these coruscations, which appeared in the north-west, was about 13 degrees long, and $\frac{1}{2}$ a degree broad. Its western edge was tinged with red and violet, and its brilliancy was almost equal to that of the moon in her first quarter, when the sun is a few degrees below the horizon. *** During this evening a *whizzing noise* was heard in the air, exactly similar to the sound which accompanies the passage of the electric spark from the glass cylinder to the conductor; and I was informed by a friend, *that during the time that the coruscations were most vivid,* the top of *St Giles' steeple seemed to emit rays of light in every respect similar to a Leyden jar when surcharged with the electric fluid.*" *

Since these facts were published, Professor Hansteen has added the following very important information on the subject.

The first is an extract of a letter from M. Ramm, Royal Inspector of Forests at Törset, to Professor Hansteen :

" On reading Scoreby's voyage for the re-discovery of the east coast of Greenland, I was surprised to observe, that neither he nor any body else had noticed the noise attending the motions of the Northern Lights. I believe, however, that I have heard it repeatedly during a space of several hours, when a boy of ten or eleven years old; (it was in the year 1766, 1767, or 1768.) I was then crossing, in winter, a meadow, near which there was no forest, and I saw, for the first time, the sky over me glowing with the most brilliant light, playing in beautiful colours, in a manner I have never seen since. The colours showed themselves very distinctly on the plain, which was covered with snow or hoar frost, and *I*

* We are informed by the Rev. Mr Grant of Cross and Burness, Orkney, that he has repeatedly heard the whizzing noise during the coruscations of the Aurora Borealis.—Ed.

heard several times a quick whispering sound simultaneously with the motion of the rays over my head."

Professor Hansteen then adds the following observations: "The polar regions being in reality the native country of the polar light, we ought to be peculiarly interested in obtaining any additional information on the natural history of this remarkable phenomenon; and we have so many certain accounts of the noise attending it, that the negative experience of southern nations cannot be brought in opposition to our positive knowledge. Unfortunately, we live, since the beginning of this century, in one of the great pauses of this phenomenon, so that the present generation knows but little of it from personal observation. It would, therefore, be very agreeable to receive, from older people, observations of this kind, made in their youth, when the *Aurora Borealis* showed itself in its full splendour. It can be proved mathematically, that the rays of the Northern Lights ascend from the surface of the earth in a direction inclining towards the south, (an inclination which, with us, forms an angle of about 73°.) If, then, this light occupies the whole northern sky, rising more than 17° above the zenith, the rays must proceed from under the feet of the observer, although they do not receive their reflecting power till they have reached a considerable elevation, perhaps beyond our atmosphere. It is, therefore, conceivable, why we should frequently hear a noise attending the Northern Lights, when the *inhabitants of southern countries*, who see these phenomena at a distance of several hundred miles, hear no report whatever. Wargentin, in the 15th volume of the *Transactions of the Swedish Academy*, says, that Dr Gisler and Mr Hellant, who had resided for some time in the north of Sweden, made, at the request of the academy, a report of their observations on the *Aurora Borealis*."

The following is an extract from Dr Gisler's account:— "The most remarkable circumstance attending the Northern Lights is, that, although they seem to be very high in the air, perhaps higher than our common clouds, there are yet convincing proofs that they are connected with the atmosphere, and *often descend so low in it, that at times they seem to touch the earth itself; and on the highest mountains they produce* *an effect like a wind round the face of the traveller.*" He also says, that he himself, as well as other credible persons, "*had often heard the rushing of them just as if a strong wind had been blowing, (although there was a perfect calm at the time) or like the whizzing heard in the decomposition of certain bodies during a chemical process.*" It also seemed to him that he noticed "*a smell of smoke or burnt salt.*" "I must yet add," says Gisler, "that people who had travelled in Norway, informed me they had sometimes been overtaken on the top of mountains by a thin fog, very similar to the Northern Lights, and which set the air in motion; they called it *sildebleket,* (Häring's lightning) and said that it was attended by a piercing cold, and impeded respiration." Dr Gisler also asserts, that he often heard "*of a whitish gray cold fog of a greenish tinge, which, though it did not prevent the mountains from being seen, yet somewhat obscured the sky,* rising from the earth, and changing itself at last into an Aurora; at least, such a fog was frequently the forerunner of this phenomenon."

To these observations, Professor Hansteen adds, that Captain Abrahamson, in the *Transactions of the Scandinavian Literary Society*, has given an account *of several observations of noises that were heard along with the Northern Lights*; and the learned Professor concludes with the observation, that he himself knows several persons that have heard the same sounds.

Art. XV.—*Some Experiments on Coloured Flames.* By H. F. Talbot, Esq. Communicated from the Author.

Great progress has recently been made in investigating the properties of light, and yet many of them are still unexamined, or imperfectly explained. Among these are the colours of flames which not only appear very various to common observation, but are shown, by the assistance of a prism, to be entirely different in nature one from another; some being *homogeneous*, or only containing one kind of light; others consisting of an infinite variety of all possible shades of colour.

1. It was discovered by Dr Brewster, that the flame of al-

cohol, diluted with water, consists chiefly of homogeneous yellow rays. On this principle, he proposed the construction of a monochromatic lamp, and pointed out its advantages for observations with the microscope. This must be considered a very valuable discovery. The light of such a lamp, however, is weak, unless the alcohol flame is very large. I have, therefore, made several attempts to obtain a brighter light, and I think the following is the most convenient method. A cotton wick is soaked in a solution of salt, and when dried, placed in a spirit lamp. It gives an abundance of yellow light for a long time. A lamp with ten of these wicks gave a light little inferior to a wax candle; its effect upon all surrounding objects was very remarkable, especially upon such as were red, which became of different shades of brown and dull yellow. A scarlet poppy was changed to yellow, and the beautiful red flower of the *Lobelia fulgens* appeared entirely black. The wicks were arranged in a line, in order to unite their effect for a microscope. A common blue glass has the property of absorbing the yellow light of this lamp, however brilliant, while it transmits the feeble violet rays. If these are also stopped by a pale yellow glass, the lamp becomes absolutely invisible, though a candle is seen distinctly through the same glasses. But the most remarkable quality of this light is its homogeneity, which is perfect as far as I have been able to ascertain. I speak of the yellow rays, which form the mass of the light, and quite overpower the feeble effect of the blue and green. The origin of this homogeneous light appears to me difficult to explain. I have found that the same effect takes place whether the wick of the lamp is steeped in the muriate, sulphate, or carbonate of *soda*, while the nitrate, chlorate, sulphate, and carbonate of *potash*, agree in giving a blueish white tinge to the flame. Hence, the yellow rays may indicate the presence of *soda*, but they, nevertheless, frequently appear where no soda can be supposed to be present.

2. Mr Herschel discovered that sulphur, when burning intensely, gives a homogeneous yellow light. To examine it, I inflame a mixture of sulphur and nitre behind a screen, having a narrow vertical slit through which the flame could be seen. This opening, examined with a prism, gave a spectrum

in which there was a very bright yellow line, indicating the combustion of the sulphur. I thought it a point of considerable interest to determine, whether this yellow ray was identical with that afforded by the flame of alcohol containing salt, and, with that view, I placed such a flame behind the other, their light passing through the same opening; so that, if the rays were of a different nature, two yellow lines should be seen in the spectrum ; but if identical, then only one. I found, upon trial, that the rays coincided ; and I obtained a further confirmation of this, by inflaming the nitre and sulphur, mixed up with a quantity of salt ; the effect of which was, not to produce a second yellow line in the spectrum, but to increase greatly the brilliancy of the original one. The result of this experiment points out a very singular optical analogy between soda and sulphur, bodies hitherto supposed by chemists to have nothing in common.

3. There are other means of procuring the same light which I shall briefly mention If a clean piece of platina foil is held in the blue or lower part of a gas flame, it produces no change in the flame, but if the platina has been touched by the hand, it gives off a yellow light which lasts a minute or more. If it has been slightly rubbed with soap, the light is much more abundant, while wax, on the contrary, produces none. Salt sprinkled on the platina, gives yellow light while it decrepitates, and the effect may be renewed at pleasure by wetting it. This circumstance led me to suppose that the yellow light was owing to the water of crystallization, rather than to the soda, but then it is not easy to explain why the salts of potash, &c. should not produce it likewise. Wood, ivory, paper, &c. when placed in the gas flame, give off (besides their bright flame) more or less of this yellow light which I have always found the same in its characters. The only principle which these various bodies have in common with the salts of soda, is *water ;* yet I think that the formation or presence of water cannot be the origin of this yellow light, because ignited sulphur produces *the very same*, a substance with which water is supposed to have no analogy. * It is al-

* It may be worth remark, though probably accidental, that the specific gravity of sulphur is 1.99, or almost *exactly twice* that of water.

so remarkable that alcohol burnt in an open vessel, or in a lamp with a metallic wick, gives but little of the yellow light; while, if the wick be of cotton, it gives a considerable quantity, and that *for an unlimited time.* (I have found other instances of a change of colour in flames, owing to the *mere presence* of a substance which suffers *no diminution in consequence.* Thus, a particle of muriate of lime on the wick of a spirit lamp will produce a quantity of red and green rays for a whole evening, without being itself sensibly diminished.) The bright flame of a candle is surrounded by the same homogeneous yellow light, which becomes visible when the flame itself is screened. The following experiment shows its nature more evidently: If some oil is dropped on the wick of a spirit lamp, the flame assumes the brilliancy of a candle surrounded by an exterior yellow flame. This appearance only lasts until the oil is consumed.

4. The flame of sulphur and nitre contains a red ray, which appears to me of a remarkable nature. While examining the yellow line in the spectrum of this flame, I perceived another line situated beyond the red end of the spectrum, from the termination of which it is separated by a wide interval of darkness. In colour it nevertheless differs but little from the rays which usually terminate the spectrum. It arises, I believe, from the combustion of the nitre, as the yellow ray does from that of the sulphur, for I have since observed it in the flame of a spirit lamp, whose wick had been soaked in nitre or chlorate of potash. It appeared to me that this ray was so distant from the rest, that it might be less refrangible than any in solar light; and I have been since informed by Mr Herschel, that he had already observed it in a similar experiment, and was impressed with the same idea.

With the hope of establishing this, I admitted candle light, and that of the nitre lamp which I have just mentioned, through the same aperture, and noticed how far this isolated red ray appeared beyond the spectrum of the candle. I then compared, in the same way, the light of the candle with that of the sun, and I found that the great intensity of the solar light lengthened the red end of the spectrum about as far, so that I was obliged to leave the question undecided, as the faintness of the lamp prevented my comparing it directly with the sun. This red ray appears to possess a definite refrangibility, and to be characteristic of the salts of potash, as the yellow ray is of the salts of soda, although, from its feeble illuminating power, it is only to be detected with a prism. If this should be admitted, I would further suggest, that whenever the prism shows a *homogeneous* ray of any colour to exist in a flame, this ray indicates the formation or the presence of a *definite chemical compound.* An excellent prism is, however, requisite to determine the perfect homogeneity of a ray.

5. Phosphorus inflamed with nitre gives a very brilliant spectrum, in which no colour appears to be predominant or deficient. It therefore resembles the spectra of ignited lime, platina, and other solid bodies, and differs totally from the solar spectrum in which there are now known to be innumerable interruptions of light. And it is worthy of remark, that no light has been hitherto discovered at all resembling that of the sun, (when analyzed with a prism) except the light of the other celestial bodies.

6. The red fire of the theatres examined in the same way, gave a most beautiful spectrum with many light lines or maxima of light. In the red, these lines were numerous and crowded, with dark spaces between, besides an exterior ray greatly separated from the rest, and, probably, the effect of the nitre in the composition. In the orange was one bright line, one in the yellow, three in the green, a very bright one in the blue, and several that were fainter. The bright line in the yellow is caused, without doubt, by the combustion of the sulphur, and the others may be attributed to the antimony, strontia, &c. which enter into this composition. For instance, the orange ray may be the effect of the strontia, since Mr Herschel found in the flame of muriate of strontia a ray of that colour. * If this opinion should be correct and applicable to the other definite rays, a glance at the prismatic spectrum of a flame may show it to contain substances, which it would otherwise require a laborious chemical analysis to detect.

LONDON, *March* 1826.

* *Edinburgh Transactions*, vol. ix. p. 456.

Art. XVI.—*Notice regarding the Red-breast (Motacilla rubecula,* Lin.*)* By a Correspondent.

Of the small song-birds, the red-breast seems most strongly attached to man and his dwellings; and there are associations connected with its history which prevent the robbing of its nest, even by those whose feelings of humanity for the other families of the feathered race are by no means similar. In this country, much of that feeling which protects the red-breast's nest is undoubtedly owing to the pathetic tale of the "Babes of the Wood;" but, on the Continent, where it is not regarded with the same associations, the red-breast is taken in numbers, at the close of autumn, for the use of the table. On this account also, it is, perhaps, that the red-breast is so seldom seen in the confinement of a cage. The following notice of one, however, which was taken by a gentleman in Orkney, and kept for nine years as a song-bird, may be interesting, as detailing the kind of food which supported him during his long captivity, and the change of plumage which took place towards the close of his life:

"Dear Sir,—At your request, I state to you some particulars respecting a robin red-breast which I had kept in a cage for nine years. As far as my information extends, this and another in Wales are the only instances in Britain of preserving that melodious bird in a domesticated state. During a fall of snow, he got into my barn, and was caught by a net, without receiving any injury. The difficulty was how to tame and feed him. I put crumbs of soft bread and potatoes into the cage; and, in order to prevent the violent struggles which he made for freedom from killing him, I removed him to a solitary room. In the course of two days he became quite tame. I perceived the food which I had given him he did not relish. I tried the common earth-worm, cut into small pieces, which he devoured greedily. He recovered his health and fine appearance, and, in a few days, began to delight us with his sweet-varied song. As the season approached for obtaining the common flesh-fly and butterflies, they were procured for him; and I have seen him use above a hundred of the flesh-flies daily. After I had him seven years, the colour of his feathers had considerably changed; his wings, back, and tail turned white, but his breast retained its red colour; and thus he continued till the ninth year, when he died. The north of Scotland does not furnish a more delightful bird for a cage than Robin. Could he be procured young, and treated as I have stated, there can be no doubt of preserving him. It is extremely difficult to obtain a young one. The female is scarcely known. I have never met with any book describing the female robin. I never saw but two of them; and I shall state the grounds of my opinion that they were female robins:—The male robin is a daring warlike bird; he does not associate even with the male of his own species, nor with any bird whatever but the female of his own kind. Of this I am certain; and I remarked his familiarity and attention to the only two females I have seen. I shall describe to you the female:—She is precisely of the same form with the male—of a dusky colour—has not the red breast—chirps as the male—and bows the head at every chirp, but is devoid of song."

Our correspondent is wrong in supposing that the domestication of red-breasts is of rare occurrence. The feeling which prevents their being taken and educated as song-birds, has, we have little doubt, taken its rise from the association we have alluded to, and is by no means to be attributed to their inability to support the confinement of a cage. The Hon. Daines Barrington (*Phil. Trans.* vol. lxiii.) mentions his having trained young red-breasts, among other birds, under a nightingale, for the purpose of acertaining whether the notes of birds were instinctive, or how much arose from imitation. In one case, three parts in four were the song of the nightingale; in another, educated under a woodlark-linnet for a month, and afterwards removed near a skylark-linnet, the robin learnt the notes of this last. Willughby says, * red-breasts may be taken "at ten days old; if you let them lie too long, they will be sullen." And Vieillot † remarks, that,

* Willughby, p. 219. † Vieillot in *Nouv. Dict. d'Hist. Nat.* vol. xi.

even when taken full grown, at the beginning of winter, the red-breast supports captivity, and sings soon after being deprived of liberty.

Though insects, larvæ and worms, be the chief food of the red-breast, yet, at the close of the season, it feeds on berries and seeds; and when the approach of winter brings it to the dwellings of men, crumbs of bread, &c. are eaten readily. One severe winter, some years ago, we picked up a poor robin battered down by sleet, and almost exhausted, and fed it several weeks in a green-house on crumbs of bread; and for several years a pensioner has come annually to our window, to feed upon the crumbs which are daily laid out by the children for his use. Whether this be always the same individual we are not aware; but his acquaintance with the locality, and his confidence in letting it be known when he is present, renders this probable. His pugnacious disposition and his boldness enable him to put to flight the crowds of sparrows which the crumbs attract to the same place.

Our correspondent's remarks upon the female red-breast we are afraid are not correct. The difference between the sexes is so little striking, as not likely to be noticed by an unpractised eye. "The cock may be known by his breast being of a deeper red, and the red going further upon the head," says Willughby; and Vieillot remarks that the female differs little from the male,—the orange-red in the former only inclining a little more to the yellow, and descending less on the breast. What our correspondent has taken for the female red-breast, is more likely to have been a young bird of the year, under the guidance of its parent—for the young do not take their proper colour till after moulting. Before this their plumage is generally brown, spotted with dull red. The red-breast, it may be remarked, is the first bird heard in the morning, and the last that is seen after the setting of the sun.

Art. XVII.—*Account of some of the Rarer Atmospherical Phenomena observed at Leith in* 1825. By Mr John Coldstream. In a Letter to the Editor.

My Dear Sir,

In compliance with your request, I now send you a short account of the principal atmospherical phenomena observed here during 1825. You are already in possession of a most accurate history of the progression of *temperature* during the year at this place, in the results of the Leith Fort hourly register; and any observations which I could communicate on the *pressure* or *humidity* would probably be uninteresting; I shall therefore confine myself to descriptions of the rarer meteors seen within our horizon in the course of the twelvemonth.

On the 7th of February two *colourless rainbows* were observed; one at 9 a. m. and the other about noon. Much rain had fallen during the preceding night, and the morning had been cloudy; but at the time of their appearance there were no clouds visible, except towards the western horizon. In the zenith the colour of the sky did not equal the 10th degree of Saussure's cyanometer. The primaries only were seen; they were vivid and distinct throughout their whole extent, and had the ordinary breadth of the common rainbow. While I was observing the one which appeared at noon, I saw its northern limb fall upon a portion of a *nimbus* in motion, and immediately assume the proper colours; but whenever the cloud had passed, the bow regained its colourless state. This phenomenon is probably rare. I am not aware of its having been observed by any of the older meteorologists; but in Mr Howard's *Climate of London*, and in Mr Forster's *Researches*, mention is made of similar appearances. Mr Howard says, " About 10 a. m., 23d January 1808, a faint, but nearly perfect rainbow appeared under unusual circumstances. At the time a few light clouds had begun to show themselves in different quarters, but none over the place of the bow, nor was the falling mist that afforded it of sufficient density to obscure the sky; the colours were not visible, so that the rainbow had the appearance of being white." *

* Dr Thomas Young, in his paper *On the Measurement of Minute*

On the morning of the 17th February, the sky presented, at sunrise, an uncommonly splendid appearance, being covered with long *cumuli* and *cirrostrati*, coloured with the richest tints of the spectrum, the *green* not excepted. The morning afterwards was dull and louring, and in the course of the day heavy *nimbi* passed in rapid succession from S.W., discharging a few showers of rain. At 4 P. M., while the sky was covered with a thin sheet of *cirrostratus* and floating *scud-clouds*, and when a large *nimbus*, advancing from the west, was obscuring the sun, then, near the horizon, a *halo* of an interesting aspect was seen. It consisted of two faintly coloured arcs, one of which had a diameter of about 45°, and the sun for its centre; the other had a diameter somewhat less, and a point a few degrees above the sun for its centre. The upper arc, therefore, cut the lower in two points, but was not visible within its circumference. The colours of the exterior arc were much fainter than those of the interior.

The month of March was particularly characterized by the long period of dry weather which then occurred. Only 0.200 of an inch of rain fell, and the pressure was very steady and high.

On the 19th, we were gratified by an unusually fine display of *Aurora Borealis*, which, as it far surpassed in brilliancy all similar phenomena seen here for many years past, I

Particles, has given the following ingenious explanation of the phenomena of white rainbows.

"In my Theory of Supernumerary Rainbows, (*Nat. Phil.* ii. 643,) I have observed that the breadth of each bow must be the greater, as the drops which afford it are smaller; and by considering the coloured figure in which their production is analyzed, it will be obvious, that, if we suppose the coloured stripes extremely broad, they will coincide in such a manner in one point, as to form a white bow, the red, which projects beyond the rest, being always broadest, so that if all the stripes be supposed to expand, while they preserve their comparative magnitude, the middle of the red may coincide with the middle of the blue; and it will appear, on calculation, that a white bow will be formed a few degrees within the usual place of the coloured bow, when the drops are about $\frac{1}{3000}$ or $\frac{1}{4000}$ of an inch in diameter. It is remarkable that, in such cases, the original rainbow is altogether awanting, and probably, for a similar reason, we scarcely ever see a rainbow in a cloud which does not consist of drops so large as to be actually falling."—*Introduction to Medical Literature*, p. 586.

may be allowed to describe in detail. About 8 o'clock P. M., after a pleasant day, there was seen in the north the diffuse light which generally precedes the Aurora Borealis, and which has been compared, with perfect justice, to the twilight. The sky was clear; the stars were sparkling vividly; the air was calm and serene. The light in the north continued to increase in intensity, till about half-past 9; when, suddenly, extremely brilliant coruscations began to play along the horizon, and dart towards the zenith in great numbers. The colour of these was generally white, or yellowish white, but blue and green were at times discernible. "Immediately below the constellation of Cassiopeia, the illumination was most vivid, and resembled a cylinder of light, white and glowing below, and gradually becoming bluish as it ascended towards the pole." The horizontal extent of the illumination did not exceed 90°, and none of the beams rose higher than 60° or 65°. This very fine display continued about 15 or 16 minutes; after which the intensity of the illumination diminished gradually, and the beams became less numerous and less vivid. But before 10 o'clock another phenomenon of equal interest appeared. This was a luminous arch, which passed through the zenith of this place, and descended towards either horizon, in the direction of about N.E. and S.W. It was of a white colour, vivid, and well defined. Its breadth in the zenith was about 7°, whence it tapered almost to a point to about 5° or 6° from either horizon, beyond which it was not visible; its lustre was more intense at the extremities than in the zenith, and throughout its whole extent it was perfectly continuous. Stars of the first and second magnitude only could be seen through it. This state of things continued till about 20 minutes from 11, when the centre of the arch seemed suddenly to grow very vivid, and a narrow stripe of light, about 30° in length, was seen to extend across the arch, not passing beyond its edges, which were still well defined. This stripe of light soon began to have a distinct motion, and retaining the same general direction and position with regard to the arch, it traversed, with a moderately rapid motion, its whole western limb, and disappeared below the horizon; soon after, the arch broke into fragments and disappeared. During the whole time of the existence of the arch, the aurora sent forth no coruscations, although the diffused light in the north was very intense. But about 20 minutes from 12, beams again arose, and continued to play with considerable brilliancy for more than an hour. The mean temperature of the next day was 41°.25. Pressure 30.62. Wind S.W., gentle.

At Paris, "on the 19th of March, at half-past one P. M., the horizontal magnetic needle went suddenly, and, after many oscillations from its usual position, nearly 5′. These irregular movements led the observer" (M. Arago, we presume) "to suppose, that, in the evening, there would be an Aurora Borealis, but no trace of such a phenomenon was discovered, although the sky was perfectly serene. At six and eight o'clock the needle did not oscillate; it did not pass its ordinary limits; but at half-past eleven, the declination suddenly diminished more than 8′, and the needle oscillated in great arcs." *

On the 7th of June, several large and dense *nimbi* passed from S. W., discharging at intervals heavy showers of rain. At 5 P. M., a *primary rainbow* was seen, within the interior circumference of which were two perfect *supernumeraries* of great brilliancy. They were of unequal breadth: the second was narrower than the first; and both taken together, scarcely equalled in breadth the *primary*. In each, all the spectral tints were distinguishable. Now and then, as the cloud moved on, a third set of colours was perceived, in detached portions; but a third bow was never completed. At the same time, a very distinct *convergence of the solar rays* was observed. The beams filled the whole space included by the rainbow, and passed beyond its circumference to a considerable dis-

* "Au reste, les zones, les arcs, les jets lumineux dont les aurores boreales se composent, alors meme qu'ils ne sont pas visibles dans un lieu donné, y exercent une influence manifeste sur la position de l'aiguille aimantée. Cette singuliere connexion merite certainement d'etre étudiée sous toutes ses faces; mais il faudra peut-etre des recherches assidues, continues pendant un grand nombre d'années, avant qu'on puisse en saisir tous les details."—(*Annales de Chimie*, T. xxx. p. 423.)

tance. The effect of the whole was exceedingly rich.—(See this *Journal*, vol. iii. p. 55.)

The morning of the 8th of July was clear, and the sun shone very brightly. About noon, a thin sheet of *cirrostratus* formed in the zenith, which did not sensibly diminish the effect of the solar beams, neither could it be easily perceived; but its existence was rendered evident by the appearance of a coloured *halo*, which remained till about 3 o'clock. It consisted of a *circle*, which subtended an angle of about 45°, and of an *ellipse*, tangential to this *circle* at the two extremities of its vertical diameter, the horizontal axis of which was about 56°. At the two points north and south of the sun, where the bands coincided, they were very vivid, and at one time assumed quite the appearance of *parhelia*. The intensity of the colours diminished in both towards the east and west; and in these quarters it was that the halo first began to fade. Ther. 59°.0, sol. rad. 45°, Bar. 30.08, falling. Wind east, moderate.

17th August.—After a very wet day, during which the temperature remained steadily at 59°, and the barometer at 29.75, a display of the *Aurora Borealis* was seen at 10 P. M. It was neither vivid nor long continued, and presented only the usual appearances of that meteor. In allusion to the notice of this observation, inserted by Mr Foggo and myself in the *Edinburgh Philosophical Journal*, the same writer in the *Annales de Chimie*, whose words I before quoted, says,—" I suspect that this was the termination of an *Aurora Borealis* of the day; I find, in fact, that, on the morning of the 17th, at half-past eight o'clock, the declination was certainly about 5′ greater than the mean of the month at the same hour; whilst, in the evening, the needle had returned to its ordinary position;" and he adds,—" In this same month of August, on the night of the 21st, the morning of the 22d, the night of the 26th, and, particularly, on the night of the 29th, great anomalies were observed in the extent of the oscillations of the needle. On all these occasions, the sky was, I believe, clouded at Leith. If not, and the observers there did not see the *aurora*, for instance, on the night of the 29th of August, we will be obliged to admit, that there exist other causes, of which we are still ignorant, which exert a considerable influence over the magnetic needle." In reply to this remark, I may observe, that the notes in our Journal, of the state of the sky on the night of the 21st and morning of the 22d, are not satisfactory; that the night of the 26th was particularly clear, with bright moonshine; and that much cloud prevailed on the 29th, so that, had an *aurora* existed, we could not have seen it.

Between four and six o'clock P. M., of the 11th September, we had a thunder storm. The *nimbi* came from S. S. E., and were of a deep blueish grey colour. The lightning was pale, but vivid. The discharges were accompanied by very violent gusts of wind and heavy rain. Bar. 29.44, rising, temp. 57.5. The rain ceased about seven o'clock. The night was calm and serene. At 10 P. M., an *Aurora Borealis* was observed playing with considerable brilliancy. The storm extended over the greatest part of Scotland, but was felt most severely in Perthshire.

For a week about this period, *convergences of the solar rays* were seen every evening at sunset, in great beauty. The sky, at the time, was generally filled with *polarized cirri*, and a few elongated *cumuli*.

27th September.—After a day of the brightest sunshine, the sky was overcast towards evening, by small *cirrocumuli*, arranged in parallel bars, whose direction was nearly N. and S. These caused a general dulness till the sun got very near the horizon, when suddenly, the rays shooting through a small opening in the clouds, and illuminating their lower surfaces, produced, over the whole western sky, quite up to the zenith, the richest golden and crimson tints it is possible to imagine. These, varying in intensity and depth every second, gradually faded as the sun sunk below the horizon, but had not entirely vanished 15 minutes after he had set. It is worthy of remark, that, whenever the sun's disc disappeared, the mountains, and, indeed, the whole surface of the earth, assumed a *deep purple* colour, which remained for a considerable time. This splendid sunset was observed throughout all Scotland; indeed it is probable that it was seen in most parts of the island, as we have learned from different accounts that it bore the same characters in Caithness that it did in Cumberland.

The morning of the 3d of November was very stormy. Wind N., strong. Heavy rain. Bar. 28.67, temp. 43°. Mean pressure of the day, 28.942. In the evening it cleared; the stars shone brightly; and, at eleven o'clock, an *Aurora Borealis* was observed. At Paris, at the same hour, "the north point of the needle deviated from its mean position, 9′ to the East." (*Ann. de Chimie.*) 4th November, pressure increasing rapidly. Mean temp. 39°. Wind N.W. Pleasant day. Another *aurora*, of great beauty, was observed in the evening; the rays were very numerous and very bright; but they remained visible only for a few minutes. The phenomenon was neither preceded, nor followed, by the diffuse illumination of the northern sky which generally accompanies this meteor.

"The horizontal needle of the Observatory of Paris, was observed on the 4th November to be much agitated from nine o'clock A. M., till 2 P. M.; but, in the evening, it had regained its usual quiescent state. The rays, therefore," M. Arago remarks, "seen by the Scottish observers, were, most likely, the remains of an *aurora* of the day."

On the nights of the 14th, 21st, and 22d of November, *fireballs* were seen. That of the 14th passed from east to west, through a space in the heavens equal to 25°, exploding like a rocket, nearly in our zenith; it left a very bright luminous tail in its course, which remained visible for a considerable time after the meteor itself had disappeared. The apparent size of those seen on the 21st and 22d was double that of stars of the first magnitude. On the 22d, also, there was a very beautiful display of *Aurora Borealis*; its lustre was much impaired by the light of the moon, but still it appeared more extensive, and played with more celerity, than any that were seen in the course of the year. The beams rose to the zenith, and seemed to influence much some polarized *cirri* in the south.* Temp. 37°, Bar. 30.07.

25th November.—A *lunar halo* was seen this night, and a

* "A Paris, l'aiguille des variations diurnes commença à sortir de ses limites habituelles le 22 Novembre à 11 heures du soir. Le lendemain 23, à 8 heures du matin, son extremité nord se trouvait à l'occident de sa position moyenne de plus de 3′. Le reste de la journée sa marche fut tres irregulier."—*Annales de Chimie*, as formerly quoted.

faint appearance of a *lunar rainbow*. Wind W.; Bar. 30.02. 26th. Very stormy; Bar. 29.17; wind S.W., boisterous; very heavy rains.

About 5 P. M. of the 14th December, a thunder storm was experienced in many districts in Scotland, especially in Fifeshire, where the lightning killed several cattle, and set fire to some stacks of hay.

In England, the same storm seems to have extended its ravages very widely; it was, perhaps, most severely felt about Northampton, Leicester, and Doncaster.

Here the pressure on that day was very low. At 9 A. M. the barometer stood at 29.05, whence it descended to 28.75 in the afternoon, and rose again a few tenths in the evening. Winds variable, but chiefly east and west, very strong; mean temperature 41°. I have the honour to be, Dear Sir,

Very faithfully yours,

LEITH, *24th April* 1826. JOHN COLDSTREAM.

ART. XVIII.—*Description of a new Register Thermometer, without any Index; the principle being applicable to the most delicate Mercurial Thermometers.* By H. H. BLACKADDER, Esq. F. R. S. E. *

IN the sixth Number of this *Journal*, we have laid before our readers an account of Mr Blackadder's ingenious contrivance for registering the indications of meteorological instruments in the absence of the observer. In this contrivance, a *sliding index* within the tube was indispensable, but, as this method is liable to objections, particularly when great accuracy is requisite, Mr Blackadder set himself to contrive the very ingenious method of registration which we are now to describe. This register thermometer consists of two mercurial thermometers, the tubes of which are attached to the same slip of ivory, but having each a separate scale.

One of the tubes *a*, Plate I, Fig. 2, is hermetically sealed as usual, and the scale also is divided and numbered in the

* This notice is an abstract of Mr Blackadder's paper, read before the Royal Society on the 17th April last.

usual manner. The other tube *b*, is not hermetically sealed, but left open at its upper extremity *c*, which must be made flat and smooth. This, in general, is easily effected, by making a scratch with a sharp-edged file, previous to breaking off a small portion of the tube. The open extremity *c* of the tube, is inserted into a portion of a larger thin glass-tube, which exactly fits it, and which terminates in a hollow bulb, containing a small quantity of mercury, *c*, Figs. 2, and 3. The inner tube is carried forward until its extremity is about opposite to that part of the outer tube where it begins to swell into a bulb; and the two tubes are then made to adhere permanently, by introducing a minute quantity of colourless varnish between them.

The scale of this tube commences from its upper open extremity *c*, and is numbered downwards 2, 3, 4, &c. but marked as in Fig. 1, 10, 20, 30, &c.

When an instrument thus formed is held upright, the globule of mercury in the bulb *e*, Fig. 2, falls on the open extremity *c*, of the tube *b*, as represented in Fig. 3; and if the bulb *n* be now heated by the hand, the mercury will rise in the tube, and unite with the globule *c*, with which it will remain connected as long as the instrument is kept in the upright position. If the instrument be now exposed in its upright position to the air, which has, let it be supposed, the temperature of 60°, the upper extremity of the mercury in the tube *a*, will be opposite that degree of the scale; but the mercury in the tube *b* will still remain at the beginning of its scale, and continuous with the globule *c*. Let the instrument now be placed in a horizontal position, and the entire globule of mercury will instantly quit the open extremity *c*, of the tube *b*, leaving the tube exactly filled with that fluid, and the globule will then take the position *c*, Fig. 3, when the instrument rests on the edge of its scale. If, from the instant the globule is thus made to quit the open extremity of the tube *d*, both of the bulbs *n* and *p* be kept moist with a rapidly evaporating fluid, such as ether, alcohol, &c. the mercury in both tubes will descend equally, and will remain permanently below the elevation due to the temperature of the air, as long as the evaporating fluid is kept applied to their bulbs. The atmospheric temperature was supposed to be 60°; let it now be supposed that the loss of heat caused by evaporation is equal to 10°. The mercury in the tube *a* will then point to 50, and that in the tube *b* to 10 on their respective scales; and then $10 + 50 = 60°$, which was the temperature of the air at the instant the globule quitted the open extremity of the tube *b*, when the instrument received its horizontal position.

The way in which the instrument may be placed in a horizontal position, at any given instant during absence, was formerly described, (see vol. iii. p. 251)—a pocket time-piece, and a small additional but simple piece of mechanism, being all that is requisite. A vessel for containing the evaporating fluid, fitted with a valve, and a capillary tube terminating in one or more small and soft hair brushes, completes the apparatus, and which can obviously be made of such small dimensions as to be easily portable.

If the bulb *c*, at the upper extremity of the tube *b*, Fig. 2, be made of the bent form represented in Fig. 4, the instrument does not require to be moved from a horizontal position. In this case, the globule of mercury is made to quit the open extremity of the tube *d*, and fall to the bottom of the bent bulb *i*, Fig. 4, in consequence of the tube *d*, on a separate piece of ivory, being made to turn half-way round on itself, the centre of motion being a line drawn through the centre of the tube, and the extremity of the bent portion being thus made to describe the half of a circle.

Art. XIX.—*Abstract of the Register of the Thermometer, Barometer, and Rain-Gage, for the years* 1824 *and* 1825, *kept at Canaan Cottage.* By Alexander Adie, Esq. F. R. S. Edinburgh. Communicated by the Author.

As the individual observations, of which we propose at present to give an abstract, are regularly recorded in every number of this *Journal*, and the circumstances under which they are made distinctly described at the head of each quarterly table, it is unnecessary to enter into any farther details upon these subjects.

Abstract of Register for 1824.

Months.	Thermometer.		Regist. Ther.		Barometer.		Rain.
	Sum.	Mean.	Sum.	Mean.	Sum.	Mean.	
	°	°	°	°	Inch.	Inch.	Inch.
January, -	1261.5	40.70	1236.5	39.89	920.355	29.689	.87
February, -	1154.5	39.81	1132	39.03	856.145	29.522	1.73
March, -	1205.5	38.89	1229	39.64	912.815	29.445	1.34
April, -	1350.5	45.02	1356.5	45.22	888.06	29.601	.57
May, -	1517.5	48.95	1552.5	50.08	919.61	29.664	.63
June, -	1631.5	54.38	1699.5	56.65	892.915	29.761	2.01
July, -	1812	58.45	1856.5	59.89	922.40	29.755	1.58
August, -	1736	56	1774	57.13	921.355	29.721	1.50
September, -	1620	54	1637	54.57	889.45	29.648	1.62
October, -	1432.5	46.21	1418.5	45.76	911.39	29.400	4.73
November, -	1212	40.4	1222	40.73	876.945	29.231	4.38
December, -	1200	38.71	1191	38.42	910.265	29.363	3.68
Annual sum,	17133.5		17305		10821.705		24.64
Annual mean,		46.793		47.251		29.567	

Greatest degree of Heat, September 2,	-	85°
———————- Cold, December 5,	-	+ 16
Greatest range of Thermometer,	- -	69
Highest Barometer, May 28,	- -	30.38
Lowest ditto, November 23,	- -	28.26
Greatest range of ditto,	- -	2.12

Abstract of Register for 1825.

Months.	Thermometer.		Regist. Ther.		Barometer.		Rain.
	Sum.	Mean.	Sum.	Mean.	Sum.	Mean.	
	°	°	°	°	Inch.	Inch.	Inch.
January, -	1229	39.64	1212	39.10	924.265	29.814	1.31
February, -	1099.5	39.27	1091	38.96	833.705	29.776	.99
March, -	1250.5	40.34	1277	41.19	925.82	29.865	.43
April, -	1400	46.67	1397.5	46.58	892.77	29.759	1.41
May, -	1500.5	48.40	1572.5	50.73	922.265	29.750	3.25
June, -	1659.5	55.32	1701	56.7	891.37	29.712	2.05
July, -	1865.5	60.18	1903.5	61.4	929.255	29.976	.15
August, -	1844.5	59.48	1862	60.06	919.735	29.669	1.89
September, -	1716.5	57.22	1707.5	55.25	888.67	29.622	2.85
October, -	1566.5	50.53	1554.5	50.14	918.435	29.627	2.19
November, -	1164	38.80	1155.5	38.52	879.685	29.323	3.91
December, -	1187	38.29	1177	38.97	907.925	29 288	1.99
Annual sum,	17483		17611		10833.900		22.42
Annual mean,		47.845		48.133		29.682	

Greatest degree of Heat, July 30 and 31,	-	83°
———————- Cold, February 5,	-	+ 22
Greatest range of Thermometer,	- -	61
Greatest Height of Barometer, January 9,	-	30.67
Lowest ditto, November 5,	- -	28.55
Greatest Range,	- - -	2.12

ART. XX.—*Demonstration of Professor Leslie's Formula for determining the Decrease of Heat depending on the Altitude,* without " *a delicate and patient research.*" * Communicated by a Correspondent.

IT is shown in our ordinary treatises on the barometric formula, that the height or $h=\log. B-\log. \beta=\log. \frac{B}{\beta}$, B being the barometric altitude at the lower place of observation, and β that at the higher. Now, for ordinary heights, $\frac{B}{\beta}$ cannot differ much from unity. Let it be equal to $1+n$ then $\log. (1+n)=M\ (n-\frac{n^2}{2}+\frac{n^3}{3}-\frac{n^4}{4}$, &c.) If from $1+n$ there be subtracted its reciprocal $\frac{1}{1+n}=1-n+n^2-n^3+$, &c. there will remain $1+n-\frac{1}{1+n}=2n-n^2+n^3-$, &c. $=2\ (n-\frac{n^2}{2}+\frac{n^3}{2}$, &c.) Now, if both sides of the equation be multiplied by $\frac{M}{2}$, then $\frac{M}{2}\left(1+n-\frac{1}{1+n}\right)=M\ (n-\frac{n^2}{2}+\frac{n^3}{3}-$, &c.)

It is obvious from what has been said, that the first side, when expanded, agrees with the first and second terms exactly, and in the third nearly with the common series for the logarithm of $1+n$. Hence, when n is a small fraction, the $\log. (1+n)=\frac{M}{2}\left(1+n-\frac{1}{1+n}\right)$ nearly.

But $h=\log. \frac{B}{\beta}$, or $\log. (1+n)$; by substituting $\frac{B}{\beta}$ for $1+n$, there will result $h=\frac{M}{2}\left(\frac{B}{\beta}-\frac{\beta}{B}\right)$ . . . . (A).

But an elevation of 81 fathoms, by experiment, (Playfair's *Outlines*, vol. i. p. 295, art. 401,) gives a depression of 1° centigrade.

Whence if ΔT denote the variation of temperature $\frac{h}{81}=\Delta T$ $=\frac{M}{2\times 81}\left(\frac{B}{\beta}-\frac{\beta}{B}\right)$. Now M for our ordinary atmosphere is

* See his *Elements of Geometry*, p. 459, 4th edition.

4243, (Playfair's *Outlines*, art. 344,) therefore,

$$\Delta T = 26 \left(\frac{B}{\beta} - \frac{\beta}{B}\right) \quad . \quad . \quad . \quad (B)$$

which is the Professor's theorem.

It is evident this theorem cannot be very correct, as it is well known that theorem (A) does not accurately give the altitude, because no allowance is made for the expansion of the air depending on the temperatures at the two places of observation, and other minor circumstances, which are indispensable in the more accurate barometric formula.

We are quite at a loss to discover how such a simple investigation could have cost the Professor so much labour and research as he seems to insinuate.

From theorem (A) a simple rule may be derived for determining moderate heights without the aid of logarithmic tables, thus:

$$h = 2171.5 \left(\frac{B}{\beta} - \frac{\beta}{B}\right) = 2171.5 \frac{(B+\beta)(B-\beta)}{B\beta} \quad . \quad . \quad . \quad . \quad (C)$$

Example. Required the height of Arthur's Seat above the Pier of Leith, from the following observations:

	Bar.	At. Ther.	Det. Ther.
Leith Pier,	29.567	55.25	54.0
Arthur Seat,	28.704	51.75	50.5
		3.50	104.5
			52.25
			32.00
			20.25

$$\frac{28.704 \times 3.5}{10000} = 0.01$$

And $28.704 + 0.01 = 28.714 = \beta$

Whence $B + \beta = 29.567 + 28.714 = 58.281$

And $B - \beta = 29.567 - 28.714 = 0.853$

Therefore $2171.5 \times \dfrac{58.281 \times 0.853}{29.567 \times 28.714} = 127.156$

But $0.00244 \times 20\frac{1}{4} \times 127.16 = 6.293$

Height in fathoms, - - $133.449 = 801$ feet nearly, differing about two feet from the result by levelling.

If the proper correction for aqueous vapour in the atmosphere were made, it would almost agree with that determined by levelling.

Cor. $h = 13000 \times \dfrac{(B+\beta)(B-\beta)}{B\beta}$ in feet nearly,

which, in small heights, may be sufficiently correct.

Art. XXI.—*Observations on Two Species of Pholas, found on the Sea-coast in the neighbourhood of Edinburgh.* * By John Stark, Esq. M. W. S. Communicated by the Author.

The Natural History of the Pholades, so far as regards their mode of burrowing in wood and stone, seems yet to be but imperfectly understood, though the Pholas was known to the ancients, and Pliny notices its phosphorescent quality. Rondeletius, Johnston, and Rumphius have figured several species; Lister, among others, gives representations of three British species, the *Pholas dactylus*, *candida*, and *crispata;* and Sir Robert Sibbald, in his Prodromus, has three rude figures of the *dactylus* or *crispata*, as Scottish shells. None of these authors, however, attempted to explain how the Pholades excavated their habitations in the rock, or perforated the submerged wood in which they seek protection. Bonanni, so far as I know, was the first who turned his attention particularly to this inquiry. In his work, entitled "*Recreatio Mentis et Oculi*," the first edition of which, in the Italian language, was published at Rome in 1681, he has given figures of the *Pholas dactylus*, and of pieces of the rock in which it was contained, showing, with considerable accuracy, the nature of the perforations, and distinctly marking the circular lines at the base of the cells. These perforations are formed, in his opinion, by the action of the file-like valves on the stone, the animal fixing itself, for this purpose, by its callous foot, to procure the necessary motion of its shell. †

The celebrated M. de Reaumur next took up the subject, without, however, seeming to have been aware of the prior investigations of Bonanni, whose book is neither quoted nor alluded to by the French naturalist. In the "*Mémoires de l'Academie Royale des Sciences*" for 1710, this intelligent observer has a paper on the progressive movement of some species of Bivalves; and in the volume for 1712 he gives the se-

* This paper is an abstract of the original one, which will appear in vol. x. part ii. of the *Edinburgh Transactions.*

† Bonanni, *Recreat.* p. 36.

quel of his observations on this curious subject. In this second memoir, after detailing the manner in which the Solenes burrow in the sand, he is led to consider the means by which the Pholas perforates the softer rocks; and this, he endeavours to prove, is done merely by the action of its muscular foot. The hardness of the substance perforated, however, induces M. de Reaumur to form a theory to account for an instrument, so apparently unsuitable, being able to perform what he ascribes to its action. The clay rock from the coast of Poitou and Aunis, on which his observations seem to have been made, was too hard on the surface to admit, in his mind, the supposition of its being bored by such an implement; and he therefore concludes, that the Pholades must have entered the clay when it was in a soft state, and that it had been subsequently hardened or petrified by some viscous quality of the waters of the sea. This theory, it may be remarked, leaves no room for the multiplication of the species; for, on the supposition that the clay has been hardened on the surface by some petrifying quality of the water, after the Pholades had made their lodgement, the same cause would operate to prevent the future races from commencing their cells. *

D'Argenville, with the knowledge, it appears, of what Bonanni and Reaumur had written upon the subject before him, next professes to give an account of the manner in which the Pholades perforate their dwellings; but, from the contrariety of his statements, and his completely misunderstanding one of the authors quoted by himself, little reliance is to be placed upon his authority as an observer. In one passage of his *Zoomorphose*, when describing the shell of the *Pholas dactylus*, he says it resembles a file, with elevated striæ and asperities, dentated and crowded from the top of the shell to its base, in such a manner that the strongest points are towards the head. "It appears," says he, "that with these arms it pierces the stones, and enlarges its tomb as it increases in size." But, in a passage a little afterwards, he adds, with a strange forgetfulness of what he had previously written, "In proportion as this animal grows, it digs its hole with a round and fleshy part like a tongue; and it is not with its two

* *Mém. de l'Acad. Roy. des Sciences,* 1712, p. 127.

valves, nor with its teeth, that it performs this operation." Further on he remarks upon another species, that it "is armed at its extremity with two strong and cutting points, in form of an auger, of which the dentated contour gives it the means of turning upon itself, and of piercing the stone downwards. The striæ and the teeth do the rest." *

Among the more modern writers, Pennant mentions having frequently taken the Pholades "out of the cells they had formed in hard clay, below high water-mark, on many of our shores. They also perforate the hardest oak-plank that is lodged in the water. The bottoms of the cells," adds this acute observer, "are round, *and appear as if nicely turned with some instrument*." † Montagu, speaking of the *Mya Pholadia*, says, "It is probable this, as well as similar animals whose habits are to perforate stone, are provided with an acid, or some other solvent menstruum capable of performing that office." And, in another passage, he observes, "The Pholades are performing similar works assigned by nature on softer substances, such as chalk, indurated clay, and wood, which, in like manner, are perforated by some solvent power:—not by the thin fragile shells that cover such animals, as some have erroneously asserted and is too generally credited." ‡

A late writer, Mr Wood, supports something like the same theory; at least he seems to think that the attrition of the shell is insufficient for the effect produced; "since," says he, "there are some species, and particularly the *P. orientalis*, which are nearly smooth at the anterior end, and, consequently, unfit for such a purpose;" § while Mr Gray, in the *Zoological Journal*, gives it as his opinion, that the Pholades "appear to bore by means of rasping." ||

Such are the discordant opinions that have been held regarding the mode by which the Pholades perforate calcareous stones and wood: one class of naturalists asserting that they

* *L'Hist. Nat. éclaircie dans une de ses parties principales.—Zoomorphose*, p. 69, 70. Paris, 1757.

† *British Zoology*, vol. iv. p. 158.

‡ *Testacea Britannica*, p. 560, 561.

§ *General Conchology*, vol. i. p. 74.

|| *Zoological Journal*, No. 3. p. 406.

do so by the rotatory motion of their valves, or by means merely mechanical; while others suppose, from the apparent fragility of the shell, that they must have the power of secreting some solvent fluid, capable of decomposing the substances in which they burrow. That the first of these hypotheses is the one most conformable to appearances, no one who has seen the living animals can doubt, and accordingly, it has been adopted by most recent observers; while that supported by Montagu and others opposes obstacles to its reception not easily to be got over. Any acid or solvent fluid that would act with effect on the calcareous stones in which the Pholades lodge, would, it is evident, act equally on the shell of the animal itself; and a solvent which possessed the power of dissolving stone, would be little likely to have the same effect on the fibres of submerged wood.

Some years ago, while residing at Portobello, I discovered, on the coast at Joppa Salt-pans, where the rocks are uncovered at low water, numerous perforations in the shale or clay-rock, which I ascertained to be the work of Pholades. On breaking the stone in different places two species of Pholas, *P. crispata* and *candida*, were procured alive, in great numbers, and of all ages. When the tide recedes, they withdraw their tube within the perforations, but when covered by the water, its rounded mouth is visible above the upper surface of the rock. On striking the rock with a hammer, near any of the holes, a spirt of water is ejected, similar to what occurs when the Myæ and Solenes are disturbed in their haunts. The Pholades are found at various depths in the stone, corresponding to the age of the animal; the largest, and of course oldest, specimens being found at from four to six inches, or even more, under the surface; others at all intermediate distances, the youngest being merely covered by a thin layer of the clay. The *Pholas candida*, not a common species on some coasts, occurs most plentifully; but both species are frequently found together.

The perforations in the rock at the surface are not much larger in diameter than a quill; many are much smaller, but they widen as they recede downwards, corresponding to the animal's growth. The Pholas itself is found in an inverted pear-shaped cavity at the bottom, the largest diameter of the shell being undermost. Where the Pholades are crowded together, which is generally the case, the divisions between the different cells are often extremely thin, and in some this partition is completely removed. The direction of the bore is not always vertical, though nearly so; but in some instances, where the rock had been broken down to an angle, or rounded, the Pholades were found at various inclinations, corresponding to the surfaces of the stone.

From repeated examination of the recent animals and their perforations, I have no hesitation in asserting, that these two species, at least, form their holes by the rotatory motion or rasping of the stone with their valves. Indeed, I am surprised how any one who has seen these animals in their native rocks could for a moment think otherwise; for in the Joppa specimens, circular lines are distinctly visible in the cell of the animal, corresponding to the elevated striæ on the shell, and presenting the appearance as of having been bored by an auger. Pennant remarks the same appearance in the cells of the Pholades found by him on the English coast, as Bonanni had formerly done in the Italian specimens. These marks, indeed, disappear in the upper part of the perforation, from the friction occasioned by the expansion and contraction of the rugous tube; but in the cavity where the Pholas lodges it is always distinctly, and often, especially when the animal is large, prominently marked.

It has been held as a presumption against the Pholades perforating rocks by a mechanical operation, that some of the species have shells nearly smooth, and unfitted for such a purpose; and the *Mya Pholadia* and *Mytilus lithophagus* are produced as instances where it is next to impossible that, without the aid of a solvent fluid, such animals could form protecting cells in hard substances. From not having seen the animals alluded to alive, and in their native habitations, it would be presumption in me to give a decided opinion on the subject. But, reasoning from analogy in the structure of the animals, and the habits of such as have been observed, it infers no impossibility to conceive that they penetrate rocks in a similar manner. Little asperity in the instrument is required where the operation is constant. In judging of the unseen or unobserved operations of nature, many are guided in their opinion by what appears possible to be effected by the limited powers which a preconceived theory prescribes to the instrument employed. But little is known regarding the time which these instinctive miners take to form their deepening cells. A drop of water falling constantly on the same spot soon leaves evidences of what time, with the smallest force, can effect; and the keys of musical instruments are, in no long period, hollowed by the softest touch of the softest fingers. There seems no impossibility, therefore, in conceiving that the Pholades may perforate a substance less hard than their own shell by mere attrition, or even a harder substance, by the constant action of their muscular foot.

Linnæus and Lamarck regard the Pholas as a Bivalve shell, with accessory pieces; while others, from the presence of these auxiliary plates, have classed it among the Multivalves. The animal is hermaphrodite and viviparous, hatching its young in the little sacs of its branchiæ. It has a membranous mantle, of a tubular form, open at both extremities, like that of the Solen or Mya. From the superior opening of this tubular mantle two united syphons arise, of which the anterior is the largest. They are slightly dentated on the margin, and serve, the one for the entrance of food, and the other for discharge. When covered by the tide, or in a basin, these tubes may be seen constantly sucking in and ejecting the water. The foot is short and conical, and, from its capacity of being projected and drawn in within its circular covering, probably affixes itself by suction to the bottom of the hole, and serves as a fulcrum for the rotatory motion of the valves, or even may itself assist in deepening the cell of the animal. Mr Gray, in the third number of the *Zoological Journal*, has given some anatomical details regarding the structure of the Pholades, particularly with regard to the singular falciform projections in the interior of the shell, which he shows are nowise connected with the arrangement of the hinge; and Poli, in his "superb work" on the Testacea of the Two Sicilies, has given the anatomy of the Pholas in detail. The opinion of Poli, it may be added, entirely coincides with the observations I have hazarded regarding the mode by which the Pholades make their perforations.

The Pholades being incapable of moving from their place, the young are dropped from the tube of the parent on the surface of their native rock. How they are enabled to penetrate the rock, so as to secure themselves protection; or how, previously to having formed a cell, they adhere to the surface, has not hitherto been explained. Rondeletius, like others of the older naturalists, who believed in spontaneous generation, supposed that the sea-water lodging in the pores of the rocks might become, in process of time, Pholades; *—a supposition not more distant from truth than that which long afterwards prevailed as to the *Lepas anatifera* being the young of a species of goose! Perhaps some glutinous matter, such as fixes the *byssus* of the Mytili, may keep the fry of the Pholades in their place till they have excavated a hole sufficient to conceal themselves: but future observation, by those who have the opportunity, will, there is little doubt, discover the arrangement by which these animals are enabled to commence their cells.

The Pholades, it may be remarked, seem admirably constructed for the purposes of their existence, so far as these are known. Possessing but a comparatively fragile shell, which the least force would break, and, having no weapons of defence against their aquatic enemies, Nature has furnished them with the means of amply providing for this apparent deficiency, by giving them an asylum in the solid rock. Having formed their destined habitations, which they can never leave, the rock is honeycombed by successive races till it falls in pieces, and a new surface is exposed for new generations. The tribes of Pholades on the different coasts are thus active and powerful instruments in the disintegration of rocks. The shale in which they occur at Joppa runs in parallel and alternating strata with a coarse sandstone; and while the unconnected ridges of the sandstone still appear, rounded by the weather, or hollowed into basins by the action of the waves, the alternating beds of shale have nearly disappeared, through the instrumentality of these powerful, though unseen agents.

* Rondelet. *De Testaceis,* lib. i. p. 49. Lugd. 1555.

The Pholades are regularly used as an article of food on the coasts of France and Italy, where they abound. In the neighbourhood of Dieppe, bands of women and children, each armed with a pick-axe, break the rocks inhabited by them, for the purpose of sending them to market, or as bait for fish. They are found in every sea where the rocks are suitable for their burrowing, and are met with fossil in many countries of Europe.*

Art. XXII.—*Farther Account of the large Achromatic Refracting Telescope of Fraunhofer in the Observatory of Dorpat.* By Professor Struve.

In the Fourth Number of this Journal we have already given an engraving, and a brief description, of this fine instrument; but as a detailed account of it has just been published by Professor Struve himself,† we shall now present our readers with a more minute description.

As soon as Professor Struve had put up the instrument, he directed it to the moon and some double stars. "I stood astonished," says he, "before this beautiful instrument, undetermined whether to admire most, the beauty and elegance of the workmanship in its most minute parts, the propriety of its construction, the ingenious mechanism for moving it, or the incomparable optical power of the telescope, and the precision with which objects are defined.

When in a perpendicular position, the height of the object glass is 16 feet 4 inches (Paris measure) from the floor, 13 feet 7 inches of which belong to the telescope itself, so that the eye-glass stands 2 feet 9 inches from the floor. The weight of the whole instrument is about 3000 Russian pounds, of which 1000 belong to the frame-work, &c. which supports

* Bosc in *Nouv. Dict. d'Hist. Nat.* vol. xxv. p. 593. M. G. P. Deshayes has recently described and figured four species of fossil Pholades, found by him, among other perforating bivalves, at the village of Valmondois, in France.—*Mém. de la Soc. d'Hist. Nat.* tom. i. p. 245.

† In the *Memoirs of the Astronomical Society of London,* vol. ii. part i. p. 93.

about 2000 pounds. The whole is constructed so as to be used as an equatorial.

The lower part of the frame of the instrument is formed by two cross beams 9 feet 8 inches long, 7 inches wide, and $7\frac{1}{2}$ inches high, which are strengthened by four smaller bars, forming a square. (See Plate VII. No. IV. of this *Journal.*) They are fastened down by eight screws, penetrating them perpendicularly, four at the extremities, and four more towards the centre, and by these screws the instrument is firmly secured. In the centre of this support is fixed an upright post, 6 feet 1 inch high, and 7 inches square. Three posts of an elliptical form support this upright to the north east and west: a beam of equal length inclining towards the horizon under an angle equal to the height of the pole rests on the sloping top of the upright post, and on that part of the lower frame-work which faces the south. This is all the wood about the frame-work, the whole of which is made of oak, and elegantly inlaid with mahogany. The posts are connected by means of 29 screws, which keep it free from every vibration or shaking.

The upper part of the instrument consists of the tube, with its axis of motion, two graduated circles, and a variety of levers and counterweights, producing the most perfect equilibrium in every direction, and preventing any sort of friction. The posts of the principal axis are fastened to the beam of the pedestal, which inclines towards the pole of the earth by means of eight screws passing through the whole thickness of the wood. This axis (parallel to the axis of the wood) is made of steel, 39 inches long, and of proportionate strength. It turns in two cylindrical collars, and lies with its lower end, which is convex and highly polished, on a steel plane, so that it is only in contact in one point. On this axis, towards the lower part, is fixed the hour circle of 13 inches, on which half a second of time may be easily read off.

The brass box or frame of the second axis is fastened to the upper part of the axis by means of twelve strong steel screws. Through this passes the second axis at right angles to the first, with which it is almost equal in dimensions. It therefore always lies parallel to the equator. At one end of it is the declination circle of nineteen inches, divided into every 10′; but which, by a vernier, may be read off to 5″. At the other end, the box or frame in which the tube lies, is fixed by means of twelve screws.

The tube itself is 13 feet long, constructed of deal, in the strongest and safest manner, and overlaid with mahogany, so worked, that it appears like a tube of highly-burnished copper. The object-glass and eye-pieces are set in metal frames, and provided with adjusting screws for the purpose of bringing the axes of the glasses into one straight line.

The diameter of the object-glass is *nine* Paris inches. The *Finder* attached to the tube, is an achromatic telescope of 30 inches focus, and 29 lines diameter, set in metal.

Two counterpoises, fixed to levers, prevent the object-end of the telescope from overbalancing the other end, and at the same time secures it from bending, since they are fixed on the same principle as the counterpoises, which, in Reichenbach's meridian circles, counteract the effect of the weight on the tube, with this difference, that, in our instrument, the levers turn round double axes on account of the changes in the position of the tube.

Two other counterpoises, (one of which is fixed to a strong iron axis turning by means of a double ring round the frame of the axis which lies parallel to the equator, and the other on the end of this axis itself,) serves to remove the weight resting on the polar axis, and at the same time to diminish the friction of the second in its frame. Another counterpoise supports the polar axis just in the centre of gravity of all the moveable parts of the instrument, by means of two friction-rollers, by which the turning of the whole round the polar axis is effected with the greatest facility.

The instrument, after being thus set up, and the counterpoise properly adjusted, is perfectly balanced in every situation. It may be turned in declination with the finger, and round the polar axis with still less force, a weight of three pounds being fixed at some distance from the eye-end, by which the friction is overcome. Thus, this enormous telescope may be turned in every direction towards the heavens, with more ease and certainty than any other hitherto in use.

But, it is equally well constructed for the more delicate motions. The declination circle is stopped by a spring, and secured, by means of a micrometer-screw, against a strong iron arm fixed to the frame.

This screw is moved by a long Hooke's joint, which the observer holds in his hand, while his eye is applied to the glass. In this manner the telescope is pointed in declination with as much certainty as in the best meridian instruments.

For the purpose of producing the finer motions round the polar axis, an endless screw is adapted to move in the hour circle. A spring presses on this screw uniformly, and a lever is employed to raise it out of the circle; another Hooke's joint is placed on the head of this screw, by which the motions are produced.

But the most perfect motion round the polar axis is produced by means of clock-work, which is the principal feature of this instrument, and the greatest triumph for the artist; the mechanism being as simple as it is ingenious. A weight attached to a projection connected with the endless screw overcomes the friction of the machine. The clock vibrating in a circular arc, regulates the motion by moving an endless screw connected with a second wheel in the above projection. The weight of the clock, as well as that of the friction, may be wound up without the motion being interrupted. When the telescope is thus kept in motion, the star will remain quietly in the centre, even when magnified seven hundred times. At the same time, there is not the least shake or wavering of the tube, and it seems as if we were observing an immoveable sky.

But the artist has done still more; he has introduced a hand on a graduated dial of the clock, by which the motion of the latter can be instantly altered; so that a star may be brought into the middle of the field, or to any other point of it to which it may suit the observer to carry it, by rendering the motion of the instrument, for a time, faster or slower than that of the heavens, as the case may require; and when once placed, it may be kept in that position by returning the hand to its original situation. The same mechanism is also used to make the motion of the instrument coincide with that of the sun and moon.

This instrument has four eye-glasses, the least of which magnifies 175 times, and the largest 700 times.

It would be very difficult to find a point of comparison for the optical powers of this splendid masterpiece of art. One fact, however, is certain, that Schroeter's twenty-five feet reflector, after a decided trial of observations on minute objects, stands far behind ours. For, according to the observations made by Schroeter with his reflector, after its construction in 1794, on σ *Orionis*, and which he published, together with a map of the stars composing it, * he saw this star *twelve*, perhaps *thirteen* fold; yet, although Orion is nearer the horizon with us than at Lilienthal, I saw not only all the thirteen stars seen by Schroeter, (including the one which is yet doubtful with him,) but even *three* more; so that, while his instrument only showed him this star decidedly *twelve* fold, ours showed it clearly *sixteen* fold.† If we compare the powers of some of the smaller achromatics of Fraunhofer with those of reflecting telescopes of thirteen and fifteen feet length, we may, perhaps, rank this enormous instrument with the most celebrated of all reflecting telescopes, namely Herschel's, whilst it surpasses it in its convenience for use, and the variety of its applications. Thus, I am inclined to consider *our achromatic refractor, as the most perfect optical instrument yet in existence.* ‡

This masterpiece was sold to us by Privy Counsellor Von Utzschneider, the chief of the optical establishment at Munich, for 10,500 Florins, (L. 950 Sterling,) a price which only covers the expences which the establishment incurred in making it. This generosity, this sacrifice to science, deserves every praise, especially as the professor and academician, Chevalier Fraunhofer, has offered to contribute in future towards perfecting this splendid masterpiece of art.

The description now given of this magnificent instrument,

* See Bode's *Jahrbuch* for 1797.

† See *Astronomical Intelligence* in this Number.

‡ See our Last Number, p. 309.

was drawn up at the beginning of 1825, when it had only a temporary position in the western apartment of the observatory; but, in the course of last year, it has been placed in its proper position in the tower of the observatory, under a rotatory cupola, where it may be used for observations in every part of the heavens.

So recently as December 1, 1825, Professor Struve has announced to Baron Zach, that he had that day completed the erection of the telescope. Previously, however, to doing this, he had discovered with it, in a zone of 19 hours, of right ascension, and of from — 15° to + 10 of declination, 145 *new double stars of the first class, and* 305 *of the fourth class.* The places of most of these stars he had determined by the meridian circle, as well as the respective positions of the surrounding stars, by means of the excellent wire micrometer with which the telescope is furnished.

Such is the description of Fraunhofer's telescope given by Professor Struve; and we think that no Englishman can read it without feelings of the most poignant regret, that *England has now lost her supremacy in the manufacture of achromatic telescopes*, and the government one of the sources of its revenue. In a few years she will also lose *her superiority in the manufacture of the great divided instruments for fixed observatories.* When these sources of occupation for scientific talent decline, the scientific character of the country must fall along with them, and the British government will deplore, when it is too late, her total inattention to the scientific establishments of the empire. When a great nation ceases to triumph in her arts, it is no unreasonable apprehension, that she may cease also to triumph by her arms.

Art. XXIII.—*Observations on some Sulphurets.* By M. Gay-Lussac.*

I have no other object in this note than to explain a very small number of facts which appear to facilitate the compre-

* Translated from the *Annales de Chimie et de Physique*, vol. xxx.

hension of some combinations of sulphur, concerning which M. Berzelius has made important researches.

The existence of sulphurets formed by the alkaline metals has been long known. In my memoir on Iodine, *Annales de Chimie*, vol. xci. p. 59, I have already shown that baryta is reduced by hydrosulphuric acid, and that a sulphuret of barium is produced. Since that first observation, the researches of M. Vauquelin and myself, *An. de Chim. et de Phys.* vol. vi. p. 5 and 321, have placed the existence of the alkaline sulphurets beyond a doubt; and the more recent investigations of M. Berzelius and M. Berthier, vol. xx. p. 34, and vol. xxii. p. 225, have given a further confirmation of it.

The sulphurets formed with the alkaline metals may contain several atoms of sulphur, and it is very easy to discover when they have more than one atom. In fact, a protosulphuret, decomposed by an acid, yields hydrosulphuric acid, without precipitation of sulphur; and for one atom of the sulphuret, one atom of water will be decomposed, the hydrogen of which combines with the sulphur, and the oxygen with the metal.

When, on the contrary, the sulphuret contains more than one atom of sulphur, and it is decomposed by an acid, sulphur is precipitated, because for one atom of metal only one atom of water will be decomposed, and only one atom of hydrosulphuric acid procured.

Now, M. Berthier, in his interesting inquiry on the decomposition of the sulphates by charcoal at a high temperature, has proved that they are converted into protosulphurets; for their weight, after their decomposition, was exactly equal to the united weights of the metal and sulphur which they contained: acids disengaged hydrosulphuric acid from them, without precipitation of sulphur, and they reproduced, when oxidized, perfectly neutral sulphates.

On the other hand, however, every chemist knows, that when a sulphate is decomposed by charcoal *at a red heat*, a sulphuret is obtained with a more or less coloured solution, and from which acids precipitate a large quantity of sulphur, though the sulphuret contains but one atom of sulphur for one of the metal.

This last result, compared with that of M. Berthier, necessarily obliges us to admit, that the sulphurets formed on decomposing sulphates by charcoal *at a red heat*, are not pure protosulphurets; that they must contain a portion of sulphuret which has more than one atom of sulphur, and that, consequently, it ought to contain a portion of metal combined with oxygen. It is quite clear, in fact, that if the metal was not in part oxidized previous to the action of acids on the sulphuret, no sulphur would be precipitated. One may even infer the quantity of oxygen combined with the metal by the quantity of sulphur precipitated. The proportions of alkali, protosulphuret, and persulphuret, vary with the temperature. I have found, on decomposing the sulphate of soda by charcoal at a red heat approaching to whiteness, that the quantity of sulphur contained in the hydrosulphuric acid, which was disengaged when the sulphuret was treated by an acid, was 5.7 times more than what was precipitated. In another experiment with the sulphate of potash, at a lower temperature, I obtained about 4.5 instead of 5.7. This relation ought also to be variable according to the affinity of the metal for oxygen.

I have shown in my memoir on prussic acid, (*Ann. de Chimie*, vol. xcv. p. 164,) that when an atom of potassium is heated in hydrosulphuric acid, one atom of it is decomposed, its sulphur being appropriated by the metal, which then combines with another atom of hydrosulphuric acid. I regarded that combination as a hydrosulphate of the sulphuret of potassium, and as long as it remains in a dry state, I think no other view can be taken of it. It dissolves in water without colouring it sensibly, and heated by our acid, it yields two atoms of hydrosulphuric acid without a precipitation of sulphur, which is a consequence of its composition.

In dissolving this hydrosulphate in water, it may happen that it does not decompose it or that it does. In the last case, we shall have a bi-hydrosulphate of potash; for the atom of metal will decompose an atom of water, so as to form another atom of hydrosulphuric acid. By evaporating it to dryness, the compound will return to its former nature.

This combination is precisely what forms when an alkali is saturated by hydrosulphuric acid, and to which I gave the name of bi-hydrosulphate, because I found that it contained two atoms of acid. (*Ann. de Ch. et de Ph.* vol. xiv. p. 263.) In giving to the alkaline solution, to that of potash, for example, only half as much acid as it can saturate, it is possible either that a simple hydrosulphate or sulphuret will be produced, or that one half of the alkali forms a hydrosulphate of the sulphuret of potassium, while the other half of it remains free. It would be very difficult to determine precisely what happens; but, happily, that is quite immaterial in practice.

In paying attention to the analogy which exists between the carbonic and hydrosulphuric acids, and to their property of separating one another from their combinations, one would expect heat to expel one half of the acid of the bi-hydrosulphates, since it produces that effect on the bi-carbonates. But this is not the case: the bi-hydrosulphates sustain a very high temperature without losing their acid. This result seems to confirm the opinion that the hydrosulphate of the sulphuret of potassium dissolves in water without decomposing it, and that it acts with this liquid like the chlorurets and iodurets; but one may admit that it is decomposed without inconvenience.

On heating the carbonate of potash in an excess of hydrosulphuric acid, M. Berzelius has obtained a compound formed of an atom of sulphuret of potassium, and an atom of hydrosulphuric acid. This result might have been easily foreseen, by remembering that hydrosulphuric acid in excess expels carbonic acid, and converts potash into sulphuret of potassium. The circumstances are then the same as where potassium is heated in hydrosulphuric acid.

M. Thenard has observed, that on heating a solution of the hydrosulphate of potash with sulphur, (*Ann. de Chim.* vol. lxxxviii. p. 132,) there is a disengagement of much hydrosulphuric acid; and M. Berzelius has proved, that when we take the hydrosulphate of the sulphuret of potassium, or, what amounts to the same thing, the bi-hydrosulphate of potash, the sulphur separates one atom of hydrosulphuric acid, and four atoms of sulphur are dissolved. Hence the compound is a sulphuret, with five atoms of sulphur, exactly similar to that which is obtained when potash is heated with an excess of sulphur, or is formed of an atom of potash and one atom of hydrogen combined with five atoms of sulphur.

In concluding this note, I may remark, that M. Berzelius admits, page 116 of his Memoir, that the hyposulphurous acid can unite with a base in three different proportions, and that it may contain the same quantity of oxygen as the base, or twice or three times as much. But we must only regard those compounds as definite, which can, with certainty, be obtained in a separate state; and as this has not been done with respect to those described by Berzelius, the distinction which he has drawn does not appear admissible. The last of these combinations, in which the acid contains three times more oxygen than the base, would obviously be acid, and hitherto it has not been obtained.

ART. XXIV.—*On the Effects of Time in Modifying Anomalous Cases of Vision with regard to Colours.* By GEORGE HARVEY, F. R. S. Lond. and Edin., F. G. S. &c. In a Letter to the EDITOR.

MY DEAR SIR,

IN the Seventh Number of your valuable *Journal*, you have given an interesting abstract of several anomalous cases of vision, with respect to colours; and it has occurred to me, from reflecting on the case which I laid before the Royal Society of Edinburgh, and which is shortly to be published in the *Transactions* of that learned Body, that *time* may possibly produce some modifications in those peculiar conditions of the retina, by which some individuals are prevented from attaining correct perceptions of colour.

With respect to that general decay of vision, which *time* commonly produces in eyes, in every respect perfectly organized, it may be remarked, that those perceptions of colour, which are active and perfect in youth, are commonly preserved through life, with no other change than that general diminution of their vividness and intensity which the natural decay of the energies of the retina may be supposed to produce.

But we are by no means certain, that *time* produces in eyes, imperfectly constituted in those interesting relations, *analogous changes;* whether age, in depriving them of the enjoyment of the minuter impressions of light, contributes to alter or modify their perceptions of colour, in any other way than a general diminution of its brilliance and power. This, it may be said, can only be determined by correct observations, made at different periods of life; and perhaps Mr Dalton is the only philosopher capable of affording any experimental information on the subject; since, in early life, he examined particularly into the peculiarities attendant on his own remarkable perceptions of colour, and, no doubt, has continued to observe, with that cool and discriminating attention for which he is so remarkable, whatever changes may have taken place in his vision, during his useful and brilliant career.

In the case recorded in the *Transactions of the Royal Society of Edinburgh*, the subject of it is not aware of his present perceptions of colour differing in any material degree from those which characterized his yearly youth; but this may possibly have arisen from his being unaccustomed to habits of philosophical observation, and that refined and delicate *tact* by which so many beautiful and interesting truths are discovered. It may not be impossible, however, in the instance of the young man alluded to by the writer of the article in question, to discover, by analogous observations and experiments performed at distant intervals of years, whether his perceptions of colour undergo any peculiar change. *Time* is an element too often neglected in our philosophical investigations; and we are apt sometimes to abandon an inquiry when the materials for its prosecution are only to be obtained by observations made at distant intervals of life.

I remain, my Dear Sir,

Yours very faithfully,

PLYMOUTH, *May* 1*st* 1826. GEORGE HARVEY.

Art. XXV.—*On the Reciprocal Decomposition of Bodies.* By M. Gay-Lussac.*

We are indebted to Berthollet for the important law, that substances whose properties are analogous eventually displace one another from their combinations, and that the principal causes which limit the separation are volatility and insolubility. Berthollet did not perhaps develope the consequences of this law sufficiently; but it is easy to foresee them in each particular case.

When two acids act on the same base, and the whole remains in solution, the base is divided between them, not according to their ponderable quantity, but to the number of their atoms, and it does not appear that its affinity for each acid has much influence over the phenomenon. It is sufficient, in order that the base should be divided between them, that the acids, whatever may be the difference in their volatility or solubility, should remain in solution; for, in that case, they ought to act as if they possessed those properties in the same degree.

Conceive, for example, that an excess of nitric acid is added to the chloruret of sodium; there will be both hydrochloric acid and chlorine in the mixture, and, on the application of heat, the chloruret will be soon changed into nitrate of soda. On reversing the experiment, that is, in treating nitrate of soda by an excess of muriatic acid, it will be converted into chloride of sodium. These reciprocal decompositions are very easy, and, by converting two nitrates into chlorurets, we may determine the proportion in which they were mixed: all that is necessary is to know the weight of the two nitrates, and the two chlorurets, and the atomic weight of each salt. All chlorurets are not decomposed by nitric acid with the same facility; that of silver, which is completely insoluble in water and acids, is not attacked by it, and that of calcium is acted on with more difficulty than those of potassium or sodium. But it must also be remarked, that we compare at present

* Translated from the *Annales de Chimie et de Physique*, vol. xxx.

compounds (chlorurets and nitrates) which are not analogous, and the law, to which we have alluded, cannot apply to them, except by regarding them without distinction, while in solution, either as chlorurets or hydrochlorates, which is not always the case.

Sulphuric acid, at the common temperature, separates in part the boracic and arsenic acids from their combinations; but, at a high temperature, on the contrary, it is separated by those acids.

The nitric and hydrochloric acids decompose the fluorurets; and, in its turn, the hydrofluoric acid decomposes the nitrates and the chlorurets.

The acetic acid decomposes several chlorurets, and reciprocally the hydrochloric acid decomposes the acetates. Many other vegetable acids, and particularly the lactic acid, give rise to analogous phenomena.

Gases that dissolve in water, and which escape from it in a vacuum, are all separated from that liquid by another gas, when passed through it in excess.

A number of similar facts might be adduced, but it will suffice to mention the decomposition of the hydro-sulphates by carbonic acid, and that of the carbonates by the hydrosulphuric acid, on which M. Henry junior has made a very long investigation, to determine facts which might have been easily foreseen by reasoning upon the laws established by Berthollet.

The bicarbonate of potash, for example, exposed in solution to the air, loses a portion of its acid, and acquires the property of precipitating the sulphate of magnesia. If a stream of hydrosulphuric acid gas be passed through it, whose acid properties are known to be nearly the same as those of carbonic acid, a portion of carbonic acid will necessarily become free; and as it will be removed at the same time by the stream of hydrosulphuric gas, the bicarbonate will be always exposed to the same causes of decomposition, and will by degrees be completely decomposed.

In like manner, on passing a stream of carbonic acid into a bi-hydrosulphate, partial decomposition of that salt will ensue, and the hydrosulphuric acid gas, so separated, being carried off by the carbonic acid, the decomposition of the hydrosulphate will at last be complete.

It is necessary to observe that these decompositions require a much greater quantity of acid than is sufficient to saturate the base; for the acid, separated from the base, can only be removed from the solution by means of a great excess of the acid which takes its place, according to the theory of vapours.

It should also be remarked that, if the carbonate and hydrosulphate were not in the state of bi-salts, they would not begin to part with their acid till after having been brought to that state. M. Henry has observed that the insoluble carbonates experience only a very partial decomposition by the action of hydrosulphuric acid, and it is easy to conceive it; but it is not easy to conceive that the carbonates, according to the same observer, should be decomposed with greater difficulty by the hydrosulphuric acid, than the hydrosulphates by the carbonic acid.

ART. XXVI.—*On an extremely Cheap and Delicate Hydrostatic Balance.* By WILLIAM RITCHIE, A. M., Rector of Tain Academy. Communicated by the Author.

HAVING been engaged in determining the ratio between the weights and measures used in the counties of Ross and Sutherland, and the new imperial standard, and not having in my possession a balance of sufficient strength and delicacy, I fell upon the following simple contrivance, which answered as well as the finest hydrostatic balance. A balance of extreme delicacy and accuracy, adapted to philosophical experiments, generally costs fifteen, twenty, or even thirty guineas. The expence attending the prosecution of physical science is thus beyond the abilities of those who are best fitted for such inquiries. The person who, by simple contrivances, will diminish the expence of such essential parts of philosophical apparatus, will therefore confer an important benefit on the young inquirer. With this view, I shall, through the medium of this *Journal*, present the public with the description of a balance, which may be made for a few shillings, and which will answer all the purposes of philosophical investigation, as well as the finest hydrostatic balance in existence.

Let a slender beam of wood be procured, about eighteen inches or two feet long, and tapering a little from the middle to each end. Let a fulcrum of tempered steel, resembling the blade of a pen-knife, be made to pass through the middle of the beam a little above the centre of gravity. Similar steel blades are also made to pass through the ends of the beam for suspending the scales. The fulcrum rests on two small portions of thermometer tube, fixed horizontally on the upright support EF, Plate I, Fig. 8. The support has a slit passing along the middle, to allow the needle EF to play freely between the sides. A small scale made of card, and divided into any number of equal parts, is placed at F, for the purpose of ascertaining the point at which the needle remains stationary. This balance possesses extreme delicacy. It may even be made more sensible than that belonging to the Royal Society of London.

I have said nothing of the perfect equality of the two ends, as this condition is not at all necessary to the accuracy of the balance, according to the method of double weighing.

To ascertain the weight of any body W, place it in one of the scales, and bring the needle to any point, by means of small shot placed in the other scale. Observe the point opposite to which the needle rests, or the middle between its extreme points of oscillation; remove the weight W, and put into the scale as many *known* weights as will bring the needle to the same division as before: these weights will evidently be equal to the weight of the body W, whether the arms of the balance be equal or not.

For this simple and accurate method, we are indebted to the sagacity of Borda. It is generally employed by the continental philosophers, and, though somewhat more tedious, is obviously more accurate than the common method. This method is so simple and obvious, that we are surprised it was not discovered as soon as the balance itself was known; yet, as the celebrated Biot justly remarks, philosophers knew the motions of the heavenly bodies, and had actually ascertained the dimensions of the earth, before they knew the method of accurately determining the weight of a body. The whole passage is very interesting: "Lorsqu'on enterprit, en France, la determination des grandes unités de poids et des mesures, on connaissait parfaitement le cours du ciel et les mouvemens des astres; on savait tres-bien mesurer les dimensions de la terre; mais on ne savait pas determiner exactement le poids d'un corps, et il fallut que Borda inventât la méthode des doubles pesées pour y suppléer."

ART. XXVII.—*Note concerning the Presence of Anhydrous Persulphate of Iron in the residue of the concentration of Sulphuric Acid.* By MM. BUSSY and LECANU. *

IN concentrating the sulphuric acid of commerce, prepared in the usual way by the combustion of sulphur and nitrate of potash, a white powder is gradually deposited, which the acid, in its more diluted state, had held in solution. The deposit has been hitherto regarded as a sulphate of lead; but, on examining it chemically, MM. Bussy and Lecanu discovered that it was a sulphate of the peroxide of iron, mixed occasionally with a small quantity of silver.

This observation led them to examine the action of strong sulphuric acid upon the salts of iron. When the crystallized protosulphate of iron (green vitriol) is put into the acid, it quickly loses its green colour and becomes white, in consequence of being deprived of its water of crystallization by the concentrated acid. A part of the anhydrous salt subsides as a white powder to the bottom; but one portion of it is at the same time dissolved by the strong acid, forming a beautiful rose-coloured solution, which passes into purple as more of the salt is dissolved. The green protosulphate of iron, previously deprived of its water of crystallization, acts in the same manner.

The colour of the solution may be destroyed in two ways. The first is by adding water to a certain extent, when the

* Abstract from the *Annales de Chimie*, vol. xxx.

rose-colour gradually weakens, and at last disappears entirely, the liquid having all the properties of a diluted solution of the protosulphate of iron. The second method is by oxidizing the iron to a maximum. This is most conveniently done by a little peroxide of manganese, or of lead, or, still more rapidly, by nitric acid. A high temperature answers the same purpose; for then the protoxide of iron decomposes a portion of sulphuric acid, and is converted into the peroxide.

These facts account very satisfactorily for the deposition of the sulphate of the peroxide of iron in the concentrated sulphuric acid. The sulphur employed in the manufactory of the acid commonly contains some sulphuret of iron, which is converted into a sulphate during the combustion of the sulphur, and mechanically carried off by the rapid ascent of the gaseous products. The sulphate of iron is held in solution so long as the acid is weak; but when the acid is concentrated by boiling, the iron, if at first in the form of protoxide, is oxidized to a maximum, and subsides as a sulphate of the peroxide. This deposition is quite free from the sulphate of lead as would be expected; for the same condition which causes the persulphate of iron to subside, tends to preserve the sulphate of lead, which is always present in the common acid, in a state of solution. This salt is thrown down when the acid is diluted.

M.M. Bussy and Lecanu obtained the persulphate of iron in a pure state by decanting off the supernatant liquid, and washing away the adhering sulphuric acid by means of alcohol. It is composed according to their analysis of

Peroxide of iron	-	-	40
Sulphuric acid	-	-	60

which is therefore the common persulphate of iron,—the persesquisulphate of Thomson, which contains one equivalent of the oxide to one and a half of the acid. It is remarkable that this salt acquires such a great degree of cohesion by long contact with boiling sulphuric acid as to be dissolved with difficulty by water or alcohol, though, when prepared in the usual way, it is very soluble in both these liquids.

ART. XXVIII.—*On the Refractive Power of the Two New Fluids in Minerals, with Additional Observations on the Nature and Properties of these Substances.** By DAVID BREWSTER, LL.D. F.R.S. Lond., Sec. R.S. Edin., and Corresponding Member of the Academy of Sciences of Paris.

IN a former paper, on the Two New Fluids in minerals, I have given the index of refraction for the most expansible of the two, as it exists in the cavities of *Amethyst;* but as I had not then ascertained the refractive power of the second fluid, and as the principal phenomena of the two fluids were observed in topaz, it became desirable to have an approximate measure of the refractive power of both of them, as they exist in that mineral. As the fluid in Amethyst had never been examined out of the cavity, its identity with that in topaz was inferred solely from the equality of their expansion by heat, so that the determination of the refractive power of the latter was necessary to establish either a difference between these two substances, or their perfect identity.

In the repetition of the experiments described in that paper, I succeeded in finding a cavity, whose shape and situation in the crystal enabled me to obtain an accurate measure of the refractive power of the two fluids.

This cavity consisted of a vacuity, of a large portion of the highly expansible fluid, and of a considerable quantity of the second fluid, which suffered almost no change by heat. The situation of this cavity in the specimen is shown in Plate III. Fig. 1, where C is a section of the cavity perpendicular to its length, and inclined to the parallel cleavage planes EF, GH of the topaz.

In a room where the temperature was about 60° of Fahrenheit, I fixed this specimen upon a goniometer, and I measured the angle of incidence at the surface EF, when the light of a candle RD, incident on the vacuity, began to suffer

* This paper is an abstract of the original one, which will appear in vol. x. part 2, of the *Edinburgh Transactions.*

total reflection. This angle was 38° 42′. From the index of the ordinary refraction of topaz, which is 1.620, I computed the angle of refraction CDB to be 22° 42′, and the angle of total reflection DCP to be 37° 38′ 35″. Hence the angle ADC was 67° 18′; the angle ACD 52° 21′, and DAC, the inclination of the face of the cavity to the refracting surface EF, was therefore 60° 21′.

Calling x the inclination of AB to EF, or DAC and φ the angle of refraction CDB, we shall have $x = \angle$ total reflection $+ \varphi$. For, in the similar triangles ADB, CPB right-angled at D and C, we have CAD = CPB. But CPB = DPQ = CDB + DCP, that is, $x = \angle$ Total Reflection $+ \varphi$.

The goniometer remaining steady in its place, the divided circle and the crystal were turned round, till the same ray RD began to suffer total reflection from the refracting surface of the expansible fluid and the topaz; and the new angle of incidence KDR′, at which this took place, was found to be 26° 39′. The goniometer being turned still farther, the same ray suffered total reflection, from the separating surface of the second fluid MM and the topaz, when the angle of incidence KD was 11° 52′.

Now, if m is the index of refraction of any substance, the sine of the angle at which light incident on its second surface suffers total reflection, will be $\frac{1}{m}$, and if any fluid is in contact with that surface, the sine of the angle of total reflection will be $\frac{m'}{m}$, the index of refraction of the fluid being m'. Hence,

$$m' = m \times \text{Sin. Angle of Total Reflection.}$$

Calling θ the angle of incidence, φ, φ' the angles of refraction, m m', m'' the indices of refraction for topaz, the expansive fluid and the second fluid; then we have $\sin \varphi = \frac{\sin \theta}{m}$; $\varphi' - x =$ Angle of Total Reflection, and

$$m' = m \times \text{Sin}\ (\varphi' - x)$$
$$m'' = m \times \text{Sin}\ (\varphi'' - x)$$

Hence we have the Indices of refraction as follows:

$m = 1.620$ Topaz.
$m'' = 1.2946$ second fluid.
$m' = 1.1311$ expansible fluid.

The following Table will show the relations of the indices of refraction of these two new substances to those of other bodies which I have found to possess a refractive power lower than water:

TABLE of Refractive Powers lower than Water.

Water - - - -	1.3358
Cyanogen rendered fluid by pressure, -	1.316
Ice, - - - - - -	1.3085
Second new fluid in topaz, in a cavity which is filled by the other new fluid, at the temperature of 83°, - - -	1.2946
New fluid in amethyst, which fills the cavity at a temperature of 83½° of Fahrenheit,	1.2106
Tabasheer, whitish, from Nagpore, -	1.1825
Tabasheer, transparent, from Nagpore, -	1.1503
Do. do. another specimen, - -	1.1454
New expansible fluid in topaz, in the same cavity as the second fluid, whose index of refraction is given above, - -	1.1311
Transparent tabasheer from Vellore, of a yellowish tint, - - -	1.1111
Ether expanded into nearly thrice its original bulk, - - - -	1.057

Additional Observations on the New Fluids in Minerals.

Several distinguished foreigners, and others who have taken an interest in this subject, have experienced great difficulty in obtaining specimens of minerals containing the fluid cavities. This difficulty has no doubt arisen from their examining the well crystallized specimens which are generally found in the cabinets of mineralogists. If they had broken up with the hammer only a few of the rounded or imperfectly crystallized white topazes from Brazil or New Holland, they could scarcely have failed to discover, with the compound microscope, innumerable cavities fitted for the purposes of observation. After a little practice in splitting and preparing the specimens, the patient observer will experience no difficulty in detecting cavities of every variety of form, and in discovering the fluid as it flows from the opened cavities over the planes of cleavage. Mr Sanderson, lapidary in Edinburgh, has obtained some of the finest specimens of these new fluids ; and by cutting and polishing the topazes which contain them, he has been enabled to show most of the phenomena to those who are interested in such pursuits.

1. *On the Number and Arrangement of the Fluid Cavities.*

In a former paper, I had occasion to mention, that, in a specimen of cymophane about one-seventh of an inch square, I counted 30,000 cavities. Although this statement occasioned great surprise, yet it was too feeble to convey any idea of their number. So minute are these cavities, that the highest magnifying powers are often necessary to render them visible ; and we might as well attempt to number the grains of sand on the sea-shore, as to count these fluid cavities when they appear in this minute state.

The strata in which these cavities are arranged, are not so closely related to the primary and secondary planes of the crystals, as I formerly supposed. I have found them in almost every possible direction, and intersecting one another at angles, which cannot be referred to any of the crystalline forms of the mineral. In a specimen of quartz observed by Mr Somerville, and now in the possession of Mr Sivright, they are arranged in hollow groupes, somewhat like the cells of a honeycomb ; and, when they are viewed by reflected light, the corresponding faces of the cavities are seen to be parallel, though the cavities have every possible variety of position with respect to each other. In other specimens, they form planes of variable curvature, and sometimes curved surfaces of contrary flexure ; and in one specimen, belonging to Mr Sivright, the longitudinal cavities are grouped and inflected, so as to resemble a curled lock of the finest hair. In a specimen of blue topaz from Brazil, belonging to Mr Spaden, lapidary in Edinburgh, there are no fewer than four strata of cavities nearly parallel to each other, and in the thickness of one-eighth of an inch.

In the distribution of most of these groupes, accident seems to have had the principal share; but there are certain modes of distribution that appear to be the result of some general principle. In a specimen, for example, belonging to Mr Sanderson, an immense number of cavities are arranged in rectilineal groupes, radiating from a centre. Each rectilineal group consists of *two*, or in some places *three*, rows of cavities, and several of the radiations are bent from their original direction. The spaces between each pair of rows are filled with curiously branching cavities, some of which are half an inch long; but the remarkable fact is, that these cavities are connected with numerous slender branches, many of which communicate with a single cavity in the nearest rectilineal row of the radiations between which the long cavities are placed.

In all the cavities of this remarkable specimen capable of being examined, there are found both the new fluids, with the exception of a long branching cavity, from which they had escaped, in consequence of the end being cut by the lapidary. The dense fluid always occupies the filamentous branches.

The plane in which these cavities lie is perfectly flat, and is nearly perpendicular to the axis of the prism.

2. *On the Form of the Cavities containing the New Fluids.*

In a specimen of topaz belonging to Mr Sanderson, and which is one of the most valuable that I have seen, each cavity consists of a variety of cavities of different lengths and sizes, bounded by parallel lines, and communicating by narrow channels, which almost escape the cognizance of the microscope. In these cavities, the two new fluids are arranged in the most remarkable manner, the dense fluid occupying all the necks, and angles, and narrow channels, while the expansible one is left in the open and less capillary spaces. When the heat of the hand is applied to the specimen, the fluids in the cavities are all set in motion. The dense fluid quits its corners, and assumes new localities; and the different portions of the expansible fluid either unite into one, or are subdivided by the interposition of some portion of the dense fluid, which has been expelled from its primitive situation, and drawn into its new position by capillary action. When the specimen cools, the two fluids quit their new position; and, as if they were endowed with vitality, they invariably resume the same positions which they occupied at the commencement of the experiment.

Another form of the cavities, still more remarkable, occurs in a very fine specimen belonging to Mr Sivright. These cavities resemble a number of parallel cylinders, as shown at AB in Fig. 2; but, owing to some cause which it is difficult to conjecture, a number of them have been afterwards turned aside towards C, so as to be open at one of their extremities. From these extremities, which terminate in the surface ACB, the fluids have made their escape, and have left the interior of the cavities lined with a black and transparent powdery residue, which always remains after their evaporation. When the cavities thus inflected and deprived of their fluids are submitted to the microscope, they exhibit the most extraordinary shapes, some of which are represented in Figs. 3, 4, 5. They have the appearance of having been formed by a turning lathe; and such is the symmetry and beauty of their outline, that it is not easy to conceive that they are the result of any mechanical cause. One of these cavities, which is unconnected with the rest, resembles a finely ornamented sceptre, as shown in Fig. 3; but what is more remarkable, the different parts of this figure lie in different planes, so that, when it is seen in a direction at right angles to that of symmetry, it appears merely a number of disjointed lines, as in Fig. 6.

The inflection of the cavities AB into the directions *b*C, &c. Fig. 2, and the discharge of their fluid contents at the surface ACB, could only have taken place when the whole mass ACB, though crystallized, had not attained its permanent induration. This opinion derives great support from the fact, that the lines *b*C are perpendicular to the axes of the prism, and consequently lie in the planes of most eminent cleavage. The direction, therefore, in which the fluids were discharged, was *that of least resistance*,—a result which might have been expected.

In the specimen now under consideration, there is a stratum of fluid cavities, composed of a great number of parallel rows of cavities, and remarkable for their symmetry. One of these rows is somewhat like AB, Fig. 7. If we now suppose that when this specimen had not acquired its permanent state of induration, the fluids in its cavities were expanded by a considerable heat, the fluid in one cavity would force itself into the adjacent ones, so that the row of cavities AB would form one cavity, somewhat like that in Fig. 5. If the cavities lay in different planes, as shown in Fig. 6, then the expanded fluid would descend to the one immediately below it, and connect the whole together as in Fig. 3. We do not mean to say, that the cavities *b*C in Fig. 7, were actually formed in this manner, because this is rendered improbable by their connection with the rectilineal ones AB, but merely to explain how cavities having the forms shown in Figs. 3, 4, 5, may have their origin from the union of a great number of cavities arranged as in Fig. 7.

When the cavities are regularly crystallized, the homologous sides of the hollow crystals are parallel to one another, and also to those of the primitive or secondary form which they resemble. In some very curious but amorphous specimens of quartz from Brazil, belonging to Mr Spaden, the hollow crystals terminate in six-sided pyramids, *with flat summits*, and the axes of these pyramids is parallel to the axis of the system of polarised rings, and consequently to the axis of the crystal.

3. *On the Condition of the Fluids within the Cavities.*

The phenomena of the expansible fluid have been so fully described in my former paper, that I have only a few observations to add upon this part of the subject. In some specimens of quartz, the expansible fluid seems to exert a very considerable elastic force, even at the ordinary temperature of the atmosphere, and when a slight degree of heat is applied, it sometimes has sufficient force to burst the specimen. A very remarkable case of this kind happened to a son of Mr Sanderson, who put one of the Quebec crystals of quartz into his mouth. Even with this small accession of heat the specimen burst with great force, and cut his mouth. The fluid which was discharged had a very disagreeable taste.

In the various cavities described in my former paper, the whole of the expansible fluid, when exposed to heat, was either driven into vapour,* or retained its fluidity after it had filled the vacuity. Since that paper was published, however, I have discovered cavities in which, after the application of heat, there may be said to be *three different substances*, viz. 1. The expansible fluid in a state of fluidity; 2. The dense fluid; and, 3. The vapour of the expansible fluid. This curious fact will be understood from Fig. 8, which represents a cavity in a specimen belonging to Mr Spaden. The cavity is *one-twelfth* of an inch long. The expansible fluid is lodged at N N and N′ N′, where there are large vacuities V, V′, and there is a globular portion of it at *n*, without a vacuity. When heat is applied, the fluid at N N and N′ N′ quickly goes off into vapour; the portion at *n* expands into an elliptical globule, but its force is not sufficient to displace the mass of the second fluid between *n* and N, and *n* and N′; and being kept in equilibrio by the opposite and nearly equal expansive forces of the vapour in N N, and N′ N′, it consequently remains fluid at *n*. In a plate of topaz shown to me by Mr Sivright, where the expansible fluid consists of two portions floating in a large quantity of the dense fluid, one of the portions is a spherical drop which expands with heat, and contracts with cold, exhibiting by transmitted light an effect similar to the opening and shutting of the pupil.

In re-examining the phenomena of the second or denser fluid, several very curious facts have come under my notice.

I had previously shown, that, when several cavities communicated with each other, the narrow necks, or lines which joined them, were filled with the dense fluid, which shifted its

* One of the largest vapour cavities that I have seen is *one-twelfth* of an inch every way. It is less than half full of fluid, and hence it is driven into vapour by heat. During the precipitation of the vapour it becomes perfectly opaque.

position when the equilibrium of the adjacent portions was destroyed by heat. The particles of the dense fluid have a very powerful attraction for themselves, like those of water, and they are also powerfully attracted by the mineral which contains it. The particles of the expansible fluid have, on the contrary, a very slight attraction for one another, and also for the mineral which incloses them. Hence it follows, that, as the two fluids never in the slightest degree mix with one another, the dense fluid is either attracted to the angles of angular cavities, or occupies the bottom of round ones, or fills the narrow necks or channels by which two or more cavities communicate with one another. The expansible fluid, on the other hand, occupies all the wide parts of the cavities, and in those which are deep and round it lies above the dense fluid.

If we now apply heat to a single deep cavity containing both fluids, the elastic force exerted by the expansible one, after its vacuity is filled up, will modify the form of the dense fluid, pressing it out of some corners and into others, till the elastic force of the one is in equilibrium with the capillary attraction of the other.

But if there are two cavities, A, B, communicating with each other, as in Fig. 9, where the dotted part represents the expansible fluid, then the dense fluid will be found in the neck at *m*, *n*, and at the angles *o*, *p*, *r*, *s*. Let us now suppose that there is a vacuity V only in the smaller cavity B, and that heat is applied to the specimen. It is obvious that the greater expansion of the expansible fluid in A, which has no vacuity to fill, will force the dense fluid *m n* towards V, where it will take up a new position about *b m c* when the expansive forces are *in æquilibrio*. But if the cavity A is very large compared with B, the fluid *m n* will be driven out of the neck *b n*, and will find its way to some of the corners *o*, or *p*, from which, upon cooling, it will again return to its position *m n*.

Let us now suppose that the cavity A communicates with other cavities which expand slowly into it, while it is expanding into B; then, at every expansion of A, the dense fluid *m n* will be driven to a side, but it will immediately return, opening and shutting like a valve. This effect is finely exhibited in a cavity of a specimen belonging to Mr Sanderson, represented in Fig. 10 by A B C D E. In ordinary temperatures, about 45°, there is a vacuity of the size V, in the expansible or dotted fluid, and the dense, or shaded fluid, occupies the necks *b c*, *d e*, DE, and also the extremity F. By applying the heat of the hand to the specimen, the expanding fluid in the branches V C, V D, finds space for itself, by filling up the vacuity, but as there are no vacuities in the portions of expanding fluid at A B, B, and E F, they must necessarily force out the dense fluid which confines them. The dense fluid in the neck E D, is thus made to appear at D, and the whole of the dense fluid at *b c* is driven off to *d e*, till, accumulating there, it is drawn by attraction to the nearest neck, *m n o p*. Here it first lines the circumference of the hollow neck, from its powerful attraction for topaz; and, as the lining becomes thicker, it appears as a slight elevation between *o* and *p*, and between *m* and *n*. These elevations increase till they leap together by their mutual attraction, and form a column of the dense fluid *m n p o*. The column *b c* of dense fluid has now disappeared entirely, and the space A B C D is filled with the expanding fluid. The heat of the hand being continued, the expanding fluid A B forces itself through the little cylinder of dense fluid *d e*, which resumes its place the moment that a portion of the former has passed. But as the same heat has been expanding the fluid between *n p* and C, which pushes out part of the dense fluid at *m n o p*, this dense fluid, and the surplus of what was displaced from *b c*, moves along the sides of the cavity till it occupies the portion *q r*, of the branch V D. Sometimes the dense fluid is entirely driven from *m n o p*, and part of it sent to the extremity C; though, in general, a very small portion remains at the very neck *m o*.

As the specimen cools, the dense fluid quits *m o* and *q r*, and is gradually transferred through the neck *d e* to the neck *b c*; every portion of it invariably resuming its primitive position.

A curious modification of these actions is seen in a cavity of the specimen shown in Fig. 11. The branch *b* V has always a vacuity V, while the cavity A, connected with it by the filamentous channel *o b*, has no vacuity. At the ordinary temperature, the dense fluid appears at *a* and *c*, and slightly at *o* and *b*, filling the narrow channel *o b*. By applying heat, the expanding fluid in *b* V fills the vacuity V; and, as the cavity A *a o c* has no vacuity, a portion of its fluid is driven through the neck *a b* into *b* V in small globules; but, owing to the narrowness of the neck at *b*, the phenomena are not easily observed. Upon cooling, however, the retransference of the fluid that had passed from A to *b* V, is finely seen. The contraction of the expanding fluid in A causes the dense fluid to appear as at *m n o*, in Fig. 11, and, in a short time, the curved surface *m n* becomes more flat; and, at last, a straight line, as at *m′ n′*, Fig. 12. This indicates a pressure along the canal *b′ o′*, in the direction *b′ o′*, and a bubble of the expansible fluid instantly issues from *o′*, as in Fig. 12, and, passing through the dense fluid, joins the expansible fluid in A′. After three or four of these have passed, the equilibrium is restored. In this case, the capillary force exerted by the channel *o′ b′* upon the dense fluid which it contains is too strong to permit the little globule of the expansible fluid in *b′* V′ to displace it, as in Fig. 10, so that it passes very slowly in separate globules.

The *fluid valves*, as they may with propriety be called, which thus separate the different branches of cavities, afford ground of curious speculation in reference to the functions of animal and vegetable bodies. In the larger organizations of ordinary animals, where gravity must in general overpower, or at least modify, the influence of capillary attraction, such a mechanism is neither necessary nor appropriate; but, in the lesser functions of the same animals, and in almost all the microscopic structures of the lower world, where the force of gravity is entirely subjected to the more powerful energy of capillary forces, it is extremely probable that the mechanism of immiscible fluids, and fluid valves, is generally adopted. We must leave it, however, to the physiologist to determine the truth of this supposition.

4. *On the Condition of the Fluids when taken out of the Cavities.*

I have already described so fully in a former paper the singular movements into which the expansible fluid is thrown when it first flows out of its cavity upon the surface of the plate of topaz which contains it, that I have nothing to add upon this subject.* It did not then occur to me that these movements might be owing to electricity, till I read an account of the following experiment made both by Professor Erman and Mr Herschel. When a globule of water, dropped on the surface of a flat dish of mercury, is brought into connection with the positive pole of a galvanic battery, while the mercury is connected with the negative pole, it instantly flattens and spreads to twice its diameter, regaining its former sphericity when the circuit is broken. This extension and subsequent re-aggregation of the globule of water, is precisely the same effect as that exhibited by the drop of expansible fluid; and it is therefore very likely that the latter is owing to an electrical cause. In separating the particles of bodies, electricity is always produced; and in the cleavage of topaz and mica, even electric light is developed. But experiments are still wanting to determine, whether, in the present case, the electricity is derived from the separation of the cleavage planes, or from the change of condition which the new fluid is undergoing during its rapid evaporation, and its partial conversion into a powdery residue.

5. *On some Miscellaneous Phenomena connected with the Formation of Fluid Cavities.*

In my former paper, I have described the phenomena of a single fluid in the cavities of various minerals and artificial crystals. Since that paper was written, I have seen many specimens of this kind; but as the fluid has always, when examined, been found to be water, such specimens possess no peculiar interest, unless their cavities are opened, in the manner first adopted by Sir Humphry Davy. One of these specimens, however, which was kindly sent to me for examination by W. C. Trevelyan, Esq. is so peculiar as to deserve notice. In the drawing of it, in Fig. 13, which is of the

* Some of the fluids in quartz seem to be entirely gaseous, while in sulphate of barytes, it appears to the mineral itself in a fluid state.—See p. 134, note, and note on p. 135.

real size, AB is a cavity in quartz, which is filled with a fluid, excepting the vacuity *a b*, which may be made to move to different parts of the cavity. The fluid does not expand perceptibly by heat, and is in all probability water. When the specimen is shaken, the fluid becomes turbid, and of a whitish colour, arising from a fine white sediment, which settles in the lower part of the cavity.

In a specimen of quartz from Brazil, belonging to Mr Spaden, there is a cavity with an air-bubble, about the tenth of an inch long. It is nearly one-third full of a white powder, consisting of crystalline particles, which, upon inverting the specimen, flow over the surface of the air-bubble like sand in a sand-glass. In the specimens of quartz already mentioned in page 128, as containing cavities with pyramidal summits, there is only one fluid, in which there is generally an air-bubble. These cavities often contain opaque spherical balls about the $\frac{1}{937}$th of an inch in diameter, which are distinctly moveable; and in one cavity I have counted *ten* of these balls, *seven* of which roll about the cavity when the specimen is turned round.* In a second specimen, spherical balls of the same kind are copiously disseminated in the quartz, and also in the cavities. In a third specimen, the balls occur near the summits of the pyramidal cavities, some of them being within, and some of them without the cavity.

In the crystallizations of ice, several phenomena occur, which are intimately connected with the preceding inquiry. When water is frozen in a glass vessel, the ice is often intersected with strata of cavities, which have the same general form and aspect as those in minerals. I have sometimes observed frozen drops of dew, containing a portion of water, which *remained unfrozen even at low temperatures*; and I have recently had occasion to examine some crystallizations of ice, which presented the same fact, under more curious circumstances.

* I have since opened several of these cavities by the blow of a hammer. In a second or two the fluid was entirely gone, without leaving a trace of its existence behind. The spherical balls remained in the cavities: They were not acted upon either by the muriatic or the sulphuric acids.

A very sharp frost occurred in Roxburghshire on the morning of the 8th October 1825. The gravel-walks in the garden were raised up about an inch above their natural level by the sudden congelation of the water in the earth mixed with gravel. All the elevated portions consisted of vertical prismatic crystals of ice of six-sided prisms, with summits which seemed to be triedral. The leaves of plants, &c. were covered with granular crystals, which were in general six-sided tables.

Upon examining, with a microscope, the prismatic crystals, aggregated in parallel directions, they presented some curious phenomena. They had numerous cavities of the most minute kind, arranged in rows parallel to the axis of the crystals, and at such equal distances as to resemble a series of mathematically equidistant points. Some of the cavities were very long and flat, and sometimes they were amorphous; but, in general, they contained *water* and *air*.

Upon submitting one of these cavities to a powerful microscope, it appeared, as shown in Fig. 14, where A B C is the piece of ice, having in it a long cavity *m o*, containing water and air. The ice gradually dissolved; and when the end *n o* of the cavity *m n* was near the edge of the ice C B, the air, in a portion of it *n o*, detached itself, and went off at *p*, through the solid ice, the cavity closing up again at *n*. This phenomenon is analogous to the passage of the expansible fluid through topaz and quartz, which has been already described; the air in the one case, and the fluid in the other, finding its way in the direction of easiest cleavage, and the fissure closing up again in the manner already mentioned in a preceding part of this paper. The singular fact, however, is, that the portion *n o* of the cavity quitted by the globule of air, was immediately filled up with ice, and the cavity reduced to the dimensions *mn*.

As the formation of ice from water is in every respect analogous to the formation of crystals, from a substance rendered fluid by heat, the examination of its cavities is likely to throw some light upon their formation in mineral bodies.*

* Since this paper was written, Mr William Nicol, Lecturer on Natural Philosophy, has shown me a very remarkable specimen of *Sulphate of*

In concluding these observations, I could have wished to enter into some details respecting their geological relations; but as these would lead us too far into the regions of speculation, I shall not enter upon them on the present occasion. It may be proper, however, to state, that the opinion which I hazarded in a former paper, that the discovery of the two new fluids in minerals attached a new difficulty to the aqueous hypothesis, has been rendered more probable by every subsequent inquiry; and that I can see no way of accounting for the phenomena, but by supposing that the cavities were formed by highly elastic substances, when the mineral itself had been either in a state of fusion, or rendered soft by heat.

Art. XXIX.—*On the Composition of the Native Phosphates and Arseniates of Lead.* By F. Wöhler.*

Klaproth has given the analysis of four specimens of lead-spar, in the third volume of his Contributions, the composition of which is as follows:

Barytes, with fluid cavities of the same general character with those which I described in my former paper, but much larger than any which I had seen. Upon grinding down, on a dry stone, one of the faces of this specimen, the largest cavity burst, and discharged its fluid contents through the fissure upon the ground surface of the specimen. The fluid lay in drops of different sizes along the line of the fissure, and, in this condition, Mr Nicol put it into his cabinet. Upon looking at the specimen about *twenty-four* hours afterwards, *each drop of fluid had become a crystal of sulphate of barytes.* These crystals had the primitive form of the mineral.

This very curious fact is analogous to the uncrystallized water in the ice-cavities mentioned above, the crystallization in both cases being prevented by pressure. When that pressure was removed, a portion of the water and the fluid sulphate of barytes were immediately crystallized. Mr Nicol distinctly remarked, that the crystals occupied nearly as much space as the drops of the fluid; so that the crystals of sulphate of barytes were not deposited from an aqueous solution, but bore the same relation to the fluid from which they were formed, as Ice does to Water.

* Abstract from Poggendorf's *Annalen der Physik und Chemie*, vol. iv.

	Green Lead-Spar from Zschopau.	Brown Lead-Spar from Huelgoet.	Green Lead-Spar from Hoffsgrund.	Yellow Lead-Spar from Wanlock-Head.
Oxide of lead,	78.40	78.58	77.10	80.00
Phosphoric acid,	18.37	19.73	19.00	18.00
Muriatic acid, -	1.70	1.65	1.54	1.62
Oxide of iron, -	0.10	0.00	0.10	0.00
	98.57	99.96	97.74	99.62

It is commonly supposed that the phosphoric acid and oxide of lead exist in these minerals as a neutral phosphate ; but, on calculating their composition on this idea, they will be found to contain too much oxide of lead for converting the phosphoric acid into a neutral compound, and too little for forming any known sub-salt with it. This circumstance led M. Wöhler to suspect some inaccuracy in these analyses, and it is obvious, on reading Klaproth's account of them, that the results cannot be altogether exact. Klaproth determined his oxide of lead, by precipitating it from a dilute solution of the mineral in nitric acid by sulphuric acid ;—a method which is inexact, because a considerable portion of the sulphate of lead remains in solution. Having collected the sulphate of lead on a filtre, and removed the excess of sulphuric acid, the phosphoric acid was thrown down by the acetate of lead, the solution having been previously neutralized as far as possible by ammonia. Now the phosphate of lead, so formed, is not uniform in composition, unless certain precautions are taken which Klaproth did not employ ; and the effect of this error was to cause the quantity of phosphoric acid to appear greater than it ought to have been. Another circumstance which attracted the attention of M. Wöhler, was the constant occurrence of muriatic acid in all the varieties which were analyzed by Klaproth ; a coincidence which could hardly be accidental, since the proportion of that acid to the other constituents of the mineral is so nearly the same in all of them.

The first variety examined by M. Wöhler, was the green lead-spar from Zschopau, being one of those which Klaproth had analyzed. The muriatic acid was determined by adding nitrate of silver to the solution of the mineral in nitric acid. To ascertain the quantity of lead, a fresh portion was dissolved in nitric acid, was precipitated by ammonia, and an excess of the hydrosulphuret of ammonia was then added. The sulphuret of lead, after being collected on a filtre and dried, was decomposed by concentrated muriatic acid; the chloride of lead was then heated to redness, and weighed. The quantity of the phosphoric acid was inferred from the loss. The composition of the mineral, according to this analysis, is,

Oxide of lead, -	82.287
Muriatic acid, - -	1.986
Phosphoric acid, (and a trace of iron,)	15.727
	100.000

Or,

Chloride of lead, -	10.054	1 atom
Sub-phosphate of the oxide of lead,	89.946	3 atoms

The other specimens were analyzed by a similar method, and the composition is shown by the following table:

	White Lead-Spar from Zschopau.		Arseniate of Lead from Johann-Georgenstadt.		Lead-Spar from Lead Hills.
Oxide of lead,	80.55	(with a trace of iron,)	75.59		82.46
Muriatic acid,	1.99		1.89		1.95
Arsenic acid,	2.30		21.20	and of iron, a trace,	
Phosphoric acid,	14.13		1.32		15.50
	98.47		100.00		98.91

Or,

Chloride of lead,	10.09	9.60	9.91
Sub-phosphate of the oxide of lead,	80.37	7.50	88.16
Sub-arseniate of oxide of lead,	9.01	82.74	00.00
	99.47		98.91

The presence of muriatic acid was also detected in several minerals of the same species; namely, in the green lead-spar from Freyburg in Breisgau, from Beresofsk in Siberia, and from Clausthal in the Harz; in the brown lead-spar from Poullouen in Brittany, and from Rheinbreitenbach. The muriatic acid is very easily detected in these minerals by Berzelius's test of copper before the blowpipe; or by melting a portion of them in the phosphate of soda and ammonia, when the muriatic acid gas escapes with effervescence, and may be detected by its odour.

The chief result of these researches is, that all the minerals included under the *Plomb phosphaté* of Haüy, and which form the green and brown lead-spar of Werner, are combinations of one atom of the chloride of lead, and three atoms of the sub-phosphate or sub-arseniate of the oxide of lead; and that the phosphoric and arsenic acids may be substituted for one another in these compounds, or may be present in them together, in variable proportions, without the crystalline form being thereby affected. This peculiarity arises from the isomorphous nature of the two acids. In all these varieties, the lead which is combined with the chlorine, is to the lead in the sub-arseniate or phosphate in the proportion of 1 to 9.

The process by which M. Wöhler separated the arsenic and phosphoric acids, depends on the conversion of the former into orpiment by the action of sulphuretted hydrogen. To a solution of the mineral in nitric acid, an excess of ammonia is added, with which the hydrosulphuret of ammonia is afterwards mixed and digested. The sulphuret of lead is collected on a filtre. The clear solution contains phosphoric acid, together with orpiment held in solution by ammonia, and the sulphuret is obtained by neutralizing the alkali, and expelling any free sulphuretted hydrogen by heat.

Art. XXX.—*On a new Photometer, founded on the Principles of Bouguer.** By William Ritchie, A. M. Rector of Tain Academy.

This instrument consists of a rectangular box A B C D, Plate I. Fig 13, about an inch and a half or two inches square, open at both ends, and blackened within for the purpose of absorbing the stray-light. Within the box are placed two rectangular pieces of plane mirror C F, F D, forming a

* Abridged from the original paper in the *Edinburgh Transactions*, vol. x. part ii.

right angle with each other, and cutting the sides of the box at an angle of forty-five degrees. In the upper side, or lid of the box, there is cut a rectangular opening E G, about an inch long, and one-eighth of an inch broad. This opening is covered with a slip of fine tissue or oiled paper. The two mirrors should be cut from the same plate, in order that their reflective powers should be exactly equal; and the rectangular slit should have a small division of blackened card at F, to prevent the possibility of the lights mingling with each other, and thus affecting the accuracy of the result.

In using this instrument, place it in the same straight line between two antagonist flames, at the distance of six or eight feet from each other; move it nearer the one or the other, till the disc of paper appear equally illuminated on each side of the middle division, and the illuminating powers of the flames will be *directly* as the squares of the distances from the middle of the photometer. In moving the instrument rapidly between the two lights, we very soon discover a boundary, on each side of which the difference between the illuminating disc becomes quite apparent. By making the instrument move from one side of this line to the other, and gradually diminishing the lengths of the oscillations, we at last place it almost exactly in its proper position. It is very convenient to have a board of the same breadth with the instrument, divided into equal parts, for the purpose of supporting the photometer, and reading off the distances of the flames from the middle of the instrument.

In viewing the illuminated disc of paper, I use a box, about eight inches long, in the form of a prismoid, and blackened within, in order to prevent any light entering the eye, except what passes directly through the disc of paper.

Instead of the two mirrors, I sometimes use the same instrument, with a piece of white paper pasted on the faces of the mirror, or on a piece of smooth wood, forming, as before, a right angle. In this case, the illuminated discs are viewed directly through the rectangular opening in the lid, without the intervention of the tissue or oiled paper.

This instrument is still simpler than the preceding, and in some experiments has decided advantages. But whatever form of the instrument be employed, the following precautions should be employed, in order to insure a very close approximation to the truth. Take any number of observations, turning the instrument round at each time, and the mean of these will give a result, perhaps as accurate as the nature of the case admits; at least, it will be sufficiently accurate for all the ordinary purposes of life.

When the colours of the flames are different, it is very difficult to ascertain the place of equal illumination. We can, however, as before, find the space over which the instrument moves, before we discover an obvious difference between the illuminated halves of the oiled or white paper. We must then take the middle of this space, which will, even in that difficult case, give us a very good approximation to the truth. But still this method is of very difficult application, when one of the lights is of a fine white, and the other of a dusky red or blue colour.

Art. XXXI.—CONTRIBUTIONS TO METEOROLOGY. Communicated by Mr Foggo.

1. *Temperature of Places in Ceylon.* *

1. *Point de Galle.*—The register for this place was kept from the beginning of March till the end of November 1812, and the thermometer observed three times a-day, viz. 6 A. M. noon, and 6 P. M. The mean temperature, however, is obtained more nearly by taking the average of the two former. The morning observations give for their mean temperature 79.93, and those at noon 83.93, the mean of the two being 81.9. The highest temperature observed was 87°, the lowest 75°; extreme range of temperature 12°. The mean temperature at sunset is 81.16, differing from the mean temperature of the day about $\frac{1}{5}$ of the mean daily range.

2. *Colombo.*—Observations were made at 6 A. M., 3 P. M., and 9 P. M. during the year 1812, excepting the month of December. The mean temperature of 6 A. M. is 79.61, of

* The registers from which these temperatures are deduced, were kindly communicated to the Editor by Henry Harvey, Esq.

3 P. M. 82°75, and the mean of these 81°.18. As these hours give precisely the minimum and maximum temperatures of the twenty-four hours, the mean daily range of the thermometer at this place is only 3.14. The mean temperature at 9 in the evening is 81. The mean of the warmest month (May) is 83.1, of the coldest month (January) 79. Max. temp. 87, minimum 75, extreme range 12°.

In January, the mean temperature is 79, m. temp. at sunrise 76, at 3 P. M. 82. Mean range 6°. Weather dry and clear, with regular land breezes during the day, succeeded by sea-breezes at night; rain fell on four nights. Mean temp. of February 80, at sunrise 78, afternoon 82; weather much the same as last month; rain on four nights. In March, mean temp. 81.8, sunrise 79, afternoon 84; land and sea-breezes regular, rain fell on 12 nights, thunder and lightning twice. April has a mean temp. of 83, at sunrise 81.5, 3 P. M. 84.5, mean range 3°; fourteen rainy nights; on the 26th, a strong sea-breeze prevailed all day, and was followed by vivid lightning at night; on the 28th, the sea-breeze blew in strong squalls, attended with heavy rain, and thunder; next day the wind blew from all points of the compass. In May, the extreme range of temperature was 7°, mean temp. 8.31, at sunrise 82.2, at 3 P. M. 84. Sea-breeze during the day, in general strong, with heavy showers; 17 rainy days. June, mean temp. 81.7, at sunrise 81, afternoon 82.5; mean range of thermometer 1.5, extreme range 5°; constant sea-breeze during the day, almost always attended with rain. July, same in every respect, even to the thermometric extremes August, mean temp. 80.7; at sunrise 79.8, afternoon 82, extreme range 4°. Sea-breeze during the day, with rain, succeeded by a land-wind at night; towards the end of the month the weather became squally. September, mean temp. 81.37, at sunrise 80.5; afternoon 82.5; extreme range 4°, max. 84, min. 80. Sea and land breezes regularly, in general with rain during the day; weather throughout the month squally. October had the same characters. Mean temp. 79.6, at sunrise 78, afternoon 81.25, max. 84, min. 76, extreme range 8°. November, mean temp. 80.7, at sunrise 78.5, afternoon 83. In this month, the land-breezes at night had increased in force, and the sea-breezes during the day were accompanied by continual rains, with frequent thunder and lightning.

3. *Trincomalee.*—The register was kept during the years 1809-10-12, and the thermometer was recorded three times daily, as at Colombo. The average temperature at sunrise, for three years, is 78.71, at 3 P. M. 84.57, and the mean of these 81.64. The average temperature of 9 P. M. is 80.74, or $\frac{1}{7}$th of the mean range below the average daily temperature. Mean temp. of the warmest month (June) 84.54, of the coldest month (January) 77.79. Max. temp. observed 72, minimum 22.5. Extreme range of the thermometer for three years, 20.5. The observations on the state of the weather are too brief to afford any other information respecting the climate of the place. The climate of Ceylon is that of islands in general, characterized by uniformity of temperature, and great humidity. The sea-breeze which prevails at Point de Galle, and Colombo, after the middle of April, and which is in fact the S. W. monsoon of the Indian ocean, has become a land wind before it arrives at Trincomalee. The effects of its passage over even that narrow country may be traced in the greater dryness of the air, indicated by an increased range of the thermometer, and the higher temperatures which occur during the season in which this wind prevails. The average of January for three years is 77.79, at sunrise 76.56, afternoon 79.03, max. temp. 83, min. 73. February, mean temp. 78.6, sunrise 76.6, afternoon 80.6, max. 84, min. 72. March, 81.3, sunrise 78.9, afternoon 83.8, max. 86, min. 74.5. April, 83.91, sunrise 81.08, afternoon 86.75, max. 90, min. 76. May, mean temp. 83.99, sunrise 80.41, afternoon 87.58, max. 72.5, min. 75. June, mean temp. 81.54, sunrise 80.58, afternoon 88.5, max. 92, min. 75. July, mean. temp. 84.45, sunrise 80.5, afternoon 88.4, max. 91, min. 75. August, mean temp. 83.08, sunrise 79.3, afternoon 86.66, max. 91, min. 76. September, mean temp. 82.28, sunrise 80, afternoon 86, max. 70.5, min. 76. October, mean temp. 80.85, sunrise 77.74, afternoon 83.96, max. 90, min. 73. November, 79.81, sunrise 76.7, afternoon 82.92, max. 89, min. 73. December, mean temp. 78.37, sunrise 76, afternoon 80.75, max. 89, min. 93.

4. *Temperature of Springs, supposed to be influenced by Thunder Storms.**

I have made many observations on the temperature of three springs in my neighbourhood. One of these, which has been long used as a well, and is within 40 yards of a pump-well, appears to be fed by springs from the higher ground, and, for many years (at least) has become dry in summer.

The temperature of this well has varied greatly at different times, and is evidently affected by the temperature of the atmospheric air. My observations on the other two nearly coincided.

One of these is a spring issuing from the bottom of a hill, about 10 feet above the level of Gala Water, between the village and the inn. The other is a pump-well, which I sunk a few years ago, immediately contiguous to the manse. Having been disappointed in springs, which I expected near the surface, I bored to the depth of 35 feet, and thus got an abundant supply. It would seem that neither *this*, nor the hill-side spring, are supplied by superficial springs. With respect to their temperature, it may be stated at 45°.5. I have tried the pump-well and the spring in all states of external temperature, from 31° to 77°, and have found both to coincide. The lowest indication I ever had being 44°, and the highest 46°, which would form a mean of 45°; but these extremes I consider to have been occasioned by the sensitiveness of the thermometer to the extremes of heat and cold in passing from the water to the external air.

There occurred just one exception to the extremes above noted, in 1822, when the temperature of the pump rose to 47°.5. The suspended thermometer was then only 60°, but it may not be unimportant to remark, that, during the day, there was thunder; this was on the 18th *July* 1822, when the temperature of *the first well was* 56°.5. On the 4th June 1822, when the suspended thermometer in shade was 77.5, the pump was 46°.

Would not this remarkable fact, as compared with what is

* From the Reverend Mr Cormack's *Meteorological Journal*, kept at the Manse of Stow, Midlothian, and communicated to the Royal Society of Edinburgh.

stated above, indicate that the temperature of springs is affected by the electric fluid.

On the evening of the same 4th June, the hill-side spring was 47°, but the aspect is westerly, and the sun had been, for some hours, beating on the bank whence it issues.

Note.—Stow is about 20 miles south from Edinburgh, and is 500 feet above the level of the sea.

ART. XXXII.—*Observations on the Volcanic Formations on the Left Bank of the Rhine.* By G. POULETT SCROPE, Esq. Communicated by the Author.

THE volcanic products which occur in the Prussian provinces on the left bank of the Rhine, are scattered over a district of no great extent, which may be described as bounded on the south and east by the Moselle and Rhine, on the north and west by a line passing from Bonn through Gemund, Prüm, and Bitburg, to Bemcastel on the Moselle.

With the exception of the volcanic rocks, the surface of this district is chiefly composed of transition slate, a part of the great Rhine schist formation. In a few places this is partially covered by some of the floetz strata, both sandstones and limestones, to which I can scarcely venture to give a name. The volcanic eruptions have forced their way with apparent indifference, both on the points where the slate is covered by these strata, and where it is exposed. The volcanic energy has not confined itself to this district; analogous formations (though appearing in general to belong to an earlier epoch,) occurring, as is well known, eastward of the Rhine, in the Siebengebirge, the high Westerwald, the Vogelsgebirge, the Rhongebirge, the Meisner, and the Habichtswald, which form altogether a remarkable volcanized band, stretching from west to east in a line parallel to the primitive axis of the Alps, and removed about four degrees to the northward of it. The volcanic country which I have at present to describe has been generally separated by writers into two districts, from the volcanic products being more thickly grouped together at its western and eastern extremities. These divisions are, 1. The group of Andernach, Mayen, and the Upper Eiffel. 2. That of the Lower Eiffel. As I visited them during two different excursions, the first from Andernach, and the second from Spa, I may as well retain this division in their description.

1. *District of Andernach, Mayen, and the Upper Eiffel.*

Upon reaching the summit of the steep and richly cultivated slope which, near Andernach, forms the left bank of the Rhine, you suddenly find yourself in a rude and barren country, presenting a strong contrast to the soft and luxuriant scenery you have left behind, and consisting of an elevated mountain plateau of greywacke slate, across which the deep valley of the Rhine appears but as a narrow trough-shaped channel which the eye overlooks entirely, the plateau being continued at the same level immediately on the eastern side of that river. On the westward the general level rises gradually to the rugged heights of the Upper Eiffel, and it is also partially broken by the narrow and sinuous gorges through which a few tributary streamlets find their way into the Rhine, and still more so by a number of isolated hills of volcanic formation, mostly of a sub-conical form, with which the surface of the plateau is irregularly studded. Some of these hills are very complete volcanic cones, with or without a central funnel or crater, as the Hirschenberg, near Burg-bruhl, the Bousenberg between that village and Olburg, the Poter, Pellenberg, and lastly, the Camillen-berg, perhaps the highest and largest of these hills, which appears to rise above 1000 feet above the level of the surrounding slate plateau. Others are less regular, seeming to owe their want of symmetry to their being thrown up on an uneven surface, as the steep side of a valley, &c. Others form elongated ridges, composed of the mingled products of three or four neighbouring volcanic orifices. Such are the hills above Nieder-nich.

Many have regularly funnel-shaped craters; others are breached on one side by the subsequent emission of a lava stream, and some are still more irregular, and appear to have suffered more or less destruction from the mechanical action of some denudating force since their production. All these cones of every kind are composed wholly of loose conglomerate, or lapillo, containing numerous pumice stones, fragments of a phonolitic lava of clay slate, partly calcined, &c.

Thin beds of these fragmentary matters also occasionally cover the flat parts of the slate plateau in the vicinity of the cones, or occupy a few bosoming hollows in the slopes of its valleys.

Many of these vallies are also filled to a considerable height, often to more than half their total depth, with indurated tufa, called in the dialect of the country *Dukstein* or Trass, of which an immense quantity is quarried on numerous points, and carried down the Rhine into Holland, where it is in great request for buildings. The lower part of the mass is universally the most solid and compact, and hence is preferred by the quarrymen. It passes gradually into loose arenaceous tufa towards the upper part of the deposit. This tufa resembles extremely that of Naples (particularly of Capo di Monte and Posilipo). When freshly quarried, it is thoroughly saturated with water, which is driven out by every blow of a hammer upon it. In this state it is of a dull bluish black colour, but, on drying, it assumes a shade of light grey. It appears to be almost wholly composed of fragmentary pumice, and is evidently a conglomerate. It contains also fragments of a slaty or phonolitic, and of amorphous basalt, of burnt clay-slate, and a great quantity of carbonized wood, not in fragments or beds, but consisting of whole trunks or branches, which penetrate the rock in all directions. The condition of this wood is very nearly that of common charcoal, but it pulverizes more readily, and often of its own accord, on exposure. In the valley of Burg-bruhl the trass rests sometimes immediately on the clay-slate, but, on other points, a bed of calc-tuff intervenes, the deposit of some mineral spring prior to the deposition of the tufa. A similar incrustation occasionally overlies the trass, and has enveloped fragments of pumice, forming a species of calcareous tufa. The indurated tufa is sometimes divided into massive beds by intervening layers of loose pumice or lapillo, and fragmentary clay-slate.

On ascending the valley of the Bruhl, I found this trass deposit occupying it to a great depth the whole way from its embouchure in the valley of the Rhine, up to the foot of the Feitsberg, one of the hills which form the circumference of the lake of Laach; from whence this, as well as many other streams, (if they may be called so) of tufa, are derived.

The basin of the lake of Laach is nearly circular and crateriform, encircled by a ridge of gently sloping hills of no great elevation. They are composed of irregular beds of loose tufa, containing numerous fragments, and some very large blocks of a variety of lava-rocks. Those which are most abundant are of a basalt with very large and regular crystals of black augite, and of olivine. Fragments also occur of trachyte, sometimes of a whitish yellow colour and conchoidal fracture; at others, of a coarse grain, consisting solely of crystals of glassy felspar and hornblende. Some fragments are also found similar to those which are common in the conglomerates of Somma, composed of an agglomeration of crystals of mica, nepheline, meionite, Vesuvian, and other rare minerals. No lava-rock appears in place within the interior of the basin, and on its exterior, the only rock of this nature which shows itself on the surface in the form of a regular current of lava, is that in which the millstone quarries of Nieder-mennig are worked. This stream certainly flowed from the crater of Laach, the ridge of which suffers a depression on that side. The eruption which produced it was probably the last, not only of this particular vent, but perhaps of the whole district, as its surface has an air of great freshness, and is not yet entirely clothed with vegetation.* The rock of which it consists is basaltic, with very few visible crystals of augite, and extremely cellular, the cavities being very small and irregular. It is divided into rude columns at the lower part of the current, which is much more compact than the upper, but still cellular. It is here so hard as to be in great request for millstones, which are exported to Holland in great numbers, and from thence find their way to England. It envelopes numerous fragments of quartz (always more or less vitrified and cracked,) of granite, and other problematical rocks like those de-

* This may have been the eruption recorded by Tacitus (xiii. lib. *Annal.*) as having ravaged the country of the Jutiones, near Cologne, in the reign of Nero.

scribed above, as occurring in the conglomerate, crystals of lazulite, &c.

The volcano of Laach appears, like so many in other countries, to have produced at first trachytic, and afterwards basaltic lavas. The trass and the pumice conglomerates, which chiefly compose its surrounding eminences, belong decidedly to the former class of products; and, though trachyte, as a rock, does not, I believe, show itself *in situ*, it probably exists, concealed by the fragmentary strata of the hills, or the thick woods which cover their slopes, and render it difficult to examine their composition. The origin of the trass has been variously accounted for, and sometimes ascribed to deluges and other similar hypothetical events. It appears to me to derive simply from an ordinary modification of the volcanic phenomena. The pulverulent matter, of which it was principally composed, mixes into a retentive paste or clay with water, so indeed, as to be used for making pottery, where it is found in a loose state. In this state it was ejected by the volcano, and thrown up as usual into a circular or elliptical ridge around the orifice. The rain, which falls generally in great abundance after the termination of an eruption, mixed with these trachytic ashes, must often have formed an impermeable crust at the bottom, and upon the sides of this cavity. Hence the water that drains down these slopes would accumulate into a lake continually increasing in depth, until either the pressure of its waters breaks down the banks on some one side, or a fresh eruption from below displaces it. In either case, a breach being made in the circumference of the crater, the contents of the lake must rush out in a violent *debacle*, carrying off great quantities of the fragmentary matter of the hills through which the water bursts, and filling with these alluvial deposits the vallies by which it escapes on the plains at the foot of the volcano.

This process may be many times repeated from the same volcanic orifice, and, I think, is without doubt the real history of the tufas of the left bank of the Rhine, as well as of those of the Mont-Dor, Cantal, and of some parts of Italy. Whether the mass hardened afterwards, or remained incoherent, appears to have depended chiefly on the quality of the ashes, and their intimate commixture with the water. This induration is evidently a chemical process, analogous to the *setting* of cements and mortars. The mud eruptions (*tepetate*) of Quito, and the tufas of Iceland, are produced by the same train of circumstances in the present day. As the filling up of the crater must usually be a slow process, a sufficient interval will often occur before the lake bursts through its sides, either by its own weight, or the occurrence of an eruption, for the slopes to be covered by vegetation, and even by whole forests of trees, which, when the banks give way, will be hurried along, and buried within the torrent of mud, (or liquid tufa,) where they are afterwards carbonized, probably by long exposure to the moisture which penetrates the whole rock.*

With regard to the trass of Laach and its vicinity, this explanation is peculiarly applicable; and the lake would, even at this day, be subject to rise until it burst its bank, but for an artificial channel, or emissary, cut for its drainage by the monks of the abbey of Laach, a picturesque ruin which stands on its western side. Currents of tufa appear to have been discharged in this manner from many points of the circumference of the lake. Those that issued on the eastern side occupied the vallies of the Brohl, and other streams which empty themselves into the Rhine; the remainder inundated the slate plateau in the direction of Niedermennig, Bell, Olburgh, and Kruft, and covered it more or less with beds of compact tufa, which alternate with others of similar composition, but loose and incoherent, probably deriving from the fragmentary ejections of the neighbouring vents.

A cavern within the basin of the lake of Laach gives out a considerable volume of carbonic acid gas, presenting all the phenomena of the Grotta del Cane. There are also many mineral springs in the vicinity, as at Tonigstein, and near the

* Since we hear that numerous trees are found *in a carbonized state*, amongst the substances blown into the air by some of the paroxysmal explosions of the Javanese and Polynesian volcanos, it remains doubtful whether this character is always owing, as in this case, to torrefaction by volcanic heat, or occasionally to long maceration in water. Are these trees only charred on their surfaces, or *throughout*, like the surturbrand?

Brohl, strongly impregnated with the same gas, which is usually the latest product of an otherwise extinct volcano.

At some distance from Laach, towards the south-west, and between the villages of Bell and Mayen, rises another group of cones, containing two or three irregular crateriform basins, from which different mud streams appear to have flowed, covering the slate plateau in their neighbourhood with their deposits. These volcanic vents differ, however, from that of Laach, in having produced leucitic lavas, and, consequently, their conglomerates are of a different character, resembling exactly the peperino of Monte Albano. Such is the rock quarried near Bell, and called *bak-ofen-stein.* It is in request for lining ovens, from its capacity of resistance to fire, which it owes to its being almost wholly composed of leucite in a fragmentary state. It encloses many small white farinaceous leucites, fragments and blocks of leucitic lava, of burnt clay-slate, and large broken plates of mica.

The leucitic phonolite spoken of by Keferstein, as existing in massive beds near Reiden and Meyr, I presume to derive from this system of vents.

Further to the south, and near the village of Kruft, rise three other smaller cones, covered with vegetation, and with faint traces only of craters. Other cones, and some of a large size, are visible to the westward of Olburg, but my time did not permit me to examine them in detail. On the whole, the volcanic products of Andernach, and the Upper Eiffel, seemed to me to bear the greatest analogy to those of Italy, particularly of the Campagna di Roma. The points on which they differ, are the result of the former volcanos having broke forth on a high and dry slate plateau, the latter from a submarine alluvial shore. In both these districts, as well as in the Campi Phlegræi, it is remarkable that the same, or at least very neighbouring vents, have produced *trachytic*, *leucitic*, and *basaltic* lavas.

2. *District of the Lower Eiffel.*

The groupe of volcanic vents which occupies this district, is in immediate contact with that of Laach and the Upper Eiffel, though the points on which eruptions have taken place are rather more thickly sown towards the western limit, particularly along the course of the river Kyll, than at its eastern extremity. The epoch of their activity appears also to be equally recent, dating at least since the formation of all the vallies of the country, into which their lava-streams have invariably flowed, usurping the beds of the rivulets, which but in very few instances seem to have had force or time enough to execute a new channel to any depth below the level of their former one. Indeed, such is the freshness of aspect which many of the volcanic rocks of this district exhibit, that it requires the silence of all historical records on the subject, to persuade us they have not been produced within the last 2000 years. Nor is such evidence, indeed, at all conclusive. It is probable that accounts of phenomena of this kind would rarely reach the meridian of Rome from distant and barbarous districts, unless when they were of a most destructive and terrific character, such, perhaps, as that spoken of by Tacitus, and mentioned in a former page; and if any such occurred during the middle ages, all traditionary account of them may well be supposed to have perished with so much of other and more valuable information.

The volcanic eruptions of the Lower Eiffel have burst through the exposed surface of the transition slate formation on many points, and on others through masses of flœtz strata, which overlie the slate, throughout a considerable part of this district; these later formations are red sandstone, shell limestone, and quader-sandstone. Some of the vents have emitted currents of augitic lava (basalt;) others have confined themselves to the discharge of fragmentary matters. The latter principally, and in some instances almost entirely, consist of broken greywacke, slate, and sandstone, more or less affected by heat, and pulverized. It is probably owing to the clayey nature of these fragments, when reduced to great fineness, that the craters of this country have nearly, without exception, become reservoirs of water, or *Maare*, as they are called by the natives. Most of them still have small lakes or peat-marshes at their bottom. Some have been drained for the sake of cultivation; a few appear to have undergone the same process by natural means, either from the lake rising till its weight burst through the banks encircling the crater, or from the slow erosion of the stream by which it discharged itself. In the last case, the sides of the basin are cut through by this natural emissary, as is seen in the Meerfelder and the Drieser maare, as well as in those near Strohn and Walsdorf. In the other case, the regularity of the basin has been more or less destroyed by the bursting of its banks, and considerable deposits of trass, or rather of peperino, have been formed, evidently aggregated by means of water. Examples of this are met with in the remains of craters near Steffler, Schalkenmeyrener, and Rockeskill. On those points where lava has been emitted in a liquid form, a regular crater is rarely to be seen; at least at the source of the lava-current. There exists, however, always one or more such craters in the vicinity of this source, which appear to have produced violent aeriform explosions, and ejected scoriæ and ashes, while the lava was flowing from the neighbouring orifice. The force and rapidity of these explosive discharges of confined vapours, is attested by the great size of the cavities they have hollowed out of the solid greywacke strata. That of Meerfeld, for instance, one of the largest, measures above 500 feet from the surface of the lake, (which is itself 150 feet in depth,) to the average height of the ridge which encircles it, and its diameter can fall very little short of a mile. The quantity of fragmentary ejections heaped round these basins is not at all proportionate to their extent. The greater part consists of slate and sandstone, in pieces of every size, and appearing half-burnt, probably from having fallen repeatedly upon the surface of lava within the vent whence the explosions of vapour were discharged.

The accompanying sketch of a map of part of this district (see Plate IV.) will convey an idea of the relative disposition, and peculiar characters of these sites of volcanic activity. The most westerly point on which any traces of volcanic eruption are met with, is Ormont, where, upon the wild and elevated transition plateau of alternating slate and quartz-rock, two small cones are seen to rest. They are in contact at their bases, and have neither craters nor visible lava-currents. The scoriæ and fragments of which they are composed are basaltic, with much augite and large plates of brown mica. Isolated crystals and pieces of augite also occur, some nearly as large as the fist.

At no great distance to the east of Ormont, the transition rocks are concealed by strata of red sandstone, inclined at a high angle, with an easterly dip. At the village of Steffler, these are in turn covered by other sandstone strata, which appear to belong to the quader-sandstone : resting upon these, to the S. of the village, rises a volcanic cone, composed of scoriæ and puzzolana, partly incoherent, partly compacted into a peperino. Steffler is built on strata of this latter kind, which, however, by their inclination, are proved to have been deposited by an eluvial torrent descending from another hill N. E. of the village, which still exhibits a large circular crater on its summit.

To the S. E. of Steffler, lies a small *maar*, or crater-lake, which has been once drained, and since filled again by a dam thrown across the channel of discharge, on which a mill is situated.

The village of Roth is built on a current of basalt deriving from the cone which rises above it, and which has also emitted a considerable mass of lava towards the north and west. A small cavern, the mouth of a deep fissure in one of these lava-currents, half-way up the side of the cone, is noted for exhibiting a phenomenon, which I have met with elsewhere, in many instances, amongst volcanic formations. The floor of this grotto was paved with a thick crust of ice, when I visited it at noon on a very hot day at the latter end of August. During the summer, the peasants of the neighbourhood say it is always found there, while in the winter there is none; but, on the contrary, that the shepherds creep into the cavern for warmth. The following appears to me the most plausible mode of accounting for this curious fact: The cave is probably the mouth of one of those arched galleries which are so frequently met with under currents of lava in Iceland, Bourbon, and elsewhere. If the other extremity of the gallery communicates with the open air at a much lower level, for instance at the foot of the cone, or where the lava stream terminates in the plain below, a current of air must be continually driven through this passage from the lower to the upper extremity. In its passage, it would be thoroughly *dried* from the absorbent nature of the rock, (which is perhaps partly owing to the sulphuric or muriatic acids it contains,) and the evaporating effect of this current on the wet floor of the grotto from which it issues, which is moistened by some superficial rill, will be sufficient to coat it with ice in summer, since the more rarified by heat the external air, the more rapid will be the current of cool dry air, and, consequently, the evaporation. In winter, a similar draught of air, though less rapid, will be produced; and taking the temperature of the rocks through which it passes, which, from the depth of the gallery, will be about the mean annual temperature of that climate, must appear warm compared with the external air, to the shepherds who seek a shelter at the mouth of the fissure.

The cone of Roth connects itself with a smaller ridgy hill prolonged towards the Kyll, which has given rise to three or four small distinct streams of basaltic lava.

On approaching the Kyll towards Gerolstein, the traveller is struck by the appearance of an elevated plateau formed of Jura limestone in horizontal strata, resting on the quader-sandstone, and bounded by a range of picturesque and craggy cliffs, with a talus of massive debris at their base. From the surface of the plateau rise four large volcanic cones, besides small eminences of a similar nature. One has given rise to a current of basalt, which descends the steep cliffs of limestone in a sort of cascade, on the western side, occupies a small bottom, and, winding round the base of the range of rocks, reaches the channel of the Kyll at Sarsdorf. *

The two largest cones of this plateau, lie N. W. of Casselburg, a romantic ruin of great picturesque beauty about two miles N. of Gerolstein.

Round Rockeskill, there are traces of another aqueous formation of peperino similar to that of Steffler, and appearing to have originated in the hill immediately behind that village. Further north, the Waldsdorfer Kopf is a very regular cone, and at its foot lies a crater-basin, once a lake, but now reduced to a peat-moss. The cone has emitted one of the largest currents of lava of this district. It has flowed towards the west, and reaches nearly to Hillesheim.

Arnsberg is a large and complete cone, which has also pro-

* A sketch of this interesting fact is giving at the bottom of Plate IV.

duced much lava. Eastward of Waldsdorf lies the Drieser Maar, a wide crater, which has been artificially drained. Masses of olivin, often of three or four pounds weight, and as large as a man's head, are found in the fragmentary strata which form the sides of this basin. Part of this encircling ridge rises into a high cone on the south-west, and this is again connected with a third hill above Dockweiler, which exhibits a well-characterized crater at its summit, and has sent forth powerful streams of basaltic lava. The road from hence to Daun, leaves on the right three or four considerable cones near Nerod and Steinborn. They consist in a great part of lava which has burst from their summits or flanks, and flooded the lowest levels of the surrounding plain.

On the east of Daun, a massive and elevated bed of basalt, bordered by abrupt cliff-sections, in which a rudely columnar configuration is visible, descends towards the town from a higher eminence at its eastern extremity, which is composed of scoriæ, and exhibits vestiges of a crater. This bears the appearance of being the least recent of all the volcanic formations of the neighbourhood.

South of Daun rises a group of hills which appear, as they are mounted, to be solely composed of greywacke slate, and in which, consequently, no volcanic appearance could be anticipated, when, on reaching the summit, the traveller suddenly finds himself on the edge of a deep circular lake-basin, evidently drilled through the greywacke by repeated and powerful discharges of subterranean vapour. There are three of these maar strung together on a line, in a N. S. direction, and in immediate contact, the same ridge forming the barrier of two neighbouring craters. The fragments of which the surrounding slopes are formed, consist chiefly of slate partially calcined, the remainder of augitic scoriæ. A large rock of greywacke slate, evidently *in situ*, projects from the bottom of one of these basins. The water in the three lakes appears to stand at the same level, and they probably communicate by means of some fissures in the intervening rocks. One only, the Schalkenonchrener maar, has any visible outlet, and there are traces of trass-streams in that direction.

A few miles farther to the south, the Polvermaar of Gillenfeld, is met with ; a magnificent oval basin, presenting exactly the same general characters as those just described, but remarkable for its large dimensions and extreme regularity. The ridge of fragmentary matters, which girds it in, is without a break, and nearly every where preserves a uniform level at about 150 feet above the water surface. The depth of the lake is above 300 feet; the sides slope in the interior at an angle of about 45°, on the exterior of 35°. Immediately at the foot of the cone of the Polvermaar, on the south side, rises a hill containing a much smaller crater, with a peat-bog at its bottom.

Still farther south, between the villages of Strohn and Trittschied, is a double cone of large dimensions. It has two considerable craters, both broken down towards the N. W. The southernmost is large and circular, and bottomed by a morass. The other has produced a current of basaltic lava, which, after forming some considerable hummocks in a N. W. direction, turns its course along the bed of the neighbouring rivulet to the S. W., and occupies its channel to a distance of two miles or more, crossing the great Coblentz road.

But unquestionably the group of volcanic vents, which presents the greatest interest of all in the Eiffel district, is the Moseberg near Bettenfeld, with the neighbouring Meerfelder Maar. The Moseberg is one of the highest hills of the whole country. Its base up to a considerable elevation above the level of the plain around, consists of greywacke slate and red sandstone. Its summit is formed by a triple volcanic cone, the accumulated ejections of three small craters, which remain very distinct. The two most northerly ones are entire, and reduced to the state of peat-marshes. The third has been broken down on its south-east side by a current of lava, of very recent aspect, which, issuing from the breach, descends the slope of the mountain in a stony flood, until it reaches the bed of a small river below.

The lava and scoriæ of these cones, have enveloped a great quantity of half-fused fragments of sandstone and slate. The circular crater, called the Meerfelder Maar, is remarkable for its vast size and depth. It has been hollowed out of both the transition-slate and red sandstone, forming the north base of Moseberg; and the steep walls which encircle it, exhibit, on many points, the abrupt sections of these rocks, which are only partially covered by a sprinkling of ashes, puzzolana, pulverized slate, and other fragmentary matter. The bottom of this cavity is occupied by water to about a third of its superficial extent; the remainder is a plain, on which the village of Meerfeld is seated.

The most southerly point of this district, on which volcanic products have been met with, is the vicinity of the baths of Bertrich, a village seated at the bottom of the deep and narrow mountain gorge of the river Isbach, which flows at the distance of a few miles into the Moselle.

Here a lava, which has congealed into an exceedingly hard, tough, and compact basalt, full of crystals of olivin and augite, appears to have been emitted from clefts in the greywacke, on three or four neighbouring points, upon the very brink of the steep slope, or rather precipice, which forms the northern flank of the valley. Very few aeriform explosions seem to have taken place, since scarcely any scoriæ were ejected, and the few that occur lie in beds *upon* the surface of the lava, around its three principal sources, and were therefore thrown up *after* its emission. At each of these points is a very small cone. The most easterly, called the Fackerkohl, has an evident crater encircled by rocks of basalt covered by scoriæ. From hence a stream of basalt may be traced uninterruptedly into the bottom of the valley, (which is here about 600 feet in depth,) falling in a sort of indurated cascade over the almost perpendicular cliffs of transition slate.

The next cone, called Falkenlay, consists of a mass of basalt covered by a deep bed of scoriæ, and also gives rise to a copious current of basalt, which descends into, and has usurped the channel of the Isbach to some distance, both up and down the stream. The third point of eruption presents two very low and small cones, formed entirely of scoriform basalt, and appears to have produced a current of no great magnitude, which may be traced at least part of the way down the nearest ravine into the main valley below.

The exceeding crispness of the scoriæ of this locality, particularly of the Falkenlay, is remarkable. Fragments of greywacke, greywacke slate, and quartz, partly fused, and graduating on these parts into the basalt, are inclosed in great abundance by this scoriform lava rock.

At the bottom of the valley it becomes evident that the mountain torrent called the Isbach has cut through and carried off the greater part of the basalt streams which once filled its channel to a considerable height, throughout an extent of more than a mile above, and rather less than this below the village of Bertrich. Patches only of basalt are left now on either side of the present bed of the river, and most usually in the concave elbows of the valley, but of these some present cliffs fifty feet in height. The lower part of these masses of basalt is regularly columnar, the columns being divided by frequent joints, from two feet to six inches apart. Where they have been long exposed to erosion from the torrent, the angles of these short prisms yielding sooner than the nucleus, the columns appear formed of rude and flattened spheroids piled upon one another. This is, in short, an example of the columnar divisionary structure passing into the globular, by the increase of the number of joints. An arched passage, which goes by the borrowed name of Fingal's Cave, nearly a mile above Bertrich, exhibits this structure in the most perfect manner. It has evidently once formed the channel of the little torrent which now runs on one side of it, and which has thus partly worn away the columns, till they are reduced to mere piles of balls.

The eruptions of these three or four contiguous vents were probably simultaneous, or very nearly so. The lava streams produced by them can be, with difficulty, distinguished from each other, all uniting in the valley below, and the basalt of all is identical in mineral character. It seems probable that the thermal springs of Bertrich-bad owe their warmth to having percolated through some mass of lava not yet quite cooled in the interior of the schist rocks, occupying perhaps the prolongation of the fissures through which the lava streams were expelled. It may be presumed, indeed, that the temperature of these springs is diminishing in consequence of the gradual cooling of this mass. It is at present below blood heat, but appears, by its ancient celebrity, to have been formerly much higher. Since the year 1773 it has not, I believe, been analyzed. If the taste is to be trusted to, it has now few or no mineral ingredients. The savour is, as nearly as possible, that of pure fountain water.

I cannot quit this spot without mentioning that the beauty of the scenery on the banks of the Moselle, south of Bertrich, and indeed along its whole course through the transition slate formation between Treves and Coblentz, is scarcely to be paralleled by the far more known and vaunted beauties of the Rhine, even on its most picturesque parts. The want of a post-road along its banks, and the numerous windings of its course, which renders its navigation tedious, has alone prevented the charms of the Moselle from sharing the celebrity of its more travelled neighbour. In a geological view this river is not devoid of interest. Its valley is worn across the whole transition slate district in a direction transverse to that of the stratification. The sinuosities which have been occasioned by this circumstance are so extreme, that in some instances, as near Zell, the river returns to within a few hundred yards of a point it left sixteen miles behind, according to the course of its current. Such windings are not uncommon among rivers meandering slowly through flat alluvial plains; but in a rocky mountain district, where the banks rise steeply to a height of 12 or 1500 feet above the river, they are more remarkable. In either case they are wholly incompatible with the notion of a rapid and powerful excavating force, such as a debacle or deluge, and can only be referred to the slow and gradual erosion of the river itself, which is yet continuing to deepen its bed, and to hollow out still further the concave elbows of its valley, by the double action of its *vertical* and *lateral* abrasive force. If the valley of the Moselle is thus incontestably shown to have been excavated by the slow agency of causes similar to those still in operation, why should we look for another and hypothetical agent to account for that of the neighbouring Rhine, the dimensions of which are greater only in proportion to the greater mass of its waters, and the different solidity of the rocks through which it has worn its channel. I need not carry on the argument from the Rhine to other rivers. All this is in fact a digression, and out of place, for which I am bound duly to apologize.

Having now given a brief sketch of the principal volcanic products of the Eiffel, I need not prolong this paper, already, I fear, swelled beyond its proper limits. There occur a few other vents in the vicinity of Ulmen, Kellberg, Adenau, and Boos, which form the connecting links between this district and that of Andernach. Some of these I did not visit, but from those which I saw, as well as from Steinenger's account of the others, they appear to be mere repetitions of the least interesting of the cones and maare already mentioned.

Upon the whole, though the vestiges of volcanic phenomena to be observed in the Prussian provinces on this side of the Rhine, offer, without doubt, a highly interesting field of study to the geologist, yet they cannot be recommended as types of volcanic formations to those who, without visiting other more distant vents of subterranean energy, either active or extinct, might seek, in the short tour between Spa and Coblentz, to acquire a general knowledge of the effects of this class of natural agents. In this view, as in every other, they are far less instructive than the analogous formations of Auvergne, the Velay, and Vivarais, where almost every possible modification of the volcanic phenomena is to be clearly traced, and on a much larger scale. In the Rhine districts, there is a comparative littleness, and an appearance as if the volcanic energy had been damped and impeded by the mass of transition and secondary strata which it had to pierce, and still more so perhaps by the fragile nature of the greywacke slate, which, shattered and pulverized by the first few aeriform explosions of every eruption, would accumulate in prodigious volumes above and within the vent, and speedily stifle its further activity. The same circumstance will account both for the general paucity of lava produced by these volcanos, and for the numerous deep and wide craters, the formation of which, by the rapid and explosive discharge of subterranean vapour, will, it is evident, have been facilitated in proportion to the fragility and incoherence of the superficial rock.

Art. XXXIII.—*Analysis of Two Varieties of Lepidolite.* By Edward Turner, M.D.F.R.S.E. Lecturer on Chemistry, and Fellow of the Royal College of Physicians, Edinburgh. Communicated by the Author.

While engaged a few months ago in analyzing several species of lithion-mica, my attention was attracted by a pretty rose-coloured mineral, said to be a mica from the Uralian mountains, in the possession of my friend Dr Anderson of Leith, which gave distinct indications of the presence of lithia. It occurs in groups of crystals like the Zinnwald mica, and its laminæ are about the same size, some of them being half an inch in diameter. Its specific gravity, after the air had been expelled from it by boiling water, was 2.855. It fuses readily before the blowpipe, tinging the flame of a red colour, and forms an opaque and beautiful white pearl on cooling. It suffers no appreciable loss in weight when heated to redness.

To show that this mineral is rather a lepidolite than a mica, I have compared its composition with that of a very pure variety of the common Swedish lepidolite. The specimen employed for the purpose has the same character before the blowpipe as the preceding, and its specific gravity, after being boiled for a short time in water, was 2.8469. It loses only 1-1000th of its weight by being heated to redness.

These analyses, in which I was assisted by Mr Gregory, were performed by the method which was minutely described in a former paper,* and, therefore, it will be superfluous to give more than the results of them at present.

Results of Analysis.

	Uralian Lepidolite.	Common Lepidolite.
Silica	50.35	50.91
Alumina	28.30	28.17
Oxide of Manganese	1.23	1.08
Fluoric acid	5.20	4.11
Potash	9.04	9.50
Lithia	5.49	5.67
	99.61	99.44

A trace of lime was also detected in the first variety.

* See this *Journal*, vol. iii. p. 261.

ART. XXXIV.—*On Kakoxene, a new Mineral Species.* By J. STEINMANN, Professor of Chemistry in the University of Prague.* Communicated from the Author.

IN the iron mine of Hrbeck, belonging to the territory of Zbirow in Bohemia, a kind of clayey brown iron-ore is found, containing a foreign substance deposited in narrow fissures traversing it, which has hitherto escaped the notice of mineralogists. It might be readily taken for Karpholite, which occurs in the same kind of stellular disposition in fissures traversing sandstone, but for its deeper tinge, which is an ochre-yellow, often passing into a bright lemon-yellow. Sometimes small filamentous crystals are grouped together in tufts; sometimes also the mineral is in the shape of a nearly-yellowish powder, and then it much resembles the common ochrey-brown iron ore.

The specimens hitherto found have been so few, and the substance itself so sparingly distributed through them, that an exact statement of all its mineralogical characters yet remains a desideratum. For the same reason, I cannot warrant the exactness of the proportions among the ingredients, as stated below. Some precursory experiments showed the existence in the mineral of a considerable quantity of water, containing a little acid, which turned out to be fluoric acid. From 100 parts of the mineral, I obtained,

Silica,	8.90
Phosphoric acid,	17.86
Alumina,	10.01
Oxide of Iron,	36.32
Lime,	0.15
Loss by ignition, being water and fluoric acid,	25.09
Total,	99.19

The quantity of phosphoric acid is greater than would be required for combining with the alumina in the same proportion as in wavellite, part of it is therefore evidently united to the oxide of iron. Also the silica appears to be an essential ingre-

* Abstract of a Paper read before the Bohemian Philosophical Society, May 14, 1825.

dient of the mineral, which, therefore, is a combination of phosphates, fluates, and silicates, the proportion of which, however, it would be premature now to determine.

Wavellite is the only native combination of phosphoric acid and alumina; it consists, according to Berzelius, of phosphoric acid 33.40, fluoric acid 2.06, alumina, 35.35, lime 0.50, oxide of iron 1.25, water 26.8. There are three combinations of phosphoric acid with iron; *a* the earthy blue iron analyzed by Klaproth, *b* the Vivianite by Vogel, and *c* the bog-iron ores analyzed by Klaproth, d'Aubuisson and Pfaff, containing

	a	*b*		*c*
Protoxide of iron,	47.5	41.0	Peroxide,	61—79
Phosphoric acid,	32.0	26.4		2.5— 8
Water, -	20.0	31.0		0.1—22

Sometimes silica or alumina are found in the last of these; but they appear not to be essential, and Professor Hausmann is therefore perfectly right in considering them as being combinations of hydrous oxide of iron with phosphate of iron, in variable proportions.

The crystalline appearance of kakoxene shows, on the contrary, that it is the result of the power of crystallization; and as it is similar in some respects to the appearance of wavellite, I am disposed to consider it as a combination of the same kind, in which only part of the alumina is replaced by oxide of iron. It is remarkable that the wavellite from Amberg, in the Upper Palatinate, described by Fuchs under the name of Lasionite, which likewise occurs in brown iron ore, nevertheless is perfectly white, and does not contain any iron, and is therefore, even in respect to chemical composition, perfectly different from kakoxene, although agreeing with it in the way it occurs.

The sandstones in which the Bohemian wavellite is found, belong to the same formation of greywacke which contains the beds of red and brown iron ore in the circles of Beraun and Pilsen. From the circumstance, that sometimes white short iron is produced from the ore of that formation, I suspected the presence of phosphoric acid in it, which, in fact, was found to be the case by Mr Zippe. The phosphoric acid is, however, not solely confined to the iron ores, but it is likewise distributed through the rest of the rocks belonging to the same formation. Both the kakoxene and the wavellite seem to have been produced by some secondary process of secretion within the mass of the rocks.

I have given the new mineral the name of kakoxene, from κακὸς bad, and ξένος a guest, in allusion to the bad influence of the phosphoric acid, and consequently also of the mineral in question, on the quality of the iron extracted from the ore with which it occurs.

Art. XXXV.—*Notice of some Fossil Remains of a Paleotherium, found in Bavaria.** By Hermann von Meyer, of Frankfort, on the Maine.

Among a number of organic remains from Friedrichsgemünd, in the neighbourhood of Roth in Bavaria, I possess two fragments of the lower jaw of that rare species of Paleotherium, which has been hitherto found only in a few fragments in the vicinity of Orleans; each of them including an intermediate molar tooth. The form of these teeth agrees exactly with Fig. 13 of Cuvier's *Recherches sur les ossemens fossiles*, Nouv. Ed. t. iii. pl. lxvii., which had been communicated to him by Bigot de Morogues of Orleans. Another fragment of a lower jaw, partly included in limestone, contains two intermediate molar teeth, similar to the preceding ones; and a fourth, the hindmost molar tooth, which is again similar to the right hand Fig. 14 of the same plate. I possess four upper molar teeth, three of them detached from the jaw. The 11th figure of Cuvier's shows the remarkable construction of these upper molar teeth.

The genus Paleotherium is intermediate between those of Rhinoceros and Tapir. About twelve species have been distinguished, which are chiefly found in the gypsum of Paris. The species, in most respects, deviating from the common type, is that found at Montabusard, near Orleans, in freshwater limestone, but it agrees, on the contrary, with that of Issel. All its peculiar characters are found in the teeth from

* Translated from Kastner's *Archiv fur die Naturlehre,* B. vii. St. 2.

Friedrichsgemünd, and leave not the slightest doubt that they really belong to the same species. In regard to size, this Paleotherium is intermediate between *P. crassum* and *P. medium*, but it has not received a specific denomination.

These remains have been discovered in a helicitic limestone, covered with loam. I have found this limestone to consist of carbonic acid, phosphoric acid, lime, iron, and a considerable quantity of manganese. Along with the Paleotherium are found also the remains of other animals. I possess a molar tooth of a hippopotamus, one of a rhinoceros, and two others, which I have not yet succeeded in determining. Bones of the hippopotamus and rhinoceros, sometimes of considerable size, vertebræ of an ichthyosaurus, and other saurians, and, among these, two flattened vertebræ of two inches diameter, belonging to an unknown animal, have been discovered, and sometimes occur also in the loam, which, besides, contains impressions of vegetables.

Art. XXXVI.—ZOOLOGICAL COLLECTIONS.

Observations on the Habits and general Structure of the Orang Outang, or Wild Man of the Woods. By John Jeffries, M. D.

Having, in our last Number, laid before our readers an account of the Gigantic Orang Outang of Sumatra, through the kindness of Dr Abel, we propose at present to direct their attention to a very interesting account of the Simia satyrus which was dissected by Dr Jeffries of Boston, and of which he has published a particular description in Webster and Treadwell's *Boston Journal of Natural Philosophy*, vol. ii. p. 570. We shall confine ourselves to the account which he has given of the habits and general structure of the animal:

This animal is a native of Batavia. He was carried from Borneo to Batavia, and came into the possession of Mr Forrestier of that place, where he remained for some time. By him he was next consigned to Mr Charles Thatcher, merchant in Boston, in the Octavia, Captain Blanchard. He died on the night of the 2d June, the first after his arrival, disappointing the expectations of his owners, of great pecuniary remuneration from his exhibition in public.

In his external appearance, he resembled an African, with the neck somewhat shorter, and the neck projecting more forward. He was three feet and a half in height. He was covered with hair, except his face, the palm of the hands and feet, which were all of the colour of the negro. The hair was of a dim colour, inclining to black. It resembled the hair of the human body more than that of brutes, in consisting all of one kind, and not, as in quadrupeds, of two forms of plicæ. On the hand the course of the hair was forward and upward; before the ears it was downward. There was very little on the anterior part of the head, leaving him an extensive forehead. On the arm its course was down; on the fore-arm up: It was longest on the back of the arms and thighs, measuring from six to seven inches. His ears were thin, small, and handsome, lying close upon the head.

His eyes were hazel-coloured, bright, and somewhat deep in the sockets. His brow was prominent, to defend the eyes from injury in the woods. He had very little hair on the brow. His nose was flat. His lips were very large and thick, more so than those of any negro I ever saw. His chin was broad, and projecting, as was likewise the upper jaw. His chest was round, full, and prominent. His shoulders were set well back. His scapulæ were flat and close behind. His waist was small. His hips were flat and narrow. His arms were very long, the fingers reaching to the ancles.

The account which I have received from Captain Blanchard illustrates his manners and habits.

He was put on board the Octavia under the care of this gentleman, and had a house fitted up for him, and was provided with poultry and rice sufficient for the voyage. Captain Blanchard first saw him at Mr Forrestier's house in Batavia.

While sitting at breakfast, he heard some one enter a door behind, and found a hand placed familiarly on his shoulder; on turning round, he was not a little surprised to find a hairy negro making such unceremonious acquaintance with him.

George, by which name he passed, seated himself at table by direction of Mr Forrestier, and, after partaking of coffee, &c. was dismissed. He kept his house on ship-board clean, and, at all times, in good order; he cleared it out daily of remnants of food, &c. and frequently washed it, being provided with water and a cloth for the purpose. He was very cleanly in his person and habits, washing his hands and face regularly, and in the same manner as a man. He was docile and obedient, fond of play and amusement; but would sometimes become so rough, although in good temper, as to require correction from Captain Blanchard, on which occasions, he would lie down, crying very much with the voice of a child, as if he had been sorry for having given offence. His food was rice paddy in general, but he would and did eat almost any thing provided for him.

The paddy he sometimes ate with molasses, and sometimes without. Tea, coffee, fruit, &c. he was fond of, and he was in the habit of coming to the table at dinner to partake of wine; this was in general claret.

His mode of sitting was on an elevated seat, and not on the floor. He was free from some of the peculiar propensities of monkeys. His bowels were in general regular. The directions given by Mr Forrestier were, in case of sickness, to give him castor oil. It was administered to him once on the beginning of the passage, and produced full vomiting and free catharsis, with effectual relief. He sickened a second time on the latter part of the voyage, and resisted the attempts of the captain and several strong men to get the oil into the stomach. He continued to fail gradually, losing his appetite, and strength, until he died, much emaciated, soon after the ship anchored.

Captain Blanchard used to feel his pulse at the radial artery, and describes it to be like the human. It was probably quicker. His mode of walking was always erect, unless when tired; he would then move or rest on all-fours.

Art. XXXVII.—HISTORY OF MECHANICAL INVENTIONS AND PROCESSES IN THE USEFUL ARTS.

1. *On a Method of Working an Air-Pump by continued Motion.* By William Ritchie, A. M. Rector of Tain Academy. Communicated by the Author.

The method of working an air-pump by reciprocating motion is extremely inconvenient, and apt to injure the instrument by the sudden jerks to which it is liable. The following method, by continued motion, is free from these objections. Let there be two small wheels A, B, Plate I. Fig. 12, having teeth completely round the semi-circumferences of one-half of the thickness, whilst the semi-circumference of the other half has none. The wheel A is turned by a handle in the usual way, and by the teeth, in its entire circumference, gives motion to the wheel B in the opposite direction. When the wheel A is turned, its teeth lay hold of those in the piston rod CD, and raise it to its proper height. At the moment the teeth in A lose their hold of the piston rod, those in B, moving in the opposite direction, seize those in the rod, and bring it down to its former position. The same will obviously hold true with regard to the piston rod EF. We have thus a reciprocating motion in the two pistons produced by the continued motion of the two wheels. The same contrivance may obviously be applied to the working of a mangle, and may, perhaps, answer better than the common method.

2. *Account of Mr Brunel's New Power obtained by Liquefied Carbonic Acid Gas.*

Among the extraordinary contrivances of the present day must be ranked the carbonic acid machine proposed by our celebrated engineer Mr Brunel, who has secured his invention by an English patent, and also by a French patent, in concert with MM. Ternaux and Delessert. Our readers are already acquainted with the beautiful experiments of Mr Faraday on the liquefication of several of the gases, among which was *carbonic acid gas.* These experiments led several persons to conceive the idea of applying the liquified gases as the first movers of machinery, and Mr Brunel has attempted to realize these views.

In the apparatus which he has contrived, the first mover is liquified carbonic acid gas at the temperature of 50°, and under the pressure of 30 atmospheres. This liquid gas is contained in two cylinders placed at the two extremities of the apparatus, and put in communication. In order to destroy the equilibrium, it is sufficient to vary the temperature of the liquid contained in one of the condensers. But the influence of the heat upon the liquid gas is such, that for an elevation of 180° we obtain a pressure of 90 atmospheres, an enormous power, which, having no resistance but that of the gas in the other condenser, tends to displace a piston with a force of 90 — 30 = 60 atmospheres.

Mr Brunel has already constructed a working model of this engine, and he is now occupied with a machine having the power of eight horses.

The enormous heat necessary in the high pressure engines of Mr Perkins are not requisite in the present machine. It is indeed the peculiar advantage of it, that it is not necessary to raise the temperature of the condenser above that of boiling water, in order to produce a pressure of 60 atmospheres. M. Thenard is of opinion that the great difficulty will consist in obtaining a pressure of 30 atmospheres to condense the gas. When this pressure is once obtained, nothing can be simpler than the play of the machine, in which there will not be lost a drop of the liquid carbonic acid. *

3. *Account of the Process of MM. Thenard and Darcet for Preserving Substances from Humidity.*

On the 27th February 1824, there was read at the Academy of Sciences of Paris, a *Memoir* by MM. Thenard and Darcet, on the employment of fatty bodies for making coverings and unalterable plasters, and for making moist places salubrious. This process, the effects of which have been established by several years experience, consists in causing a mixture of one part of oil and two parts of resin to penetrate, by means of an intense heat, either porous stones or plaster. The bodies penetrated with this mixture acquire afterwards a singular degree of solidity, and become absolutely impermeable to moisture.

This process may be employed for rendering low and damp places salubrious. It was tried at the Sorbonne, and the expence of it was only 16 sous per square metre, or a square whose side is 39 English inches. The other objects to which it is proposed to apply it are houses, statues placed in the open air, bas reliefs and sculptures in plaster, the ceilings and walls of rooms intended for Fresco paintings, basins for holding water, and reservoirs for holding grain.

M. Thenard exhibited to the Academy several objects of art executed in plaster by his process. In order to show its efficacy, he exposed to the open air for several years a bas relief, half of which was formed of ordinary plaster, whilst the other half was prepared. This last half was perfectly preserved, while the other displayed visible traces of disintegration. This process does not resemble those which consist in covering bodies with a sort of skin which keeps off humidity. The body is actually penetrated with the mixture to the depth sometimes of several inches.

* See an interesting notice of this invention in *Le Globe*, Tom. iii. No. 29, 28th Feb. 1826.

4. *Description of new Axle-Trees for remedying the extra friction on Curves for Waggons, Carts, Cars, and Carriages, and on Rail-roads, Tramways, and other Public Roads.* By Mr ROBERT STEPHENSON.

It has been long felt as a serious inconvenience and loss, that the curved parts of rail-roads are speedily worn down by the enormous friction of waggon wheels of the common form, and require to be replaced long before the straight portions are injured.

The object of Mr Stephenson's invention (which is secured by patent) is to remedy this evil; and he has succeeded so completely, that his wheels will roll round the sharpest curve without any additional friction from the sliding of the wheels. These wheels, each of which revolves upon an axle of its own, are shown in Fig. 5, Plate I. which is a horizontal view of the carriage of a railway waggon, where *b, b,* &c. are the wheels, and *a, a, a, a,* their axles. The end of the axle which is nearest the wheel turns in a long slot or recess seen below *d* in Fig. 6, while the other end *c* of the axle has affixed to it a ball or spherical knob, which turns in a socket in the opposite bearing. By this construction the wheels revolve independently of one another, and a difference in the paths which their rims describe will not cause them to rub or slide upon the rail. As rail-roads are never perfectly level, the long slot allows the axle and its wheel to fall, as at A, Fig. 6, the ball and socket joint at the reverse end giving it play. Mr Stephenson does not mean to confine himself to the ball and socket strictly, as several other modes of constructing a loose joint may answer the purpose; but he claims as his invention "the double axles, and the mode of giving them play, by the loose joint at one end of its bearing, and the slot at the other."—See Newton's *Journal of the Arts,* vol. xi. p. 169 and p. 200.

5. *Description of Union or Compound Rods in which Wood and Metal are combined so as to form Rails or Rods for Bedsteads, Cornices, &c.* By Mr SAMUEL PRATT, New Bond Street.

This invention promises to be of very great utility for producing strong but light rods for the slender parts of furniture. The rods, &c. are first to be made of wood to the desired shape, and the wood is then split or separated lengthwise into three pieces, and after some parts of the interior of the wood are removed, a bar of iron with three leaves is introduced, and the three pieces of wood united again by glue or otherwise, with the three-leaved bar inclosed. A section of these bars is shown at A, B, C, Plate I. Fig. 7, where A is a section of a rod ready to be operated upon. It is then divided and finished as at B, the iron rod having the form shown at C. The patentee proposes to coat the iron rods without wood, with cylinders of thin brass drawn over the outside of the rod, so as to give them the appearance of solid rods of metal, as shown at D.—See Newton's *Journal of the Arts,* vol. xi. p. 183.

Art. XXXVIII.—ANALYSIS OF SCIENTIFIC BOOKS AND MEMOIRS.

Observations on Mr Barlow's Theory of the Strength of Materials, and his Conclusions respecting the situation of the Centres of Tension and Compression in a Bent Body. By Eaton Hodgkinson, Esq. Communicated by the Author.

The common theories of the lateral strength of materials have, as is well known, been formed on the supposition that bodies are incompressible, and, consequently, the deflection of a bent beam is assumed to arise wholly from the extension of its fibres, the fulcrum being on the edge of the beam.

But theories derived from this supposition are much at variance with experience; and this circumstance has induced philosophers to seek for others. Coulomb assumed, that a body, when bent, was contracted on one side, and lengthened on the other; and, consequently, that there was some line, between both, where contraction ended, and extension began. With this supposition, and that of the equality of the forces (pressures) on each side of this line, which has since been denominated the "neutral line," Coulomb attempted to sketch out a theory of the strength of bodies, but which, though elegant, was so abstracted and concise, that it seems to have escaped the notice of writers, till Dr Robison, in his excellent *Essay on the Strength of Materials*, alluded to it, and, adopting the above suppositions of Coulomb, varied the mode of considering the subject a little, but made no attempt toward its practical application, and left it, not unmixed with errors, in other respects, nearly as he found it.

The next writer who, after a long lapse of time, seems to have paid attention to the embryo suggestions of Coulomb and Robison, is Mr Barlow. His object, however, was not to supply their defects, and furnish, from his experiments, the requisites for adapting them to practice, but in part unfortunately to reject them; proposing in their stead a new theory, differing from Coulomb's only in this,—that the sums of the forces on each side the neutral line, taken collectively, instead of being equal one to the other, are inversely as their distances from it. And this supposition, as will be shown hereafter, is the source of the errors mentioned above.

The paragraph in which they occur is as follows. "The mechanical operation of fracture may be considered under the form shown in" the annexed figure, Plate I. Fig. 9, "where n is the neutral axis, t the centre of tension, and c the centre of compression; w a weight equal to the tension of all the fibres in An, and w' a weight equal to all the resistances to compression in nC, which weights and distances, or levers nt, nc, must be such, that $w \times nt = w' \times nc$; for it is this equality which determines the position of the point n. "And the sum of these, when the weight W is just sufficient to produce the fracture, is equal to $\times$ W nN; that is, when the three forces are in equilibrio, we must have $w \times nt + w' \times nc = W \times n N = 2 w \times nt$.*

* See Mr Barlow's *Essay on the Strength and Stress of Timber*, Art. 120.

Now, assuming the above reasoning, respecting the forces on each side the neutral line, as true, we will examine the consequences; and since $w \times nt = w' \times nc$, and $w \times nt + w' \times nc = W \times nN$, n must, from the last equation, evidently act as a fulcrum or joint, on which the double lever Nnt, Nnc, would turn. Suppose, then, instead of the double lever, we had two levers Nnt and $N'nc$ unconnected, except at the firm joint n, on which they both turned, and at the ends N and N′ of their equal arms, we applied $\frac{1}{2}$ W; it is evident, since $w \times nt = w' \times nc$, that each lever would be in equilibrio with its load, and one have no tendency to deflection more than the other. If now we supposed the two arms cemented together, the two levers must evidently have the same effect upon the joint n as the compound lever Nnt, Nnc, with W suspended at N. And since W can only act in the direction of gravity, and consequently has no effect on the levers (of which the beam is assumed to be composed) in drawing them from, or pressing them toward the wall, we shall have in the lever Nnt, the pressure on n, (in the direction Nn) equal the tension in t, equal w; and, in the lever $N'nc$, the joint n will have to resist an effort in the opposite direction nN', equal to the pressure in c, equal w'. The imaginary joint n, which is in the neutral line, will then be affected by a force equal to the difference of the weights w and w', viz. of the forces of tension and compression, and have its fibres stretched or compressed by the force; which, when the above forces are unequal, is contrary to the definition of the neutral line. The assumption $w \times n = w' \times nc$, as a general equation, is therefore erroneous.

It will further appear, that the foregoing deductions, while they tend to refute the supposition of Mr Barlow, serve equally to establish that of Coulomb, the deficiencies of whose effort I have endeavoured to supply in the above mentioned Memoir.

The next conclusion of Mr Barlow in the above paragraph is, $w \times nt + w' \times nc = W \times nN = 2w \times nt$, and the last equation, viz. $W \times nN = 2w \times nt$, is that which he has used for estimating the strength of materials; but this, like the former, must be incorrect, since $w \times nt$ is not generally equal to $w' \times nc$, their sum, therefore, cannot then be equal to $2\, w \times nt$.

The errors in the preceding theorems extend their influence through a great number of the pages following the paragraph quoted above, entirely destroying the ingenious deductions in the first 20 of them, and the conclusions so unsatisfactory of the coincidence of the centres of tension and compression with those of gravity: those conclusions having been drawn from experiments conjoined with the theory we have just been examining.

Mr Barlow will likewise have to correct (besides some errors of secondary importance) the last column of the tables presented to the Honourable the Principal Officers and Commissioners of the Navy.

As the mechanism of the transverse strain seems by no means to be well understood, I possibly shall be excused for giving the following mechanical illustration of the matter.

I took a board ABCD, Plate I. Fig. 10, 3 feet 6 inches long, and 1 foot broad; and at about half the distance between its two ends, and near to the side AB, there were small moveable pullies affixed, as G, H, I, and similar pullies near the corner C, as represented on the figure; and in the intermediate space between these, as at F, there was a rectangular hole cut through the board, and where the dotted line is seen there projected the ends of a number of equal equidistant straight springs of iron or steel wire, which were firmly inserted at their other ends into a wooden frame *a b c d*, Fig. 11, and this frame was then fast nailed at its ends *a* and *d* to the back of the board, so that the springs between *a* and *d* might project about an inch through the hole F, and be perpendicular to the plain of the board.

I then got a very light piece of wood in the form of an isosceles triangle ELM, whose altitude was about 3 feet 6 inches, (the length of the board) and its base LM 10 inches. Along the side of LM there was nailed a piece of tin, perforated with a row of holes, so as rather loosely to fit the ends of the springs projecting through F, and this tin was slid upon them. The board ABCD was then raised perpendicularly to the horizon, its edge CD being uppermost, and having the triangular piece ELM sliding along its side, and attached to the board only by the springs: the end AD of the board serving to render the triangle steady, and, (by means of a pointed instrument passing through the latter) to hold it, if necessary, in any position.

I then hung a small weight at the end E, and there being nothing to support it, and the weight of the triangle, but the springs, the point was, as might be inferred, carried some distance down, the upper springs being drawn after the base of the triangle, nearly in the direction CD, and the lower ones made to recede in the opposite direction; the whole turning as it were on the central spring, which was not bent, and consequently supported nothing.

I next attached a weight *w* to a point of the triangle near to L, $6\frac{1}{2}$ inches from the central spring, by a string passing over the pully I, and an equal weight *w'* to another point, $\frac{1}{2}$ an inch on the other side of that spring, and increasing the weight at E, so as to bring the base LM perpendicular to the horizon, (which was done in all the experiments,) I found that the whole turned round the central spring as before, though the distances of the equal weight from the central spring were as 13 to 1.

I afterwards put weights to other points, passing over all the pullies, G, H, I, at once, putting sometimes a large one over G, and a small one over I, and sometimes the reverse; and, doing in like manner by the pullies near the corner C, I found that the apparatus always turned round the central spring, without its being bent, when the sums of the weights on each side were equal. But, if the sums of the opposing weights were unequal, the triangle no longer turned round the central spring, but round some other point, at which there was an equality between the negative and affirmative forces.

It is evident that we might have substituted for the weights in the above experiments springs, which would have been unbent, when those which are in the instrument were so, and which (when bent so that the triangle might assume the position it was in during the experiments,) would exert equal forces to the weights w, w', &c. themselves; and, therefore, LM may be considered as the line of the fracture of a beam, whereof ELM is a vertical section, the central spring on which the triangle turned being its neutral line, and the springs and weights on each side of it representing the forces of tension and compression; which, from the experiments above, have no particular relation to their distances from the neutral line, as assumed by Mr Barlow, but must, under all the circumstances, be equal.

I have now considered, at perhaps too great a length, the principal question in the review; and as the result has been, in my opinion, unequivocally to show the erroneousness of the theory in dispute, it may be the less necessary to dwell upon the other remarks of the writer. I shall, however, briefly notice each of them.

The first thing that particularly arrested my attention, (and it indeed created some surprise) was, to find the writer representing this subject, viz. the research for a correct theory of the lateral strength of materials, "as one rather of curious philosophical inquiry than of actual importance," and the reason assigned is, that we can compare the strengths of similar beams without it. In the same manner, we might assert that if we had a globe, or a barrel, of which, by filling or otherwise, we had obtained the content, it would be easy to find the content of another globe or barrel, similar to the former, though larger or smaller. But if we knew the content of a cube, or a globe, and wanted that of a barrel, it is evident that it would be indispensably necessary to have some more general rule by which the contents of dissimilar bodies could be compared together: The same observation must apply to the strength of materials. In timber, indeed, the want of such a rule may be little felt, its beams being generally rectangular; but iron may be cast into various forms, and it would be considered both expensive and inconvenient if it were always necessary to cast two beams, in order to break one of them, before we could be able to judge of the strength of the other. The opinion of the reviewer, too, in this matter, seems (judging from the labour that philosophers have bestowed upon it,) to be at variance with that of almost every writer on the subject, from Galileo to Mr Barlow. I shall, therefore, leave this, and proceed to his other remarks. I had shown, in the above mentioned Memoir, that, in incompressible bodies, Mr Barlow's theory gave the strength of a beam double what it ought to do; this, the writer of the Review admits, but makes a charge of an opposite nature against the theory I advocate. It shall be given in his own words—"It is singular Mr Hodgkinson did not perceive, that precisely the same want of generality applies also to his theory, by taking the opposite imaginary case, viz. of the material being infinitely inextensible; for, in this case, the area of tension being zero, the breaking weight would be zero, or taking any small area of tension, then the strength would be infinite, both inconsistent results." In reply to this, I would ask that ingenious writer, whether I might not, with greater propriety, express my surprise at his not having seen that a body might be inextensible, comparatively with its compressibility, without being infinitely strong, and consequently, that his remarks do not apply to the theory in question. The iron, in my experiments on compression, may be taken as an example of this extreme case.

In regard to the suggestions of the writer, in the same page of the Review, respecting the possibility of a change in the law of mechanical action, in consequence of an alteration in the situation of the neutral line, I would refer him to the last experiment with the instrument above, from which it appears, that if the forces, on each side of that which before was the neutral spring, were made unequal, that spring was no longer the neutral spring, but some other, on each side of which there was an equality in the forces.

The last observation of the reviewer which will require to be noticed here, is that in which he objects to my conclusion, " that the mean index (.97) of my experiments on extension approaches so nearly to unity, the index of perfect elasticity, that it seems unnecessary to assume any other law ;" and the reason assigned, which is certainly not a very strong one, is, that the result of one of the most anomalous of my experiments differs widely from that law :—In answer to this, and to his remarks immediately following, I would beg to refer him to my note, page 265, in the memoir above, and to page 280, example third, from which last it appears, that, in the fracture of a joist, the error from the assumption of perfect elasticity, was not $\frac{1}{100}$ part of the breaking weight. If we had taken the elasticities at $\frac{1}{2}$ or $\frac{2}{3}$ of the breaking weight, which is as far as it is prudent to strain materials in architecture, the deviation from perfect elasticity must have caused a much less error.

Mr Barlow arrived at his conclusions respecting the situation of the centres of tension and compression, from the application of his theory to experiments. It may not then be uninteresting to take one of the experiments he used, and, applying the theory I advocate to it, see what the result will be :—As the easiest, we will take his first experiment (page 156) from which it appears that a beam, 24 inches long, and two inches square, fixed at one end in a wall, required a weight of 558 lbs. to produce the fracture ; the neutral line being at about $\frac{3}{8}$ of the depth of the beam, and the force of direct cohesion on a square inch of the wood equal to 13000 lbs. The formula for the strength of a beam, (see my Essay, pages 244 and 245, Memoir above,) give

$$\text{Weight} = \frac{s}{\text{L.C}} \times \text{section tension} \times (g+g'),$$ { According to the supposition of Galileo.

$$\text{Weight} = \frac{sg}{a\text{L.C}} \times \text{section tension} \times (p+p'),$$ { According to the supposition of Leibnitz.

When s, from the above experiment, is equal 13000 lbs., section of tension $= \frac{5}{2}$ inch, $g+g' = 1$ inch, $p+p' = \frac{4}{3}$ inch, $a = \frac{3}{4}$ inch, $g = \frac{3}{8}$ inch, $L = 24$ inches, $W = 558$ lbs., and calling $C = 1$; and supposing W to be unknown, all the rest being given, we have :—

In the first formula,

$$W = \frac{13000 \times \frac{5}{2} \times 1}{24 \times 1} = 812\tfrac{1}{2} \text{ lbs.}$$

In the second formula,

$$W = \frac{13000 \times \frac{3}{8} \times \frac{3}{2} \times \frac{4}{3}}{\frac{3}{4} \times 24 \times 1} = 541\tfrac{2}{3} \text{ lbs.}$$

But the value of w from experiment is 558 lbs. from which the strength by the last formula, in which the elasticities are supposed to be perfect, differs only 16⅓ lbs.; while the other formula, in which the centres of tension and compression are as deduced by Mr Barlow, gives the strength 254½ lbs. more than it ought to do, or nearly one-half the breaking weight.

The application of the same formulæ to Mr Barlow's other experiments, which were on triangular beams, would be much more laborious, and possibly might give results showing the elasticities to be somewhat less perfect than as above: However, I think there has been enough done to convince the reader that Mr Barlow's deductions in this respect would form a very defective substitute for the more natural assumption of perfect elasticities.

Art. XXXIX.—PROCEEDINGS OF THE ROYAL SOCIETY OF EDINBURGH.

December 19.—Dr Edward Turner read a paper on a Method of detecting Boracic Acid by means of the Blowpipe.

Sir William Hamilton read a Paper on the Practical Conclusions from Gall's Theory regarding the Functions of the Brain.

January 9, 1826.—Professor Dunbar read an examination of Dr Parr's Observations on the etymology of the word Sublimis.

At this meeting H. H. Blackadder, Esq. was elected an ordinary member.

Jan. 23.—There was read a Description of a New Air Thermometer free from the pressure of the Atmosphere, by Mr James King.

There was read also a Report on the Register of the Thermometer kept at Leith Fort, for *every hour of the day and night* during the years 1824 and 1825, by Dr Brewster.

An abstract of this paper is printed in this Number, p. 18.

February 6.—There was read a Notice respecting the late severe cold in Inverness-shire and Aberdeen, as communicated to Dr Brewster in two Letters from J. P. Grant, Esq. M. P., and George Fairholme, Esq.

At the same meeting, Sir William Hamilton concluded his Observations on Gall's Theory.

The following gentlemen were elected Ordinary Members:—

Alexander Wood, Esq. Advocate.

The Rev. Dionysius Lardner, Fellow of Trinity College, Dublin.

February 20*th*.—Mr Bald read a Notice on the Fine Sand near Alloa for making Flint-Glass.—See our last Number, p. 333.

There was read a Letter from Professor Moll of Utrecht to Dr Brewster, on a New Island in the Pacific. This letter is printed in our last Number, p. 278.

March 6.—A paper by Dr BREWSTER was read, on the Refractive Power and other Properties of the Two New Fluids in Minerals. See this Number, p. 123.

The following gentlemen were elected Ordinary Members:—

George Macpherson Grant, Esq. M. P.
William Renny, Esq. W. S.
Elias Cathcart, Esq. Advocate.

March 20.—A Paper by Mr STARK was read, on Two Species of Pholas found on the Coast in the Neighbourhood of Edinburgh. See this Number, p. 98.

Dr KNOX read a paper on the Size of the Teeth of the Shark. See this Number, p. 16.

April 3.—There was read a paper on a Singular Phenomenon in Vision. By Mr THOMAS SMITH, Surgeon, Kingussie. See this Number, p. 52.

A Notice by Dr BREWSTER was read on the Advantages of making Simultaneous Meteorological Observations in different parts of the Kingdom, on one or more days of every year. See p. 181.

Dr EDWARD TURNER exhibited to the Society a Thermo-Magnetic Apparatus of Professor Barlow's.

At this meeting, ANDREW CLEPHANE, Esq. Advocate, was elected an Ordinary Member.

April 17.—There was read a Description of a new Register Thermometer, without any Index, by H. H. BLACKADDER, Esq. See this Number, p. 92.

May 1.—Mr H. H. BLACKADDER read a paper, entitled Observations on Flame.

Dr BREWSTER exhibited to the Society a new Monochromatic Lamp.

A new Safety Gas-Burner, invented by Mr W. WARDEN, was exhibited to the Society.

The following Gentlemen were elected Members:—

	Foreign.	*Ordinary.*
May 9.—	Prof. G. Moll, Utrecht.	Rev. George Coventry.
	Prof. Stromeyer, Gottingen.	Sir D. Hunter Blair, Bart.
	Prof. Hausman, Gottingen.	

The Society adjourned till December 3, 1826.

ART. XL.—SCIENTIFIC INTELLIGENCE.

I. NATURAL PHILOSOPHY.

ASTRONOMY.

1. *Mr Pond's Observations on a New Appearance in the Nebula of Orion.*—This appearance, which was described to the Royal Society on the 10th of March last, was discovered by means of Mr Ramage of Aberdeen's 25 feet reflector, which is now erected at the Royal Observatory of Greenwich. Among the stars about the nebula in Orion are *five* very bright ones, which form a trapezium, and at a little distance *three* others, which are almost in the same straight line. These three stars are neither

situated on the edge of the nebula, nor are they parallel to the edge, but they appear to be entirely free from the nebulous matter, which seems to retire from them in a semicircular form, *as if they had either absorbed or repelled the light* from their discs. Mr Pond remarked the same curious appearance round the five stars of the trapezium, from which the nebulous matter seems also to have receded. He therefore supposes that the *stars* have been in both cases the immediate cause of the disappearance of the nebulous matter, and therefore he is anxious that other astronomers should attend to the subject.

Mr Pond has noticed a similar appearance of a still more decided character, at some minutes distance from the trapezium.

2. *Local Attraction of the Plumb-Line.*—The difference between the results of the geodetical and the astronomical observations lately made in Italy, amount in one case to nearly 27″, and in another to 17″. The matter near the surface at Milan, appears to attract the plumb-line considerably to the north of the vertical, and that near Rimini considerably to the south.—*Dublin Phil. Journal*, No. ii. p. 449.

3. *Captain Ross on the Occultation of the Planet Herschel by the Moon.*—In observing the immersion of Herschel behind the dark limb of the moon on the 6th August 1824, with Mr Ramage's 25 feet reflector, Captain Ross noticed that the light of it began to diminish before it touched the disc, and it appeared to have extended *one-third of its diameter on the dark part of the moon*, at the same time separated by a fine line of light before it disappeared. At its emersion, on the contrary, it appeared *one-fourth* of its diameter distant from the moon's western limb.—*Mem. Astron. Soc.* vol. ii. part i. p. 91.

4. *Fifth Comet of* 1825 *in Eridanus.*—In our 7th No. p. 176, § 5, we have mentioned the discovery of this comet, and in No. viii. p. 377, § 5, we have given the *parabolic* elements of it by Capocci. These, however, and others that have been computed, deviate greatly from observation, and hence M. Clausen of Altona was induced to try an elliptical orbit, of which the following are the elements:

		Mean Time.
Passage of Perihelion at Altona,	1826, April 22.	18525
Longitude of Node,		198° 22′ 27″
Longitude of Perihelion,		115 6 9
Inclination of Orbit,		40 40 12
Eccentricity,		0.9498700
Log. Perihelion distance,		0.3156652
Revolution,		265 Years.
Motion,		Direct.

These elements differ very widely from the parabolic ones.

5. *Second Comet of* 1825 *in Taurus.*—In our two preceding numbers, we have given a full account of this comet, including the parabolic and ellip-

tical elements that have been calculated for it. M. Hansen has computed a second elliptic orbit for it, which is as follows:

		Mean Time.
Passage of Perihelion at Seeberg,	1825, Dec. 11,	29767
Longitude of Node,	Mean Equinox, 1st September,	215° 39′ 17″.9
Log. of Node,—Long. Perihelion,		257 24 3.2
Inclination of Orbit,	- - -	33 35 9.56
Eccentricity,	- - -	0.9817028
		0.0923926
Revolution,	- -	556 Years.
Motion,		Retrograde.

On the 3d of June, at 8^h 54′ mean time at Seeberg, this comet will be in 201° 41′ right ascension, and 15° 08′ south declination, and its distance from the earth will be 1.713.

6. *First Comet of* 1826, *or the lost Comet of* 1772.—This comet, discovered by M. Biela on the 27th February, and by M. Gambard on the 9th March, has been found by M. Clausen to be the comet of 1805, and also *that of* 1772, which has been so long lost sight of. He has found its elliptical elements to be as follows:

		Mean Time.
Passage of Perihelion at Altona,	1826, March 18,	49297
Longitude of Perihelion,	Mean Equinox, Jan. 0. 1826,	109° 53′ 29″.7
Longitude of Node,		251 27 19.9
Log. Perihelion Distance,	- - - - -	0.5496086
Eccentricity,	- -	= Sun. (48° 12′ 28″.75)
Inclination of Orbit,	- - -	13 32 52
Revolution,	- - -	2438 Days.
Motion,		Direct.

It is necessary only to suppose a revolution of 2470 days to establish the identity of this comet with that of 1772. We should then have *five* revolutions between 1772 and 1805, and *three* revolutions between 1805 and 1826.

M. Gauss has proved that the comet of 1772 cannot be identical with that of 1805; at least, that between its two oppositions, it has not passed near so large a planet, that it could have experienced from it such perturbations as would explain the difference between its elements at the two oppositions. But this is precisely the difficulty that the elements of M. Clausen satisfactorily explains, after a remark of Dr Olbers. By supposing the comet of 1772 to have a revolution of 2438 days, it ought to have been exposed in 1782, and still more in 1794, during a considerable time, to the powerful influence of Jupiter. In order to estimate this influence, M. Clausen is at present examining anew the ancient observations, and computing the perturbations.—*Letter from Professor Shumacher, March* 30, 1826.

7. *Ellipticity of the Earth at Port Bowen.*—It appears from observations made with an invariable pendulum at Greenwich and at Port Bowen in the Arctic regions, that the ellipticity of the earth is $\frac{1}{309.65}$.

8. *The Double Star* 61 *Cygni.*—It appears that M. Arago has lately attempted, in vain, to discover a sensible parallax in this remarkable double star. Dr Brinkley, long ago, (see his *Elementary Treatise of Astronomy*,) observed this star for the same purpose, but found no parallax in declination. Professor Bessel obtained a negative parallax, seeming to show that it was more distant than the stars with which he compared it. The rapid motion of this pair of stars, would certainly induce us to believe them nearer than other stars; but the notion, when examined, appears to be no better supported than the commonly received one, that the brightest stars are nearest to us.—*Dublin Phil. Journal,* No. ii. p. 450.

OPTICS.

9. *Effect of the Sun's light in diminishing Combustion.* It has always been considered a vulgar error, that the sun's light extinguishes a fire, but the following experiments by Dr M'Keever put the matter beyond a doubt. See *Ann. of Phil.* x. 344.

1. A green wax taper in sunshine lost 8½ grains in five minutes.
   A white wax taper in a darkened room lost 4¼ ————
2. In bright sunshine a piece of wax taper 7 inches long required to consume it - - - 5′ 0″
   In day light it required - - 4 52
   In a dark room - - - 4 30
3. In the spectrum one inch of taper was burnt in the following times:

At the end of the violet ray -	4′	36″
In the centre of the violet ray -	4	26
In the centre of the green ray -	4	20
In the centre of the red ray -	4	16

10. *Singular Phenomenon observed by M. Ramond on the Pic du Midi.*—When M. Ramond was on the Pic du Midi, he observed his own shadow, and those of his two companions, projected on a cloud situated a little distance above them, with a distinctness and an accuracy of outline quite surprising; but what was more astonishing, *these shadows were encircled with glories, shining with the most brilliant colours.* "Those who witnessed this magnificent spectacle," says M. Ramond, "might have supposed that they were assisting at their apotheosis." Several naturalists, among others, Bouguer, and the sons of Saussure, have seen this phenomenon; but none of them observed this distinctness of form, which can only be explained by the smoothness of the surface of the cloud upon which the shadow was projected. With respect to the glory, Bouguer supposed that it might arise from the decomposition of the light produced by the particles of ice suspended in the cloud. Thus he would say, that the rays of the sun being intercepted at the place occupied by the shadow, there is produced at the place a coldness, and the icy particles becoming more numerous there, and on the margin of the shadow, produce the decomposition of the light. M. Ramond, however, objects to this explanation, and considers it as certain, that the cloud on which his shadow was projected could not, from the temperature of the Pic, have then held any icy particles in suspension.

11. *On the Powerful Effect of Burning-Glasses at great Heights.*—The extreme transparency of the air on high mountains, which hinders the calorific rays which traverse it from heating it directly, gives rise to several effects different from those we observe on the surface of the earth. The heat of the ground, for example, which absorbs the solar rays on those summits, is often, as M. Ramond observes, out of all proportion to that of the atmosphere. When these rays, therefore, are collected in the focus of a lens, they have much greater power than when they traverse a thick and less transparent atmosphere. He found that a lens of a very small diameter was sufficient to set fire to bodies, which a lens of double the diameter would scarcely heat in lower regions. M. Ramond supposes that the temperature of the different colours of the spectrum might be well ascertained on lofty summits.

The Memoir of M. Ramond, which contains these two notices, is entitled, *on the Meteorology of the Pic du Midi*, and was read at the Academy of Sciences, on the 13th March 1826.—*Le Globe*, March 16, 1826.

MAGNETISM.

12. *Diurnal Variation of the Needle in the Arctic Regions.*—From a paper by Captain Parry and Lieutenant Forster, read before the Royal Society on the 13th April last, it appears that the diurnal variation of the needle at Port Bowen sometimes amounts to 7° or 8°, and is never less than 1°. These able observers are said to have discovered a decided connection between the diurnal variation, and the positions of the sun and moon.

METEOROLOGY.

13. *Meteorological Observations on the 17th of July next.*—Printed schedules have been circulated by the Royal Society of Edinburgh, with a request that observations on the thermometer, barometer, rain-gage, &c. and general state of the weather, should be made in various parts of the kingdom on the 17th of July next, and at every hour of that day, from one o'clock in the morning to twelve o'clock at night. It is much to be wished that corresponding observations should be made in England and Ireland, and on the Continent of Europe on the same day, as very important results may be deduced from such a series of simultaneous observations. Schedules and directions for making the observations, may be obtained, by applying to Messrs Taits, booksellers, Prince's Street, Edinburgh.

II. CHEMISTRY.

14. *Dr Henry's Analysis of a Crystalline Compound of Hyponitrous and Sulphuric Acids.*—This substance was formed in the process for making sulphuric acid in leaden chambers, and its production appears to have been determined by intense cold. The product of sulphuric acid having unaccountably fallen off, it was suspected that the ventilating pipe was closed with sublimed sulphur; but, when examined internally, it was found to have been completely stopped by a crystalline solid, not unlike borax in appearance. When kept for a day or two in a warm room, it assumed a soft pasty form; and, by standing still longer, a liquid of rather thick con-

sistence, and of the specific gravity 1.831, floated over the more solid part.

The crystalline portion of the mass, from which the liquid had been drained, but which still continued a soft solid, was intensely acid to the taste, and when handled, stained the fingers like strong nitrous acid. When added to water, a rise of temperature of more than 60° F. was produced, and a violent effervescence took place, accompanied with red fumes, resembling those of nitrous gas when escaping into the atmosphere. A similar extrication of gas was observed, on pouring the deliquiated portion of the mass into water. By collecting the gas in a pneumatic trough, it was found to be nitrous gas of remarkable purity.

The crystalline substance sustained a heat of 220° F. for more than an hour, without parting with any gas; but at 280°, nitrous gas was evolved. A temperature, however, of 400° did not entirely decompose it; for the liquid which remained, when poured into water, gave abundance of nitrous gas. The proportion of that gas which could be expelled by heating the solid salt, exceeded what was evolved from the same quantity by solution in water. Besides the permanent gas, a vapour was also separated by heat, which was evidently nitrous acid, since it tinged a few drops of water contained in a small receiver, first green and blue, and then orange.

Having ascertained that the crystalline solid contained no fixed base, and that it yielded nothing but sulphuric acid, nitrous acid, and nitrous gas, Dr Henry proceeded to ascertain the proportion of its constituents. The nitrous gas was determined by collecting the gas disengaged by the action of water on the solid compound, heat being applied to expel the whole of it. To the residual liquid, sufficiently diluted with warm water, a solution of pure barytes was added, till both the acids were completely neutralized. The amount of sulphate of barytes gave the exact quantity of sulphuric acid. To the filtered liquid, a solution of sulphate of soda was added, and a second product of sulphate of barytes subsided, from which was inferred the quantity of nitrous acid. Abstracting the weight of these substances from the quantity subjected to analysis, the remainder gave the quantity of combined water. One hundred grains of the crystalline substance afforded

		Grains.
Real sulphuric acid,		68.000
Nitrous gas,	5.273 }	13.073
Nitrous acid,	7.800 }	
Water,		18.927
		100.000

In this case, however, the results of analysis do not give direct information of the nature of the original solid, because the elements of the nitrous compounds are doubtless evolved in a state of arrangement very different from that in which they had previously existed in the solid itself. After considering the subject under various aspects, Dr Henry conceives it most probable that they are thus arranged:

Sulphuric acid, 5 atoms, (40 × 5)	200
Hyponitrous acid, 1 atom,	38
Water, 5 atoms, (9 × 5)	45
Weight of its atom,	283
Or, in 100 parts,	
Sulphuric acid,	70.67
Hyponitrous acid,	13.42
Water,	15.91
	100.00

The excess of water obtained by experiment over the theoretical proportion, is ascribed to the solid having imbibed water in addition to that which is essential to it in a crystallized form.

The changes which the solid undergoes, when brought into contact with water, are supposed, by Dr Henry, to be the following:—An atom of hyponitrous acid (regarded for the sake of convenience as constituted of an atom of nitrous gas united with an atom of oxygen) is decomposed; the atom of nitrous gas escapes; and the atom of oxygen, uniting with a contiguous atom of hyponitrous acid, composes an atom of nitrous acid.

"The crystalline solid which has been above described, is probably identical with that obtained many years ago by MM. Clement and Desormes, (*An. de Chimie,* xlix. 334,) by mingling in a glass balloon, sulphurous acid, nitrous gas, atmospheric air, and aqueous vapour; and also with a similar compound, afterwards formed by M. Gay-Lussac, by adding to sulphuric acid the product of the distillation of nitrate of lead, which he considers as chiefly hyponitrous acid, (*An. de Chimie et de Phy.* i. 407.) It furnishes another example, in addition to those before known, of a weak acid serving as a base to a more powerful one. The combinations of fluoric acid with silica and boracic acid are familiar instances; and M. Berzelius has lately discovered others in the compounds of fluoric acid, with the columbic, titanic, tungstic, and molybdic acids. These, however, differ from the compound of hyponitrous and sulphuric acids, in possessing greater permanency, so as to form with bases distinct genera of salts, entitled to the names of fluo-titanates, fluo-columbates, &c.; whereas the compound of sulphuric and hyponitrous acids is instantly decomposed by contact with a base, and the salts obtained are identical with those which would have been formed, if those acids had been separately united with the same base."—*Annals of Philosophy for May* 1826.

15. *On the Air contained in River and Canal Waters.*—Dr Ure has determined the proportion of air contained in these waters by boiling them.

	Grain Measures.	
18000 grain measures of canal water (in winter) yielded	480 or	$\frac{1}{37.5}$
Filtered river water, drawn in the city of Glasgow from the pipes of the Cranston Hill Company	454	$\frac{1}{39.65}$
Filtered river water from the pipes of the Glasgow Water-Company	450	$\frac{1}{40}$
Water taken directly from the river Clyde, somewhat swollen by winter rains	505	$\frac{1}{35.64}$

The gaseous matter obtained from the first three waters, consisted of 1-10th carbonic acid gas, and 9-10ths atmospheric air. That from the open river contained only 1-20th of carbonic acid. The above waters, when submitted to examination, had a temperature of 55° Far.—Brande's *Journal.*

16. *Substances which accompany Caoutchouc when obtained from the Tree in the state of Sap.*—A specimen of the pure sap, from the southern part of Mexico, yields, according to Mr Faraday,

Caoutchouc, - - -	317.0
Albuminous precipitate, - -	19.0
Peculiar bitter colouring matter, a highly azotated substance, Wax, - - -	71.3
Substance soluble in water, not in alcohol, -	29.0
Water, acid, &c. - - -	563.7
	1000

Brande's *Journal.*

17. *On the Nature of Picrotoxine and Menispermic Acid.*—In an analysis to which M. Boullay subjected the berries of the *Menispermum cocculus*, that chemist succeeded in separating a peculiar crystallizable principle which, from its bitter poisonous qualities, he called picrotoxine, and regarded it as a vegetable alkali similar to morphia and kina. He at the same time detected the presence of what he conceived to be a new acid, to which he gave the name of menispermic acid. As some doubt remained as to the accuracy of this analysis, M. Casaseca has made an examination of the berries, and arrived at these conclusions :

1. That the menispermic acid does not exist.

2. That the properties attributed to the menispermic acid, and which induced M. Boullay to regard it as a new vegetable acid, are owing to a mixture of sulphuric acid with organic matter.

3. That the picrotoxine does not possess alkaline properties, and therefore ought not to be regarded as a vegetable alkali, but as a peculiar bitter principle.

M. Boullay, in reply, confesses, on the authority of Vauquelin, that his menispermic acid is a mixture of sulphuric and malic acids, coloured by vegetable matter. He also admits that picrotoxine has no alkaline reaction, and cannot neutralize an acid. M. Casaseca is therefore quite justified. The picrotoxine can, however, combine with acids, and forms crystallizable compounds with the acetic and nitric acids.—*Journal de Pharmacie, for Feb.* 1826.

18. *Prize Questions of the Parisian Society of Pharmacy for* 1826.

1st, To determine the essential phenomena which accompany the transformation of organic substances into acetic acid during the act of fermentation.

2d, Is the formation of acetic acid always preceded by the production of alcohol, in the same manner as the production of sugar precedes that of alcohol in the vinous fermentation ?

3d, What are the substances which may serve as a ferment for the acetous fermentation, and what are the essential characters of these kinds of ferments?

4th, What influence does the air exert over the acetous fermentation? Is its presence essential? In which case how does it act? Is its office the same as in the alcoholic fermentation, or, if absorbed, does it become a constituent part of the acid, or give rise to foreign products?

5th, *Finally*, To establish a theory of the acetous fermentation in harmony with all the facts observed.

The Society will give a medal worth 1000 francs to the author who shall solve all the proposed questions completely. Or, if not entirely solved, the Society will grant a medal worth 500 francs to the person who treats the greatest number of questions in a satisfactory manner.

The memoirs to be written in French or Latin, and to be delivered to M. Henry, Secretary of the Society, before the 1st of April 1827. A motto is to be attached to the paper, corresponding to that on a sealed packet, containing the name of the author. Foreigners are invited to contend for the prize.—*Journal de Pharmacie*, Feb. 1826.

III. NATURAL HISTORY.

MINERALOGY.

19. *Selenium found in Bavaria.*—Mr Hermann von Meyer, of Frankfort, has found this substance in the sulphuric acid made at Bodenmais in Bavaria. He has not re-examined the one from which it is produced, and, therefore, he has not discovered whether it occurs in some particular combination, or is merely contained in the iron pyrites from which the acid is obtained, by first converting it into dry sulphate of iron, and then distilling the acid from it.

20. *Uran-bloom, a new mineral species.*—Professor Zippe, of Prague, has given the following account of this mineral, which was sent to him as something new, by Mr Peschka, of Joachimsthal. It is of a very pure and bright yellow colour, between the lemon-yellow and sulphur-yellow tints. It occurs in crystalline flakes, too small to allow of being determined in respect to their regular form, and possessing but little lustre. It is very soft and opaque. When slightly heated before the blowpipe, the colour is changed into orange-yellow. The mineral is soluble with effervescence in acids, producing a yellow solution, which affords a brown precipitate by prussiate of potash. It appears, therefore, to be a carbonate of uranium. The uran-bloom has been found in a silver-vein, called the Elias, at Joachimsthal, in Bohemia, disposed on uranium-ore, along with the yellow oxide, and sometimes accompanied with pharmacolite. It is distinguished from uran-ochre, chiefly by its stronger lustre and paler colour, and from sulphate of uranium, described by Professor John, by its insolubility in water. It appears to have been produced by the decomposition of the uranium-ore, on which it forms a coating. —*Verhandlungen der Gesellschaft des Böhmischen Museums*, vol. ii. 1824.

21. *New Localities of Rare Minerals. Levyne.*—Professor Zippe, of Prague, has discovered this mineral in the cavities of an amygdaloidal rock, forming part of a collection of minerals from Greenland, sent to the Museum at Prague by Sir Charles Giesecké. The locality atached to the specimen is Kognersoak, near Godhavn, in the island of Disco. It is in every respect similar to the variety from Dalsnypen in Faroe, established as a new species by Dr Brewster.* As at Dalsnypen, it is accompanied by Heulandite. Another variety was discovered by Mr Haidinger in the cavities of a rock of the same description, said to be from the Vicentine. Here it also occurs in twin crystals similar to those represented in Mohs' *Treatise,* (vol. ii. Fig. 194;) but it is associated chiefly with chabasite. It would be interesting to inquire into the chemical difference of two species which are so very like each other in the whole disposition and physical quality of their faces of crystallization, while they differ in their angles, which are =94° 46′ in chabasie, and 79° 29′ in Levyne. The mineral analyzed by Berzelius, under the name of Levyne, and mentioned in his last *Account of the Progress of Chemistry, &c.* † is, in fact, chabasie, with the other varieties of which it agrees also in its chemical composition. The form of Levyne has been likewise met with among the products of Hartfield-moss, near Glasgow. A twin crystal of considerable size, having this form, is preserved in the cabinet of Mr Allan. The plane perpendicular to the axis is, however, much smaller in comparison to the other faces, than in any of the other varieties. It is of a reddish colour, compact in its fracture, and opaque. This peculiar appearance, very different from the freshness of the rest, is owing, perhaps, to some particular decomposition, or to the pseudomorphous formation of another mineral in the shape of Levyne. It is to be hoped that we shall soon become acquainted with the specific gravity and other important characters, as well as the chemical composition of Levyne, which appears not to be such an exceedingly rare substance as was first supposed.

22. *Comptonite.*—The neighbourhood of Aussig, in Bohemia, is very rich in varieties of this mineral, established as a new species by Dr Brewster, and which was hitherto believed to be confined to mount Vesuvius. At Aussig, it is generally found as a thin coating on the surface of reniform masses of a kind of mesotype. More rarely it is met with in small but very distinct single crystals, disposed within the cavities of the grey rock, well known as the matrix of the chabasites. Mr Haidinger found the same species in nearly transparent crystals, exactly similar to those from Vesuvius, and approaching to them also in size, in the cavities of a perfectly compact basalt from the Pflasterkaute, near Marksuhl, in Thuringia, a classical spot in the early history of the disputes concerning the igneous or aqueous origin of basalt. The Compontite is accompanied with small crystals of harmotome, and nearly opaque white crystals, having the shape of obtuse isosceles four-sided pyramids, of a mineral not yet sufficiently examined.

23. *Brewsterite.*—Mr Bergemann of Berlin found a variety of this

* See this *Journal*, vol. ii. p. 332. † See our last Number, p. 316.

species at the lead mines of St Turpet, in the Munster valley, near Freiburg, in Brisgaw. It occurs in yellowish-white small and short prisms, and agrees, therefore, not only in its external appearance, but also in the kind of its natural repository, with the *Brewsterite* from Strontian.

24. *Selenium from Lukawitz in Bohemia.*—There is a considerable manufactory of sulphuric acid, belonging to Prince Auersperg, at Lukawitz, in the circle of Chrudim in Bohemia. The selenium, as at Gripsholm in Sweden, is contained in the brownish mud deposited in the lead chambers. According to the experiments of Professor Steinmann of Prague, this mud contains about four per cent. of selenium. The ore employed for extracting the sulphur is common iron pyrites, imbedded in mica-slate. Professor Steinmann, who already possesses upwards of six ounces of pure selenium, has contrived a method of concentration, by exposing a mixture of this sediment, or of the sulphur containing selenium, extracted from it by melting, and sulphuric acid, to a previous distillation. The greatest portion of the sulphur is oxidized and driven off in the shape of sulphurous acid, leaving a residue in which the content of selenium is predominant, to be treated afterwards, as usual, with nitro-muriatic acid. Sulphur, containing about twenty per cent. of selenium, of a more or less deep orange yellow, is sold at Prague, at the price of twelve shillings a pound. Trials have been made, though hitherto unsuccessful ones, to mould the selenium in basso-relievos, representing the portrait of Berzelius.

25. *Zircon found at Scalpay in Harris.*—Mr William Nicol, Lecturer on Natural Philosophy, has discovered fine crystals of Zircon in the primitive rocks in the island of Scalpay, Harris.

Zoology.

26. *Two-Headed Snakes.*—Dr Mitchill of New York has recorded the curious fact of three double-headed serpents being found among a brood of young ones amounting to one hundred and twenty. The occurrence of similar monstrosities had led some naturalists to form the idea of these anomalous animals forming a separate and well marked species; but two-headed snakes being occasionally found in the West Indian and Polynesian Isles, in Great Britain, in Italy, and in the State of New York, renders it probable that these singular productions are not only of different species, but of different genera; and that, in fact, the whole of the instances which have been noticed, may be classed as deviations from the usual course of nature.

"During the year 1823 (says Dr Mitchill) a female snake was killed about six miles west of the Genesee river, together with her whole brood of young ones, amounting to one hundred and twenty. Of these, three were monsters; one with two distinct heads; one with a double head, and only three eyes; and one with a double skull furnished with three eyes and single lower jaw;—this last had two bodies. The figures, correctly drawn from the originals in my collection, represent the shape and size of the several individuals. (See *Silliman's Journ.* vol. x. p. 48.) My friend, Dr Voight of Rochester, having heard of the occurrence, travelled to the place and inquired into the facts. He procured the three which were deformed, and very obligingly placed them at my disposal. The dam, or mother, was of the sort called the *Black Snake,* or *Runner,* one of the most frequent and prolific of the New York serpents. The species is very well known, and is apparently the *Coluber constrictor* of Linnæus, and *Le Lien* of La Cepede." The monstrous individuals figured, are between four and five inches long. The full grown animal frequently attains the length of six feet. Dr Mitchill, a few years ago, had received from the Fejee Islands a two-headed serpent, four inches and three quarters in length; and intelligence had reached him, when he was writing the previous notice, of a snake which had been taken near Lake Ontario with *three* heads, and which was to be sent to him.—*Silliman's Journal,* vol. x. No. i. p. 48—53.

27. *Mercantile importance of Snails.*—M. de Martens states, that the annual export of snails (*Helix pomatia*) from Ulm, by the Danube, for the purpose of being used as food in the season of Lent by the convents of Austria, amounted formerly to ten millions of these animals. They were fattened in the gardens in the neighbourhood. This species of snail is not the only one which has been used as food; for, before the revolution in France, they exported large quantities of the *Helix aspersa* from the coasts of Aunis and Saintonge in barrels for the Antilles. This species of commerce is now much diminished, though they are still sometimes sent to the Antilles and Senegal.

The consumption of snails is still very considerable in the departments of Charente Inferieure and Gironde. The consumption in the Isle de Rhé alone is estimated in value at 25,000 franks; and at Marseilles the commerce in these animals is considerable. The species eaten are *Helix rhodostoma, H. aspersa,* and *H. vermiculata.* In Spain, in Italy, in Turkey and the Levant, the use of snails as food is common. It is only in Britain that the Roman conquerors have failed to leave a taste for a luxury which was so much used by the higher classes in ancient Rome; though it would be very desirable, for the sake of the produce of our gardens, that some of the leaders of fashion in eating would, by introducing them at table, take the most effectual method of keeping our native species within due bounds.—*Bull. des Sciences Nat.* 1825, No. 10, p. 247.

BOTANY.

28. *Botany of New South Wales.*—In the "*Geographical Memoirs of New South Wales,*" lately published by Mr Baron Field, there is a valuable memoir by Mr Allan Cunningham, Botanical Collector for his Majesty's gardens at Kew, upon the "botany of the mountainous country, between the colony round Port Jackson and the settlement of Bathurst; being a portion of the result of observations made in Oct. Nov. and Dec. 1822, and disposed according to the natural orders. Several new specimens are described, and the whole is rendered particularly valuable by the ob-

servations on the geographical distribution of vegetables. Supplementary to this memoir, is given an account of a new genus of plants of the natural order *Bignoniaceæ*, named *Fieldia*, in honour of Mr Baron Field, which was discovered by Mr Cunningham in 1823, on the Blue Mountains, growing in shady forests which abound in the tree-ferns,* (*Dicksonia Antarctica, Labill. Cibotium, Kaulfuss.*)

Upon entering the dark shades of these forests, the traveller is forcibly struck with the change of appearance of the timbers, from the *Eucalypti* of the open country, to species of other genera not to be found in situations of dry exposure."

IV. GENERAL SCIENCE.

29. *The waters of Salt Springs raised by Carburetted Hydrogen Gas, in the State of Ohio.*—In the western parts of the State of Ohio, a discharge of carburetted hydrogen invariably accompanies all the salt water that has been discovered. The gas is highly inflammable, and where there is a free discharge of it, it will take fire on the surface of the water on the application of a lighted stick, or the flash of a gun, and continue burning for days, unless put out by a heavy shower or high wind. It is this discharge of gas that brings the salt water from such vast depths in the bowels of the earth to the surface; and where salt water has been discovered, and the supply of gas has failed, the water has immediately sunk in the well, and could not, by any means used, be brought again to the top of the well. On the little Muskingun, they have sunk two wells which are now more than 400 feet. One of them affords a strong and pure salt water, but not in great quantity. The other discharges such vast quantities of petroleum, and is subject to such tremendous explosions of gas, as to force out all the water, and afford nothing but gas for several days, that they make but little or no salt. The petroleum affords considerable profit, and is in demand for lamps in work-shops.—Professor Silliman's *American Journal*, vol. x. p. 5.

* The following note by Mr Cunningham upon this plant, will give some idea of the curious vegetation of these regions. " This beautiful tree-fern, he says, which was originally discovered at the southern extremity of Van Diemen's Island, where alone it had hitherto been observed, I found it also very general, in the dark forests on the mountain named by the Aborigines *Tomah*, which is distant from the Hawkesbury Ford, at Richmond, about 20 miles. Some of the caudices or trunks of these trees are thirty-five feet in height, and measure from 12 to 16 inches in diameter at the base. The stupendous size and extraordinary windings of the climbers within these shades, particular of a *Cistus* with quinate leaves, whose supple stems measured from 20 to 24 inches in the circumference, the weight of the parasitical *Orchideæ*, *Filices*, &c. borne by them, as they swing to the violent winds of these elevated lands, adding to the grandeur and magnificent appearance of the tree-ferns, failed not to picture to me, and impress me with that exuberance of tropical scenery, which, in New South Wales, is occasionally to be observed in the higher latitudes, (particularly at the Five Islands.)

ART. XLI.—*Meteorological Observations made at Leith,* by Messrs COLDSTREAM and FOGGO. Communicated by the Authors.

Leith, January 5, 1826.—THE afternoon of this day was stormy; much rain fell, and the wind blew strongly from the east and south-east. Mean temperature of the day 36°.25. Dew point at noon 33°.5. At 7 P. M., through narrow openings in the *nimbi,* with which the whole sky was filled, we perceived beams of an *Aurora Borealis,* of a silvery colour and lustre; they appeared at intervals between the dark clouds for about an hour. At the same time, portions of a broad arch of light were observed about 25° south of the zenith,

January 6.—Much rain fell to-day. Wind east. Very boisterous.

January 16.—Since the 7th, the daily minima of temperature have always been below 30°. The average of the daily mean temperatures during the interval is 26°.3. The frost was most intense this morning, when, at 7 o'clock, the thermometer stood here at 15°.* Except on the 10th, when a fog prevailed, and a little snow fell, the sky was unclouded during the whole period of the continuance of the frost; and sometimes the sun's rays had considerable power. The minimum temperature on the 10th was 22°.5; but, after the fog and snow, the temperature rose to 34°.5, and the dew point from 23° to 29°. The minimum of the 11th was 25°.5; dew point still 29°; but, on the 12th, the dew point fell to 20°, and, on the 13th, 14th, 15th, and 16th, we had minimum temperatures always under 19°. This morning the deposition of the icy crystals of hoar-frost was very abundant on all surfaces freely exposed to the atmosphere, particularly, as is often the case, on the windward sides of objects. A gentle breeze had blown from the south-west during the preceding night, and between one and two o'clock A. M. an *Aurora* was seen. From sunrise till 2 o'clock P. M. the fog was very dense; at that time it became less so, and some snow fell; about 7 P. M. more snow fell, and the temperature rose to 33°.

January 17.—The temperature remained during the whole night a little above the freezing point; and this morning, at 9 o'clock, the thermometer stood at 40°. It is perhaps worthy of notice, that although the temperature of the external air was thus high, that of the interior of houses remained very low, so that ice of considerable thickness was formed in rooms, where, during the preceding severe frosts, little had appeared; and this occurred in houses having walls of moderate thickness, and whose exposure is very free. The deposition of moisture on all buildings, &c. was of course very profuse.

February 4.—To-day, at noon, the thermometer in the shade being at 45°, the force of the solar rays was found to be 30°, which is certainly very great for this period of the year.

* At Canaan Cottage, three miles more inland, and 240 feet more elevated than our place of observation, Mr Adie's register thermometers indicated a minimum temperature at the same time of 10°.—An account of the Great Cold in Inverness-shire and Aberdeenshire will be given in next Number.

February 11.—An *Aurora* of considerable brilliancy was seen in the evening. The day had been clear, with bright sunshine. Mean temperature 42°. Wind west.

February 27.—Since the 18th, the weather has been very stormy. Winds S. W. Temperature ranging between 31° and 52°. Pressure very variable.

March 10.—A very high temperature for the season occurred to-day; the maximum having been 71° in the shade. The sky was clear and cloudless. Wind variable, but chiefly east and west. Dew point 47°.

March 14.—Since the 10th, the weather has been particularly clear and pleasant. Wind S. E. Pressure always above 30 inches. The minimum temperature of the preceding night was 31°; so that within eighty hours we have had a range of temperature of 40°.

In the evening much rain fell, and the wind veered to W.

March 29.—Immediately after the fading of the evening twilight, at 8^h 15′ P. M., a bright luminous ray was seen to rise from the eastern horizon, gradually to extend itself towards the zenith, and thence towards the western horizon, presenting, when completed, the appearance of an arch of silvery light, similar to that seen here on the 19th March 1825.

When first formed, it was a few degrees to the north of the zenith of this place; the light in the centre was rather diffuse; its edges were irregular; and the western limb had, as it were, a plumose appearance. It soon evinced a decided motion towards the south, and in a few minutes reached our zenith. Its edges were now sharply defined; and throughout its whole course it was nearly uniform in appearance and breadth: the intensity of its light in the zenith had increased; while, in the same quarter, the breadth had considerably diminished.

The direction it now had was very nearly at right angles with the magnetic meridian.

At half-past eight, faint beams of the *Aurora* began to rise from the northern horizon, and at one time promised to form a splendid display; but the coruscations never became very vivid; they were not rapid in their motions, and did not flit along the horizon.

The arch still continued its motion towards the south, and in 15 minutes passed through a space of about 20°. Its southern edge reached a point about 24° or 25° south of the zenith, beyond which it did not go. The light now became gradually fainter, and at length disappeared.

Meanwhile the *Aurora* in the north continued to play, but with no increase of vividness. For some minutes, soon after 9 o'clock, we observed broad bands of light, having their longer axes (which generally subtended angles of about 18° or 20°) parallel with the horizon, darting with great velocity across the illuminated space from E. to W., and from W. to E. These formed, ran their course, and vanished in a moment: they had no vertical motion, but they appeared at various degrees of elevation, never higher, however, than 30°. Soon after this interesting (and, perhaps, unusual) display, the beams disappeared, and nothing was left but a diffuse luminousness along the horizon.

March 30.—Minimum temperature of the preceding night, 31°. Wind N. and N. W. Weather fine.

Art. XLII.—CELESTIAL PHENOMENA,

From July 1st to October 1st 1826. Adapted to the Meridian of Greenwich, Apparent Time.

N. B.—The day begins at noon, and the conjunctions of the Moon and Stars are given in Right Ascension.

JULY.

D.	H.	M.	S.	
1	9	20	11	☌ ☽ A ♉
1	19	2	50	☌ ☽ 2 κ ♉
2	12	30	30	☌ ☽ γ ♉
3	4	19	39	☌ ☽ ζ ♉
3	14	41	40	☌ ☽ ♄
4	19	36	18	● New Moon.
5	22	50	24	☌ ☽ ☿
6	23	35	50	☌ ☽ 1 α ♋
7	0	47	31	☌ ☽ 2 α ♋
7	9	13	10	☌ ☽ ♀
8	6	7	47	☌ ☽ π ♌
9	5	51	40	☌ ☽ ♃
9	9	24	26	Em. I. Sat. ♃
12	1	24	27	☽ First Quarter.
12	6	4	44	☌ ☽ ι ♍
13	12	52	53	☌ ☽ ♂
14	13	54	42	☌ ☽ κ ♎
15	17			☍ ☉ ♅
14	18	22	38	☌ ☽ λ ♎
14	23	6	12	☌ ☽ 1 β ♏
14	23	7	33	☌ ☽ 2 β ♏
16	4	16	20	☌ ☽ ρ Oph.
16	19			☌ ♀ α ♌
17	0	43	17	☌ ☽ 1 μ ♐
17	1	17	58	☌ ☽ 2 μ ♐
18	2	10	26	☌ ☽ d ♐
18	12	21	25	☌ ☽ ♅
18	19	12	3	○ Full Moon.
19	4	46	39	☌ ☽ β ♑
22	23	34	55	☉ enters ♌
24	19	40	—	☌ ☿ α ♌
26	9	3	27	☾ Last Quarter.
27	15	28	16	☌ ☽ δ ♈
29	2	40	49	☌ ☽ 2 κ ♉
29	20	12	28	☌ ☽ γ ♉
30	12	4	32	☌ ☽ ζ ♉
31	5	1	22	☌ ☽ ♄
31	11	25	34	☌ ☽ ν ♊
31	20	48	15	♀ near ♃

AUGUST.

D.	H.	M.	S.	
1				☿ Greatest Elong.
3	7	21	14	● New Moon.
4	3	44	27	☌ ☽ o ♌
4	12	39	28	☌ ☽ π ♌
5	10	40	—	☌ ☽ ☿
5	22	31	10	☌ ☽ ♃
6	6	17	5	☌ ☽ ♀
8	10	37	17	☌ ☽ α ♍
8	11	16	43	☌ ☽ ι ♍
9	5	0	—	♀ near β ♍
10	6	14	8	☽ First Quarter.
10	14	16	47	☌ ☽ ♂
10	19	41	50	☌ ☽ κ ♎
11	0	15	22	☌ ☽ λ ♎
11	5	5	9	☌ ☽ 1 β ♏
11	5	6	83	☌ ☽ 2 β ♏
12	10	59	53	☌ ☽ ρ Oph.
13	8	0	16	☌ ☽ 1 μ ♐
13	8	35	55	☌ ☽ 2 μ ♐
14	10	5	50	☌ ☽ d ♐
14	18	41	40	☌ ☽ ♅
15	13	13	13	☌ ☽ β ♑
16	14	15	—	♀ near μ ♊
17	5	14	13	○ Full Moon.
23	6	1	58	☉ enters ♍
23	23	22	5	☌ ☽ δ ♈
25	3	9	11	☾ Last Quarter.
26	4	27	28	☌ ☽ γ ♉
26	20	29	54	☌ ☽ ζ ♉
27	18	37	10	☌ ☽ ♄
27	20	6	6	☌ ☽ ν ♊
30	2	20	—	Inf. ☌ ☉ ☿
30	15	36	34	☌ ☽ 1 α ♋
30	16	46	38	☌ ☽ 2 α ♋
31	21	15	19	☌ ☽ π ♌

SEPTEMBER.

D.	H.	M.	S.	
1	10	4	30	☌ ☽ ☿
1	17	42	10	● New Moon.
2	14	38	43	☌ ☽ ♃
4	17	1	26	☌ ☽ α ♍
4	17	39	54	☌ ☽ ι ♍
5	0	10	50	☌ ☽ ♀
7	1	9	29	☌ ☽ κ ♎
7	5	41	23	☌ ☽ λ ♎
7	10	30	1	☌ ☽ 1 β ♏
7	10	31	24	☌ ☽ 2 β ♏
7	13	8	7	☌ ☽ ν ♏
8	0	25	30	☌ ☽ ♂
8	11	44	35	☽ First Quarter.
8	16	29	1	☌ ☽ ρ Oph.
9	13	43	31	☌ ☽ 1 μ ♐
9	14	19	40	☌ ☽ 2 μ ♐
10				☿ Greatest Elong.
10	16	15	54	☌ ☽ d ♐
10	23	40	40	☌ ☽ ♅
12	19	55	57	☌ ☽ β ♑
15	17	56	52	○ Full Moon.
17	21	—	—	☌ ☉ ♃
20	20	20	—	☌ ♂ A Oph.
22	12	28	33	☌ ☽ ι ♉
23	2	39	34	☉ enters ♎
23	4	43	20	☌ ☽ ζ ♉
23	21	32	10	☾ Last Quarter.

D.	H.	M.	S.	
24	4	42	43	☌ ☽ ν ♊
25	1	4	40	☌ ☽ ♄
27	7	25	45	☌ ☽ 1 α ♋
27	2	36	47	☌ ☽ 2 α ♋

D.	H.	M.	S.	
28	7	21	17	☌ ☽ π ♌
30	7	54	54	☌ ☽ ♃
30	10	26	51	☌ ☽ ♃
30	11	10	56	☌ ☽ ☿

Times of the Planets passing the Meridian.

	Mercury.		Venus.		Mars.		Ceres.		Jupiter.		Saturn.		Georgian.	
D.	h.	′	h	′	h	′	h	′	h	′	h	′	h	′
JULY.														
1	0	36	2	5	7	36	11	54	4	6	23	6	12	57
5	0	54	2	8	7	23	11	31	3	52	22	51	12	40
10	1	13	2	11	7	8	11	8	3	35	22	33	12	18
15	1	27	2	14	6	54	10	41	3	7	22	16	11	57
20	1	37	2	17	6	42	10	21	3	1	21	59	11	36
25	1	43	2	19	6	29	9	55	2	44	21	42	11	15
AUGUST.														
1	1	45	2	22	6	15	9	23	2	22	21	18	10	46
5	1	42	2	24	6	7	9	3	2	9	21	4	10	30
10	1	34	2	26	5	58	8	45	1	54	20	48	10	10
15	1	19	2	28	5	50	8	29	1	39	20	35	9	50
20	0	58	2	31	5	43	8	4	1	24	20	15	9	31
25	0	29	2	33	5	37	7	49	1	9	19	58	9	11
SEPTEMBER.														
1	23	35	2	36	5	29	7	25	0	49	19	35	8	47
5	23	14	2	39	5	25	7	13	0	38	19	19	8	32
10	22	58	2	42	5	21	6	57	0	24	19	5	8	14
15	22	55	2	45	5	17	6	42	0	9	18	49	7	56
20	23	3	2	48	5	13	6	24	23	53	18	32	7	38
25	23	16	2	51	5	10	6	33	21	39	18	15	7	20

Declination of the Planets.

	Mercury.	Venus.	Mars.	Ceres.	Jupiter.	Saturn.	Georgian.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′
JULY.							
1	24 8 N	19 55 N	15 27 S	28 10 S	9 4 N	22 27 N	19 38 S
7	22 11	17 54	16 3	28 33	8 42	22 28	19 37
16	17 38	14 19	17 4	28 58	8 7	22 29	19 36
22	14 6	12 40	17 51	29 17	7 34	22 29	19 35
28	10 32	8 56	18 38	29 23	7 17	22 29	19 34
AUGUST.							
1	8 16 N	6 56 N	19 12 S	29 33 S	6 59 N	22 29 N	19 33 S
7	5 15	3 55	20 2	29 39	6 30	22 29	19 32
16	2 25	1 13 S	21 15	29 46	5 57	22 28	19 30
22	2 25	3 15	22 4	29 50	5 28	22 27	19 29
28	4 21	6 20	22 50	29 54	4 58	22 27	19 28
SEPTEMBER.							
1	6 26 N	8 50 N	23 15 S	29 52 S	4 28 N	22 26 N	19 29 S
7	9 24	11 44	23 53	29 52	3 57	22 25	19 28
16	10 20	15 47	24 38	29 51	3 12	22 24	19 28
22	8 5	18 17	24 49	29 50	2 46	22 23	19 28
28	4 18	20 40	25 15	29 49	2 15	22 22	19 27

The preceding numbers will enable any person to find the positions of the planets, to lay them down upon a globe, and determine their rising and settings.

ART. XLIII.—REGISTER OF THE BAROMETER, THERMOMETER, AND RAIN-GAGE, *kept at Canaan Cottage.* By ALEX. ADIE, Esq. F. R. S. Edin.

The Observations contained in the following Register were made at Canaan Cottage, the residence of Mr Adie, by means of very nice instruments, constructed by himself. Canaan Cottage is situated about 1¼ mile to the south of Edinburgh Castle, about 3 miles from the sea at Leith, and about ¼ of a mile N. of the west end of Blackford Hill. The ridge of Braid Hills is about 1 mile to the south, and the Pentland Hills about 4 miles to the west of south. The height of the thermometer is about 260 feet above the level of the sea. The morning and evening observations were made about 10 A.M. and 10 P.M.

MARCH 1826.

D. of Week.	Day of Month.	Thermometer, Morn.	Thermometer, Even.	Thermometer, Mean.	Register Therm. Min.	Register Therm. Max.	Register Therm. Mean.	Barometer. Morn.	Barometer. Even.	Rain.
W.	1	51	39	45	42	54	48	29.36	29.14	.40
T.	2	42	40	41	35	46	40.5	29.31	29.31	
F.	3	43	39	41	36	48	42	29.40	29.38	
S.	4	42	38	40	35	48	41.5	29.05	29.28	.08
S.	5	42	36	39	31	44	39	29.56	29.58	.08
M.	6	40	41	42	33	46	39.5	29.62	29.27	.01
T.	7	45	40	42.5	36	51	43.5	29.28	29.47	.06
W.	8	43	47	45	35	51	43	29.76	29.68	
T.	9	43	57	50	43	61	53.5	29.65	29.86	
F.	10	65	54	59.5	52	72	62	30.05	30.07	
S.	11	50	42	46	40	57	48.5	30.11	30.16	
S.	12	46	40	43	31	51	41	30.45	30.46	
M.	13	41	37	39	27	46	36.5	30.41	30.23	
T.	14	41	37	39	28	47	37.5	29.90	29.58	.15
W.	15	41	39	40	33	48	40.5	29.61	29.88	
T.	16	39	32	35.5	31	45	38	30.14	30.20	
F.	17	40	40	40	25	46	35.5	30.18	29.98	
S.	18	46	40	43	37	54	45.5	29.78	29.59	.04
S.	19	45	39	42	35	51	43	29.67	29.80	
M.	20	47	42	44.5	36	53	44.5	29.82	29.92	
T.	21	45	32	38.5	39	46	42.5	30.00	29.91	
W.	22	40	39	39.5	28	48	38	29.84	29.72	
T.	23	42	39	40.5	36	48	42	29.47	29.54	.19
F.	24	38	37	37.5	34	43	38.5	29.71	29.78	
S.	25	35	33	34	33	44	38.5	29.81	29.85	.26
S.	26	36	36	36	31	42	36.5	29.88	29.97	.06
M.	27	40	42	41	33	47	40	29.80	29.46	
T.	28	47	43	45	35	55	45	29.33	29.05	
W.	29	39	31	35	29	43	36	29.26	29.50	
T.	30	39	35	37	28	44	36	29.80	30.00	
F.	31	31	42	36.5	31	51	41	30.00	29.96	
	Sum,	1324	1231	1277.5	1061	15.33	1 97	921.83	921.61	1.33
	Mean.	42.71	39.71	41.21	34.23	49.46	41.84	29.736	29.729	

APRIL 1826.

D. of Week	D. of Mon.	Thermometer. Morn.	Thermometer. Even.	Thermometer. Mean.	Register Therm. Min.	Register Therm. Max.	Register Therm. Mean.	Barometer. Morn.	Barometer. Even.	Rain.
S.	1	48	47	47.5	39	50	44.5	29.86	29.65	
S.	2	44	48	46	41	56	48.5	29.55	29.77	.11
M.	3	53	49	51	45	60	52.5	29.80	29.76	
T.	4	53	48	50.5	46	55	50.5	29.72	29.69	
W.	5	50	47	48.5	45	58	51.5	29.66	29.67	
T.	6	56	45	50.5	45	59	52	29.48	29.55	.05
F.	7	51	51	51	43	55	49	29.68	29.71	.01
S.	8	57	51	54	47	60	53.5	29.68	29.57	
S.	9	54	44	49	44	60	52	29.25	29.11	.25
M.	10	47	40	43.5	38	49	43.5	29.22	29.43	
T	11	56	44	50	38	58	48	29.17	29.00	.35
W.	12	49	43	46	41	55	48	29.03	29.72	.08
T.	13	47	45	46	32	53	42.5	29.77	29.76	
F.	14	54	44	49	43	57	50	29.67	29.83	
S.	15	50	39	44.5	40	55	47.5	29.88	29.82	.03
S.	16	51	40	45.5	34	56	45	29.92	30.05	
M.	17	51	41	46	36	56	46	30.03	30.03	
T.	18	53	46	49.5	34	58	46	29.95	29.73	
W.	19	51	48	49.5	42	59	50.5	29.71	29.76	
T.	20	57	43	50	39	65	52	29.51	29.45	
F.	21	51	50	50.5	34	66	50	29.33	29.40	
S.	22	48	43	45.5	45	50	47.5	29.49	29.48	
S.	23	47	38	42.5	37	55	46	29.57	29.58	
M.	24	48	38	43	34	53	43.5	29.63	29.79	.34
T.	25	46	35	40.5	32	52	42	29.68	29.53	
W	26	46	39	42.5	30	54	42	29.50	29.37	.16
T	27	36	31	33.5	32	42	37	29.32	29 67	.16
F.	28	40	35	37.5	28	48	38	29.74	29.86	
S.	29	42	34	38	30	53	41.5	29.91	29.97	
S.	30	46	36	41	27	58	42.5	30.04	30.09	
		1482	1282	1382	1141	1665	1403	888.94	889.80	1.52
		49.4	42.73	46.07	38.03	55.5	46.08	29.611	29.66	

THE

EDINBURGH

JOURNAL OF SCIENCE.

Art. I.—*Account of a Voyage to Madeira, Brazil, Juan Fernandez, and the Gallapagos Islands, performed in* 1824 *and* 1825, *with a view of examining their Natural History, &c.* By Mr Scouler. Communicated by the Author.

Although the public are already in possession of many voyages to the Pacific Ocean, yet, as the places I had an opportunity of visiting are seldom frequented by Europeans, and as the natural history of the North West Coast of America is still but imperfectly known, the remarks contained in the following Journal may perhaps be interesting.

The voyage of Captain Vancouver, and the journeys of Sir A. M'Kenzie, and of Captains Lewis and Clarke, have laid open the geography of these remote regions, and added some valuable contributions to our knowledge of their natural productions. The botanical investigation of the North West Coast by Mr Menzies was as complete and extensive as its survey by Captain Vancouver, and it is only to be regretted that some equally active zoologist had not accompanied this expedition. The overland journey of Captains Lewis and Clarke enriched the American Flora with many new and curious plants, whose descriptions form the most interesting part of Pursh's work on North American plants. Little need be said recommendatory of the zoological riches of a country which possesses such a variety of animals of the tribe *Rodentia* or Gnawers, from the Beaver down to the Marmot and Squirrel, and which contains the *Vultur*

Californianus, with many other rare or nondescript species of the Eagle tribe.

The Hudson's Bay Company, with an honourable zeal to advance the knowledge of those extensive regions which are within the sphere of their commercial exertions, were anxious to have a surgeon, (in their vessel about to undertake a voyage to the Columbia River,) who, in addition to his professional acquirements, was qualified to make collections in the various branches of natural history. Through the kind recommendations of Dr Hooker and Dr Richardson, I had the good fortune to meet with the company's approbation, and was appointed to visit the North West Coast of America. To the encouragement of the company, and the cheerful assistance I obtained from their servants, I am entirely indebted for the numerous excursions and extensive collection I was enabled to make. As it is to the Hudson's Bay Company I am indebted for the means of making my collection, so, on my return, the objects I had procured would have been of very little use to the public, unless I had enjoyed the assistance of Dr Hooker, and the free use of his extensive library. The following paper, containing an account of our voyage from London to the Gallapagos, &c. will be continued in a future number, when some papers of a more scientific nature may also be communicated.*

On the 25th July 1824 we left Gravesend, with every thing necessary for the preservation of plants and animals. In a medical point of view we were also excellently supplied. Every article, either of medicine or food, which could in any degree

* While in London I received much important information from Dr Richardson and Mr Menzies with respect to the countries I was about to examine. The knowledge acquired from Mr Menzies was peculiarly interesting, as he had already explored the very coast I had to visit, and cheerfully allowed me at all times to examine the plants he had collected on the North West Coast, and to direct my attention to those which were most likely to be useful when cultivated in this country. Through his advice I was induced to pay particular attention to the seeds of *Gualtheria Shallon*, which have already produced young plants in the Botanic Garden at Glasgow. Dr Richardson also gave me much instruction with regard to the best means of preserving animals, a subject on which his advice was of the utmost value; and I was farther indebted to him for specimens of many of those interesting plants he had collected while engaged in the Arctic expedition.

contribute to our comfort, or assist in preventing scurvy, was liberally provided. But the best evidence of the prudence of the means employed is their success; and it may be stated that, during a long voyage of twenty-two months, we never once could detect a symptom of scurvy on any individual in the vessel. In the prospect of a long voyage, I esteemed myself fortunate in having for a companion Mr Douglas, a zealous botanist, who was engaged by the Horticultural Society of London to explore the vegetable treasures of the North West Coast of America.

During our voyage from London to Madeira nothing occurred to attract the attention of the naturalist, and, as the weather was agreeable, we employed ourselves in making those arrangements which our new mode of living required. Since leaving England, the only animal we saw was the *Procellaria pelagica* (Petrel,) which became more numerous as we approached the land. On the 9th August we saw the island of Porto Santo, and afterwards that of Madeira, which, to use the expression of Spix and Martius, "appeared to float like a pleasant garden on the bosom of the ocean;" but we were so detained by the calmness of the weather that it was the evening of the 10th before we came to anchor off Funchal. Next morning, impatient to make the most of our limited time, we proceeded to the interior of the island. On leaving the coast we found ourselves among the vallies of this fertile island, which present the appearance of one continued vineyard, interspersed with fields of the esculent *Arum*, and groves of Sugar-canes; at a greater elevation these vegetables disappear, and are replaced by the Chesnut-tree and the Myrtle; and the steep sides of the Pica da Cruz are only supplied with the heath and a few grasses and ferns common to alpine regions. Although we collected a considerable variety of plants and insects, the results of our journey were far from satisfying our too sanguine expectations. The phenogamous plants were sufficiently known to us, and the alpine regions afforded but a poor supply of Lichens and Mosses.

To give any detailed description of an island so well known as Madeira would be superfluous, and to acquire a knowledge of its productions during our short visit was impossible. The island consists of steep hills, intersected by numerous deep vallies, which are generally watered by some small rivulet, whose supplies are obtained from the melting of the mountain snows. The rocks are of a blackish colour, inclining to blue, and the decomposition of the basalt affords a favourable soil for the growth of the grape.

The fortunate situation of Madeira, placed between the limits of the temperate and torrid zones, enables the inhabitants of this favoured clime to cultivate the plants of two climates. The common potato grows in company with the esculent *Arum*, and the *Date* of the east with the Banana, and the *Fuschia coccinea* is seen in company with the *Vinca* and *Lonicera*. In the course of our excursion we visited the monastery of Nossa Senhora del Monte, surrounded by groves of chesnut-trees, and the cultivation of its garden seemed to form the chief amusement of its inhabitants, who have adorned their retired abode with some of the finest plants of Europe and America. At sunset the chiming of the bells reminded us that it was time to return to the vessel, while our strange pursuits had attracted the notice of the islanders, and seemed to have excited their contempt. Next morning we left Madeira, and by the 15th August our proximity to the tropic was indicated by the abundance of flying-fish we now saw; and, in the dull monotony of a long voyage, it was no small pleasure to preserve and dissect even these well-known animals.

On entering the tropical regions, the marine Zoophytes become more abundant, and we had now every opportunity of witnessing that beautiful though still obscure phenomenon, the luminous appearance of the ocean. We fortunately were successful in procuring one of the most interesting of the phosphorescent inhabitants of the Atlantic. Since we had left the temperate zone, we were delighted by the brilliancy of a tropical sun, and the clear and serene sky, where a cloud or a shower are regarded as an agreeable novelty, and where, in the evening, the deep azure colour of the waves is replaced by flashes of vivid phosphorescence; but as we approached the equator, the weather became squally and cloudy, attended by frequent though moderate thunder storms, which generally prevail in the vicinity of the line. On the evening of the 3d September, during one of these squalls, the sea became so uncommonly luminous as to attract even the attention of the sailors; and on bringing up a bucket of water, we found it contained some beautiful specimens of the *Pyrosoma atlanticum* of Peron. It was probably from the phosphorescence of this animal that the sea acquired its uncommon brilliancy. This animal, or rather aggregation of animals, is about two inches long, and as thick as the finger, somewhat cylindrical and diaphanous. On its surface are numerous scattered tubercles; at one extremity is a circular orifice, which opens into a central cavity; the other extremity has a globular form, and has no vestige of an aperture. The central cavity extends through the body. On its surface are little yellowish papillæ which appear to communicate with the external tubercles. At first sight the *Pyrosoma* might be mistaken for a solitary individual of the zoophyte class, but the researches of Cuvier prove that it is an assemblage of smaller animals united organically together. This animal we never found in any other part of the ocean,—a circumstance in accordance with the observations of Peron, who remarks that these oceanic Mollusca and Zoophytes are by no means scattered indiscriminately over the ocean, but generally confined within definite geographical limits. See Peron, *Voyages*, t. i. p. 488. For a figure of the *Pyrosoma*, see Plate 30, Fig. 1 and 2 of the same work.

On the 11th September we crossed the equator, but were detained for some time among the variable winds and heavy tropical showers. The sea-birds of the torrid zone, the tropical bird *(Phaeton aethereus,)* and the man-of-war-bird *(Tachypetes aquilus,)* were frequently to be seen, and seemed to be in alliance with the Bonito, *(Scomber Pelamis,)* for maintaining a perpetual war with the flying-fish. As we advanced to the south, the *Procellaria Capensis*, a beautiful species of Petrel, became very abundant, but though they greedily devour any fatty substance we throw overboard, all our endeavours to procure one of them have as yet been unsuccessful.

25th September.—The abundance of land-birds around us, and the number of butterflies which fluttered among the rigging, indicated the vicinity of land, and in the afternoon our expectations were realized by the sight of Cape Frio, the first land in the new world we had an opportunity of seeing.

27th.—While sailing into the harbour of Rio de Janeiro, we were entirely occupied in preparing to add to our collections a rich variety of specimens in every department of natural history. From the deck of our vessel, the hills of Brazil, covered to their summits with the richest verdure, promised to satisfy the ardour of the most zealous botanist.

28th.—To-day we landed near the Palace, which is utterly unworthy of being a royal residence; and in our progress through the town, although some of the streets had a good appearance, no public edifice of any merit attracted our attention. The streets are narrow, and the houses are built of granite, with which the streets are also paved. The churches are numerous, but none of them are very remarkable for the beauty of their architecture, and the interior is distinguished only by a tasteless profusion of gilding. The city is supplied with water by fountains, which draw their supplies from the neighbouring hills by means of an aqueduct, which is certainly the most splendid and useful public edifice in South America. Rio also possesses several useful institutions, which, however, are still in their infancy. There is a museum of natural history, which we had no opportunity of seeing during our stay in Brazil, as it was undergoing some repairs. In the town there is a sort of public garden, which contains some curious plants; but there is a much more extensive establishment at Botafogo, where are several interesting oriental trees and shrubs. In this garden the tea-plant, the bread-fruit, and the nutmeg-tree are cultivated.

After visiting the town, we set out to examine the natural history of its environs. The coast attracted my chief attention, that I might have an opportunity of collecting some marine animals,—and my expectations were not disappointed. The number of crustaceous animals with which the shore abounds is astonishing, and the rocks are everywhere covered with fine species of *Holothuria*, sea-stars (*Asteriæ*,) and sea-anemones (*Actineæ*,) &c. In this profusion of interesting objects, one is more perplexed in making a selection than in procuring specimens. In the afternoon I returned to the ship with a collection only limited by ability to carry it.

29th.—The heavy showers prevented us from collecting many plants, as one is exposed in the woods to the double inconvenience of the wet and the mosquitoes. I was, however, fortunate in finding a friend, whose hospitality and knowledge of the country enabled me to spend my time to more advantage than a stranger could otherwise have done. To Mr Boag I was further indebted for considerable additions to my collection of reptiles and insects, and in directing me to those places where the most interesting plants were to be found.

30th.—The few days I had now to spend at Rio were occupied in making excursions to the neighbouring woods and hills. But although plants were easily collected, they were rendered so moist by the frequent rains as to render the task of drying them extremely difficult. In these excursions, it is with intense curiosity one newly arrived from Europe visits the woods of a tropical country, and sees growing, in their native wildness, those plants which are cultivated with so much trouble and expence in more northern regions! Here one sees the *Melastomae* and *Bauhiniae* unregarded, except by the curious foreigner, and the trees of Europe rivalled in height by the ferns of the tropics.

The most abundant rock in the neighbourhood of Rio is granite. Near the sea this rock is interesting, from the large size of the crystals of felspar and mica which enter into its composition; some of the crystals of felspar were from two to three inches in length. In the vicinity of the coast this rock is protected from the influence of the weather by the dense vegetation which covers the soil. In ascending one of the neighbouring hills, the rocks are quite exposed, and destitute of vegetables: these rocks are of a white bleached appearance, and consist of decomposing granite, so altered, that its component minerals can scarcely be recognised. The summit of this hill is also composed of granite, but not in a decomposing state, like that lower down; nor is it of so coarse a texture as the granite of the coast.

The crystals of mica and felspar are smaller, and the former is of a deeper colour than it is near the sea. On this hill (Corcovado) the Brazilian government have a telegraph; and no place could be better adapted for such a purpose, as it commands a beautiful and extensive view of the coast. To the north, Cape Frio is distinctly seen, while the city of Rio and the bay of Botafoga appear like a magnificent chart spread at the feet of the spectator. The fatigue of this journey is amply repaid by the beauty of the view; and the descent under a meridian sun is one of the most cheerful scenes a naturalist can witness. The numberless variety of insects, displaying the most brilliant colours to advantage in the rays of the sun—the serpents and lizards issuing from their holes in quest of their prey,—exhibit an appearance of life and activity that cannot fail to please.

No excursion in the vicinity of Rio can be more agreeable than exploring the Corcovado, in the vicinity of the aqueduct, where the traveller enjoys its cooling streams, and, for the same reason, finds animals more frequent in such a situation. Here one may procure an endless variety of insects,* and of the most curious reptiles, while the strange appearance of toucans, humming-birds, and parrots, pleases the ornithologist. In proceeding further up the hill, the streams which supply the aqueduct spread over a large surface of granite rocks, in the form of gentle cascades. After leaving the cascades of Caryoca, the ascent became more steep; but one had little reason to complain, as there was always a supply of cooling water at command, and curiosity was always kept awake by the variety of new objects which attract attention. In this situation the *Bignonia Chambelaini* grows in great abundance. During this excursion, I was often interrupted by the unfortunate slaves, who seemed to be aware of the nature of my occupations, and brought me many fine insects for a small pecuniary reward; one of them brought me a fine living specimen of a beautiful snake, *Coluber venustissimus.*

On the 13th October we left Rio, and proceeded on our voyage to Cape Horn, our progress southward was soon indicated by a corresponding change of climate. The absence of the tropic bird and man-of-war-bird, (*Tachypetes,*) and other inhabitants of the torrid zone, was now compensated by the appearance of the petrels and albatrosses of the southern hemisphere. We succeeded in procuring plenty of specimens of the Cape petrel, (*Procellaria Capensis,*) by means of a fish-

* Papilio Torquatus, Pandrosus, Evander, Colias, Statira, Thecca, Galathea.

hook bated with a little suet; while off the Patagonian coast we caught about 200 individuals, which, notwithstanding their fishy flavour, were not disliked by the sailors. The Petrel, when caught, never fails to vomit a considerable quantity of yellowish oily fluid on his enemy, and on dissection the source of this supply is easily detected. The first stomach is large and membranous, and thickly set with numerous glandular follicles, which appear to be the organs which secrete this oily fluid, the only defensive weapon this animal possesses. The Petrel lives chiefly on the minute crustacea, as we found no other kind of animals in the numerous stomachs we examined.

29th.—For several days past great quantities of sea-weed have floated past us, and we at last succeeded in procuring a mass of this fucus, which, on examination, proved to be the *F. pyriferus.* The roots of this plant abounded in marine animals, forming a little floating menagerie of crustacea and zoophytes. We obtained five species of sertularia, two species of testaceous mollusca, two sea-stars, (*Asteriæ*,) two fine species of *Cancer*, an *Echinus*, and a *Hirudo*.

4th November.—We have now got round Cape Horn without experiencing any of those dreadful storms which are far more alarming in the journals of travellers than off the coast of Terra del Fuego. The chief difficulty arises from the constant westerly winds; but in the summer season probably little danger is to be apprehended.

8*th*.—This morning we were nearly becalmed, and had abundance of albatrosses in the vicinity of the ship. In the course of an hour we succeeded in procuring forty specimens, all of the dark-coloured variety, *D. fuliginosa.* Some of these birds measured seven feet between the tips of the wings. Their weight did not correspond well with their size, as they generally weighed about five pounds. This was owing to the very thick plumage with which they were provided. The physiognomy of the albatross is very remarkable; its flat head and crooked bill give it some resemblance to the owl, which is much heightened by its large eyes and very convex cornea,—a structure which renders it probable that this animal seeks its food chiefly during twilight. The œsophagus of this bird is furnished at its upper part with an apparatus similar to what we find in the gullets of the marine turtles, and probably for a similar use, as the albatross lives principally on molluscous animals of the genus *Sepia.*

As we advanced to the north, the *D. fuliginosa* became more scarce, while the larger species, the *D. exulans*, appeared more abundant; and, as far as our experience goes, we always found that the dark leaden-coloured species was more plentiful in high latitudes, and that the *D. exulans* always approached nearer the confines of the tropics. The last named species is by far the largest of aquatic birds; one of them we examined measured twelve feet between the extremities of the wings, and weighed eighteen pounds. The feathers of this species abounded in a large species of *Ricinus*, and in their intestinal canal we found two intestinal worms,—the one was an *Ascaris*, which inhabited the œsophagus, and the other was a *Tænia*, which abounded in the great intestines.

14th December.—This forenoon we saw the island of Massafuero, bearing N.N.E.; and the appearance of land, however inaccessible, is always agreeable, especially during a tedious voyage. This island had a rugged appearance, terminating in steep, almost perpendicular, rocks, which render it of very difficult access. The highest land might be about 200 feet above the level of the sea. The only inhabitants of this rock are the goats and seals; and on account of the latter it was frequently visited by vessels occupied in killing seals, and carrying their skins to China. The master of one of these vessels, alike destitute of every principle of honour and humanity, formed the design of taking away a number of the inhabitants of Easter Island, and leaving them to kill seals for him on this desolate spot. With this intention he proceeded to Easter Island, and after seizing a number of the unsuspecting natives who had visited the ship, and secured his unhappy victims, he resumed his voyage to finish his scheme. After being three days at sea, they were allowed to come on deck, under the idea that distance from land would have rendered them tractable, as all hopes of again seeing their native island must now be at an end. In this, however, he was disappointed, for they all leaped overboard, expecting to swim to Easter Island. The boat was sent to pick them up, but they preferred death to slavery, and, by their dexterous diving, successfully eluded the pursuit of the sailors. They were seen to swim away in different directions, as each thought was most direct to their native island, which they were never to revisit.

At a distance Juan Fernandez brings to recollection the appearance of Madeira, only its superior verdure is rendered doubly charming by the vast extent of ocean one traverses before he can visit its fertile valleys. The island was approached with equal interest by every one in the vessel, but with different feelings; the seamen regarded it as classic ground, from the romance connected with its history, and the naturalists expected many additions to their collections, in a land as yet untouched by the botanist.

15th.—We landed in a small bay at the northern extremity of Juan Fernandez, and hastened to explore the hills whose verdure promised us abundance of plants. The level land near the coast had more resemblance to a European cornfield than to a desolate valley of the Pacific Ocean, being entirely overgrown with oats, interspersed in different places with wild carrots. On penetrating through the corn-fields, we discovered a small cavern excavated from the decomposing rock, and bearing evident traces of having been recently inhabited. A kind of substitute for a lamp was suspended from the roof, and the quantity of bones scattered about showed there was no scarcity of provisions on the island. A little to the eastward of this strange abode, our curiosity was amply gratified by a beautiful example of romantic scenery. A natural arch, about seven feet in height, admitted us to a small bay, bounded on all sides by steep perpendicular rocks, continually washed by the waves. The almost inaccessible crags afforded a secure retreat to the sea-birds, which resort thither to deposit their eggs. These rocks are of a more volcanic appearance than those of Madeira, and contain many small crystals of a green-coloured mineral. This bay abounded in sponges, which had been washed ashore, and many of them in a very fine state. We succeeded, though with much difficulty, in detaching some specimens of a species of *Cerastium*, which grew on the surface of the rocks.

Having satisfied our curiosity respecting the shore, we proceeded up the valley, in expectation of finding more plants. Here we found a little stream of excellent water, which was first detected by its rippling, as its surface was entirely concealed from our notice by the immense quantities of mint (*Mentha piperita*) and balm (*Melissa officinalis*) which grow on its margins. In the afternoon we returned to the ship, well satisfied with our excursion; but the boat's crew had procured very little water, as the stream lost itself in the sand about a mile and a half from the beach.

17th.—This morning we landed in Cumberland Bay, which we found far better than the place we had visited yesterday, for procuring water and vegetables. On approaching the landing-place, we were surprised by the appearance of smoke arising among the trees, and by seeing goats feeding near the shore. When we got ashore, we were much pleased by finding an Englishman, who welcomed us to the island, and offered us all the assistance in his power. He told us, that, when our boat first made its appearance, he was afraid we had belonged to some Spanish privateers, and had concealed himself in the woods, as his little establishment had been formerly destroyed by these unwelcome visitors. Our new friend's name was William Clark; he had sailed from Liverpool several years ago, and visited most places in the South Pacific. At present he belongs to a party of English and Chilians, employed in killing the goats and bullocks, which are plentiful here, and in remitting their flesh and skins to different parts of the Chilian coast. The rest of the party had gone to the other side of the island, and would not return for a week. We were highly delighted with the beautiful situation where they had fixed their abode. A fine stream of water ran into the bay, a few yards from the landing-place, and the house was situated amidst a shrubbery of *Fuschia*, mixed with peach and apple-trees. The sea abounded in fishes, and the fruits of Europe grew in the greatest profusion. In the vicinity of Cumberland Bay we saw the following foreign vegetables, chiefly European: oats, pears, apples, strawberries, peaches, vines, rue, mint, balm, radish, Indian cress, and figs.

Our guide had very little European furniture in his house, but we were much surprised at the extent of his library, as he possessed upwards of twenty English books on different subjects. The most curious article he had was an iron pot with the bottom knocked out. It was, however, too valuable an article to be thrown away, and he had fitted a wooden one to it; when he had occasion to boil any thing, he immersed it in the earth and kindled a fire round its sides.

During our short excursion to the interior we had no occasion to complain of the poverty of the country, as it abounded in the most beautiful plants and shrubs. The dry soil was covered by an evergreen *Arbutus* and a shrubby *Campanula*, (bell-flower,) and almost every sheltered rock afforded a different species of fern. During this excursion we were tempted to stop in the vicinity of the old fort by the abundance of ripe strawberries which grew on the sides of the hill; these strawberries were of small size and pale colour, but of a very agreeable flavour. One curious circumstance is the redness of the soil in this situation, which is, however, much exaggerated by Lord Anson, when he says it equals vermilion in brightness; but the redness of the ground was so inconsiderable that it would not have attracted our attention had we not been directed to it by Lord Anson's statements.*

Cumberland Bay used to be the favourite resort of the English privateers and whalers; and in time of war its utility to them was so great as to excite the jealousy of the Spaniards, who, in 1765, constructed a battery mounting fifty guns, to command the harbour, and at the same time formed a settlement on the island; but in a few years this colony was abandoned. In 1811 the island was resettled and used as a place of banishment for convicts from Chili. This attempt, however, like the preceding, was given up after a short trial. At present the island is seldom visited by ships, but is still the occasional residence of the adventurers employed in procuring cattle and fishing. The battery, which still remains

* These two statements may be reconciled by supposing that Lord Anson saw the soil when the sun was near the western horizon. We have seen the same soil exhibit the same discrepancy of colour under different circumstances.—Ed.

almost uninjured, is situated on an eminence about 500 yards from the beach, and effectually commands the landing-place. Most of the guns remained till a few years ago, when they were removed by the Chilians to prevent their falling into the hands of the Spanish royalists. The ground on which the fort stands consists of a red-coloured earth, formed by the decomposition of the basaltic rocks, and is plentifully covered by strawberries, now in a state of ripeness, and very abundant. To the west of the battery a church, and an excellent oven, still remain. The church is built in the form of the Latin cross, and bears the following inscription. "La caza de Dios overto del cielo y saccolacaesta, 24 de Septiembre 1811." Although the doors and windows of this building had been removed, it still possessed the font, and the walls still retained their whitewashed appearance. To the north east of the church this beautiful valley is quite covered by corn-fields, which are still divided from each other by their former landmarks. As the valley approaches the mountains, the clusters of ferns raising their green fronds on the margins of the stream, have a most pleasing appearance, and, in my opinion, forms the most beautiful vegetable ornament of the island.

Such is the present state of that island which afforded to Lord Anson's ships so much refreshment after his voyage round Cape Horn, and fully merits all the praises he bestows on it. With a climate similar to Madeira, and a similar geological structure, it is probable that Juan Fernandez should afford equal advantages for the cultivation of the vine; and those plants which we saw appeared to grow luxuriantly, and were loaded with plenty of grapes, but still in an early state.

Land animals are by no means numerous, nor, with the exception of the seal, can Juan Fernandez boast of a single indigenous mammiferous animal. The bullock, the goat, and the rat, are the only other animals of this class, and all of them have been introduced. The cattle are now driven from the north side of the island, since the hunters have fixed their residence there; but they are still abundant on the southern extremity, which is more inaccessible. The hunters in killing the bullocks drive them into a small plain, bounded by steep hills, and then shoot them. In killing the goats, a different method is adopted. The people employed in this difficult business lie down in those rocky situations which the goats frequent, and when they approach the hunters, their hamstrings are cut with a sharp knife.

Juan Fernandez is entirely destitute of lizards and serpents, at least we never saw any.

The rocky shores afford a safe retreat to the Cape petrels and other sea-fowls which abound near the island, so that it was in vain we attempted to reach their nests. The only land-birds we saw were pigeons and owls. The former are exceedingly abundant, especially in the vicinity of the corn-fields, from which they probably obtain their chief support. The owls are of small size, and by no means abundant; they appear to be confined to the more secluded places, at a distance from the shore.

The bay abounds in fishes, which are to be procured with very little trouble, so that, if the visitor fails in procuring cattle, he may at all events depend on a plentiful supply of fresh provisions. Our limited time did not allow us to examine the different fish we caught with sufficient care; but the most common, and by far the best, is the cod (*Gadus morhua*;) the next in frequency is the lump-fish (*Cyclopterus lumpus*,) which is seen adhering to almost every stone; and this helpless animal becomes a ready prey to the seal and the sea-fowls.

The articulated animals are the most plentiful on this island; and although we saw few insects, I have every reason to believe they are exceedingly numerous at a more advanced period of the year, for almost every vegetable had its peculiar caterpillar feeding on it. Near the shore we found several kinds of crab, and the deep water abounded in a beautiful species of lobster, which may be described in a future paper.

The antennae were as long as the body, which is of a fine red colour, and thickly set with strong sharp spines. The difficulty of obtaining this animal, from the quickness with which it swims, and the trouble of laying hold of it from its sharp spines, rendered it an interesting specimen.

At low water we found some species of corallines and sponges, and a sea-star (*Asterias*,) furnished with from twenty-five to thirty-eight rays.

19th December.—This morning we left Juan Fernandez, and directed our course to the Gallapagos. The island of Juan Fernandez, for beauty of scenery and richness of verdure, exexceeds any place we visited during our voyage. Independent of its natural beauty, the deserted houses and ruined gardens give variety to the landscape, and add an interest to the scenery which the unsettled desert cannot possess. Previous to going on board the ship, our countryman, whose exhausted wardrobe we had in some degree replenished, gave us the acceptable present of a goat which he had feeding near the house, and would gladly have added more to our fresh stock, had it been in his power.

7th January.—Our passage to the Gallapagos was the most pleasant part of our voyage. We enjoyed the serene weather and cloudless sky of the tropical regions. During this weather the Noddy (*Sterna stolida*) for the first time alighted on our vessel, a bird which we only saw in the tropical climates. This bird is remarkable for the stupidity with which it allows itself to be taken; it would perch on the rigging, and, regardless of our presence, quietly allow itself to be laid hold of.

9th.—We saw Chatham Island, one of the Gallapagos. The appearance of this island at a distance indicates but little fertility. The land consisted of low conical hills rising gradually from the ocean, and bounded by a flat sandy beach, against which the sea beat with some violence. On the hills many dark patches of land appeared entirely deprived of vegetable covering.

10th.—To-day the boat was sent to land on James's island, to ascertain what was to be found in the way of fresh provisions. The land is in some places very abundant in trees and shrubs, while other situations presented a bare and exposed surface, consisting of masses of lava. Such at least was the appearance from the ship. In the afternoon the boat returned, bringing two very large turtles (*T. viridis*,) Iguanas, and plenty of fish. Those who had been in the boat assured us that the shore abounded in turtles, and that tortoises were to be got in the woods. They had not however seen any fresh water.

11th.—Next day we went ashore in the long-boat, and found considerable difficulty in landing, on account of the heavy surf which beat against the beach. The place where we now were consisted of a low sandy bank which separated a small salt water lake from the sea. Here we found traces of previous visitors, but the most unequivocal and most affecting was the tomb of an American officer. This unassuming grave was only accidentally discovered, as it is concealed from notice by a thick bush-wood, cotton trees, and *Tournefortiæ*. At the head of the grave was a board painted black, and bearing the following inscription, so honourable to the deceased. "Sacred to the memory of John Cowan, lieutenant of the U. S. frigate Essex, who died here September 1813. His memory is lamented by his friends and country, and honoured by his brother officers." *

On penetrating into the country, we found very few plants, at least few in comparison to what we might expect in such a climate. The abundance and interesting nature of the animals well compensated for the scarcity of plants; but the heat was so intense, and the moisture of the country so great, that we were unable to preserve many birds and fishes which we thought new or curious. The rocks were covered by pelicans and other web-footed birds watching the fish, and, near the coast, various species of heron were very common. The pelican belonged to the common species, (*P. onocrotalus*,) but most of them were young individuals.

In this excursion we trode, for the first time, on volcanic ground, and made our way, with difficulty, through the loose lava, which readily gave way under us, and reminded us of the slag and melted matter in the vicinity of a smelting furnace. Near this place we saw a large column of volcanic matter, situated amidst a stream of lava; its surface was rough and uneven, and in many places deeply excavated—it reached to the height of sixty or seventy feet. During my excursion, I had not the good fortune to see any vestiges of a crater; but Mr Douglas, who had taken a different route, informed me he

* This unfortunate gentleman was killed in a duel with one of his fellow-officers. In another part of the island we saw the remains of a small hut, or rather cave, which had been occupied by a Spaniard, who spent two years on this wretched place, where he had been left by his companions.

had seen one, a circumstance which we had expected, as we saw one of the conical hills of Albemarle island burning every night we were in the vicinity of this group of islands. In the woods, where the grass is abundant, we found the tortoises grazing, and many of them of large size, weighing probably 200 pounds.

The tortoise, (*T. Indica,*) we found to be much more agreeable food than the green turtle, as it is quite free from the fishy flavour which the other possesses. We found much difficulty in taking them to the shore, on account of the excessive heat, and the roughness of the ground.

The birds were so tame, as to be easily knocked from the branches on which they were perched, and frequently alighted on the sticks we happened to have in our hand. In returning to the beach, we killed plenty of Iguanas, an animal of the lizard tribe, and esteemed a most delicate kind of food in tropical countries. Although our Iguanas differed very much from the West Indian species, both in size and appearance, being larger and of a yellowish colour, we found them much more palatable food than turtle.

The following is an account of the most frequent animals we saw during our short visit to James's island. The only mammiferous animal is a species of seal, with very short ears and short brown hair. We killed one individual, but it soon became so putrid, that we were unable to make a description, a circumstance which prevented us from examining, in a detailed manner, many other animals. In addition to the birds already alluded to, we saw a beautiful bird of the genus *Sula*, nearly allied to the soland goose; its colours are very fine, and, what is most remarkable, the feet and legs are of a beautiful azure colour. On the elevated rocks, we frequently saw a small though handsome species of eagle, of a golden yellow colour. A small species of pigeon was very common in the woods, distinguished by the beauty of its plumage, and the bright metallic hue of the feathers of its neck.

The reptiles, which are very numerous and interesting, are different kinds of turtles and lizards. The tortoise frequents the shady places in the interior of the island, where grass is plentiful, which they consume in large quantities. As the tortoise is destitute of all offensive weapons, he draws his head and limbs within his shell on the approach of danger, making at the same time a hissing noise. These animals are capable of enduring very long fasts, and in cold weather they remain quite torpid. I kept one of these tortoises for eight months, and, during that time, it did not consume above an ounce of food.

The green turtle is very plentiful, and attains a great size, often weighing 300 pounds; and, in the course of two days, we caught about thirty of these animals. We had two methods of taking the turtle; we either surprised them while they came on shore, or caught them while asleep on the water. In this case we approached them in the boat, making as little noise as possible, while a man stood ready to fix a tomahawk into the shell, and to hold him till he could be lifted into the boat. This last method was attended by an inconvenience, that the turtle was often so injured, as to die in a few days.

The woods abound in a species of Iguana, which I think is new, but, unfortunately, the specimen I attempted to preserve became so putrid, that I was obliged to throw it away. It is almost twenty-nine inches long; the back and sides are of a brown colour, and the belly is yellow; the whole skin was covered by small scaly tubercles, and had a ridge of very large pointed ones extending along the back, from the occiput to the extremity of the tail. There was a dilatation under the throat, but no large tubercles in that situation. The tongue was fleshy, inextensible, and slightly bifurcated at the point. The Iguana lives entirely upon leaves and fruits, and burrows deeply into the ground.* It is a timid inoffensive creature, and always runs from the pursuer, unless when wounded, when it turns upon its enemy. We killed great numbers of them, and used them as food. There is a smaller aquatic species, belonging to the genus *Monitor*, with a flat perpendicular tail, but it is much rarer than the other.

* The sandy ground near the coast is quite ploughed up by these animals, so as to render walking in the vicinity of their abodes very troublesome.

Although snakes are said to abound on the Gallapagos, yet in all our excursions we never saw a single species.

Shells and molluscous animals were not very plentiful. Crabs of different species were very numerous, and some of them very beautiful. The land-crab was common near the shore, and appeared to be more gregarious than the other species; they were seen running about in small families of twenty or thirty individuals, and when pursued covered themselves in the sand.

On the 19th we left these islands and proceeded to the north-west coast.

All the islands of this group have a similar appearance. In some places the coast rises into perpendicular rugged cliffs, attaining the height of 200 feet, and in other situations it assumes the form of a low sandy beach, separating some salt-water lakes from the sea. The mountains are generally of a conical shape, very gradual ascent, and moderate elevation. The country, in most places, is pretty well furnished with trees, except where the lava has run down, and in these situations very few vegetables grow.

ART. II.—*Illustration of some Facts connected with the Developement of Magnetism by Rotation.* By PETER BARLOW, ESQ. F.R.S. Mem. Imp. Ac. Petrop. &c. In a Letter to the Editor.

DEAR SIR,

As I feel interested on some of the subjects alluded to in Mr Christie's letter in your last number, I must beg to be allowed to make a few observations, with a view to correcting any errors which may have been committed in the reports of our experiments. Neither Mr Christie nor myself can wish to have any thing recorded but what we believe to be correct, and therefore the plainer the facts connected with these questions are stated, the better.

Mr Christie objects first, to that part of the historical notice, in which it is said that " in repeating some of my experiments," he was led to observe that property of iron which forms the subject of his paper. Now the plain fact is this:—In 1819, I proposed my correcting plate, and from that time it became necessary for me to ascertain the attractive power of circular iron plates in different positions, and at different distances from the needle, and to determine their strong and weak points of local magnetism; which was done by making them revolve on their axis in certain situations near the compass.

In 1821 Mr Christie, with some particular views of his own, undertook a series of experiments on the attraction of circular iron plates, on which it was likewise necessary for him to determine their strong and weak points of local magnetism, by making them revolve on their axes; and while thus engaged, he fell upon the property in question.

His object, of course, was different from mine, and the results he obtained were entirely his own; but one may see clearly, that it was the similarity in the two processes that led to the passage in the report complained of. Strictly speaking, however, these experiments were not a repetition of mine, and it was certainly not my wish they should have been so represented. At the same time, as mine were probably the first experiments in which iron was put in rotation for magnetical observation, I think they were very properly introduced into the historical notice.

I must beg, also, to bear testimony with Mr Christie, that his paper in the *Camb. Phil. Trans.* was undertaken with a different view to mine; but still, as the experiments were not made till after mine were completed, and for the purpose of verifying an hypothesis suggested by a comparison of my results,* on the apparatus which had been constructed for me, and with the same designations of latitude and longitude of position, I can hardly consider the inquiries as " quite unconnected."

There was indeed this difference, as Mr Christie has stated in his letter, that, both in this paper and that more particularly in question, he referred the centre of the ball to the sphere circumscribing the compass, while I referred the compass to the sphere circumscribing the ball, and pages 21 and

* See p. 110, 1st Edition.

28 of my first edition are quoted, to show that I in "all cases" so made my reference. I undoubtedly generally made my reference in this way; but still, in page 51 of the same edition, in the "General Summary of my first series of Experiments," I have stated, that, "instead of conceiving the imaginary sphere to surround the ball, we may imagine a similar sphere concentric with the pivot of the needle; then it is obvious, that the centre of the ball will have the same relative position on the latter sphere, as the pivot of the compass has with respect to the former; so that the reference may be made to either at pleasure."

In fact, whether I had stated this inversion or not, it does not necessarily alter one step in any investigation, nor change a single letter or sign, whether the reference be made to one centre or to the other. It is obviously the idea of employing latitude and longitude of position by means of an imaginary sphere, instead of the usual position by rectangular co-ordinates, that is meant, where it is said that "Mr Christie, adopting the views of his friend Mr Barlow, by conceiving an ideal sphere to surround the compass," &c.; and I must think that common courtesy required this reference.

Mr Christie's next remark, which applies rather to myself than to the reporter, is certainly a very singular one, viz. that notwithstanding I waited from December to May, that our papers might appear together, I afterwards rendered that accommodation nugatory, by permitting a report of my experiments to appear in the Edinburgh Journal for the July following, that is, two months after the papers were read, and the *very day* on which two distinct reports of Mr Christie's experiments were published in two other quarterly journals; and he at the same time expresses his surprise how it should be known in Edinburgh, (although I had been there just before) that this delay had taken place. The following explanation, therefore, does, upon the whole, appear to be necessary.

When the thought had occurred to me to make my experiments on the rapid rotation of the iron ball, and that I had obtained the result, (some months after Mr Christie had given the first sketch of his experiments in the *Phil. Trans.*) I mentioned the circumstance to him, and in consequence of the analogy between the two series proposed, and I thought it was agreed between us, that he should complete his paper in the form he had intended, and that mine should be delayed till he was ready. Having taken this step, and duly noticed Mr Christie's prior experiments in my memoir, I hoped I had complied with every thing that good fellowship, or the interests of science required, by thus leaving to Mr Christie all the advantages he could have derived from an earlier publication of his experiments. I must say, therefore, that I was rather surprised afterwards to find that he had, in this interval, added an appendix to his paper on this new class of rotations, in which no mention whatever is made either of my experiments, or of this arrangement. This omission, and a very injudicious remark in one of the reports above alluded to, served to throw a mystery over the subject, and to imply a want of candour on one part or the other, which the slight reference that had been made in another part of the paper, was by no means calculated to remove, but which, I conceived, ought to be cleared away. It might therefore easily have been conjectured through whom the information relative to the delay was obtained; and I was pleased to find it had been given exactly as I desired, that is, merely stating the fact, without any reference to the omission alluded to; and I cannot but wish it had been allowed to pass as it was stated in the report, without rendering this further explanation necessary.

I have only one other observation to make, relative to Mr Christie's remarks on my correcting plate. It would certainly appear to any general reader, from what is said about the "necessity of some precaution" to prevent the plate revolving, that this precaution had been hitherto omitted, whereas it has *never* been omitted since the plate has been permanently applied, it having been always necessary to secure it against the motion of the vessel. The precaution, therefore, although introduced for another purpose, is always taken; and it is a little remarkable, that the very first plate I had made in August 1819, and which I have still by me, did *slide on*, as Mr Christie now recommends, the socket and rod being both square; but I afterwards found it more convenient to make them cylindrical, in order the better to rotate the plates separately on their axes, for the purpose stated in the first page of this letter. The motion of rotation is prevented on ship-board by a *steady pin*, and proper printed directions are given with the plates, to insure their being attended to. I remain, Dear Sir,

Yours very truly,

PETER BARLOW.

ART. III.—*Observations on the Decrease of the Magnetic Intensity of the Earth.* By CHRISTOPHER HANSTEEN, Professor of Astronomy in the University of Norway. Communicated by the Author in a Letter to the Editor.

THE horizontal part of the magnetic intensity of the earth here in Christiania, has been almost quite invariable for these six years since 1819. The observation of 300 horizontal vibrations of my invariable magnetic cylinder, made every day at $10\frac{1}{2}$ A. M. and 5—7 P. M. in the months of maximum (January) and minimum (June,) has given the following results. The observations were made in three different places of my house, A, B, and C, but all very carefully reduced to C.

Place.	Time.	Time of 300 Vibrat. Medium of the Month.	Mean of Max. and Minim.	Difference between Max. and Med.
A.	1819, December,	825″.27	828″.11	5″.69
B.	1820, June, July,	830 .96	829 .09	3 .75
B.	1821, January,	827 .21		
B.	1821, June,	830 .93	829 .07	3 .72
B.	1822, January,	827 .95	829 .44	2 .98
C.	1822, June,	Not observed.		
C.	1823, January,	825 .36	827 .63	4 .54
C.	1823, June,	829 .90	828 .51	2 .77
C.	1824, January,	827 .13		
C.	1824, June,	829 .24	828 .18	2 .11
	1825, January,	Not observed.		
C.	1825, June,	829 .98		
C.	1826, January,	828 .34	829 .16	1 .61

From these results the following consequences may be drawn. The *intensity is more constant in June than in January.* In six summer months it has only varied between 830″96, and 829″24, but in the winter months between 825″27, and 829″98. But the regular daily variations from 10 A. M. to 6—7 P. M., are much greater in June, when they amount to 1″4, than in January, when they are not greater than 0″2. In both these circumstances, these variations have a great resemblance to the variations of the barometer, of which the regular daily variations are greater in summer than in winter, the irregular greater in winter than in summer. I suppose that both these phenomena, (the regular daily variations of the barometer, and of the intensity and the magnetic declination,) have a common cause, viz. a regular motion or stream in the atmosphere, caused by the different effects of the sun-rays, (proportioned to the sine of their angle of incidence,) upon different places of the earth. This streaming, or transposition of great quantities of air from one place to another, will affect the barometer; and different streams of air, of different temperatures, at different heights, may perhaps produce a weak electromagnetic effect, which may have some influence upon the direction and rate of vibrations of the magnetic needle. Consequently these regular variations may be much greater in the summer, in proportion to the variations of the temperature from noon to midnight. But these are only rude ideas, which, on another occasion, I shall more fully explain. 2. The *mean between maximum and minimum of intensity is so very nearly constant*, that it is difficult to say whether it has decreased or increased from 1819 to 1826. 3. The *difference between summer and winter* is very variable, and seems to have regularly decreased from 1819 to 1826; but probably this difference will again increase in the following years. In those days, (from 1st to 3d June,) I have found the time of 300 vibrations varying between 832″9 and 834″0; but as some few observations in the open air have given almost the same result as the observations in June in the same spot in all the foregoing years, I fear that some change in the house may have produced a little local variation, which, by further observations, will be detected.

But as the horizontal part of the magnetic intensity here in Christiania is very nearly constant, and the dip decreases, it follows, that *the whole intensity is decreasing*. Denoting the whole intensity by F, its horizontal part by f, the dip by i, the time of a certain number of vibrations of the horizontal needle by T, and upon another place of the surface of the earth the same quantities by F', f', i', and T', it is evident, that

$$f = F \cos. i, \quad \text{accordingly } F = \frac{f}{\cos. i}.$$

Now, as i is decreasing, cos. i is increasing, and consequently F. decreasing. Further,

$f : f' = (T')^2 : T^2 = F \cos. i : F' \cos. i'$, and $F T^2 \cos. i = F'(T')^2 \cos. i'$; that is, $F\,T^2 \cos. i$ is for the same magnetical needle a constant quantity over the whole surface of the earth, and also in the same place at different times. Calling this constant = C, we have,

$$\text{I. } FT^2 \cos. i = C, \text{ or } F = \frac{C}{T^2 \cos. i}.$$

Where C can be found when upon a single place F, T, and i are observed. Differentiating the equation, No. I., you will find, (C being constant,)

$$\text{II. } \frac{dF}{F} + \frac{2dT}{T} - \text{Tang. } i\, di = 0,$$ (where di may be expressed in parts of the radius.)

As in Europe di is *negative*, the last member, Tang. $i.\ di$, changes its sign, and consequently the whole sum cannot be = 0, unless $\frac{dF}{F}$, or $\frac{2dT}{T}$, or both of them, are *negative*; that is, unless the variation of intensity dF, or of the time of vibrations dT, are negative. In Christiania I have found, by a great number of observations,

In 1820, - -	$i = 72°42'6$
1825, - -	$i = 72°26'4$
Decrease in five years,	$= -16'2$
Yearly di = - -	$- 3'24$.

By the observations of *Mr Arago* at Paris, (where the whole intensity, according to Humboldt's Observations, is supposed = 1.3482,) with one of my cylinders, I have found log. C = 5.45064 ; in Christiania, in the open air, by the mean of the year, T is nearly constant = 814″76. By equation No. I., I then find,

For 1820,	F′	=	1.4306
1825,	F′	=	1.4093

Difference in five years, F′ — F = — 0.0213
Yearly dF = — 0.00426.

By putting $di = -3.24$, $dT = 0$, in equation No. II., you will find $\frac{dF}{F} = -0.003$, and $dF = -F.\ 0.003 = -0.00426$, as before.

By comparing my own observations of 300 vibrations of the magnetic cylinder at London and Paris in 1819, with those of Captain Kater and Mr Arago in 1823, I find the following differences:

	London.		Paris.
1819, Hansteen,	777″79	Hansteen,	756″19
1823, Kater,	775″34	Arago,	753″03
Difference = —	2″45	Difference =	— 3″16.

I must confess that my observations were not made in the open air, as those in 1823, but in the middle of great rooms, where no iron was visible. Accordingly, they are not quite unexceptionable. But as they agree in making the time of 300 vibrations in both places nearly 3″ longer than in 1823, I will assume the annual decrease of T for London dT = — 0″61, for Paris = — 0″79. Further, supposing in 1821,

At Paris, $i = 68°23′$, $di = -3′84$, $T = 754″61$, $dT = -0″79$,
At London, $i = 70°3′$, $di = -3′22$, $T = 776″56$, $dT = -0″61$,

by these suppositions, Formula II. gives dF at Paris = — 0.00098, and at London = — 0.00138.

By comparing my own observations at Berlin with those of Mr Humboldt, I have found, that the intensity there is also decreasing; namely,

Christiania, dF	= — 0.00426
Berlin,	= — 0.00193
London,	= — 0.00138
Paris,	= — 0.00098.

Hence it seems evident, that the *decrease of the intensity is greater in the northerly and easterly parts of Europe than in the southern and westerly.* The cause of this change is evidently the same as the cause of the decrease of the dip, and the increase of the westerly variation in the same places, viz. the motion of the magnetical North-Pole in Siberia towards the east; hereby the dip and intensity in the neighbourhood of this pole may decrease more than in greater distances from it, and the horizontal needle may turn its northern extremity more towards the American North Pole. But as this latter pole also has a slow motion against east, it is probable, that in the north-westerly parts of the Atlantic Ocean, for instance at Iceland and Greenland, the intensity is *increasing.* The greatest difficulty on this inquiry, is to get a perfectly invariable magnetical cylinder, or needle. I hope to surmount this difficulty, and I shall, on another occasion, communicate the result of my endeavours.

CHRISTIANIA, *June 3d* 1826.

ART. IV.—*Account of an Earthquake at Sea, felt in the Mediterranean, on the* 29*th November* 1810, *in his Majesty's frigate Salsette.* In a letter from CAPTAIN BEAUFORT R.N. F.R.S. to Dr BREWSTER.

SIR,

As it appears from a passage in your last *Journal,* that you are desirous of putting on record notices of earthquakes that have been felt at sea, the following account of one which I witnessed in the Mediterranean is at your service.

On the 29th of November 1810, at 7 A. M., his Majesty's frigate Salsette being about nine leagues S.W. by W. (true) from the island of Cerigo, and ten leagues south from Cape Matapan, the sky suddenly assumed a remarkably black and threatening appearance, which, however, spent itself before eight o'clock in heavy rain. The wind had changed during the shower from E.S.E. to N.W., where it continued the rest of the day, and very faint, with the exception of one gust, which will be again mentioned. At 11 A. M., solar time, while tranquilly standing to the southward, the ship was felt to quiver violently from stem to stern,—the masts, yards, and rigging partaking of the general tremor, and even the guns being strongly affected. The agitation, which commenced with considerable force, seemed rather to increase for about two-thirds of its duration, and then gradually subsided till it became insensible. According to the general opinion, it lasted between two and three minutes; but, when allowance is made for the surprise occasioned by such an unusual phenomenon, a minute and a half will probably be the safer estimate. The sensation it produced will be accurately recognised by any person who has been launched in a boat over a rough beach of gravel; indeed, the resemblance was so alarmingly manifest, that the leads were instantly thrown overboard; but no bottom was found with seventy fathoms of line, and I have since sounded nearly in the same spot with 500 fathoms without reaching the ground. No peculiar smell was detected in the air, nor was there any ebullition in the sea, nor tremor on its surface, nor change of colour; yet the water alongside had something of a fretful unnatural appearance, not easy to describe,—the little waves suddenly rising and dropping as if their motion was arrested by some unseen impulse acting in a direction contrary to their course. It did not appear that any change had taken place in either the barometer or thermometer; but circumstances unfortunately prevented their being examined for ten or twelve minutes. Many persons afterwards asserted that this singular scene was accompanied by a hollow indistinct noise; but nothing of the kind was heard by the officers, who with me had been attentive observers of all that passed.

In about five minutes after it had ceased, we were assailed by a very sharp squall, accompanied by large hail, and by repeated flashes of forked lightning, with thunder, at the distance of a few seconds of time. The squall was transient, the musky appearance of the sky quickly vanished, and the afternoon was peculiarly serene and clear.

We afterwards ascertained that, on the same day, earthquakes had taken place both in Candia and in the Morea; and as the ship was nearly in a line connecting the extremities of those countries, it was probably the same great convulsion which had extended throughout that space. The only accounts, however, that could be obtained were too loose to identify the shocks, much less to discover in which direction they had been propagated. It is remarkable that from two officers of the English garrison at Cerigo, who came on board the following morning, we learned that no earthquake had been felt in that island, though it forms such a connecting link between the above places, and though that which we had experienced must have been of very considerable violence, to be transmitted through a mass of water of at least 500 fathoms in depth. Slight shocks, I imagine, are seldom communicated, even through shallow water; for it has twice happened to me in Smyrna to have been wakened at night by smart vibrations of the bed, when nothing was felt on board, though the ship was at anchor only one-third of a mile from the house in which I slept, and though officers and sentinels were upon deck, by all of whom such an occurrence could not have been unobserved.

Though very unlikely to have been connected with the earthquake which was felt on board the Salsette, it may not be uninteresting to mention that, on the preceding evening, between 9 and 10 o'clock, several meteors, of different degrees of brilliancy, were seen; and that one of them, which emitted a long train of sparks, passed so near the ship that I heard the whizzing sound of its flight through the air, and, immediately after its disappearance, the fall of a ponderous body into the water. I am, &c. F. B.

ART. V.—*Conjectures as to the Cause of the high degree of apparent acceleration in the Rates of the Chronometers observed by Mr Fisher, and reported by him in the Phil. Trans.* By PETER BARLOW, Esq. F. R. S. Mem. Imp. Acad. Petrop. Communicated by the Author.

WHEN we consider the long practice which has now been had in the use of chronometers on ship-board, without any very remarkable change having been observed between the land and sea rates, although there can be no doubt some small change does take place; and when we combine with this previous practice, the valuable observations of Captain Parry in his late voyages, we cannot do otherwise than consider the results obtained by Mr Fisher at Spitzbergen as anomalous, and as depending upon some cause very distinct from that usually operating on ship-board.

This being the case, I beg to offer what I consider to be by no means an improbable explanation of the irregularity in question; that is to say, Is it not probable, or at least possible, that what Mr Fisher has attributed to an unusual acceleration in the ship, was actually a corresponding retardation on shore, occasioned by the action of some terrestrial magnetic power below the surface of the earth at Fair Haven? Such partial terrestrial action is by no means unknown, I might almost say not uncommon; some instances of the kind have, I believe, been published, and two or three others have come to my knowledge, upon information on which I can place the greatest reliance. The first is a statement made to me by Captains Vidal and Mudge, who informed me, that during their former voyage, while they were engaged in surveying the coast of St Mayo, one of the Cape de Verd islands, they found the land on which they were carrying on their observations so strongly magnetic that the needle of their theodolite became wholly useless: the dip was so much increased that the needle would not traverse till they had inclined the face of the instrument at a very considerable angle, and even then the direction of the former was found so variable and uncertain as to be wholly inapplicable to the purposes of the survey. Now, let us suppose that the chronometers of the ship had been brought on shore in this place to obtain their rates, there can be no question that they would have been found very different from what they were on board, and as the difference would be all that could be shown by the observations, and supposing no partial action to have been suspected on shore, the change would naturally be referred to some attraction in the vessel, but the character assigned to it would be the reverse of that which actually belonged to it; viz. if the chronometers lost on shore, they would be supposed to gain on board, but if they gained in the former case, they would be supposed to be losing in the latter. It is true, that, on the return of the vessel, the error would be detected, provided the rates were still taken in London; and it is much to be regretted that Mr Fisher has not informed us whether this precaution was taken in the cases he has reported, or whether, as in most instances, the chronometers were suffered to go down the moment the expedition returned.

The other case to which I have alluded, I give verbatim from the note I took of it a few years back, while I was at Chatham dock-yard on some business for the Navy Board relative to the stowage of the compasses in that establishment. "Mr Duncan, the master attendant of this yard, who appears to have always paid great attention to the compasses, informed me of a remarkable case which happened to him in the year 1791, while he commanded the Beaver, a vessel belonging to the Hudson's Bay Company. His object seems to have been to find a north-west passage, and while on this service, on the 18th of August of the above year, in latitude 61° 52′ north, and longitude 92° 23′ west, being then about twenty leagues from land, and with soundings from sixty to sixty-five fathoms, with blue mud, he found his azimuth compass, (which he describes as a very excellent one, by the senior Gilbert) suddenly affected in a very remarkable way, the needle refusing any fixed direction whatever. He immediately ordered up his other compasses, seven in number, and they were found to be all affected in the same way, revolving round and round in the most singular manner. He then stood off from the land, and soon after these instruments all resumed their usual action."

"Mr Duncan had with him also a dipping-needle, furnished by the Royal Society, and the dip, on which he also made some observations, varied during a short time from 78° to 86°." The above particulars were all noted by him immediately, and I extracted them from his log-book.

Another instance of a very similar kind was reported to Dr Gregory by Mr Edmondston of Unst, one of the Shetland islands. This case is as follows: Dr Gregory, while making his pendulum experiments, having found the results to be different from what he had anticipated, suspected that it might arise from some partial terrestrial magnetism, and having mentioned his suspicions to Mr Edmondston, that gentleman informed him, that, in one instance, several of his boats were out fishing, and the weather being foggy, they had recourse to their compasses to regain the shore, when the man in the landing-boat, looking to his compass, found it running round, as described by Mr Duncan. He then called to the man in the next boat, whose compass was in the same state, and so also were those in all the others. Mr Edmondston moreover stated, although he could not speak to the fact from his own knowledge, that it is always asserted and believed, that, in approaching the small island of Fetlar, the compass always points directly to the land, on whichever side the approach is made.

Now, there cannot, I conceive, be the least question, that, in any spot of this kind, where a partial terrestrial action so strongly manifests itself, a considerable change would necessarily be observed in the rate of a chronometer; and as we must look to some extraordinary cause for the anomalous results obtained by Mr Fisher, I think it by no means an improbable conjecture, that they might be occasioned by some such partial attractions as those above described. I offer this, however, merely as conjecture, and with every respect for Mr Fisher's talents as an observer and mathematician.

Art. VI.—*Remarks on an Optical Phenomenon observed at sunrise from the Summit of Mount Ætna.* By H. H. Blackadder, Esq. F. R. S. Edin. Communicated by the Author.

From the earliest ages the less familiar optical phenomena of the atmosphere have attracted particular attention, less, however, from their grandeur or beauty than from their supposed mysterious origin and incomprehensible nature. In several of the most ancient writings now extant, distinct references are made to some of these phenomena; and when it is considered that the human mind has a natural tendency to superstition, and that it is only in the present age that the torch of science has thoroughly consumed the veil which gave to these portentous appearances almost all their previous interest, we shall have but little occasion to be surprised at the wildly erroneous notions that were so long entertained regarding them.

At the present day, when these phenomena have received the most satisfactory explanation on well-known physical principles, the interest that is felt in them is no longer the same; but if it be less intense, it is more rational; if less irresistible, it is infinitely more pleasing.

The following notice is extracted from *Travels in Greece, &c.* by the Reverend Mr Hughes of Cambridge, 2 vols. 4to:—"I must not forget to mention one extraordinary phenomenon which we observed, and for which I have searched in vain for a satisfactory solution. At the extremity of the vast shadow which Ætna projects across the island, appeared a perfect and distinct image of the mountain itself, elevated above the horizon, and diminished as if viewed in a concave mirror. Where or what the reflector could be which exhibited this image, I cannot conceive; we could not be mistaken in its appearance, for all our party observed it, and we had been prepared for it before-hand by our Catanian friends: it remained visible about ten minutes, and disappeared as the shadow decreased. Mr Jones observed the same phenomenon, as well as some other friends with whom I conversed upon the subject in England."

The interesting phenomenon here described was observed from the summit of Mount Ætna on the 28th June, at sunrise; and the fidelity of the writer is not to be questioned. But while Mr Hughes is persuaded that he and his friends "could not be mistaken in its appearance," we all know that "appearances are deceitful." There is indeed reason to suspect that the alleged difficulty of solution has proceeded either from inaccurate observation, or from the relation of the facts having unintentionally received a deceptive colouring. We are given to understand that a distinct and perfect image of Mount Ætna, diminished as if viewed in a concave mirror, was seen elevated above the horizon, and by observers who were at the time standing on the summit of the mountain, whose image was thus seen reflected. On reading such a statement, one who is at all familiar with phenomena of this nature, is forced either to suspect inaccuracy, or to admit something altogether new; and, on such occasions, "*le doute philosophique*" is certainly not out of place. It may be asked, What proof was there that the image was that of Mount Ætna?—To say that there was no other mountain whose image could be thus seen reflected, would be merely to enunciate an opinion, and far from giving such an answer as the question required. When an object is seen by reflection from a concave mirror, it appears inverted as well as diminished; it is not said, whether, in this instance, the image was or was not inverted. But, on the supposition that the appearances were produced by unequal atmospheric refraction, the upright or inverted position of the image would be contingent on the particular state of the air at the time of observation. A distinct and perfect image of any part of the earth's surface appearing elevated above the horizon is never produced by simple reflection, but is the effect of unequal refraction; hence the image, as above described, could not be that of Mount Ætna, for the place occupied by the observer could not be represented to him by any reflective power of the atmosphere; and it would be absurd to suppose the effect to be produced by refraction. If it were allowable to suppose that what is described as a perfect and distinct image of Ætna, elevated above the horizon, was merely a part of the shadow of that mountain rendered visible by the presence of a white cloud or misty vapour, somewhere between the place of the observer and the horizon, the description, though inaccurate, would be so far intelligible, and the image might disappear as the shadow of the mountain decreased. The well-known optical phenomenon seen on the Hartz mountains, and vulgarly named the Spectre of the Brocken, is of this nature: When a person stands at sunrise on the top of the mountain, and looks toward the west, if there be any white clouds, or even a thin misty vapour, in that direction, he sees his own shadow on these clouds immensely magnified, but so well defined as to render his form, attitudes, and motions, distinctly visible. If, by observing the representation of smoke issuing from the crater, or by other means, Mr Hughes had determined, with certainty, that the image was that of Mount Ætna, there is little reason to doubt that the above would have been the true explanation; but his description taken as a whole, and particularly the circumstance of the image being diminished as in a concave mirror, is against this supposition, and renders it probable that the appearances were produced by unequal refraction.

In that state of the air which gives rise to unequal refraction, the natural appearance of objects undergoes surprising modifications. They are seen diminished, magnified, multiplied, and transformed, so as to bid defiance to description; mountains seem levelled or divided, and plains raised into mountains. On the occasion referred to, some part of the island of Sicily, lying to the west of Ætna, may have had its appearance thus modified, and the aërial creation may have had such a resemblance to that mountain as to have been mistaken for its image. If the observed image was evidently at a greater distance than any part of the island, every allowance being made for ocular deception, the appearances may still be traced to unequal refraction. Mr Hughes states that the island of Malta, which is distant about 140 miles, has been seen from the summit of Ætna.* At the time of the year when he and his party visited that mountain, its shadow at sunrise is nearly in a line with the solitary island of Pontellaria, which is distant about 180 miles. If, then, Malta has been seen, whether aided by looming or otherwise, at the distance of 140 miles, Pontellaria may also be seen, through the influence of unequal refraction, though it be forty miles farther off. Pontellaria thus elevated, and rendered visible at the extremity of the shadow of Ætna, may have been the source of deception. As the diurnal altitude of the sun increased, causing the shadow of the mountain to diminish, the state of the air upon which the unequal refraction depended would likewise be changed, and the image would consequently disappear. It may readily be determined, either by those who have witnessed, or who may yet have an opportunity of witnessing, the

* It appears, that, from the summit of Ben Lomond, which is 3191 feet above the level of the sea, the Isle of Man is visible, though distant about 130 miles. The Peak of Teneriffe, 12358 feet in height, has been descried at a still greater distance from the deck of a ship. Mount Ætna, by barometrical measurement, is 10936 feet in height; and mountains at a greater distance than the Island of Pontellaria are said to have been distinguished from its summit.

phenomenon in question, whether or not this be the true solution; for the shadow of Mount Ætna at sunrise lies in the direction of Pontellaria only at a particular season of the year.

Art. VII.—*Abstract of Meteorological Observations made in the Isle of Man, from* 1822 *to* 1825, *inclusive.* By Robert Stewart, Esq. Receiver-General of the Isle of Man. Communicated by Dr Hibbert.

A general state of the weather, for the year ending the 31st of December 1822. Thermometer (Fahrenheit) always out, on a northern exposure. Taken at 9 o'clock A. M., and at 11 o'clock P. M.

1822.

1822.	Medium of Thermom.		Wind, Number of Days.				Weather, Number of Days.		
Months.	A. M.	P. M.	N.	S.	E.	W.	Rain.	Snow	Fair.
January, . .	45	45	5	1	,,	12	8	,,	10
February, . .	41½	41	8	10	8	2	,,	,,	28
March, . . .	45	42	6	11	5	9	14	2	15
April, . . .	53½	48	3	9	4	14	10	2	18
May, . . .	53	51½	10	12	3	5	8	,,	23
June, . . .	62	57½	12	5	10	3	4	,,	26
July, . . .	64	59½	12	9	3	7	7	,,	24
August, . .	63½	59½	5	5	10	11	12	,,	19
September, .	60½	55½	2	10	6	12	12	,,	18
October, . .	55½	46	4	10	2	15	7	1	23
November, .	51	48	8	10	2	10	15	,,	15
December, .	47½	47	6	10	4	11	15	1	15
General Medium.	52¾	50¼	81	102	57	111	112	6	234

	A. M.	P. M.
Highest state of Thermometer . . .	64	59½
Lowest	41½	41
Mean of the year 1822		51½

Note.—With reference to the "Wind," the *prevailing* point for the day is taken. If *any* rain, snow, or sleet, during the day, not considered as a fair day.

1823.

1823.	Medium of Thermom.		Wind, Number of Days.				Weather, Number of Days.		
Months.	A. M.	P. M.	N.	S.	E.	W.	Rain.	Snow	Fair.
January, . .	36½	34½	4	23	2	2	5	5	21
February, . .	37	35½	9	7	4	8	7	4	17
March, . .	40	41	12	7	2	10	12	1	18
April, . . .	46½	43	7	2	13	8	9	,,	21
May . . .	52½	49	9	11	9	2	16	,,	15
June, . . .	54	51	12	12	5	1	10	,,	20
July, . . .	59	54	11	16	,,	4	15	,,	16
August, . .	56½	53½	7	10	4	10	15	,,	16
September, .	54	49	13	3	3	11	14	,,	16
October, . .	48	45½	6	6	10	6	14	,,	17
November, .	45	42½	3	7	6	14	9	,,	21
December, .	42	42	11	4	2	14	13	2	16
General Medium.	47¾	44½	104	108	60	93	139	12	214

	A. M.	P. M.
Highest state of the Thermometer . .	61	60
Lowest	26	22
Mean of the year 1823		46⅛

1824.

1824.	Medium of Thermom.		Wind, Number of Days.				Weather, Number of Days.			Rain Fallen.	
Months.	A.M.	P.M.	N.	S.	E.	W.	Rain.	Snow	Fair.	Inch	100pt
January, . .	40½	40½	15	4	1	11	8	2	21	2	47
February, . .	41½	40	2	8	12	7	9	,,	20	1	52
March, . . .	41	39¼	9	,,	7	15	14	3	14	3	43
April, . . .	45½	41½	7	8	8	7	7	2	21	1	86
May, . . .	52½	48	9	4	13	5	7	1	23	,	62
June, . . .	57	55	2	7	18	3	2	,,	18	2	42
July, . . .	57	59	4	6	3	18	12	,,	19	1	37
August, . .	59	56	1	8	10	12	17	,,	14	2	45
September, .	53	51	7	4	5	14	10	2	18	5	36
October, . .	48	46	12	5	12	2	20	,,	11	6	58
November, .	45	45½	11	5	3	11	18		10	5	93
December, . .	42	42½	14	2	,,	15	16		12	6	74
General Medium.	49¾	49¾	93	61	92	120	150	15	201	40	75

	A.M.	P.M.
Highest state of Thermometer . . .	68	64
Lowest	32	32
Mean of the Year 1824		49° ¾

1825.

1825.	Medium of Thermom.		Wind, Number of Days.				Weather, Number of Days.			Rain Fallen.	
Months.	A.M.	P.M.	N.	S.	E.	W.	Rain.	Snow	Fair.	Inch	100pt
January, . .	46	43	8	4	3	16	11	,,	20	3	80
February, . .	39	40	11	7	4	6	11	2	15	2	67
March, . .	44½	41	5	8	12	6	7	1	23	2	11
April, . . .	47½	45½	,,	1	16	13	9	,,	21	1	22
May, . . .	53½	48½	5	3	17	6	10	,,	21	2	7
*June, . . .	58	54½	9	8	5	8	12	,,	18	2	20
†July, . . .	64	59	6	6	11	8	2	,,	29	,,	57
August, . .	64	59	5	1	7	18	15	,,	16	3	71
September, .	63	59	1	8	12	9	16	,,	14	3	38
October, . .	52	52½	7	7	2	15	20	1	10	6	52
November, .	43½	43	12	3	3	12	19	1	10	7	67
December, .	40	38	11	6	5	9	13	2	16	2	76
General Medium.	51¾	48½	80	62	97	126	145	7	213	38	68

	A.M.	P.M.
Highest state of Thermometer. . . .	72	68
Lowest	30	28
Mean of 1825		50°⅛

From these tables we obtain the following results:

1822	51°½
1823	46 ⅛
1824	49 ¾
1825	50 ⅛
Mean of four Years	49°25
Correction in consequence of 9 and 11 not being the hours of Mean Temperature	—0 838
Corrected Mean Temperature	48°312
Mean Temperature according to Dr Brewster's formula, ...	47°58
Difference between the formula and observation .	+ 0°732

* In the month of June, the thermometer at *mid-day*, from the 10th to 20th, 76 to 78, in the shade.—100 to 110 in the sun.

† 17th to 27th July—range of Thermometer, mid-day, in the shade, from 76 to 79.

ART. VIII.—*An Attempt to account for the fact that the Stars appear greater in number when viewed cursorily than when examined with attention.** By a Correspondent.

THE discoveries of science are well known to be frequently accidental, and the observations of one literary man will often prove useful and applicable to the pursuits of another, even in a different branch of study. It is the adoption and generalization of such a discovery that constitutes the aim of these remarks.

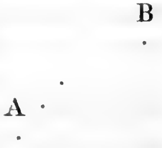
I have long been dissatisfied with the explanation currently given of the apparent number of the stars being greater to a cursory observer, than when attentively examined. Ferguson says, (Astronomy, chap. xx.) "The number of the stars discoverable by the naked eye in either hemisphere is not above a thousand. This at first may appear incredible, because they seem to be without number; but the deception arises from our looking confusedly at them without reducing them to any order; for, *look but steadfastly on a pretty large portion of the sky*, and count the number of stars in it, and you will be surprised to find them so few."

The method by which I account for the circumstance is as follows: Messrs Herschel and South, (*Edinburgh Journal of Science*, vol. ii. p. 28, &c. Also *Phil. Trans.* and *Mem. Ast. Soc. Lond.*) giving an account of their observations on double stars, remark, "A rather singular method of obtaining a view, and even a rough measure of the angles of stars of the last degree of faintness has often been resorted to, viz. to direct the eye to another part of the field; in this way, a faint star in the neighbourhood of a large one has often become very conspicuous, so as to bear a certain illumination, which will yet totally disappear, as if suddenly blotted out, when the eye is turned full upon it, and so on, appearing and disappearing alternately as often as you please."

I may illustrate this by an observation of my own, made some months since, with a $3\frac{1}{2}$ feet achromatic by Carey, and 2.750 inches clear aperture, using a low power which I have

* We should be glad to hear again from the author of this article, and, if agreeable, to learn his address.—ED.

not exactly ascertained. The following is an extract from my original memorandum: "17th December 1825.—Last night was very fine. I observed Saturn just past his opposition; he was very beautiful, and I saw him in great perfection; his ring was broad, well defined, and very open; I am almost certain that I observed the belts parallel to it. * I observed, in the strongest and most satisfactory manner, the fact mentioned in Brewster's *Journal of Science* for October, (the article of Observations on Double Stars,) that minute bodies may be distinguished by directing the eye to another part of the field. This I saw in a speck which was almost certainly one of Saturn's satellites, or an extremely small star. I could not always see it, and never when I directed my eye to the spot where it was, but when I looked at Saturn's body, I could see it a little to the south," [Qu. north ?] "and though so exceeding minute, I have not *the smallest hesitation* in pronouncing it to have been no deception. I saw it at several intervals, and under different circumstances. I next directed the telescope to the sword of Orion, — — — — — — — : the moon was at her first quarter, yet I saw admirably. The accompanying is a sketch of the group. The star A I observed only or almost entirely by the method of oblique vision mentioned last, and of which this was scarcely a less satisfactory example. But the most interesting observation was on the star B, &c. &c. — — — — — — — —."



My note then goes on to state at large my observations on that famous quadruple star, which, however, I need not now quote. I however remark, that "I found the oblique vision of use here too, though not so strikingly as in the other particulars;" and conclude, "It is proper to observe, that these observations were made about 8 P. M., when Orion was *rising*."† The above extracts abundantly illustrate the influence of this agent in practical observation, and its power is such, that I am astonished that it has not been long ago observed. According to Dr Brews-

* This is hardly probable, from the lowness of the power applied.

† I had not *then* read the note, (*Ed. Journ.* p. 292,) which mentions the application to Saturn's satellites; *that* observation was therefore perfectly unbiassed on that score.

ter, (iii. 292,) Messrs Herschel and South are not the first who have noticed it. I shall not debate the priority of discovery, but proceed to apply the fact to our observations on the heavens with the unassisted eye.

The expressions of Mr Ferguson already quoted, and the judgment of every attentive spectator, prove that the number of stars *appear* to be reduced on fixing the eye steadfastly on any portion of the heavens. Now, the application of the principle appears to me as simple as it is evident, and I scarce look out on the sky without being confirmed in my opinion. The stars seen in a hasty view of the heavens, are chiefly observed by oblique vision, and the number visible to the naked eye (as I hope I have satisfactorily proved,) is actually increased. I cannot quote a stronger instance than the Pleiades, and it is one which I have very frequently observed. While the eye is many degrees from them in the heavens, it is attracted by the compressed blaze of light which they exhibit. Fix the eye steadfastly upon them, and they almost vanish from the sight, and six or seven stars, so faint as to be just discernible, is all that remains. The telescope shows very numerous stars surrounding these six or seven, and very near as bright and conspicuous as them, which one may therefore consider in the *first degree of invisibility*; the oblique vision supplies this, and instead of a few twinklers, we behold a compressed starry heaven of themselves. This I think is a proof so satisfactory as to amount almost to demonstration. It is certainly the most striking exemplification of the principle I have observed in the heavens; but I have experimentally found, that, if you review almost any spot of the Milky Way, that vast tract of stars, in the method just mentioned, it will almost seem depopulated before your eyes. The lesser stars "hide their diminished heads" before the penetration of direct vision; and I cannot help thinking, that this explanation is applicable to that confused whiteness which we observe on a slight view, without going so far as to imagine with Dr Derham, that it arises from planets circulating round these very distant suns. The telescope sufficiently proves that there are plenty of stars *one stage less than visible* in this singular tract, which must contribute infinitely more than the atoms of planets (if such exist) to give it the milky appearance for which it has so long been famous. By our indirect glances during a careless review of the heavens, thousands of these minute objects are sufficiently increased in apparent diameter, as I shall presently mention, to make a sensible impression on the retina of the eye; and from the false glare surrounding each point, and the closeness of the stars, they appear, in many cases, absolutely in undefined contact, necessarily producing the appearance which the galaxy presents, and very similar to what I have already observed, and any one may convince himself of it, in the Pleiades. Other parts of the heavens present similar facts, of which I may notice that the frequent small clusters in the stream of Aquarius are favourable examples.

There are two opinions regarding the physical cause of the phenomenon; the one is that of Messrs Herschel and South, and also probably of the first observers of the fact, the French astronomers. They conceive, that "the lateral portions of the retina, less fatigued by strong lights, and less exhausted by perpetual attention, are probably more sensible to faint impressions than the central ones." Now, were we to stand by this explanation, my generalization of the fact must fall to the ground; for in such a survey of the heavens as I speak of, the retina cannot be said to be "fatigued by strong lights," or "exhausted by perpetual attention."* Or, on the other hand, if my adoption of the principle is acknowledged to be correct, the explanation of these gentlemen is untenable. We therefore look to the second method of accounting for it, by Dr Brewster, who observes that "a luminous point seen indirectly, swells into a disk, and thus loses its sharpness, and acts upon a greater portion of the retina;" and he adds in a note, that this advantage of expanded vision does not give the colours of the point truly; we therefore only gain a knowledge of its existence, and an idea of its situation. This last explanation applies equally in both cases; for the stars are indivisible points, whether viewed by the telescope or the naked eye, and we thus receive a confirmation of the correctness of

* Our correspondent, we suspect, mistakes the meaning of this passage in Messrs Herschel and South's paper. The exhaustion, we presume, here referred to, is a permanent effect, supposed to be produced upon the central parts of every retina.—Ed.

the hypothesis. This curious fact cannot fail to strike one as a very wise dispensation of Providence; for, when the eyes are both placed in the front of the head, as in man, the circle of accurate vision is extremely small, but whatever approaches within the wide limits of indirect vision, particularly attracts the attention by its expanded size, and gives a remarkably extended scope to our field of observation.

July 1826. Δ

Art. IX.—*On the Spawn of Salmon, observed in its progressive State, and Drawn from Nature.* By L. Schonberg, Esq. Communicated by the Author. *With a Plate.*

The eggs or spawn of the salmon, represented in their natural state in Figs. 1—4. Plate V., are of the size of a common pea. Their colour is lively, and they are transparent, mixed with yellowish brown and red. When they pass into whitish red, and lose their transparency, they are of no use for experiments, as they are then in a corrupted state. Few, indeed, can be brought, or rather kept in a proper condition. Out of nearly 200, four eggs only succeeded, however fresh their appearance at first was. Changing of the water, and, if possible, from the same river, must be repeated hourly, and they must likewise be exposed to the sun's influence.

Fig. 1. *b.* Shows a spawn magnified; position of the fish visible; head joined with tail; a large artery passing between them; point of pulsation very distinct, almost the day when taken from the river. The animal moves itself now and then with alternate contraction and dilatation. The spawn keeps generally a fixed point of gravity, viz. eyes sideways: The eyes are manifested by two gray-black spots, situated sideways in the globe. The following day no motion perceptible; the day-light not strong enough to reflect upon the glass. Eyes assuming the third day a white spot in its centre.

Fig. 2. Shows the spawn in different positions, after the head had made its way through the shell or egg; this happened the fifth day.

The spawn advanced to the state in Fig. 3. after a lapse of eight hours. Tail twisted around a transparent substance, perhaps the yolk, filled with a quantity of red spots, now and then variegated with some of a paler kind, which together seem to be oily and floating. This membrane presses itself out of the shell.

Fig. 3. *b.* Whilst examining it under the microscope, the fish made considerable progress with regard to the quitting of the shell; this disengagement was perhaps too precocious, on account of its being often removed from its place, in order to be observed under the glass. A sight the most imposing, was, without contradiction, that of beholding the active motion of the heart; the innumerable streams rolling small globules of blood, interposed with air, into larger vessels, where the number combine in forming some of a greater volume.

The streams issue, as shown in the outline Fig. 6, from below the body of the fish, a vein not visible, (concealed in the spine;) the colour of the blood light-brown red; it flows through numberless vessels, situated in the bladder, or transparent membrane itself; is collected into the large vessel seen below the membrane, always increasing in breadth, ascending towards the throat; drawn thence by short regular intervals (twelve pauses in eleven seconds) into the heart, or rather into various chambers, one of which empties itself every time, colouring the next, which again throws it out into the third, and then ascending into the gills, as shown by the dart.

The blood in the veins at the neck and head is much darker. Several other blood-vessels in the fore part of the body are distinguishable.

Fig. 4. The spawn left the shell at the time when the sketch was made; the animal lay motionless for some hours, the pulsation continuing; tail much curved; eye more brilliant.

Fig. 5. The motion of the water, caused by pouring it into the vessel, made the body grow straight. The bladder attached to the animal is oval; it lived only two days in a state of languor, without enjoying its element.

Fig. 7. The shell or egg, after the animal had left it. It was semi-transparent, and three-fourths of it entire. In a former case, the shell was excessively fragile, and almost disappeared in filaments; in this, however, it remained for many days solid, which proves the immaturity of the fish.

Three fishes came out on the 5th April, swimming with agility, sometimes leaping beyond the surface, moving constantly their lips and pectoral fins. Their appetite seems awake, and they snatch some grains of meal, sometimes throwing it out again to get again hold of it. The red spots decreasing, show sufficiently that it is partly nutritive matter, partly, as I had opportunity to perceive, digestive matter, (for it is considerably caustic, staining through and through paper, and is acted upon by acids.)

The bladder assumes with time a more pointed shape, and loses at last the more transparent one, which is only visible at the posterior extremity.

They repose sideways when there is no rough ground, but when upon pebbles, they conceal their heads between them, and seem to prefer this way of resting to any other.

Their growth is now very considerable, and their colour, particularly the gray shades, more decided.

Sea-water has a considerable effect on them; they seem to be at first full of vigour, twisting themselves with all possible muscular strength. When replaced in fresh water, they immediately sink to the bottom exhausted for some minutes. I found afterwards, and by means of an experiment, where the fish was at liberty to be either in fresh or salt water, that the latter only was to be their abode.

On the 15th two died; and this is presaged by the change of the blood in the heart and gills growing darker some hours before.

Length of one ten days old.—From head to tail, 11 lines; from head to bladder, $2\frac{1}{2}$ lines; from tail to bladder, or anus, 4 lines; body of the fish, 1 line; from back to under part of the bladder, $3\frac{1}{2}$ lines. *Fins.*—Pectoral, 2 lines; dorsal, 1 line; ventral, 1 line; abdominal, 2 lines; tail, 1 line.

Art. X.—*Notice of the severe Cold of last Winter, and of the late great Heats in June* 1826, *with original Observations.* By a Correspondent.

From my observations in January last, chiefly made in the country near Edinburgh, I find the mean temperature to have been only 35°34, and according to Mr Adie 34°35, or lower than the *minimum* for January 1825. About the middle of the month, there occurred a very intense frost, of which I have collected the following observations.

Within a few miles of Edinburgh, and near 400 feet above the sea, I made the following observations with the utmost care. The instrument used was one by Knie, in which I put the utmost confidence. The mercury readily runs up the tube when reversed, and returns to the bulb with a click. Besides, it agrees to the certainty of a small fraction of a degree with a very large scale thermometer by Adie. I therefore do not hesitate about the accuracy of the following numbers from my register.

Day.	Hour.	Therm.	Hour.	Therm.	Wind.
9	8 15′ M.	25¼	8 A.	23¼	N.W.
10	8	31½	8	29	N.W.&N.E.
11	8	26½	8	28½	N.W.
12	8	30½	8	27½	N.
13	8	24½	8	36¾	N.W.
14	8	22	8	20½	N.W.
15	8	23½	8	19¼	N.W.
16	8	15¾	8	34	N.W.
17	8	40	8	42½	S.W.

Additions to these observations:

9 7½ A. M. 25°. 3 P. M. 26¼. 10 P. M. 24¼. In the country.

9	Barometer at Edinburgh, - -	2	P. M.	29.90
12	— — — — —	1½	—	29.60
13	— — — — —	4	—	29.75
14	— — — — —	12½	—	29.85
14	Therm. in the country at - -	10	P. M.	22¼
15	Barom. at Edinburgh, - -	2	P. M.	30.06
15	Therm. country, - - -	10	—	15½
16	Barom. Edinburgh, - - -	1	—	30.13
16	Therm. country, - - -	10	—	36½
17	Barom. Edinburgh, - - -	1	—	30.00

By Dr Orpen, South Frederick Street, Dublin.

Jan.	Thermometer.		Barometer.		Wind.
10	10 M. 28°	10 A. 30°	10 M. 29.95	10 A. 29.33	N.E.
11	27	31	29.35	29.86	E.
12	29	28	29.88	29.95	E.
13	26	25	30.01	30.00	E.

Jan.	Thermometer.		Barometer.		Wind.
14	10 M. 36	10 A. 38	10 M. 29.93	10 A. 29.93	S.E.
15	40	36	30.08	30.23	S.E.
16	42	46	30.23	30.26	S.E.

It is a highly curious fact, that the wind throughout was diametrically opposite to what it was at Edinburgh, and that the very thick fog was not accompanied, as it usually is here, with an east wind. The weather was in general clear, and very delightful, except on the 15th, and the ice sometimes seven inches thick. The wind had been almost constantly due east since the beginning of the year before the 9th, on which day also the frost began, *being new moon*, and broke up on the 16th, with *her first quarter*, being one instance out of many of the moon's influence.

At Earl Spencer's, Althorp, Northamptonshire.

	Thermometer.		Barometer.		Wind.	
Jan.	Low.	High.	Morn.	Even.	Morn.	Even.
9	19	28	29.96	29.90	E.	E.
10	16	31	74	59	W.	W.
11	22	31	59	61	N.W.	N.W.
12	16½	29	70	70	W. by N.	W. by N.
13	16	27	84	86	W. by N.	N.W.
14	13	28	97	97	W.	W.
15	8	27	30.24	30.23	W.	W. by N.
16	8	26	32	38	W. by N.	W. by S.
17	16½	33	38	38	S.	W. by S.

At the Observatory, Calton Hill, Edinburgh.

Jan.	Thermom. 9 M.	4 A. Reg.*	Barom. 9 M.	4 A.	Wind.
9	18	23	29.807	29.740	Var.
10	13	32	367	404	Var.
11	21	28	455	435	N.W.
12	21	28	470	556	N.W.
13	18	23	630	764	N.W.
14	15	21	715	737	Var.
15	16	24	918	920	S.E.
16	10	22	989	999	Var.
17	22½	38	931	812	S.W.

In the north of Scotland† this cold was much more severe, as appears from the following observations.

* I presume the maximum.

† We have taken the liberty of adding this paragraph to complete the paper of our Correspondent.—Ed.

Observations made at the Doune, Inverness-shire, by J. P. Grant, Esq. of Rothiemurchus.

Jan 12.	Midnight,	20° Fahr.
13.	Ditto,	8
14.	9 A. M.	0
	Noon,	20
	Midnight,	— 6
15.	9 A. M.	— 3
	10 A. M.	— 5
	Noon,	+ 12
	Midnight,	— 5
16.	9 A. M.	+ 22
	Noon,	+ 25
17.	Midnight,	+ 37
	9 A. M.	+ 42
	Noon,	+ 45

The following observations were made in Aberdeenshire by George Fairholme, Esq. On the 14th, at 11 P. M. the thermometer stood at + 6° at Castle Forbes, which is situated at a considerable elevation above the river Don, and overlooking the valley of Alford. At the above hour Mr Fairholme observed this valley covered with a dense fog; and supposing that the temperature would be much lower near the level of the river, he sent a thermometer down to the manse of Keig, where it stood at 5° *below* zero at 7 o'clock on the morning of the 15th. In a few hours afterwards, a change of wind occasioned a rapid thaw, which continued for some time.

I shall now simply state my own very careful observations made on the late uncommon heats in June in the country.

June 24th, 9 M. $72\frac{1}{2}$° at a N. window, 3 floors from the ground, and perfectly open, with a large thermometer of Adie's, $\frac{1}{10}$ of a degree easily visible.

		Therm.	
10 M.	5′	75°.0	Circumstances the same.
11	0′	74 .5	Ditto, ditto.
12	0′	78 .2	Ditto, ditto.
12	40′	79 .2	Ditto, ditto.
1	3′	80 .2	Ditto, ditto.
1	40′	80 .7	Ditto, ditto.
2	0′	80 .9	Ditto, ditto, and a thermometer per-
2	14′	80 .8	Ditto, fectly agreeing, (see page 241,) hung
2	25′	81 .1	Ditto, out at a distance from the wall in a

2 M. 40 81°.3 Circumstances the same. N.E. exposure, only 79½°—2h 14′ 79⅔. 2h 25′ 80½. Exposed to the E. at a distance from the wall, and a white

9 A East exposure 50°. Ditto, ditto. paper shade against reflection, from a flat roof near, 2h 40′ 82°.—Ditto, 3h 6′ (well-shaded) 81¾. 3h 12′ 81½°.

June 25th, 90½ M. 77°.2 Circumstances as above.
80½ A. 82 East wall. Other thermometer well shaded in
9 A. 71. Ditto. *trees,* at 3h 50′, exactly 80°.

On the 26th a very intense temperature occurred, and as my observations were made in a peculiarly cautious manner, and with the greatest attention to every possibility of reflection, I have no scruple that they should be made public.

June 26th.
9 M. 75°.4 Adie's at a N. window, as last page
12h 56′ 81 1h 0′ [other therm. exposed behind a shady hedge, 80½°.]
1h 35′ in the sun 110°
1h 38 at the house 83.°3. Brought out Adie's, and hung it behind a very large stem of a tree, perfectly screened from the sun by high trees, &c.
1h 45 (Knie's) 82° hung behind a fragment of building, with an immense head of ivy, and thoroughly shaded. Not far from Adie's.

In the sun 111°
2h 0′ Sun 113° Knie's 82½° Adie's 82.5
2. 20′ — 114½° — 82¾ fully — 82.9
2. 30′ — 114½° — 83½ — 83.3
2. 45′ — 113° — 84⅓ — 84.0 Finding that Knie's was ⅓° above Adie's, probably arising from the sun's reflection, which was on the grass 20 feet off, I now moved it to quite a different place.
3.0′ Sun 114° Knie (New Place) 84½° Adie 84°.3
3.12′ — 112° — 84.1
3.17 — — 82¾ — 84.0
Finding Adie's 1¼° highest, I brought Knie's beside it, and found them at
3.30′ Sun 112 Knie's (beside Adie) 82¾°, Adie 84°.0, or just the same as before. Now, I should state, that Adie's was in his sympiesometer case, which probably kept it too hot by producing a reflection of the heat from the surrounding brass, after long exposure.

At 10h A. at the house, E. window 72°.

After all my care, the delicacy of these observations is such, that I do not feel myself entitled to give the true maximum with so much precision as I had hoped; but I feel confident that it was above 84°, and state without hesitation, that in perfect shade, and free from all usual defects in observation, such as the proximity of buildings, errors in the height of the mercury, &c. it was between the degrees 83 and 84.

The temperatures in the sun cannot be perfectly trusted to perhaps within 1°; the bulb of the instrument was covered with black woollen stuff. The wind was variable throughout these experiments, and cirri, cirro-cumuli, and cumuli, slightly prevailed.

The following days were very warm, but not so remarkably as the above. On the 27th was a thunder-storm, in the middle of which I took the temperature of a spring, which was no higher than I had reason to believe, from my observation of the day before on the same spring. This does not confirm the conjecture mentioned in the last number of the *Journal of Science.*

P. S.—Some have stated that few and small solar spots indicate hot weather, and others the reverse. On the 17th June, while the weather was quite cool, and I was not thinking of such coincidences, I found a spot coming on the sun, which I have stated in my memorandum to be an "immense" one. Indeed, it was almost the largest I ever saw, and I took a sketch of it. It was approaching the sun's western limb on the 24th. This appears to favour the latter hypothesis.

July 1826. Δ

Art. XI.—*On the formation of the Cyanuret of Mercury, and the Sulpho-cyanate of Potash.* By Edward Turner, M.D. F.R.S.E. Lecturer on Chemistry, and Fellow of the Royal College of Physicians, Edinburgh.

The directions contained in systematic works on chemistry for the formation of the cyanuret of mercury, appear to have been derived from Proust's excellent paper on Prussian blue, published in the 60th volume of the *Annales de Chimie.* M. Thenard directs that two parts of good Prussian blue, in fine powder, and one of the peroxide of mercury, should be boiled in eight parts of water until the colour of the mixture, from being blue, becomes yellow. The solution, after being filtered, is evaporated by heat and cooled alternately, in order to obtain the cyanuret of mercury in the form of crystals. As the compound, thus procured, always contains oxide of iron, Proust recommends, with the view of freeing it from the iron, that the crystals should be redissolved in water, and boiled with an excess of the peroxide of mercury. Hydrocyanic or muriatic acid is then added to neutralize the solution, and the purified cyanuret of mercury is separated as before by crystallization.

In making the cyanuret of mercury by this process, I always find considerable difficulty in procuring it free from iron. The solution, from the commencement, though the best Prussian blue which I could purchase in Edinburgh is employed, has uniformly a deeper colour than can be well produced by a small quantity of iron rendered soluble by the cyanuret of mercury; and on separating the cyanuret as much as possible by crystallization, a yellow solution remains, which has no disposition to crystallize. Suspecting, from these circumstances, that the inconvenience of the process is owing to impurities contained in the Prussian blue, I boiled some of that substance in muriatic acid diluted with nine or ten times its weight of water, collected the insoluble matter on a filter, and edulcorated. From the colour of the acid solution, it was obvious that it contained iron; and, accordingly, on adding an excess of pure potash, the hydrous peroxide of iron was thrown down in large quantity. On filtering the alkaline solution, and boiling it with muriate of ammonia to neutralize the potash, a copious precipitate of alumina took place. These substances appear to exist in the Prussian blue, as subsalts of sulphuric acid; at least pure water did not take up a trace of iron, whereas the solution made by dilute muriatic acid was precipitated copiously by muriate of baryta.

When the purified Prussian blue and the red oxide of mercury, in due proportion and in fine powder, are boiled together with water, the former is entirely decomposed, and a perfectly colourless solution is obtained, which yields, by evaporation, pure crystals of the cyanuret of mercury, even to the last drop. The success of the operation depends entirely on the proportions which are employed. The most convenient proportion is eight parts of the purified Prussian blue, well dried on a sand bath, to eleven of the peroxide of mercury. This quantity of the peroxide of mercury, without being in excess, decomposes the ferro-cyanate completely; and the weight of the cyanuret which is obtained, somewhat exceeds that of the peroxide employed in its preparation. The ratio of eight to twelve gives an excess of the peroxide; in consequence of which the solution acquires an alkaline reaction. Two inconveniences arise from this circumstance. In the first place, the cyanuret of mercury does not crystallize properly; and, in the second, the excess of mercury occasions some of the peroxide of iron to be dissolved, which colours the solution, and renders the cyanuret of mercury impure. This fact I have observed repeatedly. If, after decomposing eight parts of purified Prussian blue by eleven of the peroxide of mercury, one part more of the latter be added, the solution, from being neutral and colourless, acquires an alkaline reaction and a yellow colour, and deposits peroxide of iron when it is evaporated.

The most economical method of obtaining pure ferro-cyanate of potash, is by direct combination of its elements. The best Prussian blue, which in Edinburgh costs a shilling an ounce, yields, after being purified and well dried, little more than half its weight of pure ferro-cyanate of iron; while the ferro-cyanate of potash, which is the most expensive material in its manufacture, may be purchased in Glasgow at the rate of three shillings and sixpence per pound. The formation of pure ferro-cyanate of iron from the ferro-cyanate of potash, is very simple to the practised chemist; but, as there are one or two points of delicacy in the process, it may not be superfluous, in a pharmaceutic point of view, to state briefly the different steps of it. In principle, it consists merely in mixing the ferro-cyanate of potash, dissolved in a large quantity of water, with some persalt of iron, taking the precaution to have an excess of the latter, and washing the resulting ferro-cyanate of the peroxide of iron with successive portions of water, until the edulcoration is complete. The best method of doing this, is to operate in a large glass vessel, and to draw off the supernatant liquid daily with a syphon. It is remarkable that the ferro-cyanate of the peroxide of iron does not subside well, unless an excess of the salt of iron be present; and, consequently, after repeated washings with fresh water, by which the free salt of iron is removed, the Prussian blue loses its power of subsiding, and remains suspended in the liquid. This is a sign that the edulcoration has been carried to a sufficient extent. The pure ferro-cyanate is then dried on a sand-bath.

The readiest mode of forming a persalt of iron, is by adding nitric acid to a solution of the proto-sulphate, and boiling it for a few minutes. A measured drachm and a half of nitric acid, specific gravity 1.4, is sufficient for an ounce of the proto-sulphate. A few drops of sulphuric acid should afterwards be added, to prevent the formation of a sub-salt.

Sulpho-cyanate of Potash.

In preparing the sulpho-cyanate of potash, according to the method recommended by Vogel, it is difficult to obtain it quite pure, except by continuing the operation for a considerable length of time. An accident which occurred to my friend, Mr John Home, while making this salt in my laboratory, led me to the following modification of the process, by which it is rendered more speedy and effectual. Mix the ferro-cyanate of potash in fine powder, with an equal weight of sulphur, and after putting the mixture in a porcelain capsule, place it just above a pan of burning charcoal, so that it may be exposed to a very strong heat, but short of redness. The mixture speedily fuses, takes fire, and burns briskly for one or two minutes, during which it should be well stirred. The combustion soon ceases spontaneously; and the dark-coloured residue, on being dissolved in water and filtered, yields a very pure and neutral sulpho-cyanate of potash. To insure the decomposition of all the ferro-cyanate of potash, I generally allow the mass to remain in a fused condition for a few minutes after the combustion has ceased, previous to withdrawing it from the fire; but this precaution is not necessary, if a strong heat has been employed in the first instance.

Art. XII.—*Results of a Meteorological Journal kept at Seringapatam during the years* 1814 *and* 1816. By Mr John Foggo Junior.*

These journals contain a register of the thermometer at sunrise, and in the afternoon, of the thermometer within doors, and of the temperature of the river Caveri, taken at 6 A.M. and 3 P.M. These are followed by a column for the height of the river, and another for the evaporameter. In the year 1816, the barometer was added to the register, and observations made regularly three times a-day, namely, at 4 A.M., 10 A.M., and 4 P.M., and in the last three months it was also observed at 8 P.M. The amount of rain was also measured during this year, and in both the state of the weather was carefully noted.

Mean Results for both Years.

The mean temperature of the whole year is, by observation, 77.06; by Dr Brewster's formula 76.92, without correction for elevation. From the register of the barometer kept in 1816, it appears that this city is elevated 2412 feet above the sea. As in the tropics an elevation of 613 feet depresses the temperature 1.8 Fahr. for moderate heights, we have for the mean temperature of the coast intermediate between Madras and Pondicherry, 84.14. Now, in the year 1823, the mean temperature of Madras was 83.53, and the temperature of Pondicherry, according to the old observations of Le Gentil, 85. By Mr Atkinson's formula for depression of temperature according to the altitude, the temperature of the coast is 82.4. The mean temperature of these places appears to vary considerably from year to year, as we find that Dr Roxburgh's observations give the temperature of Madras no higher than 80.42. The mean temperature at Seringapatam at sunrise is 63.17, at 3 P.M. 90. 95, and the mean temperature of the day is 84°, of the night 70.11; the average daily range of tempera-

* The very valuable Registers, of which the following is an abstract, were kept by Mr Scarman. The editor owes them to the kindness of Henry Harvey, Esq.

ture 27.7. The mean temperature of January, the coldest month, is 70.8; from this the monthly temperature rises till May, of which the temp. is 85; after this it declines till the end of July, but, at the approach of the sun in his progress southward, the temperature in October increases to the mean of the year, after which it falls till January. The curve of monthly temp. has, therefore, two convex summits, of unequal elevation, and about 120 days distant from each other. The highest temperature observed is 115°, and the lowest 48°; and the extreme range of temperature experienced during the two years = 67°.

The mean temperature of the river is 77.2, agreeing exactly with the temperature of the air. At sunrise, the mean temperature is 76.47, and at 3 P.M. 78.03, and the difference between these = 1.56°.

The highest temperature observed in the river is 88°, and the lowest 68°. The mean height of the river is 2 feet 8 inches, the greatest height being 12 feet, and the lowest 9 inches; but these appear to be relative heights. It is highest in July and August, and lowest in April. The register of the amount of evaporation does not agree with the other observations. The mode of registering was to observe the loss of height in a column of water of 30 inches, from the 1st of January till the end of the year. We thus observe a gradual diminution of the column of .07 of an inch daily, or 26.5 in the year. As the mean temperature of the air is 77°, an evaporation to this amount would take place though the point of deposition was only 2½ below the temperature of the air. But the remarkable range of 27° daily, shows that the climate of this place is one of the driest of the habitable regions of the globe, so that it is probable the evaporameter has been kept *within doors*, in which case its results would coincide with the indications of the thermometer in the house, of which the mean is the same as that of the air, and the range is not greater than that of the river. The measure of evaporation must in every case be more or less hypothetical, and Mr Daniell has shown that a very close approximation would be obtained by the difference of elastic force of the vapour at the temperature of the air and the dew point. The mean temperature of the air, or of the river, which must be the principal source of the vapour, being 77, and the probable dew point 63°, then .966 — .615 = .351 of an inch, the depth of water evaporated in twenty-four hours, or 128 inches yearly.* The degree of dryness on the thermometer will be therefore 14°. The degree of moisture on the natural scale of the hygrometer .636, 1.000 being perfect dampness; and the weight of a cubic foot of vapour, 6.522 gr.

The prevailing winds are the N. E. and S. W., or the general monsoons of the Indian Ocean. The S. W. sets in during the month of April. When it first commences, its reciprocation with the N. E. interrupts the serenity of the weather, and during its continuance thunder storms occur almost every day, with heat,—lightning at night. This is the rainy season, but the monsoon having deposited its superabundant moisture upon the Ghauts, very little rain falls at Seringapatam. During the N. E., which begins about the end of October, the weather is settled and fine, with heavy dews before sunrise.

Results for the Year 1814.

I have arranged the numerical results of this year under (A) Table I. The temperature was considerably higher than in 1816. The mean temperature at sunrise = 64.65; in the afternoon 92.1, mean temp. 78.4. Mean temp. of the day 85.2; of the night 71.52; of the coldest month 72.6; of the warmest 86.5;

* Mr Anderson has observed that in settled weather the minimum temperature of the night does not fall below the term of precipitation taken at sunset, or in the evening; and a variety of experiments made at Leith have proved the general truth of the principle. Since the temperature at sunrise will be a very little above the minimum by a register thermometer, and since the constituent temperature of the vapour varies very little during the day, there cannot be a great error in assuming the temperature at sunrise to correspond with the mean point of deposition. Dr Young has shown that the mean evaporation in twenty-four hours is expressed by the height of a column of mercury equivalent to the elasticity of the vapour, and the effect of the moisture in the atmosphere may be allowed for by deducting the tabular number of the elasticity at the dew point. The evaporation at London, calculated in this way by Mr Daniell, accords in a remarkable manner with the amount observed by Mr Howard.

December, January, February, 75.20.
March, April, May, 84.58.
June, July, August, 76.22.
September, October, November, 77.30.

Of the coldest decad (beginning 1st January) at sunrise, 50.5; in the afternoon, 80.5, mean, 68°; of the warmest decad (15th May) sunrise, 69°, afternoon 107, mean 88.

On the 31st of May, a severe thunder storm occurred, the effects of which are described in the Journal:—"Weather, towards evening, fresh, north-west wind, distant thunder N.Ed.; before 6 P. M., strong N. E. wind, with a heavy shower, vivid lightning, and twice exceedingly loud thunder; the last loud explosion took effect on the terrace of the house. Ten or thirteen small holes were made in the terrace by the explosion, within the space of thirteen feet in the direction, and over a thick partition-wall. All the holes, excepting three, did not penetrate deeper than the outer thick layer of plaster. Of the three which appeared to have penetrated beyond the layer of tiles under the plaster, one, which was much larger than the others, but not exceeding the diameter of a pistol-ball, situated rather on one side, and at a little distance from the wall, passed through the terrace, and penetrated the room between the rafter and cornice. The thick chunam plaster over the cornice, projecting about 2 inches under, and adhering to the under surface of the rafter, to the extent of near 2 feet in length on each side of the hole, and down the wall about 3 feet in length and 2 in breadth, was thrown off, and an irregular groove, superficial at top, and deeper at bottom, was formed down the cornice and wall about $2\frac{1}{4}$ feet in length. The surface between the place from which the chunam was thrown off, and the door-frame underneath, a distance of near four feet, was not injured, excepting a very fine crack being just perceptible from the broken chunam to the frame, and the plaster immediately above the frame little broken. The side of the door-frame, situated in a line under the hole through the terrace, was split down in two or three pieces, the mortice of the upper piece of the frame, and some of the surfaces of the splintered side frame being charred. The chunam and jelly of the floor adjoining the bottom of the splintered side frame was broken up to the distance of a few inches. Another of the holes which penetrated the terrace, was situated nearly over the other side piece of the door-frame, which was also split down in two or three pieces, the surface of the wall above did not appear to have been injured, but two or three holes, apparently not deep, were observed in the side of the doorway on the surface of the wall, against which the side piece of the door-frame was situated. The lower hinge of the opposite half door was slightly melted at two points, and the fine chunam on the opposite side of the door-way, rather above the level of the hinge, was blackened to the extent of about 6 inches in length and 3 in breadth, as if the electric fluid had passed down the inside of the wall out at the surface, against which the side of the door-frame was placed, and, splitting the door-frame, struck the opposite hinge and surface of the opposite side of the doorway. The upper piece of the door-frame was a little split near the mortices, but the under piece was not injured. The broken surfaces of bricks were slightly vitrified, and surfaces of chunam plaster blackened, or of gray colour."

Results of the Year 1816.

The observations of this year were made on a more extended scale, and the remarks on the weather are detailed at considerable length, though deficient in precision. The mean temperature of the year was 75.75 ; at sunrise, 61.7 ; in the afternoon, 89.8 ; the mean temperature of the night, 68.7, of the day, 82.7 ; of the coldest decad in the year (13th January) 67.8, at sunrise, 54.9, in afternoon, 80.9 ; of the warmest decad (25th April) 85, at sunrise 67, in afternoon 103 ; of the coldest day, 15th January, 64 ; of the warmest, 20th May, 90.

December, January, February, 71.3.

March, April, May, 82.08.

June, July, August, 75.83.

September, October, November, 74.66.

Mean temperature of the river 76.

The average height of the barometer is 27.568.* The pres-

* Hence the elevation of Seringapatam is 2412 feet, assuming the pressure at the level of the sea to be 29.88, and the mean temperature of the intercepted column of air = 78°.

sure at 4 A. M. is 0.027 below that of 10 A. M., and .047 above 4 P. M. The average of 10 A. M. is .074 above 4 P. M. In the last three months the average of 8 P. M. is .006 below that of 4 A. M., .04 above 4 P. M., and .041 below 10 A. M. I do not find one instance of the horary oscillations being suspended; but during the prevalence of the S. W. monsoon the extent of the variation is diminished. See Table II. col. 9, 10, 11. Besides the horary oscillations, there is a monthly variation from the annual mean pressure of remarkable regularity, when it is considered that the results are obtained from one year's observations only. This variation, however, is not the same at each hour of observation, so that the decrement has reached its maximum for 4 A. M. and 4 P. M. in June, but for 10 A. M. not till July. It appears to be occasioned by the united effects of increase of vapour and the influence of the monsoons.

The amount of this variation is .262. The maximum pressure observed throughout the year is 27.79, and the minimum 27.34; extreme range 4.5.

The mean height of the river this year was 3 feet. The amount of rain measured 23.7 inches, and the probable amount of evaporation 122 inches. I have calculated a hygrometric table for this year (Tab. III.) according to the method mentioned above, which is perhaps as near the truth as any similar table for an intertropical climate that has been published.

Monthly Results for 1816.

In January, the temperature is at its minimum, but the pressure has attained its maximum, the N. E. monsoon is fairly established, and the weather clear, without rain or thunder. The mornings generally hazy, from the rapid evaporation occasioned by the energy of the sun's rays. Copious dews fall during the night, and particularly before sunrise. The only two mornings on which no dew was observed were subsequent to the two coldest days of the year, the 7th and 15th; lightning was seen only once, on the evening of the 16th. The height of the river on the first of the month, 2 feet 3 inches.

February.—Weather in general the same as last month; lightning more frequent at night; and rain apparently all round the horizon on the hills. On some mornings the wind was from the S. W. Height of the river on the 1st, 1 foot 8 inches.

In March the dew is scarcely so heavy. During the day, the wind variable from N. E. E. and S. E. In the evening, the S. E. generally; and after the middle of the month the S. W. prevailed during the night. Frequent lightning at night. Height of the river 15 inches.

In April, S. W. the prevailing wind; large clouds rise from all quarters during the day; rain at night frequent, but in slight showers; lightning every night. The river began to rise on the 4th, and at the same time the electric explosions first became audible.

May.—Weather as in last month; height of the river 20 inches. A period of ten days, beginning with the 7th of this month, gives the mean annual pressure; and during this time the N. E. wind prevailed after noon, but the S. W. at night.

In June, thirteen rainy days; height of the river on the 1st, 10 inches, and it remained nearly at this height till the 24th, when it rose in the course of the night to 7 feet 6 inches. S. W. uninterrupted. Heavy dew, when no rain fell; lightning with thunder almost every night.

July.—21 Rainy days. Greatest height of the river 9 feet; weather as in last month. Barometer rising after the 7th, exactly when the river had attained its greatest depth.

August.—Temperature very uniform throughout the month; height of the river on the first day of the month 5 feet 7 inches; eleven rainy days; lightning less frequent; continual S. W. wind, with heavy dew, every night.

September.—Continued S. W. monsoon, nine rainy days, light dew at night, height of the river 5 feet.

October.—Height of the river 4 feet 6 inches; twelve rainy days, the amount of which was only 4 inches; the showers in the vallies of the Mysore have little resemblance to tropical rains in general. Of the heaviest shower that fell this year the amount was only 1 inch. About the middle of this month the wind varied from S. W. S. E. and N. E. and afterwards chiefly from N. E. Lightning frequent, with very heavy dew.

November.—Height of the river 3.4, six rainy days; weather as in last month; N. E. prevailing.

December.—Height of the river 20 inches. On two nights a few drops of rain. Rain appeared on several days to be falling on the hills all around. Wind variable from N. E. and S. E.

TABLE I.—*Thermometric Results of a Meteorological Register kept at Seringapatam during the years* 1814 *and* 1816. *E. Long.* 76° 51′. *N. Lat.* 12° 45′. *Height above the level of the sea* 2412 *feet.*

1814 (A)

Months.	Temperature of the Air. Max.	Minim.	Extreme Range.	M. Temp. of Sunrise.	M. Temp. of Aftern.	Mean Range.	Monthly M. Temp.	Temp. of the River.
January,	98°	48°	50°	56°.25	88°.7	32°.5	72°.6	73°.5
February,	105	57	48	63 .5	95 .5	32	79 .5	79 .7
March,	109	54	55	62 .5	101	38 .5	81 .75	81 .25
April,	110	65	45	68 .8	102 .5	33 .7	85 .5	82 .8
May,	115	64	51	69 .28	103	33 .75	86 .5	83 .1
June,	109	64	45	68 .9	91 .1	22 .2	80	79 .75
July,	106	66	40	67 .25	85 .5	18 .25	76 .37	75 .7
August,	96	64	32	66 .25	81	14 .75	73 .5	75 .9
September,	100	63	37	66 .5	89	22 .5	77 .75	77 .9
October,	105	58	47	63 .5	92 .5	29	78	78 .5
November,	99	50	49	62	90 .5	28 .5	76 .25	77 .4
December,	98	55	43	62	85	23	73 .5	75
Extremes and Averages.	115	48	67	64 .65	92 .10	27 .54	78 .4	78.36
	Extremes.			Averages.				

1816 (B)

Months.	Temperature of the Air. Max.	Minim.	Extreme Range.	M. Temp. of Sunrise.	M. Temp. of Aftern.	Mean Range.	Monthly M. Temp.	Temp. of the River.
January,	96°	48°	48°	54°	84°	30°	69	71°.6
February,	102	51	51	58	91	30	74	75 .3
March,	109	53	56	59 .5	100	43 .5	79 .75	78 .4
April,	109	62	47	66	100	34	83	81 .2
May,	108	62	46	66 .5	100 .5	34	83 .5	81 .3
June,	105	62	43	65 .25	90 .5	25 .2	77 .75	78 .1
July,	94	62	32	64 .5	82	17 5.	73 .25	73 .6
August,	101	60	41	62 .5	85 .5	23	74	73 .8.
September,	102	57	45	62 .25	89	26 .75	75 .5	75 .35
October,	99	58	41	64 .5	88 .5	24	76 .5	78 .2
November,	90	54	36	61 .5	82 .5	21	72	74 .7
December,	89	52	37	57	85	28	71	71 .8
Extremes and Averages.	109	48	61	61 .7	89 .8	28 .1	75 .75	76 .1
	Extremes.			Averages.				

TABLE II.—*Results of observations on the Pressure of the Atmosphere, made at Seringapatam during the year* 1816.

Months.	Maxima.	Minima.	Range.	4 A. M.	10 A. M.	4 P. M.	8 P. M.	Excess of 4 A. M. above 4 P. M.	10 A. M. above 4 A. M.	10 A. M. above 4 P. M.	Monthly Mean Pressure.	† Diff. from Annual M. Pressure.
	Inches.	Inches.	Inches.	Inches.				Inches.				
January,	27.79	27.60	00.19	27.715	27.763	27.677		00.038	00.048	00.086	*27.720	+. 66'
February,	.75	.55	.20	.648	.687	.608		.040	.039	.079	.647	+.077
March,	.72	.52	.26	.638	.664	.571		.067	.026	.093	.617	+.032
April,	.70	.43	.27	.569	.614	.499		.070	.045	.115	.556	—.042
May,	.64	.34	.30	.539	.559	.478		.061	.020	.081	.518	—.080
June,	.60	.41	.19	.498	.509	.458		.040	.011	.051	.483	—.096
July,	.57	.40	.17	.498	.507	.471		.027	.009	.036	.489	—.078
August,	.60	.39	.21	.502	.514	.470		.030	.012	.044	.492	—.078
September,	.64	.44	.20	.536	.545	.483		.053	.009	.063	.514	—.059
October,	.70	.50	.20	.592	.621	.534	27.578	.058	.029	.087	.587	+.011
November,	.69	.46	.23	.588	.630	.559	.587	.029	.042	.071	.598	+.034
December,	.70	.50	.20	.616	.650	.563	.613	.053	.034	.087	.607	+.012
Extremes and Averages.	27.79	27.34	00.45	27.578	27.605	27.5309	27.592	00.047	00.027	00.074	27.568	
	Extremes.			Averages.								

* Calculated from the mean of col. 6 and 7.

† In this column, the numbers have been calculated after the Monthly Means had been reduced to the standard temperature of 32°.

TABLE III.—*General View of the State of the Atmosphere during the year* 1816.

Months.	Mean Pressure.	Mean Temp.	Probable Mean Dew point.	Force of Vapour.	Dryness.	Degree of Humidity.	Weight of Cubic foot of Vapour.	Evaporation.	Rain observed.	Proportion of Winds.			Height of the river.
										N.E.	S.W.	Variable.	
								Inches.	Inches.				Feet.
January,	27.720	69	54	.460	15°	.617	5.021	8.83		30	1	0	2.1
February,	.647	74	58	.526	16	.599	5.684	10.17	.3	21	5	0	1.5
March,	.617	79	59	.543	20	.528	5.816	15.03	.01	12	17	2	1.
April,	.556	83	66	.678	17	.583	7.208	14.52	2.47	4	26	0	1.3
May,	.518	83	66	.678	17	.583	7.208	15.	5.46	3	28	0	1.8
June,	.483	7	65	.657	12	.681	7.064	9.27	5.85	1	29	0	2.3
July,	.189	73	64	.636	9	.748	6.817	6.6	1.86	0	31	0	5.6
August,	.492	74	62	.594	12	.679	6.424	8.77	1.37	0	31	0	6.5
September,	.514	75	62	.594	13	.655	6.412	9.36	.8	0	30	0	4.2
October,	.587	76	64	.636	12	.679	6.852	9.30	4.07	17	13	1	4
November,	.598	72	61	.577	11	.901	6.263	7.35	1.51	26	4	0	2.5
December,	.607	71	57	508	14	.638	5.524	8.92		28	3	0	1.6
Averages,	27.568	75	61	.577	14	.639	6.377	123.12	Total. 23.7	145	218	3	3.05

Art. XIII.—*Farther Observations on the supposed Optical and Physiological Discoveries of Mr Charles Bell*

"Que d'ecueils doit craindre celui qui prend son imagination pour guide! Prevenu pour la cause qu'elle lui presente, loin de la rejeter lorsque les faits lui sont contraire, il les altere pour les plier à ses hypotheses ; il mutile, si je puis ainsi dire, l'ouvrage de la nature, pour le faire ressembler à celui de son imagination ; sans reflechir que le temps detruit d'une main ces vaines phantomes, et de l'autre affermit les resultats du calcul et de l'experience." *Laplace, Expos. du Syst. du Monde,* liv. v. chap. iv.

The superiority of physical over metaphysical science has been generally held to consist in the superior evidence of its facts and reasonings. We accordingly find that scientific controversies have related principally to technical questions respecting priority of inventions and discoveries, and that, in those cases where they have involved points of pure science, either one or both of the combatants have been unable to discover the truth themselves, or incapable of recognizing it when it has been brought before them with all the fulness of demonstration. Those who have once ventured to publish extravagant opinions on the authority of hasty observations, and ill-devised experiments, are not likely to renounce them, even when their absurdity has been calmly and courteously pointed out. The love of truth is not the moving principle of such minds. A feverish thirst of fame alone impels them, and, under the influence of this passion, they seek to involve truth in an ambuscade, or to get possession of her by storm,—while humbler and less ambitious spirits are only rearing the redoubts by which her outworks can be approached, and her strong holds secured. When a controversy, therefore, arises between these two classes of inquirers, between those who, as Laplace elegantly expresses it, mutilate, as it were, the work of nature, in order to make it resemble that of their own imagination, and those who found their results on calculation and experiment, we must not suppose that the empire of science is divided against itself, or that her eternal and immutable laws can be thus brought into doubt

These observations have been suggested by some controversial discussions, to which we have had occasion to direct the attention of our readers. When Mr Brooke attempted to put down a general law * of nature on the single authority of a hasty observation on the sulphato-tri-carbonate of lead, which he made out to be rhombohedral, he erected that little fabric of his imagination against a principle deduced from hundreds of facts, and now admitted by every mineralogist who has examined it. Although it was hinted to Mr Brooke, that a law without any exception required a number of facts, and these well established, to bring it into doubt, and that it was possible that his solitary observation might be wrong, or at least that some explanation of the anomaly might be found if his observations were right,—yet this gentleman again presented himself at the bar of the public with fresh asseverations of the truth of his observations, and committing the most unheard of trespasses on the fields of double refraction and polarisation, on which he had no qualification to sport. The point at issue was now taken up by Mr Haidinger, who examined a great variety of the finest crystals of the sulphato-tri-carbonate of lead. This skilful mineralogist speedily found that the mineral in question was a *compound* and *not a simple* crystal as Mr Brooke had supposed, and, by measuring its angles with great nicety, he proved, by actual *calculation and experiment*, that its primitive crystal was *not a rhombohedron*, but belonged to the *hemiprismatic* system of Mohs. Although Mr Haidinger pointed out the very re-entering angles of the composition, and though the combination is so plain to the dullest eye that we have observed it in polarised light in more than an hundred crystals without a single exception, yet, will our readers believe it, Mr Brooke again came forward, asserting the accuracy of his results, and questioning the demonstrations of Mr Haidinger.† This dying struggle for error neither merited nor has received any reply ; and those who have on this occasion combated for the truth, have (to use the sentiment of Laplace)

* We allude to the optical law of primitive forms, of which we shall give an account in an early number. See EDINBURGH ENCYCLOPÆDIA, Art. OPTICS, vol. xv. p. 572, &c. and Beudant's *Traité Element. Mineral.* Paris, 1824, p. 167.

† The able and elaborate paper of Mr Haidinger will be found in the *Edinburgh Transactions*, vol. x. p. 217. See also this *Journal*, vol. ii. p. 73.

left in the one hand of time those vain phantoms which she destroys, and committed to the other those humble results of calculation and experiment which she will not fail to spare.

From the rhombohedral visions of Mr Brooke, we now pass to the optical and physiological phantasies of Mr Charles Bell, to which the sentiments in our motto bear a more peculiar application. We have already attempted, by a gentle admonition, to conjure back these nebulosities into the *mare nubium* in which they have been generated; but they have returned to our atmosphere with showers of mud and stones, and we are again compelled, from self-preservation, either to dissipate the storm, or suffer from its ravages.

Had the speculations of Mr Bell been confined to the work in which they originally appeared, their influence would not have been widely extended; but they have been reprinted in a more popular form, and they are, besides, taught in public lectures delivered to students of surgery, who cannot fail to imbibe them as sacred truths, and make them the basis of a rash and dangerous manipulation. The diseases of the eye have been long the special field of empiricism; and there is no branch of the healing art which calls so loudly as this for an improved practice, founded on a thorough knowledge of the structure and functions of that important organ. We have ourselves seen the needle and the lancet thrust into the interior of this delicate organ, to cure diseases which were incurable, and which existed only on its surface; and we have seen defects of vision treated as cases of amaurosis, when they arose merely from a temporary debility in the external muscles. We cannot doubt, therefore, that Mr Bell's speculations, if they shall ever form an article of surgical belief, must mislead the hand, as well as the judgment of the operator; and under the influence of this opinion, we shall examine them with a degree of attention, which they should not otherwise have received from us.

1. In the third Number of this *Journal*, we have laid before our readers Mr Bell's doctrines in his own words, and we endeavoured, in the most courteous manner, to demonstrate their fallacy, both by general reasoning, and by direct experiment. It did not surprise us, that Mr Bell remained insensible to the force of these arguments; but we were astonished

at the method which he chose to repel them. As a fellow of the Royal Society of Edinburgh, he announced his intention of communicating to that body a paper "on the motions of the eye-ball;" and in order that both sides of the question might be before the society at the same time, Dr Brewster announced a notice, entitled, *Further Observations on the Vision of Impressions on the Retina*, which we shall give as it was read.

Farther Observations on the Vision of Impressions on the Retina.

"Having learned from Professor Bell, that the paper on the Motions of the Eyeball, by Mr C. Bell, was an answer to the Observations on the Vision of Impressions on the Retina, which I had the honour of submitting to the Society, and which have for some time been before the public, I take it for granted, that that paper has not carried conviction to Mr Bell's mind.

As the part of the subject which came under my notice is strictly physical, and is susceptible of experimental proof, and of rigid demonstration, it will not admit of that special pleading, by which, in the less accurate sciences, the gravest errors have often gained a temporary ascendancy. The points at issue between Mr Bell and me are too simple in themselves, and too much insulated from physiological mysteries, to admit of being involved, either in the ambiguities of language or of argument; and if any such cloak is thrown over them, it is easy to strip them of the unnecessary drapery.

Mr Bell maintains, that when the eye, with a spectral impression, is pushed aside by the finger, the spectrum remains absolutely fixed and immoveable. In direct opposition to this, I maintain, that the spectrum does move, because I have seen it move, and have measured the extent of its motion.

Mr Bell next maintains, that the immobility of the spectrum is a physiological fact, arising from the non-exertion of the proper muscles; whereas I maintain, that the motion which does take place is an optical fact, and that the amount of it actually observed, can be computed from optical principles.

Mr Bell likewise maintains, that when the eye is closed, the eyeball instantly turns upward; and he distinctly describes the experiment by which he *feels* it move, by the application of his finger to the ridge of the cornea. In opposition to this, I, and other persons who have made the same experiment, find that the eyeball remains at rest; and we have the high authority of Professor Soëmmering of Gottingen in support of our result. If Mr Bell, therefore, has performed his own experiment accurately, he has mistaken a casual motion of his own eye for a general function; and if that motion has, as he alleges, the effect of smoothing the accumulated ridge of the lubricating fluid, he enjoys a privilege of vision which others are not fortunate enough to possess.

In the latter part of my former paper, I endeavoured to show, that, even if the spectrum were immoveable, the notion of position was actually acquired without the exercise of the proper muscles. Against this position, which formed no part of the philosophical argument, Mr Bell may make a stand; for it is here alone that refuge is to be found, among the physiological sympathies—the never-failing strong-holds of hypothesis and error. Even here, however, the argument may be brought within the grasp of fixed principles, and the experiment may be conducted as follows:

Let the eye be supposed to be pushed by the finger from left to right, through an arch of 10°, in a horizontal plane, then, according to Mr Bell, the spectrum has not followed the motion of the eye, because the motion was brought about by the finger, and not by the proper muscles, which alone have the power of conveying the idea of change of place.

Let the head be now placed so as to be capable of being turned round through the same arch of 10°, by the pressure of the finger upon the eye; in this case, the spectrum does follow the motion of the eye, and the head, though the proper muscles are no more exerted in the one case, than in the other.

It may perhaps be said, that the *sensorium* being now turned round along with the eye, has some how or other obtained a notion of the change of position; but such a supposition, besides being unintelligible, is hostile to Mr Bell's opinion, unless the *sensorium* has acquired its knowledge from an *incipient action* of the muscles, or rather from a *disposition* to act when the finger is applied. But such a supposition, if at all intelligible, returns with equal force against the argument which it is brought to support, for the same disposition to act, on the part of the muscles, ought to be conveyed to the sensorium when the motion of the eyeball is produced by the finger alone.

I forbear saying any more on the subject, although the views which I have given are susceptible of numerous illustrations.

Those who are desirous of being acquainted with the fundamental difference between ordinary vision, and the vision of impressions, will see it in the two figures on the board, the lowest of which represents the effect produced, when the eyes receive an angular motion of translation from the fingers, while the upper one, which I gave formerly, shows the effect produced when the eye is pushed so as to move parallel to itself. In the first case, the change of place of the spectrum, which Mr Bell cannot see, is equal to the vertical ascent of the eye, added to the tangent of its angular motion, while in the second case, it is equal only to the vertical ascent of the eye; but in both cases, there is the same relative difference between the change of place in ordinary vision, and the change of place in spectral vision, a difference of such magnitude as to have occasioned the oversight which Mr Bell has committed."

Mr Bell's paper on the Motions of the Eye-ball, which was read after the above notice, was a controversial reply to a paper inserted in Number iii. of this *Journal*, and was printed in a periodical work now at an end. It was read by his brother, George Joseph Bell, Esq. advocate, who supported the contents of his scientific brief by the system of attack and defence which is still tolerated at the bar. There were present at the meeting of the Royal Society, a very great number of medical gentlemen, and among them several of the most distinguished medical professors in the University; and as soon as Mr Bell's paper was read, Dr Brewster rose, and pointed out to the society the various errors which Mr Bell had committed, both in his experiments and in his reasoning, and he pledged himself to answer any objection, or explain any difficulty, which any of the gentlemen present might state; and as no objection was stated to his views, he had reason to believe from this, as well as from other causes, that there was not one of the numerous members then present, who did not concur in the refutation which he had given of Mr Bell's paper.

As Mr Bell had now embalmed his erroneous views in the Transactions of the Royal Society of London, and in the Memory of the Royal Society of Edinburgh, the two great scientific bodies of the kingdom, and by publishing a defence of his doctrines, had evinced a resolution to maintain them at all hazards, it might have been thought advisable to put down, with a strong hand, a philosophical heresy, which had assumed such an obtrusive character, and which had come before the world apparently under such imposing patronage. We, however, had resolved not to disturb its repose. Scientific truth, when once clearly expressed, forces its way in silence to the judgment-seat of time; and her march is rendered only more quick, and more steady, by the clamours and the impertinences with which she may be assailed.

Under such feelings we had determined to be silent. But, while perusing Dr Wells's *Essay upon Single Vision with Two Eyes*, published at London in 1792, we were surprised to find that the experiments and conclusions, brought forward by Mr Bell as his own, were given in the most minute manner by Dr Wells. We felt ourselves, therefore, called upon to resume the subject, and to point out the fallacies by which this distinguished writer was led to maintain, and to apply to the explanation of the phenomena of vision, opinions so contrary to reason and experiment.

The following are the passages in which Dr Wells has recorded his opinions:

"When we have looked steadily for some time at the flame of a candle, or any other luminous body, a coloured spot will appear upon every object to which we shortly after direct our eyes, accompanying them in all their motions, and exactly covering the point which we desire to see the most accurately. Whatever can, therefore, be proved concerning the apparent direction of such a spot, in any given position of the eyes, must likewise be true in the same position of the eyes, with regard to the apparent direction of an object situated at the concurrence of the optic axes, as its pictures must occupy, in this case, the very parts of the retinas, upon the affections of which the illusion of the spot depends. This being premised, I shall now relate one or two observations respecting the apparent directions of the spot, and, consequently, upon those of external objects, which, as far as I know, have not been mentioned by any other person.

" 1. The spot is always seen single, whether the surface, upon which it is projected, be touching the face, or at the greatest distance from us; and the reason is plain. For the parts of the retinas, by whose affections from the luminous body it is occasioned, are those likewise which receive the pictures of objects placed at the intersection of the optic axes; and as such objects always appear single, so must also the spot. The fact indeed is so open to observation, and its cause so easily shown, that I should scarcely have thought of mentioning it had not Dr Darwin lately told us that the spot is seen double as often as the eyes are directed to an object more or less distant than the luminous body which gave rise to it. With respect to our different assertions upon this point, I shall only say, that I have made the experiment, I believe, upwards of an hundred times, uniformly with the same result; and that, if the spot ever appears double, this must be from some cause very wide of a change in the mutual inclination of the optic axes, to which he attributes it.

" 2. The spot not only appears single in every ordinary position of the optic axes, but cannot even be made to appear double by any means whatever. If it be projected, for example, upon a piece of white paper, whoever makes the trial, will find that, although on pressing one eye upward or downward, or to either side, the paper will be seen double, yet the spot will always appear single, and to possess its former place on the paper, as seen by the eye which is not disturbed. Before I knew the result of this experiment, I had imagined, that the position of one eye being forcibly altered, the external situation of the spot, which was suggested by the affection of that eye, would likewise be altered, and the spot by consequence be seen double. As the event, however, was contrary to my expectation, I began to suspect some cause of fallacy had been overlooked, which, at length, I thought might be this, that the spot had been seen by that eye only whose position had not been disturbed, the violence suffered by the other interrupting the due exercise of its functions. To determine, therefore, whether my conjecture was well founded or not, I made another experiment, which is mentioned in the following article.

" 3. Having looked steadily for some time at the flame of a candle, with *one* eye only, I directed afterwards, with both eyes open, my attention to the middle of a sheet of paper, a few feet distant; the consequence of which was, that a spot appeared upon it, in the same manner as if I had received the flame with both eyes, though somewhat fainter. My attention remaining fixed upon the sheet, I now pushed the eye, by which the spot was seen, successively upward and downward, to the right and to the left, and in every oblique direction; the spot however, never altered its position, but kept constantly upon the middle of the appearance of the paper perceived by the undistorted eye, though the appearance of the paper to the distorted eye was always separate from the former, and the sheet consequently seen double. My conjecture, therefore, was proved to be ill grounded, and all suspicions of fallacy in the former experiment ceased.

"Now it is evident, from these two last experiments, that the situation of the spot does not depend upon the bare position of the eyes, or else in the former of them it would have appeared double, and in the latter it would have been moved from the middle of the paper, when the only eye by which it was seen, was pushed from its place. Neither can it depend upon the bare position of the muscles of the eye, as these were also moved in the same experiments, nor upon any affections whatever of the optic nerve. For since this last substance is altogether passive, even in those motions of the eyes which do occasion a change of the spot's situation, every alteration induced upon the nerve by those motions, must be ultimately ascribed to a change of its position; and we have seen, that similar changes of its position, have been produced by external violence without any alteration of the spot's situation. The apparent situation of the spot being, therefore, dependent upon none of these circumstances, and being at the same time affected by the voluntary motions of the eye, it must, I think, be necessarily owing to the *action* of the muscles by which these motions are performed. Assuming, then, as true, that the apparent direction of an object, which sends its picture to any given point of the retina, depends upon the state of action existing at the same time in the muscles of the eye, and, consequently, that it cannot be altered, except by a change in the state of that action, I shall proceed to trace to this principle several phenomena of vision, particularly the uniform singleness of the spot already described, and the two facts respecting the visible directions of objects in the optic axes, which were mentioned in the beginning of this part of my essay."

Having thus quoted Dr Wells's own account of his experiments, we shall give a brief, and we trust an irrefragable demonstration of their fallacy.

1. When we push up the one eye by the force of the finger, and keep it in its new position, it has not performed an angular movement in its socket, but merely a small vertical ascent, by which, in an upright position of the body and head, it is raised into a more elevated horizontal plane. In this elevated position, the eye can execute horizontal, and even vertical angular movements, and can direct itself to contemplate either one or other of the double images of the objects before it. The consequence of this is (as we have explained in this *Journal* No. iii. p. 5,) that the spectral impression ascends only through a very small space, which it requires nice observation to appreciate, but which increases with the force applied to the eye.

2. It is impossible, by the pressure of the finger, to fix the left eye in a different angular position from the right eye;

because, however much we press upon the former, such is the power of its muscles, and such is the tendency of both eyes to execute similar movements, that the pressed eye directs its optic axis as near as possible to the point contemplated by the right eye, or that which is free. The attempt, therefore, to force the left eye into an angular position different from the right eye, is immediately resisted; and while one of the doubled images is descending, in consequence of the ascent of the pressed eye, the pressed eye, so far from having changed its angular position, will be actually contemplating the fixed image, provided the other eye is contemplating that image, or it will direct itself to any other part of space to which the right eye may direct itself.

3. It is a circumstance not a little remarkable, that it never occurred to Dr Wells, nor, so far as we know, to any person else, to *press upwards the two eyes at the same time.* When this is done, *the two spectral impressions will be seen to move,* and to rise through spaces so obvious to the dullest perceptions, as to put an end for ever to the extraordinary dogma, that they are capable of being put in motion only by the action of the voluntary muscles.

As Mr Charles Bell has not been sensible to the two first of the preceding observations, we recommend to his notice this last experiment; and we trust that he will have the candour to communicate the result of his observations to the Royal Societies of London and Edinburgh, and to acknowledge that he has discovered the true locality of that *hallucination* which he dared to ascribe to the functions of a sound mind.

ART. XIV.—*Mean Results of Observations with the Thermometer and Barometer at Batavia.* By M. KRIEL, M. D. Communicated by Professor MOLL of Utrecht.

WITH the view of obtaining a measure of the mean temperature of the equator, we requested Professor Moll to obtain for us observations on the mean temperature of Batavia, which is situated within 6° of the equinoctial line; and he was so kind as to favour us with the following communication:

"The following abstract is made from the *Transactions of the*

Society of Sciences at Haarlem, vol. vi. part ii. p. 9, printed in 1762.

1758.

	Therm. Fahr.			Barometer in English Inches.					
				Max.		Min.		Mean.	
	Max.	Min.	Mean	Inch.	Lines.	Inch.	Lines.	Inch.	Lines.
January,	86°	75°	79°	29	11.00	29	9,50	29	10.17
February,	86	76	80	29	11.00	29	975	29	10.45
March,	86	76	80	29	10.75	29	9,00	29	10.17
April,	84	76	79	29	10 50	29	8,50	29	9.97
May,	84	76	80	29	10.75	29	8,75	29	10.12
June,	83	75	77	29	11.25	29	10,25	29	10.59
July,	86	74	78	29	11.00	29	9,50	29	10.49
August,	87	75	79	29	11.25	29	10,25	29	10.61
September,	86	76	79	29	11.50	29	10,25	29	10.65
October,	83	76	77	29	11.25	29	10,25	29	10.75
November,	83	74	75	29	11.00	29	19,75	29	10.40
December,	84	74	79	29	11.00	29	9,50	29	10.20

Hence the mean temperature of the year is 78°5.

In the above volume the observations are given at full length. The thermometer was observed regularly at 6 in the morning, at 12 and 2 P.M., and at 10 P.M. The thermometer was made by Prins, successor of Fahrenheit, at Amsterdam, and it indicated 32° in snow, and 214° in boiling water. No regular hours, which is to be regretted, were kept in observing the barometer. The observations, however, were generally made in the morning and evening.

1759.

	Therm. Fahr.			Barometer in English Inches.					
				Max.		Min.		Mean.	
	Max.	Min.	Mean	Inch.	Lines.	Inch.	Lines.	Inch.	Lines.
January,	82°	74°	77°	29	11.25	29	10,00	29	10.55
February,	81	71	78	29	10 75	29	9,75	29	10.31
March,	83	76	79	29	11.00	29	10,00	29	10.44
April,	84	76	79	29	10.50	29	9.50	29	9.86
May,	85	75	80	29	11.25	29	9,00	29	10.29
June,	84	72	78	29	10.75	29	9,00	29	10.65

The mean annual temperature, deduced from these observations for half a year, is obviously below 78°5.

Prins was an excellent thermometer-maker. I possess some of his manufacturing, which agree very well with those of Dollond and Newman. The thermometer hung *within* the house.

Professor Reinwardt, who is preparing for the press his Travels in Java, writes me, that he found the mean temperature of Batavia, near the sea shore, 82° F.; and at Buitenzoig, about 40 English miles from Batavia, 737 feet above the level of the sea, the mean temperature was 79° F."

These observations, so far as they go, confirm the opinion of Humboldt, which has been called in question by Mr Atkinson,* that the mean temperature of the equator cannot be assumed above 82°½ of Fahrenheit. This very important subject will be resumed in another paper.

ART. XV.—*Account of a Survey of the Valley of the Setlej River, in the Himalaya Mountains.* From the Journal of Captain ALEXANDER GERARD, Surveyor to the Board of Commissioners.

THE Journals of the preceding excursions of Captain Gerard having been printed for the first time in the pages of this *Journal,*† as communicated to us by his uncle, the late Colonel Gerard of Rochsoles, we have been anxious to procure an account of his more recent examination of the Valley of the Setlej, and had written to India, with the view of obtaining it. The journal, however, of the examination having been transmitted to the East India Company, it was, at the request of its author, communicated to Thomas Colebrooke, Esq. Director of the *Royal Asiatic Journal,* who has given a very able and interesting summary of it in the newly published part of the *Transactions of the Asiatic Society.*‡ As this work must be in the hands of a very few of our readers, we need not make any apology for drawing from it a continuation of the travels of our enterprising and intelligent countryman. Captain A. Gerard was accompanied with his brother, Mr J. G. Gerard, and their Journal begins on the 6th June 1821.

Ról, at the foot of the *Shátúl* pass,§ is a small district in *Chúárá,* one of the larger divisions of *Baséhar.* It contains

* See this *Journal,* vol. vi. p. 180.

† See No. I. p. 41, and No. II. p. 215.

‡ Vol. i. part ii. p. 343.

§ See the Map of the Countries north of the Sutlej, given in No. iii. of this *Journal.*

five villages, situated upon the south-western declivity of the mountainous range. These villages vary in altitude, from 9,000 to 9,400 feet above the level of the sea. *Ròl* itself is 9,350 feet. It is the highest inhabited land without the *Himálaya.* The crops are wheat, barley (H. hexastychon,) Siberian barley (H. cæleste,) called by the mountaineers *U'ä*, Polygonum? (phàpar) and pease: they just reach to 10,000 feet. The wheat seldom ripens; and, when the rains fall early in June, most of the grains are cut green.

The travellers proceed from *Ról* through a fine wood of oak, yew, pine, rhododendron, and horse-chesnut, with some juniper, and long thin bambus, to *Búchkálghat*, just overtopping the forest at the elevation of 11,800 feet.

They passed by an extremely difficult and tiresome way, amongst piles of loose stones, which seemed to have been but lately precipitated from above, to *Rëúní*, a halting-place for travellers, on the bank of a rivulet, at an elevation of 11,750 feet. In the vicinity were stunted birches, dwarf oaks, pines, and juniper, and two species of rhododendron; one, as called by the natives, *Tálsár*. Flowers abounded, such as thyme and cowslips. The soil is a rich moist black turf, not unlike peat.

The *Shátúl* pass had not been traversed since the month of September, 1820, when Mr James G. Gerard effected the passage with much difficulty and danger, and lost two of his servants, who were frozen to death at mid-day. It was attended with less peril at this early season: Messrs Gerard were the first persons who visited it in 1821. Having before travelled the ordinary road through the pass, they determined to strike directly across the ridge, which they accomplished. Its elevation was found by barometric measurement to be 15,556 feet above the sea, confirming a similar measurement in the preceding year, which made it but two feet less.

The rocks were chiefly mica slate, and gneiss. In the ascent they had noticed a huge granitic rock, in the chilly recess of which they rested; and their route had led them in some places over heaps of angular fragments of gneiss, granite, quartz, and felspar, jumbled together in wild disorder, where every step was dangerous.

To the east and south-east was seen a low part of the Himálayan range. Its altitude is much less than that of *Shátúl;* but it is rendered impassable by a perpendicular wall of gneiss, that forms an impracticable barrier for several miles.

The snow became more frequent as they ascended, till they attained the crest of a ridge, at the elevation of 13,450 feet, where it is continuous at that early season. A month later, it would be dissolved. Upon the snow, at the greater height of *Shátúl*, were many insects like mosquitoes; at first they were torpid; but sunshine revived them. Some birds were seen, resembling ravens. Mosses were found on the few rocks.

The travellers halted for the night at *Kaniján*, under the shade of a large rock, at the height of 13,400 feet, whence the steep ascent of the pass begins. There were plenty of flowers where the snow had melted, but no bushes. The firewood was brought from the last camp.

From this spot the ascent seemed appalling. The crest was nearly 2,200 feet higher. Here and there a rock projected its black head; all else was a dreary solitude of unfathomable snow, aching to the sight, and without trace of a path.

The travellers found the snow, which was soft at mid-day, afford good footing, and reached the summit with less fatigue than they anticipated. They remained the night and following day at the crest of the pass, and suffered much from headache and difficulty of breathing, usually experienced at such elevated positions. It snowed in the evening. The temperature did not rise above 41° at noon: it was 24° and 26° at sunrise (9th and 10th of June.)

On the subsequent day, they descended upon the same side, and proceeded along the dell of the *Andréti*, a branch of the *Pabar* river, rising near *Shátúl*, and halted on the bank of a rivulet called *Dingrú*, at an elevation of 12,300 feet, just above the limit of the forest. The lowest point in the dell was 11,100 feet. Leeks were gathered at the height of 12,000 feet. The ground was here a rich sward, cut up in grooves by a large kind of field-rat, without a tail. (Spalax, "Mus typhlus?")

Captain Gerard and his brother continued to explore the glens and valleys of the tributary streams of the *Pabar* river;

in particular the valley of the *S'ipon* river, and that of the *Pabar* itself, visiting the confluence of these rivers, the summit of the ridge which divides them, and the sources of both rivers.

The Himálayan glens for the most part run almost perpendicular to the range, or from N.N.E. and N.E. to S.S.W. and S.W. The face exposed to the N.W. is invariably rugged; and the opposite one, facing the S.E., is shelving. The roads to the most frequented passes lie upon the gentle acclivity: the difference of the elevation of forest on either side is remarkable. On the declivity towards the N.W., which, as before observed, is the most abrupt, the trees rise several hundred feet higher than those upon the opposite face, which has a more gentle slope; and in some instances, the difference exceeds 1000 feet. The general height of the forest on the southern face of the *Himálaya*, is about 11,800 to 12,000 feet above the sea. Oaks and pines reach that elevation; birches extend a few feet higher. Descending from the pass of *Bandáján*, the level of the highest juniper was observed 13,300 feet.

From *Shéarghal*, at an elevation of 13,720 feet (which the travellers reached by a very steep path, crossing several snow-beds, where it was necessary to cut steps with a hatchet, and passing among gigantic oblong masses of mica slate, disengaged from the impending crags,) the prospect is very extensive. Towards the plains appear the *Chúr* mountains, 12,000 feet (one measured barometrically is 12,143 feet;) to the S.E., snowy summits of immense altitude, in the direction of *Yamunávatárí*, rising one above another in majestic disorder, and presenting mountains of eternal snow; and beyond the source of the *Pabar*, one of the huge *Raldang* peaks, above 21,000 feet. Across the *Pabar*, is the *Chashíl* range, through which are several passes, 13,000 to 14,000 feet high.

The travellers passed through *Tangno*, which gives name to a small district, comprehending five villages. Abundance of thyme, strawberries, nettles, thistles, and other European plants, was noticed. The houses are shaded by horse-chestnuts, walnuts, and apricots. The elevation of the place is 8,800 feet.

Unable to procure guides to the *Súndrú* pass, Messrs Gerard proceeded to *Janglig*, a place already visited in 1820. Its height is 9,200 feet: the highest habitation, 9,400 feet.

The *Yúsú* pass, at the head of the *Sípon* river, which is called *Yúsú*, in its upper course, above *Bandáján*, is 15,877 feet high. The dell, between this and *Bandáján* pass (14,854 feet above the sea), is shut in towards the N.E. by snow-capped mountains, upwards of 17,000 feet high, amongst which the river has its source. The rocks at *Bandáján*, and on the bank of the river, where the travellers encamped at the height of 13,650 feet, were gneiss; and the adjoining mountains the same, and clay slate. The descent was over broken slate, from *Bandáján*.

The ascent of *Yúsú* pass was extremely fatiguing: Messrs Gerard describe themselves as having been so exhausted at first, that they rested every hundred yards; and, had they not been ashamed, before so many people, some of whom they had induced to accompany them after much intreaty, they would have turned back.

At the summit of the pass, there is a plain covered with snow for 400 or 500 yards. The ground slopes suddenly to the valley of the *Setlej*: the peaks on each side seemed about 800 feet higher.

The *Yúsú* river is divided into several streams, all of which, but the principal one, were crossed by arches of snow. The largest, which was forded, was forty feet broad, and six inches deep: the bed full of pebbles, and the margin snow-washed by the stream. With the exception of that principal channel of the river, and some openings partially disclosing the smaller branches, the rest is a bed of snow six or eight inches thick.

The glen becomes more and more contracted, till at last it is bounded by mural rocks of granite, with the *Yúsú* forcing its passage between them in impenetrable obscurity, under immense heaps of indestructible ice, running in ridges, and studded with mounds of snow.

The source of the *Pabar* is in a lake, called *Chărámâï*, above a mile in circuit, whence the river rushes forth over a perpendicular rock, forming a fine cascade. Above it are enormous banks of snow, 80 or 100 feet in thickness, which have cracked and partly fallen outwards into the lake. Just beyond them are three high passes, *Níbrang*, *Gunás*, and *Ghúsúl*, which lead over the summit of the range, into the valley of the *Baspá* river, and are very steep. The travellers were unable to persuade the guides to conduct them over either of these passes, but subsequently visited them from the other side.

The *Búrendo*, or *Bruäng* pass, near the *Pabar*, was again visited. It had been measured barometrically in 1818: the measurement now taken exceeded the former one (which was 15,095 feet) by 153 feet. To that extent the barometric measurements must be considered uncertain. They halted two days on the summit of the pass; and, as is usual at so great elevations, were troubled with headaches and difficulty of respiration. The nights were calm; but the solemn stillness was now and then interrupted by the crash of falling rocks.

They descended into the valley of the *Baspá;* sliding down the declivity of a snow-bed, by seating themselves upon a blanket on the snow. This mode is invariably practised by the mountaineers, where there are no rocks nor precipices. They had then a dreadfully dangerous footpath, along the rugged sides of the dell: it crossed many snow-beds, inclined at an angle of 30° or more; which delayed them much, as they had to cut steps in the snow.

The *Baspá* is a noble river, running through a romantic valley, which, the people have a vague tradition, was formerly a lake, and it has every appearance of it. The valley is bounded, on each side, by abrupt ridges of the *Himálaya*, which present a great deal of bare rock.

The travellers advanced to the confluence of the *Baspá* and *Bakti* rivers; examined the valley of the latter, and reached the confluence of the *Bakti* and *Nalgún* rivers, proceeding along the ridge, which is traversed by several passes before-mentioned, all of which they now visited, *viz. Níbrang*, 16,035 feet high; *Gúnás*, 16,026 feet; and *Ghúsúl*, 15,851 feet; as also *Rúpín*, 15,480 feet.

At *Núrú*, a halting-place, where there are good caves for shelter, at the elevation of 13,150 feet, and at *Dóǹsón*, where they halted the following evening, at the height of 14,200 feet, there was, through the night, a continued crash of falling rocks, on the rugged side of the dell. The species of rhododendron called by the natives *Tálsár*, was observed in the vicinity of *Dóm̀són*, at its level.

The *Nalgún* pass, the lowest pass through the *Himálaya* which had been yet visited, is 14,891 feet above the sea. From this pass they descended to the confluence of the *Nalgún* and *Bakti* rivers, and thence proceeded along the *Bakti*, and across the *Baspá* river, to *Sangla*, where they halted several days (23d to 29th of June,) and whence they despatched their collection of plants and geological specimens; but the paper envelopes of the latter were rendered illegible, and the whole of the former destroyed, by the heavy rain which overtook the despatch, in the following month.

Messrs Gerard, resuming their journey, ascended the valley of the *Baspá* to *Chétkúl*, the last, and highest village in it; crossing, the first day, two large branches of the *Baspá*, the *Chuling*, and *Gór*, from the *Cailás* range on the north; and, the second day, two other considerable streams, the *Mangsá* and *Shútí*. They first passed over tremendous blocks of coarse-grained granite, the decomposition of which seems to have formed the sand in the river; it gives the water a turbid appearance. The granite is white, and from a distance looks like chalk.

The first part of the valley has the same general character with most others in the *Himálaya;* but it is considerably broader. The face of the mountain exposed to the S.W., which is part of the *Cailás* or *Raldang* group, presents abrupt precipices and threatening cliffs, with little soil, and but few trees; the opposite face again is more gently sloped, and thickly wooded with pines, which are overtopped by a belt of birches. Near the top of this chain, there is a good deal of snow. The last half mile to the village of *Rákchám*, situate in the western corner of the glen (and 10,500 feet above the sea,) is a rugged descent upon enormous masses of granite. The dell has here a pleasing appearance, and it expands to three furlongs in breadth: half of it is laid out in thriving crops of wheat and barley, and the rest is occupied by sand-beds, which form many small islands, with the river winding among them. Just above the village, huge piles of black rock * rise abruptly,

* Composed of black mica (fine-grained) with a little oxide of iron.

in numerous black spires, to about 9000 feet higher, or nearly 20,000 feet above the level of the sea. Approaching *Chétkúl*, the dell becomes more contracted; the right bank becoming very precipitous, and almost mural to the *Baspá*. The altitude of the village is about 11,400 feet, and the highest fields are scarcely 200 feet more. The valley continues about 800 yards wide for two or three miles; the *Baspá* then makes a bend to the southward, and the view is shut up by snowy mountains of great height.

From *Chétkúl* the travellers attempted the *Kimlíá* pass, at the head of the valley of the *Rúsú* river, a large stream, derived from a double source, one branch rising in the snow of *Saglá* pass, which bears nearly south; the other, or smallest, in the *Kimlíă*, about S.W. Above the elevation of 13,300 feet, the level of the highest birches, the *Rúsú* is increased, in rapidity and turbulence, to a torrent, and foams in dreadful agitation and noise. Still higher up, the road ascends gradually, upon snow of immense thickness in the channel of the current, which now and then shows itself in deep blue lakes. The travellers passed along the margin of one, 150 feet in diameter: the way was extremely dangerous, upon ice sloping abruptly to the water; in this there was no footing, till notches were cut with a hatchet, an operation which long delayed their progress. Latterly, they travelled over mounds of unfathomable snow, so loose as scarcely to be capable of supporting them at the depth of three feet. The guides had snow-shoes, which were at least five or six inches in breadth. They said, that early in the morning, before the sun had power, the snow would bear the weight of a loaded person; and in May and June, when the pass is most frequented, it does not sink at any time of the day.

The travellers reached the elevation of 15,500 feet, where the pass appeared to be 1400 or 1500 feet higher, over vast fields of snow.

The dell is broad (half a mile wide,) and covered with snow in high wreaths. The mountains, which have a S.E. exposure, are nearly bare, a few patches of snow only appearing at great heights. The line of cliffs may be 17,500 feet. On the other side, the mountains are nearly of the same height, and they present a chain of mural precipices, eaten away by frosts into forms like towers and steeples. Much of the rock near the summits is exposed; and snow, having lost its hold on their steep craggy sides, has accumulated below.

It had rained several hours; the sleet fell thickly, without any prospect of its clearing up. Messrs Gerard thought it prudent to order a speedy retreat; especially as the guides were greatly alarmed, and strongly remonstrated against their proceeding further, lest they should fall into some deep chasm, concealed by soft snow.

The shower of sleet continued with them the greater part of the descent; and latterly changed to rain, with a milder climate. From the craggy sides of the dell the rocks were loosened by the rain, and followed each other in a continued crashing, and some pieces tore up the path a few yards from them.

Having caught severe colds, they did not renew the attempt to visit *Kimliá* (nor *Saglá*,) but returned to *Chétkúl*; and were dissuaded from attempting the *Neilang* pass, where, several years ago, eighteen persons perished in the passage: since which time, few loaded travellers have ventured by that route.

Messrs Gerard proceeded by the *Chárang* pass (17,348 feet high) to the valley of *Nangalti*. The inclemency of the weather rendered it very arduous. They were detained three days at *Shalpiá* (a resting-place for travellers) by incessant rain; on the fourth day their guides consented to proceed. Many snow-beds were crossed; and, about the height of 16,300 feet, continuous snow-beds commenced; at first a gentle acclivity, and latterly a very steep slope, surpassing in terror and difficulty of access, any thing which the travellers had yet encountered. The acclivity was at an angle of $37\frac{1}{2}°$, of loose stones, gravel, and snow, which the rain had soaked through and mixed together, so as to make moving laborious, and all but impracticable. The stones gave way at every step, so that it became necessary to use hands as well as feet. The travellers reached the crest of the pass at noon, in a state of exhaustion and numbedness of hands and feet, from continued exposure to snow and sleet, with a violent freezing wind.

The dell leading to the pass is very much contracted; and the ridges on each side are almost bare. The rock is generally a sort of slaty gneiss, sometimes in large masses, but more commonly tumbling in pieces, with little soil, and less vegetation.

Here, as at *Shâtúl*, Captain Gerard noticed the circumstance of the mercury appearing quite pure [perfectly fluid?] when they left camp; but, at the pass (when used for filling a barometer) it had lost its lustre, and adhered to the fingers and cup as if it were amalgamated.

The descent from the pass, for half a mile, was at an angle of 33°, upon gravel and snow, with a sharp-pointed rock occasionally projecting through it. Some of the loaded people slid down this declivity at the greatest risk. Travelling was rendered laborious on the easier slope of snow, from its sinking one and a-half to two feet. The fissures were beginning to appear, and the guides picked their steps with much caution, leaping over whatever had the least appearance of a rent. The snow fell fast; and a piercing wind blew with fury down the dell.

The principal branch of the *Nangálti* has its source much further to the west; a rivulet joins it from the pass. The mountainous range having a N.W. aspect, is very rugged; and the snow (often of a reddish colour) presents enormous banks of sixty or eighty feet thick, as shown by the part towards the dell having fallen down where it cracked. This is always the case on the precipitous sides of the vallies, because the ridges, for a considerable way down, are too abrupt for the snow to rest upon them: it therefore accumulates in large quantities, where the inclination is more gentle; it then cracks, and tumbles down by its own weight, during the rainy season, and leaves a perpendicular wall of eighty to a hundred feet in depth. The mountains on the other side were less steep, and the snow lies in continuous fields.

The travellers proceeded over heaps of loose stones, snow, and slush, at the point of congelation. They passed by several deep blue lakes, with their banks of frozen snow: these are always to be dreaded; and they made a circuit by a seemingly more arduous road, to avoid the danger. Two avalanches descended opposite to them: one of rock, which spent its force in distance, the smaller fragments just reaching them; the other of snow, but arrested by intervening rocks.

The rocks in the vicinity of *Kiúkúche*, an enclosure for cattle, on the banks of the *Nangaltí* (where they encamped at an elevation of 12,400 feet, as indicated by the barometer,) were granite, and fine-grained mica slate.

Four considerable streams were forded, which rise at the back of the *Cailás*, and joining the *Nangaltí*, at length mingle their waters with the *Tidúng* river.

After fording the *Nangaltí*, thyme, and further on juniper, mint, sage, and a variety of odoriferous plants were met with. At *Kiúkúche* there were a few animals of the cross-breed, between the *yak* (bos grunniens) and common cow.

On either side, for a few hundred yards, there is a grassy slope, with juniper and other bushes; and just above it, the dell is inbound by craggy cliffs of horrid forms. A little further down, the glen becomes more contracted in breadth, and the mountains present mural faces of rock, which continue for two miles, to the union of the *Nangaltí* with the *Tidúng*.

Few of the loaded people arrived the same day; two of them stopped all night at the top of the pass, and tore up their blankets to protect their feet. Fortunately it did not snow, and clouds prevented severe frost, or they certainly would not have survived the night. People were despatched to their assistance; and all were up soon after noon next day.

Recommencing their journey, the travellers followed the course of the *Nangaltí* river to its junction with the *Tidúng*, and explored the valley of this last-mentioned river, ascending to the village of *Charang* (12,000 feet,) amidst mountains 18,000 feet high; and proceeding thence to *Thangi*, and afterwards to the confluence of the same river with the *Setlej*. The principal branch, retaining the name of *Tidúng*, flows from the E.S.E., having its source in Chinese Tartary.

The valley of the *Tidúng* is very narrow; in parts so much so, as scarcely to afford a passage for the river. The stream is furiously rapid, the declivity very great, and the rumbling of large stones, carried down with velocity by the force of the water, was incessant. For six or seven miles the fall of the river is 300 feet per mile, and in some places almost double: where it presents an entire sheet of foam and spray, thrown up and showered upon the surrounding rocks with loud concussion, re-echoed from bank to bank with a noise like thunder.

The dell of the *Tidúng*, at *Húns*, a Tartar village, is confined by towering cliffs of white granite and mica slate. The mountains in the neighbourhood of *Chárang* are all of blue slate, naked to their tops, and exhibiting decay and barrenness in the most frightful forms. They tower in sharp detached groups to about 18,000 feet. No vegetation approaches their bases, whilst their elevated summits offer no rest to snow.

Where the dell was narrowest, there was so little space for the stream, that the road continued but for a small distance on the same side, and crossed the river repeatedly by *Sangas;* one was inclined at an angle of 15°. The travellers had to pick their way: one while upon smooth surfaces of granite, sloping to the raging torrent; at another, the route led among huge masses and angular blocks of rock, forming capacious caves, where fifty or sixty people might rest: here the bank was formed of rough gravel, steeply inclined to the river; there the path was narrow, with a precipice of 500 or 600 feet below, whilst the naked towering peaks, and mural rocks, rent in every direction, threatened the passenger with ruin from above.

In some parts of the road there were flights of steps; in others frame-work, or rude staircases, opening to the gulf below. In one place is a construction still more frightful to behold; it is called *Rápïá*, and is made with extreme difficulty and danger. In the instance, it consisted of six posts driven horizontally into clefts of the rocks, about twenty feet distant from each other, and secured by wedges. Upon this giddy frame a staircase of fir spars was erected, of the rudest nature; twigs and slabs of stone connected them together. There was no support on the outer side, which was deep, and overhung the *Tidúng*, a perfect torrent.

After surmounting this terrific passage, they came to another, where the footpath had been swept away. It would have been impracticable; but, from previous intimation, thirty people had been despatched the preceding night from *Thangí*, and had just completed two tolerable *sangas* by the time the party arrived, so that they passed in safety.

The last mile and a-half to *Thangí* was better; the road ascended from the river, often by staircases and scaffolding; and at the village, the shade of the *Deödár* and *Neoza* (same with Mr Elphinstone's *Chilgooza*,) two species of pine, was again enjoyed.

Grámang, one of two divisions of *Thangí*, is pleasantly situate upon a southern slope; the houses rising above each other, with the inclination of the soil. There are few fields, but they appeared thriving. The grains were wheat, barley, phápur (Polygonum?) Siberian barley, and millet (Panicum miliaceum,) with some patches of turnips and pease. The whole is neatly laid out, and intersected with aqueducts, whose banks are adorned with walnut, apricot, apple, and poplar-trees. Above the village is a thick forest of pine: and the summits of the surrounding mountains are all peaked, and very rugged. On one side of the river they are fine-grained black mica, so hard, that it was difficult to break off a good specimen with a hammer; across the *Tidúng*, the rocks appear to be white granite.

The route from *Thangí* to *Marang* lies through a forest of pine (*Rí*,) upon the slope of a hill, composed entirely of blue slate, often crumbling in pieces.

From the confluence of the *Tidúng* with the *Setlej*, the town of *Ríbé*, or *Rídang*, has a charming appearance: yellow fields, extensive vineyards, groves of apricots, and large well-built stone houses, contrast with the gigantic *Raldang* mountains. These are scarcely four miles from the town.

*Marang** is a large town, surrounded by high mountains. Although 8500 feet above the sea, it enjoys a mild climate. During eight days' halt, the temperature varied from 58° to 82°; and flies were very troublesome. The sun, even at this season (July) does not appear more than nine hours: was scarcely visible above the mountains before 8 A. M., and disappeared behind them at 5 P.M. There were alternately light clouds and sunshine, and now and then a little rain, which in this valley never falls heavy: the height of the outer chain of

* Already visited by Capt. Gerard in 1818 and in 1820.

the *Himálaya* being sufficient to exclude the rains, which deluge *Hindusthán* for three months.

Having collected from the surrounding villages, supplies for ten days, Messrs Gerard proceeded to examine the valley of the *Táglá* river, which has its source in Chinese Tartary. They travelled to *Nisang* (on the *Táglá*,) a Tartar village, already visited both in 1818 and 1820; crossing the *Túngrang* pass, which was again measured, and the previous measurement (13,739 feet) confirmed.

The pass leads over a spur, which runs down to the *Setlej* river, from a cluster of snowy mountains, upwards of 20,000 feet high. The rocks are slate : it easily splits into large even slabs, which are well adapted for carving the sacred Tartar sentences upon them. Across the *Setlej* the mountains are of white granite, breaking into gravel, and more abrupt than on the hither side.

They proceeded along the banks of the *Táglá* to *U'rchá*, and thence to *Rakor*, through the *Ruthingí* pass, and near the source of a rivulet of that name, after passing the *Khátí*, which descends very steeply from the *Himálaya* on the south, in which direction a peak of vast altitude is visible. The elevation of the pass is 14,638 feet; that of the resting-place at *Rakor*, 14,100 feet. A few birches are growing 200 or 300 feet lower.

Upon the left bank of the *Táglá*, the height of the mountains is upwards of 16,000 feet, and no snow appears. The rocks are brown clay slate, and mica slate. Upon the right bank of the river, the mountains appear to be all clay slate, crumbling into soil, and forming a natural declivity. The summits seem to be 18,000 feet high at least; and there is very little snow in streaks. Farther to the east is a large mountain, white with snow, and near it a naked ridge of rocks, ending in a number of sharp points, apparently formed of slate. In the vicinity of the source of the *Ruthingí*, several conical points are seen covered with snow.

The travellers continued along the banks of the *Táglá* to *Zongchen*, passing several streams which fall into it, and a larger one named *Kegóche*, which comes from the south (S.

by W.) and one less considerable, called *Langúrge*, from the S.E., both very muddy. The *Táglá* itself is quite clear, and its course is from the N.E. They crossed at once by a *sango.*

The path lay upon broken slate and slippery soil, then upon inclined faces of rock; at one time ascending steeply upon loose stones; at another, descending abruptly upon rude steps and scaffolding, projecting over the stream, and between cliffs that subtend an angle of 60° or 65° on either side. Now and then these crags are perpendicular for 200 or 300 feet, and they even overhang the pathway. Large snow-beds conceal the river for several hundred yards: an immense load of stones and gravel lies above the snow. In one place the accumulation of rocks, which have fallen from the surrounding peaks, is sixty or seventy feet thick; and the river is seen rushing from beneath a large vault, whose under surface is frozen snow.

The height of *Zoncheng* is 14,700 feet, which, in lat. 31° 36′, according to received theory, should be buried under everlasting snow. The situation, however, is far different. On every side of the glen, which is a bowshot broad, appeared gently-sloping hills, for the most part covered with *Támá*, (Tartaric furze.) The banks of the river were covered with grass turf, and prickly bushes. Around, the land was covered with verdure; flocks of sheep were browsing, and deer leaping; altogether it was a romantic spot, wanting but trees to make it delightful.

During the march the sun was found at times powerful; but the temperature was evidently decreasing with the elevation. The highest observed in the day (23d of July) was 68°.

The rocks were limestone; the soil a stiff yellow clay, rent in every direction by small fissures, and seeming to have been under water. The surface was ground to dust.

The next stage was to *Zamsírí*, by the *Këubrang* pass; after tracing the *Táglá* (crossed frequently by snow-beds,) until it was reduced to an inconsiderable rivulet at the foot of the pass.

The ascent of the pass is by no means steep, the angle being only 19° or 20°. But the difficulty of breathing and severe headaches, which all the party, not excepting their Tartar guides, experienced more or less, rendered the exertion of walking very laborious. As they advanced, vegetation became more scarce, till at length it wholly disappeared; and the last mile presented a scene of solitude and desolation.

The elevation was found by barometric measurement to be 18,313 feet above the sea. The pass is reckoned the boundary between *Kunáwar* and that part of Chinese Tartary which is under the authority of the Grand Lama of Lahasa.

There was very little snow in sheltered situations contiguous to it, but none in the pass itself. Several birds were heard, and especially the call of a species of pheasant, which lives near the snow.

The mountains inclosing the dell of the *Táglá* river, which lead to the pass, are between 19,000 and 20,000 feet above the level of the sea, just tipped with snow; else they were covered with *támá*, a prickly bush, to which the travellers in a former journey gave the name of whins, and which they now called Tartaric furze. It is the ordinary fuel of the Tartars; and appears to thrive best among arid gravel, and in the bleakest places. Its upper limit near *Këúbrang* was observed at something above 17,000 feet.

After halting some time, it began to snow; and though the thermometer was not below 44°, the violence of the wind, added to the difficulty of respiration, rendered the situation unpleasant; and the travellers hastened down to a milder climate.

Zamsírí, a mere halting-place for travellers, on the banks of the *Shéltí*, to which they proceeded from *Këúbrang*, is 15,600 feet above the sea, a height equal to that of the passes through the outer range of snowy mountains; yet there is nothing to remind one of the *Himálaya*. Gently sloping hills and tranquil rivulets, with banks of turf and pebbly beds, flocks of pigeons, and herds of deer, would give one the idea of a much lower situation. But nature (Capt. Gerard remarks) has adapted the vegetation to that extraordinary country; for, did it extend no higher than on the southern face of the *Himálaya*, Tartary would be uninhabitable by either man or beast.

It seems surprising (he goes on to observe) that the limit of vegetation should rise higher the further we proceed, but so it is:—on ascending the southern slope of the snowy range, the extreme height of cultivation is 10,000 feet; and even there the crops are frequently cut green. The highest habitation is 9500 feet; 11,800 feet may be reckoned the upper limit of forest, and 12,000 that of bushes: although in a few sheltered situations, such as ravines, dwarf birches and small bushes are found almost at 13,000 feet.

In the valley of the *Baspă* river, the highest village is at 11,400 feet; the cultivation reaches to the same elevation; and the forest extends to 13,000 feet at the least.

Advancing further, you find villages at 13,000 feet, cultivation at 13,600 feet, fine birch trees at 14,000 feet, and *támá* bushes, which furnish excellent firewood, at 17,000 feet.

To the eastward, towards *Mánassaróvar*, by the accounts of the Tartars, it would appear that crops and bushes thrive at a still greater height.

The travellers descended the valley of the *Shélti* river to its confluence with the *Súmdó* river, and ascended to the crest of the *Húkëó* pass, of which the elevation is 15,786 feet. The soil is reddish, apparently decomposed limestone, with no large stones. The ground is thickly covered with green sward and beds of prickly bushes. No rocky points are seen, the whole being gentle slopes of gravel, much resembling some of the Scotch Highlands; the *támá* at a distance seeming like heath. *Yaks* and horses were feeding on the surrounding heights; and the climate was pleasant; the temperature being 57°.

There are the usual piles of stones to mark the crest of the pass, and a great number built upon all the surrounding heights. At a distance they could not be distinguished from men; and were taken at first sight, by the servants, for Chinese come to dispute the pass. The guides assured them they were piles of stone; and a view through a telescope confirmed the assertion.

Three of the people, who were attending the cattle, watched the party for some time, until being convinced there were Europeans, they mounted their horses, and set off at a gallop. The travellers quickened their pace, determined to advance as far as practicable; but two miles further they were stopped by the Chinese, after they had crossed a rivulet with swampy banks, winding among rich turf, near which, they found many ammonites, at the height of 16,200 feet, on the elevated land between *Húkëó* and *Zinchin.*

The Tartars under Chinese authority were encamped, awaiting their arrival, of which previous intimation had been received, and pointed out a spot for their camp, and a line beyond which they should not pass. Their manners were polite, and their civility was requited by presents of tobacco, the only thing for which they seemed to have any, the least desire.

The height of *Zinchin* is 16,136 feet, and the eminences in the vicinity rise many hundred feet higher. In every direction, horses were seen galloping about, and feeding on the very tops of the heights; altogether there were about 200. Kites and eagles were soaring in the air; large flocks of small birds, like linnets, were flying about, and locusts jumping among the bushes.

Immediately across the *Setlej*, the mountains are abrupt; but, more to the east, there is a succession of gentle slopes. Beyond them again, appeared a lofty snowy range. It seemed to run N. 50° W. to S. 50° E. Clouds hang about it.

At this altitude the atmosphere exhibited that remarkable dark appearance which has been often observed in elevated situations. The sun shone like an orb of fire, without the least haze. At night, the part of the horizon where the moon was expected to rise, could scarcely be distinguished before the limb touched it; and the stars and planets shone with a brilliancy never seen, unless at great heights.

With a transit telescope of 30 inches, and a power of 30, stars of the fifth magnitude were distinct in broad day; but none of less size were perceptible. At *Súbáthú,* 4200 feet above the level of the sea, stars of the fourth magnitude require a power of 40 to make them visible in the day.

The temperature was greater than expected: the thermometer rose to 60° in the shade, and at sunset was 42°. It sank to $30\frac{1}{2}$° before sunrise. About nine in the forenoon, a wind from the S.W. began; it was at its greatest strength at 3 P. M., and subsided at sunset.

The climate is very different from that which is experienced in crossing the outer range of the *Himálaya* at the same season. Here, at the height of 16,000 and 17,000 feet, is abundance of fuel (*metóh*, bearing a beautiful yellow flower, and no prickles,) good water, and a serene sky; there, at an inferior elevation, no firewood is nearer than five or six miles, the clouds hang around the mountains, the sun is rarely visible, and showers of rain are frequent.

Art. XVI.—*On the relation of the Density of Solid and Fluid Bodies to the size of their Molecules, and their affinity for Caloric.* By M. Le Chevalier Avogadro.

During a long series of years, the genius of mathematicians and philosophers has been directed to the determination of the laws which regulate the mutual action of the planetary masses. The progress which has been made in this inquiry since the time of Newton, is not more remarkable from the beauty of the laws which have been proved to exist, than from the singular accuracy with which they have enabled the astronomer to compute the various phenomena of the celestial motions.

In consequence of this advanced state of astronomical science, it has for a long time been nearly stationary. The tide of ambition has flowed into new channels, and the efforts of intellectual power have been directed to the facts and laws of *Molecular Philosophy*, as exhibited in the actions, the properties, and the organization of terrestrial matter. The great discoveries which have been made in chemistry during the last forty years have paved the way for this branch of *Transcendental Physics*; and various important preliminary laws have already been established.

The law of Definite Proportions was one of the first great steps in this inquiry. The optical law of primitive forms, and the connection between the optical structure and the chemical composition of crystallized bodies, formed another step; and the researches of M. Avogadro, of which we now propose to give a brief account, promise to carry us still further among the mysteries of elementary matter.

In a preceding number,* we have already given some account of a remarkable law announced by M. Kupffner, who has endeavoured to establish a relation between the crystalline form, the weight of the atom, and the specific gravity of bodies. If y, for example, is the volume of its primitive form, the cube of its axis of crystallization being unity, p its atomic weight, and s its specific gravity, then, according to M. Kupffner, $\frac{ps}{y} = \text{const.}$; and, consequently, s is in the direct ratio of y, and the inverse ratio of p.† But this relation, as M. Avogadro has remarked, is not indicated by any theoretical consideration; and, with regard to the facts upon which he rests it, there is so much latitude in the relation of primitive forms, and in the determination of the atomic weights, that there is reason to believe, that any other arbitrary relation might, by similar means, be made to agree with observation, and that the one which he has adopted has no real foundation.

MM. Royer and Dumas have endeavoured to show, that the volume of the atom of all solid bodies is either equal to, or represented by, a variable multiple of the smallest of these volumes, or rather of an ideal unity, assumed as the type of them all; or, what is the same thing, that the density of solid bodies is proportional to the mass of the molecule, or to an aliquot part of this mass. But M. Avogadro is of opinion, that this law is not established by the observations they have brought to its support, and that it is liable to other objections, which we have not room here to enumerate.

The density of any body is, in general, necessarily in the ratio of the mass of its integral molecules, divided by the cube of the distance of the centres of these molecules. In ductile bodies, whose molecules may change their position without separating, and in which, consequently, the figure of the molecules does not appear to exert any sensible influence, the

* See this *Journal*, vol. iv. p. 186,—188.

† In the *Scientific Intelligence* of this Number, we have given several results, deduced by M. Vincent from Kupffner's Law, which are so remarkable, as to render a farther examination of it very desirable.

distance of the centres of the molecules ought to depend only in its turn on the mass of these molecules, and on their affinity for caloric; for it is this fluid which, interposing itself between the molecules of these bodies, ought, by the repulsive force which it exerts among its own molecules, to determine the distance in question, according to the quantity and the density to which it may raise itself, when this repulsive force is in equilibrium with the attractive force which the molecules of the body exert upon it. With regard to an attractive force which would exert itself immediately between the molecules themselves of the bodies, it could take place between similar molecules, only in virtue of some polarity depending on the relative position of the molecules, and on their figure, which cannot be admitted in ductile bodies. There should be still another quality of molecules, which ought to have an influence on the distance of their centres, in the state of equilibrium of the forces which we have mentioned, that is, their volume, from which there ought to result, round their centres, a space more or less great, which can only be occupied by caloric, and, consequently, a different limit in the distance of the molecules of caloric from the centre, and a different action of the molecule upon it. But we may suppose, with sufficient probability, that this volume of the molecules is proportional to their mass, as if the matter of the molecules of bodies was of the same density for all; and then the influence of the volume of the molecules, in changing the distance of their centres, ought to be included in the function, by which we express the influence of the mass of which we have spoken, and it will only modify this function. This circumstance obliges us, therefore, only to consider separately the mass of the molecules, and their affinity for caloric, in the determination of the total function on which their distance ought to depend, without being able to confine ourselves to a function of the attractive power of the molecule for caloric; that is, of the product of its mass, by its affinity for that fluid, provided that the law, according to which the distance in question depends on the mass, may be found by the circumstance indicated, different from that by which it depends on the affinity for caloric.

By the application of these principles, which we have not room to detail, M. Avogadro obtains the following law, viz.

$$d = \frac{m}{a^3}, \text{ or, } a = \sqrt[3]{\frac{m}{d}}$$

in which d is the density, m the mass of the molecule, and a the affinity of the body for caloric. In these formulae the affinity for caloric is given relatively to potassium, which is taken for unity. In order, however, to apply the formula to metals in general, he puts it into another form, in order that he may immediately make use of the masses of the molecules related to that of oxygen, taken for unity, and of the densities relative to that of water, and which gives the affinities for caloric, by taking for unity that of oxygen.

Calling, therefore, M, D, A, the quantities m, d, a, expressed in the new units, he obtains $D = 0.87\, d$; $A = 3.3\, a$; $M = 4.9\, m$; or, $d = \frac{D}{0.87}$; $a = \frac{A}{3.3}$; $m = \frac{M}{4.9}$. By substituting these values in the original formula, it will become

$$\frac{A}{3.3} = \sqrt[3]{\frac{0.87.M}{4.9.D}}; \text{ or,}$$

$$A = 3.3 \sqrt[3]{\frac{0.87.M}{4.9.D}}; \text{ or,}$$

$$A = 3.3 \sqrt[3]{\frac{9.87}{4.9}} \sqrt[3]{\frac{M}{D}}$$

$$A = 1.855 \sqrt[3]{\frac{M}{D}}.$$

In applying these formulae to ductile metals, M. Avogadro has obtained the following results:—

1*st* Group. *Ordinary Metals.*

Affinitary number, between 1.95 and 2.47.
Neutralizing power, between — 0.057 and + 0.46.

	Affinitary Number.	Neutralizing Power.		Affinitary Number.	Neutralizing Power.
Platina,	1.950	— 0.057	Water, -	2.222	+ 0.217
Point of Neutrality,	2.004	0.000	Iron, -	2.240	+ 0.235
Gold, -	2.018	+ 0.014	Mercury,	2.243	+ 0.238
Silver, -	2.019	+ 0.015	Tin, -	2.341	+ 0.336
Copper, -	2.134	+ 0.130	Lead, -	2.439	+ 0.433
			Zinc, -	2.462	+ 0.456

2d Group. *Alkalifiable Metals.*

	Affinitary Number.	Neutralizing Power.
Potassium, - -	3.300	+ 1.291
Sodium, - -	3.371	+ 1.361

By applying the same formula to frangible metals, M. Avogadro has obtained the following results:

	Affinity for Caloric.	Neutralizing Power.		Affinity for Caloric.	Neutralizing Power.
Iodine, -	1.705	— 0.297	Cobalt, -	2.095	+ 0.090
Arsenic, -	1.934	— 0.070	Copper, -	2.134	+ 0.130
Selenium,	1.942	— 0.061	Iron, -	2.240	+ 0.235
Platina, -	1.950	— 0.057	Mercury,	2.243	+ 0.258
Chrome, -	1.969	— 0.037	Bismuth,	2.261	+ 0.256
Antimony,	1.973	— 0.031	Tin, -	2.341	+ 0.336
Gold, - -	2.018	+ 0.014	Manganese,	2.368	+ 0.362
Silver, -	2.019	+ 0.015	Lead, -	2.439	+ 0.433
Tellurium	2.034	+ 0.030	Zinc, -	2.462	+ 0.456
Nickel, -	2.035	+ 0.031	Potassium,	3.300	+ 1.291
Molybdæna,	2.069	+ 0.065	Sodium,	3.371	+ 1.361
Tungsten,	2.075	+ 00.71			

M. Avogadro considers these results only as approximations, particularly for the frangible metals, to which the formula is perhaps less exactly applicable than to the ductile metals.

In applying the formula to bodies which are not metallic, M. Avogadro supposes that the molecules either remain without alteration, or double and quadruple themselves in passing from the gaseous to the solid state. In sulphur and iodine the gaseous molecule suffers no change. In antimony and selenium two molecules go into one in the passage to the solid state, and so on with the other bodies, as given in the following table:

The formula by which this table is computed is changed into $A = \frac{1.855}{\sqrt[3]{2}} \sqrt[3]{\frac{M}{D}} = 1.472 \sqrt[3]{\frac{M}{D}}$, for reasons which our author has fully explained.

	Mass of the Gaseous Molecule.	Number of Gaseous Molecules which form a solid one.	Mass of the Solid Molecule.
Gold, -	12.43	4	49.72
Tin, -	7.35	4	29.40
Platina, -	12.15	4	48.60

	Mass of the Gaseous Molecule.	Number of Gaseous Molecules which form a solid one.	Mass of the Solid Molecule.
Silver, -	6.75	4	27.00
Lead, -	12.96	4	51.80
Zinc, -	4.03	8	32.26
Iron, -	3.39	8	27.12
Copper, -	3.96	6	23.74
Mercury, -	12.65	4	50.60
Potassium, -	2.45	4	9.80
Sodium, -	2.91	4	11.74
Tungsten, -	12.10	4	48.40
Molybdæna, -	5.97	4	23.88
Arsenic, -	4.70	4	18.82
Antimony, -	8.06	2	16.13
Selenium, -	4.96	2	9.92
Tellurium, -	4.03	4	76.12
Chrome, -	3.52	4	14.07
Iode, -	7.69	1	7.69
Manganese, -	3.56	8	28.48
Nickel, -	3.70	6	22.18
Cobalt, -	3.69	6	22.14
Bismuth, -	8.87	4	35.48
Sulphur, -	2.00	1	2.00

Such is a very brief view of the First Memoir of M. Avogadro, which was read on the 7th March 1824, and is published in the thirtieth vol. of the *Memorie della Reale Accademia delle Scienze de Torinó.* In the thirty-first vol. of the same work, our author has published a second Memoir, the object of which is to give for all bodies a general formula, expressing the relation between the density, the mass of the molecule, and the affinity for caloric, of which the above formula is only an approximation, and which might even apply itself in all its generality to bodies which appear commonly under a solid form, if we had for them all the data which that application requires.

This Memoir is divided into two sections; in the *first* of which our author establishes a formula for the densities of liquids, in relation to a particular state in their law of dilatation; while, in the second, he transforms this formula, in order to compare it with that for solid bodies, and to point out the connection between the two.

M. Avogadro considers, that the dilatation of liquids may be represented by two terms, the one proportional to the increase of temperature and positive, the other subtractive and proportional to the square root of this same increase of temperature reckoned from a determinate point of temperature for each liquid, or expressed by the ordinate of a parabola, whose abscissæ, reckoned on a diameter of this parabola, are proportional to the increments of temperature. He calls that the *minimum of temperature* for each liquid, which corresponds to the origin of the diameter of the above parabola, where the ordinate of the parabola becomes nothing, and below which, consequently, this ordinate, and the term of the law of dilatation which it represents become imaginary, because he supposes, that at this point a new subtraction of caloric would augment the temperature anew, in place of farther diminishing it, and would give rise to a new branch of the curve representing the law of dilatation, for which we ought to take the ordinate of the parabola with the positive in place of the negative sign.

Let T be the number of centigrade degrees, which the *minimum of temperature* for each liquid is below the temperature of ebullition of this liquid under the pressure $0^m.76$; d the density of this liquid at this minimum of temperature, taking the density of water at *zero* as unity; and g, the coefficient of the term of the law of dilatation of this liquid, proportional to the increase of temperature, or the increase of volume which that liquid takes in virtue of this term for each centesimal degree of the increase of temperature, taking for unity the volume at the minimum of temperature: The density of this liquid, at its boiling point, such as it would be if its law of dilatation from the *minimum of temperature* had been expressed by the single term of which we have spoken, will obviously be $\frac{d}{1+g\mathrm{T}}$. Since the densities are in the inverse ratio of the volumes, let m be the mass of the gaseous molecule of the liquid, or the density of its gas, taking that of oxygen for unity, the fraction $\frac{\frac{d}{1\times g\mathrm{T}}}{m}$, or $\frac{d}{(1+g\mathrm{T})m}$, will express the ratio between the density of the liquid in the state supposed, and the density of its gas under a given pressure and temperature.

Now, since the distance of the molecules is in the ratio of their affinity for caloric a, and since the density is necessarily in the inverse ratio of a^3, the cube of this distance, M. Avogadro obtains $\frac{a^3 d}{(1+gT)m}$, as the ratio which ought to be constant in all liquids in the case of a non-alteration of the molecules, in passing from *the gaseous* to *the solid state*, or in the case where the number of duplications and divisions are the same in the liquids compared, and which ought to be double, quadruple, &c. in one liquid of what it is in another, if in one of them there are duplications of the molecules which do not take place in another.

In applying this formula to water, alcohol, ether, and sulphuret of carbon, M. Avogadro assumes the *minimum of temperature* at — 70° cent. and consequently T = 170°.

In Water.	In Alcohol.
$T = 170°$ cent.	$T' = 170°$ cent.
$d = 0.8865.$	$d' = 0.6426.$
$g = 0.00177.$	$g' = 0.0034.$
$m = 0.0005873.$	$m' = 0.001514.$
$a = 1.$ *	$a' = 1.256.$
$a^3 = 1.$	$a'^3 = 1.983.$
$\frac{a^3 d}{(1+gT)m} = 1160.$	$\frac{a'^3 d'}{(1+g'T')m'} = 537.3.$

But $537.3 \times 2 = 1074.6$, which differs little from 1160, which it should be on the hypothesis of the duplication of the molecule. In applying the formula to ether and sulphuret of carbon, and comparing them with water, we obtain,

Ether.	Sulphuret of Carbon.
$T = 170°$ cent.	$T = 170°$ cent.
$d = 0.581.$	$d = 0.6426.$
$g = 0.00427.$	$g = 0.0034.$
$m = 0.00244.$	$m = 0.001514.$
$a = 1.318.$	
$a^3 = 2.291.$	$a^3 = 0.212.$
$\frac{a^3 d}{(1+gT)m} = 316.16.$	$\frac{a^3 d}{(1+gT)m} = 57.45.$

* The affinities of *water* and *alcohol* for caloric, are 23.22, and 2.791, that of oxygen being unity; but in taking that of water for unity, we have that of alcohol $= \frac{2.791}{2.222} = 1.256.$

But 316.16, quadrupled = 1265, not very different from 1160, and 57.45, taken 16 times = 919, not very different from — 1160.

By taking a new value of *a* for sulphuret of carbon, we obtain 1075, which approaches still nearer to 1160 than 919 does.

In the transformation of the formula for the purpose of comparing it with that for solid bodies, which occupies the second section, M. Avogadro, taking $D = \frac{D}{1.054}$, obtains $A = 1.475 \sqrt[3]{\frac{M}{D}}$, almost exactly the same as $A = 1.472 \sqrt[3]{\frac{M}{D}}$, which he obtained for solid bodies.

The formula for solid bodies, thus connected with the formula for liquids, is obviously inexact for bodies which undergo a dilatation in place of a condensation, when they become solid. In order to apply the formula to such bodies, we must determine their dilatation by experiment. In this case, and in general for all bodies of which we know immediately the condensation and dilatation, we may make it enter into the formula, in place of the supposed relation of $D' = \frac{D}{1059}$ and calling the ratio n, we have $D = n\,D'$ or $D' = \frac{D}{n}$, n being a number greater than unity or a fraction, according as there is condensation or dilatation. The formula will then be,

$$A = 1.449 \sqrt[3]{\frac{\frac{M}{D}}{n}} = 1.449, \sqrt[3]{n}, \sqrt{\frac{M}{D}}$$

And there will remain in this formula no other hypothetical approximation, than that which results from the supposition, that the coefficient really variable in the formula for liquids, is constant and equal to that which takes place in alcohol, according to our calculations.

The general formula, free of every supposition, for solid bodies, taken with their density, D, at the temperature zero, will be,

$$A = 1.1555 \sqrt[3]{\frac{1 + g\,T}{1 + g\,(T - E - 2h\sqrt{T - E})}} \cdot \sqrt[3]{\frac{M}{D}} \cdot \sqrt[3]{n}.$$

which requires us to know, beside the ratio of condensation n when it becomes solid, the law of the condensation and dilatation in the body in question in the liquid state, viz. the temperature E of its vaporisation at the ordinary pressure, the depression T of its *minimum of temperature* below the temperature of its ebullition, and the two coefficients g and $2h$ of this law.

This formula will therefore not differ from that for liquids, taken in its generality, and relatively to their density D′, excepting in the presence of the factor $\sqrt[3]{n}$ depending on the condensation or dilatation of the body in its passage from the liquid to the solid state.

Art. XVII.—*On the Structure of the Eyes of Insects.* By Mr William Ewing. In a Letter to the Editor.

Sir,

Having diligently employed my leisure time in investigating the structure of the eyes of insects, and conceiving I had made some progress beyond what was at present known on that subject, I arranged my observations into a shape for publication, which I had put into the hands of Dr Hooker to be forwarded for your approbation. That gentleman's knowledge of the subject, however, prevented it, and favoured me with the third volume of a very learned and systematic work, at present publishing on the subject. The impressions which I have received from my observations and experiments differ materially from the descriptions given in that work; I will, therefore, under the same arrangement, submit to you a few remarks on the Ocular Organs of Insects.

Simple Eyes.

These are the eyes with which we find insects provided in the first state of their existence, as well as those that are produced perfect from the egg. They differ, indeed, as to number, situation, and arrangement, in those insects, but they are identically the same; their structure is that of a double convex lens, but more convex without than they are within: they are all transparent when cleaned, and capable of refracting light: they are of a hard substance, and change not on being taken from the insect.

Conglomerate Eyes.

They are exactly the same as simple eyes, being double convex lenses, each of them capable of refracting light; only they are more numerous than simple eyes, and are collected into patches, and have a common retina.

Compound Eyes.

Under this head are included the whole of those eyes which we find provided with a lace-like covering. I am satisfied, however, that, under this division of the subject there are different modifications, which I shall notice separately.

Beetles' Eyes.

It appears to me that those eyes differ not from simple eyes of the conglomerate kind. The form indeed varies, but the structure is the same. It is spherical, and composed of a number of hexagonal apertures, filled with lenses, each of which possesses the same properties as simple eyes; and having a common retina, which is connected to the external covering, so as to exhibit the appearance that two watch glasses would have if they were cemented together.

Butterfly's Eye.

This eye differs from all the insects eyes I have examined. It consists of a ball which is orbicular, and of a dark purple colour towards the external lace-like covering; and on the other side, where the optic nerve enters, it is white and less convex. This ball occupies a circular cavity formed by the external covering and the retina, and is surrounded by a very clear gummy liquor into which it appears to move. My way of ascertaining this, was by fixing the live insect in the pliers under the microscope, and, putting a mark on the centre of the external covering, I turned the insect backwards and forwards; and I observed, that when the lace-like covering moved round, the dark spots in the eye were stationary, and could be moved from one edge of the eye to the other. Now, this may either be a reflection, or it may be the dark orbicular side of the ball above-mentioned, shining through the limpid gummy liquor into which it floats. There are no lenses in the lace-like covering of the eyes of this insect, but they are lined with a thin transparent membrane betwixt the external covering and coating of the eye.

The eye of the night butterfly, or moth, has the same structure as the one just described, only it is dark when viewed in the light, but if examined in the shade, it shines with a beautiful yellowish lustre. This is emitted from the ball of the eye after being extracted from the insect. There is a peculiarity in the eye of this insect which I cannot find in any other I have examined ; viz. from the hexagons in the external covering proceed tubes which convey the apertures through the dark coating of the eye. They are smallest next the ball, are hard and transparent, and appear to be of the same substance as the external covering. There are no lenses in the covering of the eye of this insect.

The next modification of compound eyes belong to a very numerous class of insects of the fly kind, (*and it is to this class chiefly I think the term can be applied ;)* viz. to all those which are provided with stemmata, (a kind of eyes which I shall next mention.) As I have not been able to discover the effect of these as organs of sight, I shall merely state, that, in all those appendages called compound eyes in insects having stemmata, I could never find lenses, nor any internal organization similar to those that have them.

Stemmata.

These are eyes with which the greater number of bees and flies are provided, and they appear to be their real eyes. They are exactly similar to, and capable of the same properties as simple eyes ; they are variously situated in various insects, but in all of them which I have tried, if they are shut up, the insect is rendered blind.

In the foregoing remarks, I have merely mentioned the result of many experiments, from which I have preserved specimens of various eyes, which prove the facts stated ; and since the oculi of insects arrange themselves under three different modifications, I have suggested the three following queries, which I hope some of your learned correspondents will be able to solve:

Query, How is vision performed in those insects of the butterfly kind, since they are not provided with stemmata, nor have lenses in the hexagonal apertures, in the external covering of their eyes?

Query, How is vision performed in those insects which we find unprovided with stemmata, but in the external covering of whose eyes we find the hexagonal apertures filled with double convex lenses?

Query, How is vision performed in those insects which we find provided with stemmata, but want lenses in their compound eyes?

If the foregoing remarks are deemed worthy of a place in your valuable publication, your inserting them will oblige, Sir,

Your very humble Servant,

Mitchell-Street, Glasgow,
21*st August* 1826. WILLIAM EWING.

ART. XVIII.—*On Metallic Iron and its Oxides.* By F. STROMEYER, M. D. F.R.S.E. &c. &c. Professor of Chemistry in the University of Göttingen.

THE third volume of Poggendorff's *Annalen der Physik und Chemie*, contains some observations by M. Gustav Magnus on the spontaneous combustion of certain metals, in which that property has not been previously noticed. He finds that nickel, cobalt, and iron, reduced from their oxides by means of hydrogen at a very low heat, undergo spontaneous combustion when they are exposed to the air at common temperatures; whereas they are not subject to the same change if the reduction is effected by hydrogen in a strong fire. M. Magnus ascribes the difference of combustibility to the density of the iron being greater in the second than in the first case, owing to the more intense heat which is employed in the operation.

In the sixth volume of the same Journal, Professor Stromeyer has offered a different explanation of the phenomena, at least so far as regards the combustibility of iron. The Professor remarks, that, in order to obtain iron with ease and certainty in a perfectly metallic state, by means of hydrogen, it is necessary to conduct the gas, previously dried by the chloride of calcium, over the peroxide of iron at a red heat. The process does indeed succeed at temperatures which are much below a red heat; but the reduction in these instances takes place very slowly, so that it is exceedingly difficult in this way to prepare metallic iron perfectly free from the protoxide.

Professor Stromeyer maintains that pure metallic iron obtained by the preceding process, however low the temperature which may have been employed in its reduction, does not possess the property of burning spontaneously; but that on being heated to the degree at which cadmium fuses, it then suddenly takes fire, and burns with emission of heat and light till the whole of it is converted into the black oxide. But if hydrogen gas is conducted over the red oxide of iron at a temperature still lower than that at which complete reduction is effected, a partial deoxidation ensues, and the peroxide is converted into the *real* protoxide of iron. Professor Stromeyer employs the term *real* protoxide, because this oxide, previous to his experiments, has never been obtained in an insulated state, and because the black oxide, procured by passing watery vapour over metallic iron, though commonly mistaken for the protoxide, is in reality a compound of the protoxide and peroxide of iron.

The *real* protoxide of iron has a dark blackish blue colour, which appears almost black by reflected light. It stains glass blue, and is the cause of the blue colour of iron slag. This protoxide is combustible in a high degree. If, after its formation, it is completely protected from the atmosphere by being kept in hydrogen gas till quite cold, it will take fire the instant it is placed in a saucer, so as to be completely exposed to the air; but instead of passing, like metallic iron, into the black oxide, it is converted at once, and completely, into the peroxide.

Professor Stromeyer ascribes the spontaneous combustion of the metallic iron in the experiment of M. Magnus to this protoxide, the presence of which it is difficult to avoid altogether, when the peroxide is reduced by hydrogen at a low temperature. He affirms that the protoxide is first inflamed, and that the caloric emitted by it sets fire to the metallic iron, in consequence of which combustion takes place rapidly through the whole mass.

In addition to these interesting remarks, the Professor observes, that there are only two proper oxides of iron, namely, the blue or protoxide, and the red or peroxide. He confirms the opinion of Proust, that the black oxide, whether formed by the direct combustion of iron, or by passing the vapour of water over ignited iron wire, is not a distinct oxide, but a combination of the two others. He adds, also, that the proportion of the oxides to one another, in the black oxide, is variable, the relative quantity of each being dependant on the duration of the process, and on the temperature at which it is conducted.

M. Magnus has replied to the observations of Professor Stromeyer in the same Number of Poggendorff's *Journal.* After repeating and varying his former experiments, he draws from them the two following conclusions: First, that the combustion of iron does not arise from the presence of the protoxide, but is occasioned by the porous condition of the metal. Secondly, that iron at a temperature between the boiling point of mercury and the degree at which zinc fuses, is completely reduced by hydrogen, and that, according to his experiments, no deoxidation at all takes place at a lower temperature.

This le es us theref ore in the dark as to the real cause of the spontaneous combustion of iron. It is clear from the second conclusion of M. Magnus, either that he must have committed some oversight, or that Stromeyer's protoxide cannot be formed in the way which that chemist has described. The character of Stromeyer is too well known to leave a doubt as to his accuracy; and we, in particular, have good reason to know that he is right on the present occasion, having, in his laboratory, so long as four or five years ago, both seen the blue oxide of iron, and witnessed its formation.

ART. XIX.—*Account of the Burning Chasms of Ponohohoa in Hawaii, one of the Sandwich Islands.** By the Reverend WILLIAM ELLIS. *With a PLATE.* †

AFTER travelling about five miles over a country fertile and generally cultivated, we came to Ponohohoa. It was a bed of ancient lava, the surface of which was decomposed, and in many places stumps of trees had grown to a considerable height. As we approached the places whence the smoke issued, we passed over a number of fissures and deep chasms, from two inches to six feet in width. The whole mass of rock had obviously been rent by some violent convulsion of the earth, at no very distant period; and when we came in sight of the ascending columns of smoke and vapour, we beheld immediately before us a *valley or hollow, about half a mile across, formed by the sinking of the whole surface of ancient lava, to a depth of fifty feet below its original level.*

Its superficies was intersected by fissures in every direction; and along the centre of the hollow two large chasms, of irregular form and breadth, were seen stretching from the mountain towards the sea, in a south-and-by-west direction, and extending either way as far as the eye could reach. The principal chasm was in some places so narrow that we could step over it, but in others it was ten or twelve feet across. It was from these wider portions that the smoke and vapours arose.

As we descended into the valley the ground sounded hollow, and in several places the lava cracked under our feet. Towards the centre it was so hot that we could not stand more than a minute in the same place. We passed as near to the apertures that emitted smoke as the heat and sulphureous vapour rising from them would admit. We looked down into several, but it was only in three or four that we could see any bottom. The depth of these appeared to be about fifty or sixty feet, and the bottoms were composed of loose fragments of rocks, and large stones that had fallen in from the top or sides of the chasm. Most of them appeared to be red hot, and we

* From Ellis's *Missionary Tour through Hawaii*, p. 190.

† See Plate VII. Fig. I.

thought we saw flames in one; but the smoke was generally so dense, and the heat so great, that we could not look long, nor see very distinctly the bottom of any of them; our legs, hands, and faces, were nearly scorched by the heat. In one of the small fissures we put our thermometer, which had stood at 84°; it instantly rose to 118°, and probably would have risen much higher could we have held it longer there.

After walking along the middle of the hollow for nearly a mile, we came to a place where the chasm was about three feet across at its upper edge, though apparently much wider below, and about forty feet in length, and from which a large quantity of lava had been recently vomited. It had been thrown in detached semi-fluid pieces to a considerable distance in every direction, and from both sides of the opening had flowed down in a number of small streams.

The appearance of the high and long grass through which it had run; the parched leaves still remaining on one side of a tree, while the other side was reduced to charcoal; and the strings of lava hanging from some of the branches like stalactites, together with the fresh appearance of the shrubs, partially overflowed and broken down, convinced us that the lava had been thrown out only a few days before. It was highly scoriaceous, of a different kind from the ancient bed of which the whole valley was composed, being of a jet black colour, and light variegated lustre, brittle and porous, while the ancient lava was of a gray or reddish colour, compact or broken with difficulty. We found the heat to vary considerably in different parts of the surface; and at one of the places where a quantity of lava had been thrown out, from which a volume of smoke continually issued, we could stand several minutes together without inconvenience. We at first attributed this to the subterranean fires having become extinct beneath; but the greater thickness of the crust of ancient lava at that place afterwards appeared to us the most probable cause, as the volumes of smoke and vapour which constantly ascended, indicated the vigorous action of fire below.

Our guide told us that the two large chasms were formed about eleven moons ago; that nothing else had been visible till two moons back, when a slight earthquake was experienced at

Kapapula, and the next time he came by, the ground had fallen in, forming the hollow that we saw, which also appeared full of fissures. About three weeks ago, he saw a small flame issuing from the apertures, and a quantity of smoking lava all around. The branches of the trees that stood near were also broken and burnt, and several of them still smoking.

Though the surface of the whole country around had a volcanic origin, this infant volcano seems to have remained undisturbed a number of years, perhaps ages. The lava is decomposed, frequently a foot in depth, and is mingled with a prolific soil, fertile in vegetation, and profitable to its proprietors; and we felt a sort of melancholy interest in witnessing the first exhibitions of returning action, after so long a repose in this mighty agent, whose irresistible energies will probably, at no very remote period, spread desolation over a district now smiling in verdure, repaying the toils, and gladdening the heart of the industrious cultivator.

Ponohohoa is situated in the district of Kapapula, and is about ten or twelve miles from the sea-shore, and about twenty miles from the great volcano at the foot of Mauno-roa.

Art. XX.—*Remarks on the Electric effects of Contact produced by changes of Temperature.* By M. Becquerel.*

This interesting paper, of which we propose to give an abstract, is divided into three sections.†

1. On the process for measuring the intensity of the electric current.

2. On the laws of the electric effects of contact when the temperature of each metal is made to vary equally.

I. The electro-chemical theory, as adopted by several celebrated chemists, admits it as a certain fact, that two bodies, capable of combining, have different electric states when they are put in contact; that bodies which have an acid tendency assume negative electricty, and alkaline ones the positive electricty; that these electric states increase with the elevation of

* *Ann. de Chim,* Avril 1826, tom. xxxi, p. 371.

† See the next Article, which forms the third section.

temperature till the instant when the combination takes place; that fire then bursts out, produced by the simultaneous combination of the two electricities, and that all the electric phenomena soon cease.

In this theory only one point has been demonstrated by experiment, and that is the electric condition of acid and alkaline bodies on their mutual contact, but we are quite ignorant of what takes place when their temperature is simultaneously varied.

I shall now describe the process by which I have measured the electro-dynamic force produced by an electric current, which describes a metallic circuit enveloped with a silk thread, and rolled round a box so as to form a galvanometer, in which is placed a system of two magnetised needles, as devised by M. Ampere. A divided circle upon a plate of glass points out the deviations of one of the needles. The first point is to ascertain the ratios between these deviations, and the corresponding intensities of the electro-dynamic force.

This intensity has been supposed proportional to the size of the angle of deviation, but this law is not founded on any experiment. My object was to determine the intensity of the current which corresponds to a given deviation.

By employing two magnetised needles fixed in a parallel position, and with their opposite poles near one another, one in the inside of the box, and the other without it, we destroy, in a great measure, the influence of terrestrial magnetism, and we leave them no other directive force but what is necessary to bring them back into their ordinary position of equilibrium, when they are made to deviate from it. Its sensibility is such, that when we employ a divided brass circle, crossed by a bar of the same metal, the magnetic needle, when made to oscillate, will place itself in the direction of this bar. This source of error, therefore, is avoided by making use of a circle divided upon glass.

Instead, however, of one wire of copper, I take three of the same metal, equal in length and in diameter, equally covered with silk, and rolled in the same manner round the apparatus. If we cause the same quantity of electricity to pass into each of these wires, it is perfectly evident, that every thing being similar on all sides we shall have three perfectly equal currents, and the deviation will then correspond to a force triple of that which we would have had if we had only considered a single current. In causing to vary equally the quantity of electricity which passes into each wire, it becomes easy to compare the deviations of the needle with the corresponding intensities of the electric current.

Nothing is more easy than to procure equal currents. It is sufficient to solder to each of the ends of the same wire one of the extremities of an iron wire, so as to form three closed circuits, then to bend each of them to each soldered joint similarly placed, in order to pass the curved part into a tube of glass, closed at one of its extremities, and plunged into a mercurial bath, whose temperature is raised by a spirit lamp. A thermometer also placed in the mercury indicates the changes of temperature. In proportion as it is heated, the magnetised needle, according to the discovery of M. Seebeck, deviates from its position of equilibrium, and if we submit successively to experiment one soldered joint, two soldered joints, and mark at each time the deviation of the magnetised needle for the same temperature, we shall have the angle which corresponds to single, double, and triple forces.

This method of experimenting requires great precautions if comparable results are required. We must first plunge the soldered joint, whose temperature is not to be raised, into melting ice, and the thickness of the tube into which is passed part of the circuit, where the soldered joint is, ought to be sensibly the same as that of the thermometer, in order that the mercury of this instrument, and the metal of the circuit, may receive the heat in the same time. Experiment proves also that a mercurial bath is preferable to one of oil, on account of the great difference of conductibility of heat between oil and the metal, a difference which occasions retardations in the simultaneous production of phenomena. It is also necessary, that, in the curved part of the circuit, whose temperature is raised, the metals have no other points of communication but those of their contact, for the intensity of the current would certainly experience modifications from such a cause. This inconvenience is avoided by covering with silk one of the wires; and care must be taken that the thermometer and the points of the circuit heated by the mercurial bath attain exactly the same temperature at the moment of observation. This may be obtained by raising the temperature to the heat at which the experiment is to be made, and suddenly extinguishing the lamp. The temperature will then remain stationary for some seconds, and we are certain that the thermometer and the soldered joints have the same temperature.

The following table contains the results of the experiments thus made.

Temp. Cent.	Deviations with 1 Wire.	Deviations with 2 Wires.	Deviations with 3 Wires.	Deviations with 4 Wires.
10°	1°.30	2°.60	3°.90	5°.20
20	2 .60	5 .30	7 .80	10 .10
30	4 .00	7 .65	10 .55	13 .25
40	5 .40	10 .00	13 .35	16 .50
50	6 .65	11 .75	15 .40	19 .40
60	7 .90	13 .5	17 .50	21 .50
80	10 .30	16 .5	21 .00	25 .00
90	11 .10	17 .65	22 .35	26 .00
100	11 .90	18 .80	23 .75	28 .00
110	12 .55	19 .90	25 .60	29 .17
120	13 .20	21 .00	26 .50	30 .35
130	14 .00	22 .00	27 .30	31 .17
140	14 .75	23 .00	28 .00	32 .00
160	15 .50	24 .00	29 .40	33 .25
200	16 .90	25 .00	30 .00	35 .25
300	17 .80	26 .50	31 .10	

It appears from this table, that from 0° to 10° of deviation the increments of heat are proportional to the increments of deviation, but beyond that term the ratio is no longer the same.

Let us suppose, however, that the deviation 1°.30 is produced by an electro-dynamic force equal to 2, the deviation 2.60 will be produced by a force equal to 4, because there are two wires in action; the deviation 3.90 by a force equal to 6, &c. By continuing the same reasoning, and by placing beside each deviation the number which corresponds to it, and admitting, that, at the same temperature, two wires produce a double force, three a triple force, &c. we shall form the following table, in which we have, in one column, the deviations of the magnetic needle, and in the next the corresponding intensities of the electro-dynamic force.

Temperatures.	1 Wire.		2 Wires.		3 Wires.		4 Wires.	
	Deviations.	Electr. Intens.	Deviations.	Electr. Intens.	Deviations.	Electr. Intens.	Deviations.	Electr. Intens.
5°	0°.65	1	1°.30	2	1°.95	3	2°.60	4
10	1 .30	2	1 .60	4	3 .90	6	5 .20	8
15	1 .95	3	3 .95	6	5 .85	9	7 .60	12
20	2 .60	4	5 .30	8	7 .80	12	10 .10	16
30	4 .00	6	7 .65	12	10 .55	18	13 .25	24
40	5 .40	8	10 .00	16	13 .35	24	16 .50	32
50	6 .85	10	11 .75	20	15 .40	30	19 .00	40
60	7 .90	12	13 .50	24	17 .50	36	21 .50	48
70	9 .00	14	15 .00	28	19 .25	42	23 .25	56
80	10 .30	16	16 .50	32	21 .00	48	25 .00	64
90	10 .90	18	17 .65	36	22 .50	54	26 .00	72
100	11 .90	20	18 .80	40	24 .00	60	28 .00	80
110	12 .55	22	20 . 0	44	25 .30	66	29 .15	88
120	13 .20	24	21 .20	48	26 .50	72	30 .10	96
130	14 .00	26	22 .10	52	27 .30	78	31 .17	104
140	14 .75	28	23 . 0	56	28 .30	84	32 .00	112
150								
160	15 .50	30	24	60	29 .40	90	33 .25	120
180								
200	16 .90	32	25	64	30 .00	96	35 .15	128
250								
300	17 .	36	26 .50	72	31 .21	108		

The numbers which express the deviations of the magnetised needle are the arithmetical means of the results of a great number of experiments which it would be useless to detail at present. With regard to the numbers which express the electrical intensities we have given only the whole numbers.

The following tables show the effect produced in a closed circuit composed of two wires of copper and iron soldered at their ends, and in which each joint is raised to a different temperature.

	Temp. 1st Joint.	Temp. 2d Joint.	Dev. of Needle.	Electro-dynamic Intensity
No. I.	50° cent.	0	7°.15	11
	100	0	12 .75	22
	150	0	16 .00	31
	200	0	18 .00	37
	250	0	19	40
	300	0		
No. II.	50	50°	7°.25	11
	100	50	11 .75	20
	150	50	14 .00	26
	200	50	15 .25	29
	250	50	16	30.50
	300	50		
No. III.	50	100		
	100	100		
	150	100	6	9
	200	100	9.50	15
	250	100	11	18
	300	100		

In Table No. II. the joint which was at *zero* in No. I. is brought to 50°, and in No. III. to 100. But in Table II, the electro-dynamic force 11, produced by the temperatures 100 and 50, is equal to the difference of the forces 22 and 11, obtained in Table I. by the temperatures 100° and 50° of the same joint. Besides the force 20 is equal to the difference of the forces which have been given in Table I. by the temperatures 150° and 50°, and so on. The force 9, Table III. is equal also to the difference of the forces produced by the temperatures 150 and 100 of Table I.

Hence we obtain this general rule, that in a circuit formed of two metallic wires soldered end to end, when we raise each of the joints to different temperatures, the resulting electro-dynamic intensity is equal to the difference of the forces produced successively by each of the temperatures in the same joint, the other being at *zero*, and not to the intensity of the force produced by the difference of temperature alone.

But since the electric state of each joint depends on its temperature, and not on the temperature of the neighbouring joints, we may form a table similar to that in p. 309, without employing four metallic wires. I take, indeed, four copper wires and four iron wires, about 5 decimetres long, and $\frac{1}{3}$ of a millimetre in diameter, and solder them end to end, in such a manner as to have alternately a copper and an iron wire, and the whole communicates with the wire of the apparatus already mentioned. I then raise successively to the same temperature, one joint, two joints, &c. taking these alternately, in order to have currents in the same direction. We shall then obtain an electro-dynamic force, simple, double, triple, &c. and it will then be easy to construct a table the same as that of p. 309.

II. *On the Laws of the electric effects of Contact, when the temperature of each metal is equally varied.*—In the present state of the science, it is impossible to determine the absolute quantity of electricity which disengages itself in the contact of two metals, or at least to compare together those which result from the contact of the same metal with several others. For this purpose, it would be necessary that we should be able to join the two metals by a body which is a good conductor of electricity, and which should not exercise electromotive actions upon either of them, a thing which at present is impossible; but by the aid of what precedes, by taking for the point of departure the electric state of the two metals, both at the *zero* of temperature, we may discover what modifications that state experiences, either by increasing or diminishing it at the same time in both metals. This is the only means of arriving at a knowledge of what takes place in the electric effects of contact, until the combination of the metals begins to operate.

Circuits are formed with wires of different metals, by making the wire of the apparatus enter into it; and the whole is so disposed, that its two extremities may communicate with the same metal, the only means of annulling its action on bodies submitted to experiment. These wires have the same diameter, about the third of a millimetre. The temperature is then raised, and we operate as above described. The results are given in the following table :—

Metals in Contact.		Temperatures.	Deviations.	Intensities of the Electric current.	Differences between the Intensities.
		50	7.50	11	11
		100	12 25	22	9
	Copper.	150	16.00	31	3
		200	17.25	34	
		250	18.10	37	3
		100	11.00	18	6
		150	13.50	24	3
	Gold.	200	14.50	27	3
		250	15.50	30	
		300	"	"	"
Iron.		40	5.80	8.50	
		80	10.00	16.00	7.50
	Silver.	120	12.50	22.00	6
		140	"	"	"
		200	15.75	30	"
		250	"	"	"
		40	6.50	10	10
		80	11.50	20	10
		120	15.10	30	9
	Platina.	160	18.50	39	10
		200	21.60	50	10
		250	24.00	60	
		300	25.50	69	9

Metals in Contact.		Temp. Cent.	Deviations.	Electrical Intensities.	Differences between the Intensities.	Differences calculated.
Platina	Lead.	50°	1	1.50	"	"
		100	2.00	3.00		
		150	3.75	6.00	3	3
		200	7.00	10.50	4.50	4.25
		250	10.00	16.00	5.50	5.50
		300	12.75	23	7.00	6.75
	Zinc.	50	2	3.		
		100	4.50	6.7	3.7	3.4
		150	8	12.	5.5	5.5
		200	11.50	19.00	7.00	7.6
		250	14.75	28.00	9.00	9·7
		300	19	40	12	11.80
	Copper.	50	1.20	2	3	3
		100	3.15	5		
		150	6.00	9	4	4.40
		200	9.50	15	6	5.80
		250	12.50	22	7	7.20
		300	14.00	31	9	8.60
		350	18.75	40	7	10.00
	Silver or Gold.	40	1.50	3		
		80	3.50	6	3	,,
		120	6.10	9	3	3
		160	8.50	14	5	4.10
		200	11.25	18	4	5.20
		240	13.75	26	6	6.30
		280	16.00	32	6	7.40
		320	18.50	40	8	8.50
	Iron.	40	6.50	10		
		80	11.50	20	10	10
		120	15.10	30	10	10
		160	18.10	38	8	10
		200	20.35	49	11	10
		250	22.35	54	5	5
		300	24.10	60	6	5
	Palladium.	40	3	5	,,	,,
		80	8.25	12	8	,,
		120	11.80	20		
		160	15.00	28	8	,,
		200	17.75	36	8	,,
		240	20.25	44	8	,,
		280	22.55	52	8	,,

Metals in Contact.		Temp. Cent.	Deviations.	Electrical Intensities.	Differences.	Differences calculated.
Copper.	Silver.	40	0.35	0.5		
		80	0.70	1.00		
		120	1.05	1.50		
		160	1.45	2.00		
		200	1.75	3		
		240	2.15	3.50		
		280	2.45	4.00		
	Tin.	50	0.50	1	1	
		100	1.25	2	2	
		150	2.50	4	2	
		200	3.80	6		
		250	5.00	8	2	
		300	,,	,,		
	Lead.	50	0. 5	1		
		100	1.25	2	1	
		150	2.50	4	2	
		200	3.80	6	2	
		250	5.00	8	2	
	Zinc.	50	1.25	2	2	2
		100	2.75	4		
		150	4.50	7	3	3
		200	7.	10.50	3.50	4
		250	9.50	15.00	4.50	5
		300	12.	21.00	6	6
		350	14.50	27.00	6	7

From the preceding tables, it appears that the *iron* is always positive with platina, copper, gold, silver, &c. and, consequently, the rise of temperature exalts the electric effects produced by its contact with the metals. For if it had been otherwise, the strongest positive electricity would be furnished by the joint whose temperature is the lowest, and then the current would change its direction. With the *copper* the following effects take place. From 0° to 140° of temperature, the intensity of the electro-dynamic force increases, and the same quantity for each equal increment of temperature. From 140° this increase diminishes with considerable rapidity, and at 300° it is hardly sensible. This very remarkable effect leads me to suppose that the current changes its direction. I plunged, indeed, the points of junction in a flame, in order to give it a high temperature, and the electric effect immediately became inverse.

Gold and silver comport themselves nearly in the same manner in their contact with iron, and there is no other difference but in the temperature at which the increments of the electro-dynamic force cease to be proportional to the increments of temperature.

The manner in which *Iron* comports itself in its contact with the different metals when the temperature is raised, is in manifest contradiction with the electro-chemical theory, which admits that the electrical effects of contact increase continually with the rise of temperature, till the combination operates.

Platinum, in its contact with copper, gold, silver, lead, zinc, palladium, does not comport itself in the same manner as iron. At first it is always negative, whatever be the temperature, which proves that the electric current increases in intensity with the elevation of temperature; but the manner in which this increase takes place, is not such as might have been supposed. Experiment proves, as may be seen in the table p. 312, that, from zero to 350°, for equal increments of temperature, the differences between the successive increments of the electro-dynamic force are sensibly in an arithmetical ratio.

Palladium follows the same law, for, from zero to 350°, there is a constant ratio between the equal increments of temperature and the increments of intensity.

Copper and *Zinc* do not oppose the ordinary law. The electrical intensities increase with the temperature, and the differences between the increments are in arithmetical progression. With tin, lead, silver, these increments are sensibly equal, but as they are feeble, there may exist between them differences which the apparatus cannot recognise.

Diminutions of temperature produce effects analogous to those which I have obtained by an increase of it. I take a closed circuit of two wires, one of copper, and another of platina, and I put one of the joints into melting ice, and the other into a mixture of snow and diluted sulphuric acid. The following were the results:—

Temperature below Zero.	Deviations of the Needle.	Electro-dynamical Intensities.	Intensities calculated.
4	2.60	4	3. 4
8	4.70	7	6. 8
12	7	10	10. 2
16	8.50	13	13.60
20	10	16	17.00
24	12	20	20.40
28	13.50	25	23.80
32	14.75	28	27.20

Hence it appears that the intensity of the electric current diminishes proportionally to the diminution of temperature.

An important question here presents itself. How comes it, if there really exists such intimate relations between the electrical effects of contact and the chemical forces, that the increments of these effects, in consequence of the rise of temperature, are not more rapid than experiment shows them to be, and that the electrical actions are not more intense at the moment when the chemical forces increase with so much rapidity? It is difficult to reply to this question. Besides, how happens it that iron, in its contact with the other metals, gives electrical effects which change their sign with a rise of temperature? And perhaps iron is not the only metal which enjoys that property. By forming circuits with different metals, so as to have in each of them two different metals, and raising the temperature of one of the joints of junction, we find the following electrical series, in which each metal is *negative* in relation to those which *follow* it, and *positive* in relation to those which *precede* it.

Bismuth,
Platina,
Mercury,
Lead,
Tin,
Gold,
Silver,
Copper,
Zinc,
Iron,
Antimony.

From these experiments we conclude, that zinc and copper in contact, when they make part of a circuit, give rise to an electric current, the less intense as the temperature is elevated. Other metals enjoy equally the property of producing electrical effects less strong in proportion as the temperature in each of them is raised.

We might perhaps be led to believe that the rise of temperature, diminishing the conducting power of the metallic wires, the apparatus does not then show all the increase of the electro-dynamic intensity which takes place from the rise of temperature. But this opinion is destroyed by experiment; for if we operate at moderate temperatures, which give distinct effects, and if we bring to a red heat a part of the circuit remote from one of its joints, the diminution of the conducting power is not sufficiently sensible to alter the results obtained before the experiment was made. This fact seems to contradict the observation of Sir H. Davy, who has found that a conducting wire allows less and less electricity to pass in proportion as we raise to a red heat the temperature of a small portion of its circuit. But it is easy to reconcile these apparently contradictory results, for Sir H. Davy has shown that when we make a small quantity of electricity pass through the conducting wire, the least change in the conductibility of the place where the electric fluid has not the power of extending itself, ought to diminish sensibly the quantity of electricity which it transmits; whereas, when we come to pass only a very small quantity of electricity, we may conceive that the fluid, not experiencing any difficulty in extending itself, a diminution in the conductibility ought to allow to pass nearly the same quantity, which is confirmed by experiment.

Art. XXI.—*On a method of measuring High Temperatures.* By M. Becquerel. *

We have seen in the preceding pages, that a metallic circuit, formed of a palladium wire and a platina wire, possesses the property, where one of the joints is raised successively from 0° to 350° of temperature, of giving equal increments of electro-dynamic intensity for equal quantities of temperature.

* This article forms the third part of the preceding paper. We have given it separately, in order to excite that attention which it so well merits. Ed.

Besides, it is easy to prove, that this property belongs to two platina wires of any diameter, but not formed of the same platina. We first take a platina wire, and cut it in two, and we then pass one of its halves through a wire-drawing machine, to diminish its diameter. The two wires are then united together by twisting together their ends. If we bring one of the joints to any temperature, no electrical effect is manifested; but if we melt a fragment of the metal at one of the ends of the wire, there is immediately a manifestation of the electrical current, and this will happen whenever the circuit is formed of two wires which do not proceed from the same platina. The least difference in the platina of the two wires, is sufficient to give rise to an electric current, when both are brought to the same temperature at the points of contact. I may remark, that the wires were previously plunged in boiling nitric acid, so that we cannot suppose that the preceding effects are owing to any foreign substances adhering to their surfaces.

It would appear, then, from these experiments, that the more remote the melting point of metals is, the higher is that temperature at which the ratio between the increase of heat, and that of the electro-dynamic force ceases to be constant; but as the platina does not melt but at a very high temperature, and as in feeble melting, the law of decrease is not rapid, we may suppose, without any fear of committing great errors, that, in the circuit of two platinum wires, which do not proceed from the same metal, the constant ratio between the increments of heat, and the increments of the electro-dynamic intensity still exists at elevated temperatures, but remote from their melting point. This property will now enable us to express the temperatures of red heat in functions of the degrees of the centigrade thermometer.

As an application of the method which I am about to explain, I shall proceed to determine the temperature which the two platina wires assume, (put together as above described) when we place successively their points of junction in the different cones of the flame of a spirit lamp.

It is known that a flame in general, particularly that of a taper, or spirit lamp, is formed of several unequal divisions, of which we may easily distinguish *four*; the 1*st*, which is at its base, is of a sombre blue, and becomes less, as it removes from the wick; the *2d*, is the obscure place in the middle of the flame; the *3d*, is the brilliant envelope which covers this last, and which, properly speaking, is the flame; and the *4th*, which is slightly luminous, and surrounds the flame.

We first place one of the junctions of the two wires at the superior limit of the blue flame, where the air, still charged with all its oxygen, begins to meet the flame. The deviation is here 22°.50. When the junction is placed in the white part, or in the proper flame, the deviation is 20°, while in the obscure part round the wick, it is only 17°. Now, when we raise the point of junction to 300°, the deviation was 8°, which corresponds to an electro-dynamic force of 12; hence the intensities of the current in the three preceding places will be 54, 44, 32, which correspond to temperatures of 1350°, 1080°, 780°, upon the supposition that if the force 12 is produced by a temperature of 300, the force 48 will be produced by a temperature four times as great. The temperature 1350° (2462° Fahr.) is therefore the greatest that a platina wire $\frac{1}{5}$ of a millimetre in diameter can assume in an alcoholic flame, and it corresponds precisely to the points of the blue zone which touches the brilliant part of the flame, where we know the greatest heat resides. With respect to the temperature 780° (1436° Fahr.) it cannot represent that of the same wire placed in the dark part of the flame, which surrounds the wick, since the wire receives all the heat of the brilliant envelope which it traverses; hence it follows that the temperature is much higher than it would be without this.

In order to confirm the accuracy of the law which I have used to determine the temperature of each of the parts of a flame, or at least of the wires immersed in them, I have operated with wires of platina of any diameter not less than the third of a millimetre, and not containing the same quantity of alloy, and I have always obtained the same results. But if this law were not exact, it would inevitably experience changes in operating with wires which contained more or less alloy. Besides, the results obtained by the above method, compared with those given by other methods, may draw attention to a question so interesting to the arts and sciences.

Art. XXII.—*Description of an Apparatus for producing Intense Light, visible at great Distances, invented* by Lieutenant Thomas Drummond of the Royal Engineers.

The memoir from which the following article is taken, is entitled *On the Means of Facilitating the Observation of Distant Stations in Geodetical Operations.* It was read before the Royal Society of London on the 4th of May 1826, and will appear in their *Transactions* for the present year.

It has been long ago observed by those who have been in the habit of using the blowpipe, that lime and other earths give out a very intense and dazzling light when exposed to the action of that instrument.

The idea of applying this kind of light to economical and useful purposes, seems to have been first published in a notice *on a singular luminous property of wood steeped in solutions of lime and magnesia*, written by Dr Brewster in 1820, and printed in vol. iii. p. 343, of the *Edinburgh Philosophical Journal.*

" The sight of these experiments (it is there remarked) naturally suggests the idea, which occurred also to Mr Cameron, that such a brilliant light, capable of being developed by the heat of the flame of a candle, might have some useful application. In order to obtain some information on this point, I prepared three or four pieces of wood, terminated with the white masses of absorbed lime, and placed these masses so as to remain near the circumference of the flame of a candle. In this situation they yielded the brilliant light already described, and lasted, without any apparent diminution, for more than two hours. I next prepared a *very thin slice of chalk*, and having held it on the flame of a candle, I found that it did not give the same brilliant light as the absorbed lime. Upon exposing it, (the chalk) however, to the heat of the blowpipe, it emitted the *same white and dazzling light*, which has already been described ; (namely, *a brilliant dazzling light, not much if at all inferior to that which arises from the deflagration of charcoal by the action of galvanism.*")

" As this light seems to be developed by degrees of heat inversely proportional to the minute state of division in which the particles of lime are combined, it is highly probable that denser kinds of wood, in which the pores are very small, might leave after combustion a residue in which the lime exists in a much more attenuated state than that which I used, and, therefore, the same intensity of light might be evolved at a temperature still lower than that which exists at the edge of a common flame. If this should turn out to be the case, the light of the lime and the magnesia might be developed at a temperature lower than that which discharges the phosphorescent light of minerals, and it might have a most extensive and useful application, both in the arts and in domestic economy. Even in the present state of the fact the subject deserves farther investigation."

In order to obtain an intense light for facilitating the observation of distant stations in geodetic operations, Mr Drummond endeavoured to make use of some of the most brilliant pyrotechnical preparations, and to try phosphorus burning in oxygen; but he found in these cases the flame large and unsteady, and unfit for a focal light; and he was therefore led to try the brilliant light emanating from several of the earths when exposed to a high temperature. Having completed an apparatus for this purpose, he produced a light so intense, that, when placed in the focus of a reflector, the eye could with difficulty support its splendour, even at the distance of forty feet.

"In order to obtain the requisite temperature," says Mr Drummond, "I had recourse to the known effect of a stream of oxygen, directed through the flame of alcohol, as a source of heat, free from danger, easily procured and regulated, and of great intensity. Fig. 2. of Plate VIII. represents the apparatus such as it is now made for the survey. The spirit entering at *a*, ascends through the tubes *t*, while the oxygen entering at *d* is directed by the jets t' upon the small ball of lime *b*; the tubes t' are connected with the cylindrical box *h* by flexible caoutchouc tubes *e*, *f*, and also pass with friction through small cylinders at *c*, which admit of being moved backwards and forwards upon the arms, and are clamped, when in the proper position, by small mill-headed screws at the sides. By these means every requisite adjustment is obtained for the jets through which the gas issues. The apparatus is attached by its base to the stand which carries the reflector, (Fig. 1. Plate VIII. ;) and the small ball may then, by means of the horizontal and vertical screws *r*, be brought with great accuracy into the focus of the reflector. The cistern *c* containing the alcohol is placed behind the reflector, (Fig. 1 ;) and being connected with the stem *a* by a flexible caoutchouc tube, may be elevated or depressed on the upright rod *r*, Fig. 2, and the flame of the spirit, accordingly, regulated so as to produce the greatest effect. A flexible tube leads from *d* to the vessel containg the oxygen, which may be either a common gas-holder, or, perhaps, a silk bag, with a layer of caoutchouc, such as they are now made, might be conveniently employed for this purpose. The apparatus first made was provided with *five* jets, and could light up a ball $\frac{3}{8}$ inch in diameter; that now represented has only *three*, and with it a ball $\frac{1}{4}$ of an inch in diameter may be used sufficiently large to admit of the requisite allowance being made for aberration in the reflector, from its true figure, as well as uncertainty of direction, arising from terrestrial refraction.

" To ascertain the relative intensities of the different incandescent substances that might be employed, they were referred by the method of shadows to an argand lamp, as a common standard, the light from the brightest part of the flame being transmitted through apertures equal in diameter to the small spheres of the different substances submitted to experiment.

" The results of several trials made at the commencement, gave for

Lime, - - -	37 times
Zirconia, - - -	31 times
Magnesia, - - -	16 times

the intensity of an argand burner. The oxide of zinc was also tried ; but, besides wasting away rapidly, it proved inferior even to magnesia.

" The mean of ten experiments, made lately with every precaution, gives, for the light emitted by *lime*, *eighty-three* times the intensity of the brightest part of the flame of an argand burner, of the best construction, and supplied with the finest oil. The lime from chalk, and such as is known at the London wharfs by the name of *Flame-lime,* * appears to be more brilliant than any that has been tried.

"The lime from the chalk, besides being the most brilliant, is, in other respects, very convenient for use; it admits of being turned in the lathe, and thus any number of the small focal balls, with slender stems attached to them, may be prepared with the utmost facility. The surface of the ball, by the continued action of the heat, appears to be kept nearly in a state of fusion. It is gradually worn down, and in cooling presents a semi-crystalline appearance." †

This method of producing an intense light, visible at a great distance, was successfully applied, in October 1825, to the purposes of the trigonometrical survey in Ireland. The lime-light was exhibited by Mr Drummond on Slieve Snaght, the highest hill of Innishowen, about 2100 feet above the sea, and 15 miles north of Londonderry; and it was distinctly seen from the Divvis hill near Belfast, a distance of 66¼ miles. Colonel Colby proposes to employ this light to effect the observation of Benlomond from Knock-Layd, in the north-east extremity of Ireland, a distance of 95 miles, and of the Calton Hill, Edinburgh, from Benlomond, and thus to measure the difference of longitude between the Edinburgh Observatory and that of Dublin, which is nearly in the meridian of Knock-Layd.

We cannot conclude this abstract without noticing the strange oversight of Lieutenant Drummond in ascribing to M. Fresnel the invention of the compound or built up lens, which he could scarcely fail to know was invented by Dr Brewster, and described by him in the *Edinburgh Encyclopædia* ten years before M. Fresnel directed his attention to the subject.

* Well-burned *Carrara marble,* made into a paste and gradually dried, was found by Mr Drummond to be nearly equal to the *flame-lime.*

† Mr Drummond found that the intense light discoloured a mixture of chlorine and hydrogen, and produced an equally remarkable effect on chloride of silver.

Art. XXIII.—*Account of the Discovery of a Mine of Platinum in Columbia, and of Mines of Gold and of Platinum in the Uralian Mountains.** By Baron Alexander de Humboldt.

At a meeting of the Academy of Sciences of Paris, held on the 18th July last, Baron Humboldt communicated verbally to the academy the following interesting information.

M. Boussingault, a celebrated French chemist, has just discovered a mine of platinum at Antioquia in the department of Cundinamarca. Hitherto this precious metal, so valuable in the arts, had only been found in the Uralian Mountains in Russia, in Brazil, and in the provinces of Choco and Barbacoas, on the coasts of the South Sea, but always in alluvial lands, where it could only be met with accidentally. As this circumstance renders the discovery of M. Boussingault much more interesting, M. Humboldt has been anxious to establish it. He observes, that in all lands where platinum has been discovered, there are found at a very great depth the trunks of trees well preserved. It cannot, therefore, be supposed, that, in this case, transplanted earth has been mistaken for real rocks decomposed *in situ*. With regard to the platinum found in the province of Antioquia by M. Boussingault, there can be no doubt that this metal exists there in real veins in the valley *de Osos*, and it is sufficient to pound the materials which these veins contain, in order to obtain from them, by washing, the gold and the platinum which they contain.

M. Humboldt had not himself visited the country where M. Boussingault has discovered the platinum and gold; but experience has proved to him that almost all the auriferous soils of America belong to the formation of Dyorite and Syenite, and it is in this formation that M. Boussingault has discovered the platinum mixed with gold. The valley *de Osos*, where the platinum occurs in veins, being very near the province of Choco, from which it is separated only by a branch of the Cordillera of the Andes, this circumstance accounts for

* We have taken this interesting Notice from *Le Globe*, No. 90, July 20, 1826.

the presence of the same metal in the alluvial soils of the valley *de Osos*.

M. Humboldt announced at the same time, that mines of platinum had recently been found in the Uralian Mountains, in the government of Perma. These mines are so rich that the price of platinum fell nearly one-third at St Petersburg. Hence we may reasonably expect that this valuable metal will cease to bear that high price at which it has hitherto been sold. In 1824, the auriferous and platiniferous soil of the Ural produced 286 *puds*, which gave 5700 kilogrammes of metal, having a value of nineteen millions 500,000 francs. The mines of all Europe together do not produce annually more than 1300 kilogrammes. Those of Chili yield only 3000, and all Columbia furnishes only 5000.

The Ural yields at present as much gold as was ever obtained from Brazil at the time when its mines were most productive. The maximum, which took place in 1755, was 6000 kilogrammes of gold. At present Brazil yields only 1000.

It would be reasonable to suppose, that this prodigious increase in the productiveness of the mines of the Ural might have a very important influence, not only on the prosperity of Russia, but on the real value of gold. But this opinion cannot be maintained, if we attend to the circumstance, that the quantity of this metal actually existing on the surface of the globe is so considerable, that a quantity eighteen millions of francs in value, is, comparatively, almost insensible; and, besides, that the diminution of the produce of almost all the mines of the New World would occasion a compensation. Relatively to the particular prosperity of Russia, an augmentation of eighteen millions is, in reality, very little for a state of such vast extent, particularly as nearly one-third of this must be expended in working the mines.

Nothing, besides, is more variable than the product of mines. Those of Mexico, which in 1700 furnished only six millions of piastres in gold and silver, produced twenty-five millions in 1809; and this immense augmentation was unknown in Europe, (where it had not produced any sensible result,) when M. Humboldt announced it a long time after it had taken place. The revenue of Mexico has since that time kept at nearly eighteen millions of piastres, without any effect being produced on the price of commodities.

With regard to platinum the case is quite different. As the quantity of this metal, which has only been worked for a short time, is still very inconsiderable, an increase in the produce of the mines which furnish it may bring down greatly its price,—a result which will be extremely fortunate for the useful arts.

Art. XXIV.—*Notice of the recent Researches of M. Arago, on the Influence of Bodies reckoned not magnetic, on the motions of the Magnetic Needle.**

We have already, in various articles in this work, had occasion to lay before our readers an account of M. Arago's magnetical experiments, and of those of Messrs Barlow, Christie, Babbage, and Herschel, by which they were preceded and followed.

At the sitting of the Academy of Sciences, held on the 3d of July, 1826, M. Arago made a new communication on the subject. M. Nobili and another Italian natural philosopher, having denied that substances not metallic have any influence on the magnetic oscillations, M. Arago makes the following reply.

I cannot conceive what could have prevented these observers from recognising a fact so easy to verify. In order to show the Academy how impossible it is that I should have been deceived, it will be sufficient to state the results at which I have arrived relative to bodies which may be supposed not to contain a single metallic particle: for example, *distilled water* and *ice*.

With respect to *water*, the variation between the position of the needle at a very small distance, and at a distance so great that the distance of the body may be regarded as nothing, is in the last case double of what it is in the first. The error of the Italian observers arises perhaps from this, that

* This article is partly composed of the abstract of the proceedings of the Academy of Sciences, published in Nos. 84, 85, and 87 of that excellent periodical work *Le Globe*.

they have made the experiments on non-metallic bodies at too great distances.

The cause of the phenomena produced by metallic and other bodies in rotation, has been generally attributed to the formation of a certain number of poles situated upon the non-magnetic body, and which, subsisting during a certain time, are supposed to be sufficient either to fetter the motion of the needle, when the disc remains immoveable, or to cause it to turn in the case when the disc itself is put in motion. This explanation, apparently so simple, is however liable to the objection that the formation of these poles, even if their existence is admitted, would be insufficient to account for the motion of the needle. If the observers who give this explanation had endeavoured to compute the force which might be supposed to reside in these poles, they would have found that the limit of the motion which they could have communicated to the needle would perhaps not have exceeded a minute, whilst, in order to explain the rotation, it should have exceeded 90 degrees.

Not content with this refutation of the common hypothesis, M. Arago has endeavoured to point out its insufficiency by direct experiments.

Having suspended above the disc which he uses in his experiments, a vertical magnetic needle, which can move only by turning round its axis in a plane also vertical, and passing through the radii of the disc; and having put the disc in motion, he observed the needles carried *towards* the centre of the disc, whenever it was placed at a *less* distance than about two-thirds of the radius of the disc from its centre. At *this* distance, the needle remained *immoveable*, while at a *greater* distance it was carried in a *contrary* direction, or *from* the centre of the disc. When the distance was equal to the radius, and even greater, the needle was still pushed in the same direction.

M. Arago next placed a needle in a horizontal situation, so that it could move only round its middle in a horizontal plane, and so that one of its extremities was found above and very near the disc. When the disc was made to turn, this extremity of the needle was raised, as if it had been repelled by it.

As the force which is developed in a great number of cases is repulsive between the different parts of the disc and the pole of the needle which is near it, M. Arago conceives that it is impossible to attribute it to any magnetism of the disc, since it is known that, in whatever way a needle acts upon another body, in order to communicate to it its magnetic properties, it can only give it a magnetism from which there will arise an attractive force. *

At a meeting of the Academy of Sciences, held on the 10th July, M. Arago continued the account of his magnetic experiments. He announced that he had made experiments from which it resulted that, for certain positions of a vertical needle, and for velocities of rotation sufficiently rapid, the repulsive force which is exerted in the direction of the radius is as great as the force perpendicular to the radius, the effects of which are observed upon a horizontal needle.

M. Poisson having stated, in his memoir *on the theory of magnetism in motion*, (of which we shall give some account in the next article,) that Coulomb had recognised the magnetic virtue in all bodies, independently of the iron which they contain, M. Arago remarked that the idea of Coulomb was quite different from his, Coulomb having been of opinion that a quantity of iron too small for chemical analysis even to appreciate, was yet sufficient to produce in bodies which contained it appreciable magnetic effects. MM. Thenard and Laplace confirmed this remark, and M. Poisson said that he would suppress the assertion, which he had made without attaching to it any importance.

In justice to M. Arago, we have given the above statement as we find it: but in justice to M. Coulomb, it is necessary to remark, that he is the undoubted author of the discovery *that all bodies, whether organic or inorganic, are sensible to the influence of magnetism.* M. Biot † has remarked, that there are two ways of explaining this, *either all substances in nature are susceptible of magnetism*, or *they all contain portions of iron, or other magnetic metals, which communicate to them this property.* This last explanation, though adopted by Cou-

* M. Ampere stated to the Academy his opinion that the action of the disc on the needle is *always repulsive,* and he ascribes the apparent attraction which is manifested, when the needle is placed at two-thirds of the radius, to the action of the excentric part of the disc.

† *Traité de Physique,* Tom. iii. p. 117.

lomb, by no means affects his claim to the discovery of the general fact that all bodies, whether organic or inorganic, are susceptible of becoming magnetic. Coulomb's explanation may be right, or it may be wrong, and it is one of those opinions which are not likely to be overturned by experiment; but were it proved to be erroneous, his discovery remains as much his own as if he had never attempted to explain it. M. Biot has distinctly stated, in the page already quoted, that the phenomena may not really be magnetic; that other circumstances may develope forces similar, or analogous to those of electricity by contact; and that the magnetic action experienced by needles of all substances made use of by Coulomb, may be owing to some small force which is yet unknown to us.

Professor Hansteen of Christiania, whose important magnetic researches we have frequently communicated to our readers, has drawn from numerous experiments and observations the important conclusion, that *every vertical object,* OF WHATEVER MATERIAL IT IS COMPOSED, *has a magnetic south pole above, and a north pole below.* This curious fact we had occasion to publish, for the first time, in the *Edinburgh Philosophical Journal* for January—April 1821.

ART. XXV.—*Abstract of a Memoir on the Theory of Magnetism in Motion.** By M. Poisson.

AT the sitting of the Academy of Sciences of Paris held on the 10th July last, M. Poisson communicated his Memoir on the *Theory of Magnetism in Motion.*

This celebrated mathematician, who had long ago given a formula representing all the phenomena in magnetism as then known, has undertaken the same task for the new facts observed by M. Arago and others.

Besides the effects produced in the interior of bodies by the austral and boreal magnetic fluids, when they are in a state of rest, there are others which are the result of the same fluids in motion. The *first* take place when the external forces, which separate the fluids from one another in the small spaces

* Abstracted from *Le Globe,* No. 87.

where they are enclosed, are constant in magnitude and direction. In this case, the two magnetic fluids spread over the surfaces which envelope these small spaces, and are distributed over these surfaces in a manner determined by the magnitude and direction of the external forces.

The *second* effects take place when the external forces, varying continually either in magnitude or direction, there are continually new portions of the neutral magnetic fluid decomposed, so that the austral and the boreal fluid resulting from that decomposition act in the time even that they take to pass from the interior of the small spaces, where their decomposition takes place, over the surfaces which envelope these spaces.

Admitting, as M. Poisson has done, that a species of friction hinders this transport from being instantaneous, the action which is thus produced upon an external point of the body rendered magnetic, may, according to the nature of that body, predominate greatly over that which the same fluids exert in the first case upon the same external point.

With regard to the friction above mentioned, which, without opposing itself to the transport of the molecules of the fluid, only diminishes the velocity with which the transport is effected, we must carefully distinguish it from the coercive force, the effect of which is absolutely to prevent the displacement of the magnetic fluids, till it is overcome by an external force more considerable. There is no coercive force in most bodies susceptible of being magnetised; and it is chiefly in steel that this force shows itself, both by the property which this body has of being magnetised, and by that which it possesses of preserving its magnetic properties when once acquired.

M. Poisson admits, on the contrary, in all bodies, the existence of the force which he compares to friction, and those even in which we cannot discover any coercive force are not exempt from it. He remarks, that the action produced by the magnetic fluids in motion is nothing in the two extreme cases, viz. the case where we would suppose that the magnetic fluids would be transported instantaneously into the position where they should remain in equilibrium, and the case in which we would admit a coercive force sufficient to oppose itself to any displacement of these fluids.

In setting out from this theory, M. Poisson announces that his memoir contains general formulæ which give at once the action produced in a state of rest and in a state of motion. The first embrace the magnetic phenomena long known; and the author thinks that the second are sufficient to explain the phenomena discovered by M. Arago.

It follows from M. Poisson's calculations, that there is no dependence between the two sorts of actions, and that experiment alone is capable of determining the respective co-efficients of the values of these actions.

Art. XXVI.—*On the Fall of Leaves.* By Professor Vaucher of Geneva. *

Among the phenomena of Nature obvious to every eye, and interesting in many respects, is the *Fall of the Leaf*—that period of the season when the foliage of summer, having performed its office, shrivels and falls off, to make way for the buds and leaves of a future summer. This phenomenon has afforded to the Moralist and the Poet many of their most beautiful allusions, and has served for an illustration of that alternate decay and renovation which seem to pervade all the classes of organized matter. To the medical philosopher the *fall of the leaf* is no less interesting, as having some how or other a connection with certain states of health and disease; and common observation has long regarded this epoch as peculiarly marked in our variable climate by a more than usual mortality—when the fairest hopes of many families "drop off like leaves in autumn." The structure and functions of leaves—their use to the plants of which they form a part—and their use in the general economy of nature—have long occupied the attention of the vegetable physiologist; but the causes of defoliation, and the means by which that defoliation is accomplished have been less successfully investigated. In a paper by Dr Fleming in the seventh Number of this *Journal*, that able naturalist has made some judicious remarks upon the defoliation of trees, and upon the classification of systematic

* *Mém. de la Soc. de Physique et d'Hist. Nat. de Geneve*, vol. i. p. 120.

writers upon this branch of Natural History. But by far the best and most philosophical account of this periodical defoliation that has fallen under our notice, is contained in a memoir upon this subject by Professor Vaucher of Geneva. As the memoir of this excellent observer does not seem to be generally known, we make no apology for presenting an abstract of its contents.

There are few phenomena more remarkable than the fall of leaves. Trees, which during summer preserve their foliage in spite of the changes of the atmosphere and the effects of winds, despoil themselves naturally on the approach of autumn, whatever be the temperature of the season, and the circumstances in which they are placed. The only exceptions to this law of nature, says Professor Vaucher, are what are called evergreens, of which the defoliation does not take effect till the lapse of years, and trees of which the leaves lose their vitality at the same time with the others, though they do not separate from the stem till the era of spring.

Many theories have been formed by ingenious men to account for the periodical fall of leaves. Some have believed that leaves fall from trees in autumn, because the bud which they shelter, increasing in size, separates the leaf-stalk insensibly from the stem. Others have imagined, that this fall is caused by a disease in the leaf itself, occasioned by the superabundance of the juices it receives in autumn, and the diminution of insensible transpiration; while others have attributed this phenomenon to the difference of growth between the circumference of the twig and the leaf-stalk, the effect of which is to break the fibres which attach it to the stem. None of these explanations, however, seem sufficient, in M. Vaucher's opinion, to account for the fact. As to the first, it is evident from simple inspection that it cannot be admitted. This pressure of the bud, which, like a wedge, ought to detach the leaf-stalk from the stem, almost never operates in this way; and, besides, if it did, its action ought to be as general as the fall of the leaves. But leaves which have no buds at their axil, or which have them very small, fall as quickly as the others; and in compound leaves, the leaflets, which have no buds, are separated from the principal leaf-stalk before it is detached from the stem. There exists, however, one case where the pressure of the bud, if not the principal cause, is at least the secondary one of the fall of the leaf; and this is when the leaf-stalk, instead of being placed under the bud, according to the common law, envelopes it like a bonnet; but this arrangement is not common. The only trees in which it has been observed are the Plane, the arborescent Sumach, the *Ailantha glandulosa*, and *Acacia*.

Disease or plethora of the leaves cannot occasion the rupture of the leaf-stalk; for it happens sometimes, and particularly after white frosts, that they fall whole and green. Besides, in dry autumns, when the juicies are less abundant, the leaves fall as quickly, and even sooner than in moist seasons. In short, this hypothesis does not explain why, in the case of disease, the leaf separates by the base of the leaf-stalk rather than at the leaf; how it always takes place in the same manner and at the same point; and how, above all, the fracture appears smooth and well-defined, in place of presenting an irregular and lacerated surface.

The third supposition, which attributes the fall of leaves to the increase of the diameter of the twig, although more conformable to the course of nature than the preceding, does not explain all the appearances which accompany the rupture. For example, it is easily conceivable that the increasing thickness of the twig must favour the separation of the leaf-stalk; but it is not known how this separation, in place of presenting all the irregularities of ordinary fracture, is found so well marked, and so similar to itself in all plants. Farther, although this explanation may suffice for simple leaves, that is to say, for those of which the leaf-stalk is not divided, it cannot apply to compound leaves, for the leaflets of these separate from the common leaf-stalk, without its receiving any more growth than the smaller petioles which it supports.

If the point of adherence of a leaf-stalk, says Professor Vaucher, be examined at the moment of separation, it will be remarked, that it forms a clean and perfectly defined section. This species of cicatrix, of which the impression is also seen upon the twig, is differently figured, according to the conformation of the leaves. In some it presents the appearance of a horse-shoe—in others a heart, the segment of a circle, &c. but always similar in trees of the same species. But if the leaf-stalk be attempted to be broken elsewhere than at its ordinary point of separation, the fibres are lacerated and torn, and proof is thus afforded that means for this separation have been previously prepared by Nature at one exclusive point, without reference to exterior causes.

The fibres of a leaf-stalk, in place of being a simple prolongation of those of the twig, are therefore, in M. Vaucher's opinion, separated from it at the point where this cicatrix is seen. There appears, indeed, no real continuity between them; and the temporary union which connects the leaf-stalk with the twig, is merely kept up by a kind of adhesive substance, which, when the purposes of the leaf to the parent plant are served, is dried up or dissolved. This adhesive substance is probably formed by some portion of the parenchyma interposed between the two systems of fibres. While this parenchyma is under the influence of the vegetable action, the adhesion is maintained; when this action ceases, the union is dissolved, and the leaf falls.

The point of separation is also to be perceived exteriorly in the form of a circular ring, at the point which separates the leaf-stalk from the stem. This ring is easily perceptible in most trees. It is particularly marked in the leaf-stalks of compound leaves, the fall of which present more varieties in their appearance than simple leaves. In the *Aralia spinosa*, for instance, it divides the principal leaf-stalk and its dependent petioles into many parts. In the great Chesnut, the ring is seen at the base of the leaves. In the Walnut, this appearance explains how the odd leaflet remains adhering while the others detach themselves; and in the green leaves of the *Clematis* may be remarked all the appearances which precede their fall. At the same time, it may be observed, that the solution of continuity which takes place in compound leaves is not of the same nature as that which occurs in simple leaves.

This natural separation, however, is not a phenomenon peculiar to the leaves of arborescent stems. It is equally seen in the peduncles which support the male flowers of a great number of plants, such as the walnut, the willow, &c. and it is still more distinctly marked in the pericarps. The different ways in which these pericarps open at the moment of maturity, and the constancy of the mode of opening in the same species, cannot be explained without having recourse to the supposition of a peculiar organization—to a primitive solder, similar to that which retains the leaf-stalks in their places. In short, says Professor Vaucher, the same traces of stricture or tightening may be perceived on the exterior covering of a great number of pericarps; and even seeds do not separate from the feeble peduncles which support them but by analogous means.

But it may be asked, continues M. Vaucher, how the fall of leaves is determined?—Why, if there be an original separation of the leaf-stalk and stem, do not the leaves fall as soon as they appear?—and why, on the contrary, do these leaves, so intimately united to the stem, fall at the approach of winter?—The reason is, 1. That there exists between the leaf-stalk and the stem a substance which unites them, and which botanists call *parenchyma.* While this substance is impregnated with vegetable juices, it fulfils its vital functions, adhesion is maintained, and any attempt to remove the leaf produces laceration; but in autumn, the interposed parenchyma having dried up, ceases to preserve the continuity with the stem, and the leaves necessarily fall. 2. Because the fibres which envelope the vessels in the stem or branch are not of the same nature as those which penetrate the leaf-stalk. At their first developement the difference is not manifest, but in autumn the first are hardened, while the others remain herbaceous—the first continue to live, while the others die, and there is in consequence a natural separation. Besides, the twig and the branches increase in diameter, while the leaf-stalk contracts in drying till the separation is complete. It must be recollected, however, that this difference of increase in the stem and leaf-stalk is not the chief cause of the fall of leaves; it is but one of the accessory circumstances. The true and only cause is the solution of continuity, and this depends primarily on the difference of organization. Without this difference leaves would never separate from their stems in a manner so general and uniform. They would on the contary be broken on all sides, and irregularly, as the peduncles of a great many species of fruit; and a tree deprived of its leaves would present branches loaded with useless vestiges of their former footstalks—a species of disorder which is never seen in Nature.

In examining more closely the phenomena of the fall of leaves, it is observed that their separation is favoured by the torsion of the peduncle. This torsion is seen in leaves which are ready to drop off, and in those which have fallen. M. Vaucher observed it in the apple, the peach, the cherry, the willow, and many other trees, but did not notice whether it followed the same direction in all. The ring or circle which indicates the approaching fall is most easily perceived on the approach of autumn. It is double in the orange, the leaves of which sometimes break off by the first mark, sometimes by the second. In the barberry it is placed above the point of contact between the leaf and the stem, so that, after the fall of the leaf, the rudiments of the leaf-stalk may protect the young bud.

In compound leaves, while the parenchyma retains its functions, the adherence between the two systems of fibres or vessels is maintained; but when the leaf has finished its growth, it twists and dries by little and little, the fibres and the vessels are disunited, and the least exterior agitation breaks the adhesion. In this case, however, the separation is not so determinate as in simple leaves. Sometimes the entire leaf separates itself from the stem, and the leaflets remain adherent; sometimes portions of the common leaf-stalk break off—often leaflets; and never, as may be easily conceived, does this rupture (determined by the drying up of the parenchyma alone) appear so clean and well-defined as in simple leaves. Traces, more or less distinct, of the disorganized parenchyma are often to be observed adhering at the place of separation.

It is not difficult to reconcile what is here said with the phenomena which the fall of leaves presents. Since the rupture of the leaf-stalk depends upon a primitive organization, and the period of its fall is determined by the increase of the stem, and the branches of the year begin to harden at their base, it is easy to understand why the inferior leaves are detached before those of the summit, as happens indeed in most trees. It is also easily understood why leaves fall in warm as well as in cold countries—in stoves as well as in the open air; the heat, which favours the increase of the stem, advances the moment of separation, and the more southerly we advance, the more defoliation ought to be accelerated. The cold and snows which, in altering the organization of a petiole, destroys its adhesion, hasten also the fall of leaves, and on this account they sometimes fall when green. Trees of which the shoots are more tardy or more vigorous, ought, on the contrary, to preserve their leaves till the twigs acquire a woody consistence; and this is found to be the case with oaks and elms which have been lopped. Branches likewise which have been cut before autumn, ought not to part with their leaves after drying, because these have been prematurely stopped in their vegetation, before the natural period of their fall.

The chief objection to this theory is, that there are trees which preserve their leaves during autumn and even in winter. This, according to M. Vaucher, so far from forming an exception to the general law, rather tends to confirm it. If the leaves of these trees be examined, they will be found dissimilar in structure to the other leaves. Harder, more coriaceous or ligneous, their tissue approaches nearer to that of the stem upon which they are produced. But when the stem has acquired sufficient size, its adherence with the leaf-stalk is broken, and the leaves follow the common law. The epoch of the fall of leaves of this description, varies with the nature of the tree—in spring—summer—or even after some years. But even admitting these considerations, and others of a similar nature, it is finally found, says Professor Vaucher, that the defoliation of these trees depends upon the cause which he has assigned, viz. a solution of organic continuity between the vessels and fibres of the stems, and the vessels and fibres of the leaf-stalk.

M. Vaucher concludes his memoir with some reflections, and with the observation, that the circular ring or stricture found at the base of the petiole, and common to all trees, is not perceived in annual plants, nor in those which, though perennial, decay down to the root. When leaves are torn from these, the plant is wounded, the fibres lacerated, and the place of junction possesses not the clean and well-defined cicatrix of the leaves which are destined to fall at stated periods. His reflections are—

1. That the leaves in our climate are nearly all petiolated, never sessile, decurrent, or amplexicaul, and that he knows but of one instance where the stricture is placed in the substance of the leaf, and not at the base of the petiole—the orange.

2. That leaves are always attached to new stems—never to branches of the preceding year; and that the necessary union cannot exist between the woody stem and the new leaf.

3. That the cicatrix which the leaf leaves in falling, and which is well marked in many trees, gradually disappears. The epidermis of the cicatrix is detached, and carries away in falling the last trace of the rupture.

4. That it is interesting to know whether the peduncles which sustain the fruit, and those which bear flowers and stamens, as in the trees which have catkins, are attached to their places by this predisposed adhesion. These last fall when fecundation is over, while the others adhere till the fruit is mature. Their peduncle acquires a woody consistence, and dies a long time before falling. At the period of its fall, occasioned by agitation of the air, it breaks irregularly at various parts of its length, and presents, in general, no trace of a ring or stricture. This anomaly affords another proof of that wisdom by which all the processes of Nature are regulated. The male catkins are useless when they have performed their office, and of course they fall, but the peduncle of the fruit remains till the fruit reaches maturity.

5. That there exist many genera of plants, species of which have woody stalks, persistent during winter, while others are annual, or at least only preserved by their roots. Not the least discontinuity is perceived in the petiole of the leaf of the last of those, while in the first, the ring which marks the place of rupture is generally extremely well defined.

6. The simplicity of the assigned cause is proof of its reality.

7. The temporary adhesion or solder should be found in all forest trees of cold and temperate climates, of which the leaves are parenchymatous, and of a loose tissue, and which belong to the class of Dicotyledons. M. Vaucher is not aware of what happens in regard to trees of the torrid-zone, and is inclined to suspect that Monocotyledonous and arborescent vegetables enjoy not this property, or at least it may be modified in regard to them.

Such is Professor Vaucher's theory of the Fall of Leaves. Whether he be right or not in assigning the solution of continuity between the leaf-stalk and the stem as the sole cause of the fall, we stop not to inquire. To us it appears to be only the last of a train of circumstances intended to produce this effect. The pressure of the bud—the increase of the stem—and the diminution of transpiration and absorption, caused by change of temperature, may all be said to contribute to the fall of the leaf: But M. Vaucher has the merit of first directing the attention of Vegetable Physiologists to an organic structure at the base of the petiole, which has escaped the observation of Malpighi and Grew, as well as of later writers; and has shown that the connection of the vessels of the stem and the leaf, though necessarily intimate, is merely temporary. A similar arrangement, there is little doubt, prevails in the other parts of plants which successively drop off—in the corolla and stamens, for instance—and in the means by which the capsules or pericarps of many plants burst open for the discharge of the seed; and although this last circumstance has been marked by botanists as a specific distinction, it has hitherto failed to lead to the investigation of the means by which this rupture is accomplished. This investigation offers a new field for botanical research, and will no doubt furnish matter for future and interesting observation.

Art. XXVII.—HISTORY OF MECHANICAL INVENTIONS AND PROCESSES IN THE USEFUL ARTS.

1. *Account of a Cheap and Effectual Method of Blasting Granite Rock.* By William Dyce, M. D. F. R. S. Ed. Communicated by the Author.

The city of Aberdeen is particularly favourable, in point of situation, for the exportation of granite; and, as it is well known that this mineral abounds in an especial manner in and about it, it is no wonder if the inhabitants avail themselves of every opportunity of supplying their neighbours wherever a market can be found. The quality of this granite has been universally allowed to be superior to any that has yet been discovered, not only in point of beauty of colour, but in durability and tenacity of parts, so as to resist the greatest weight that can almost be put upon it, whereas all other granites are crushed by their own superincumbent weight where they exceed 200 feet in altitude. This tenacity of its composition renders it valuable for many purposes, and its superiority for street pavement does not require to be pointed out; independent of its great use in the construction of arches in bridge work, and in the simple article of a fire-proof press or repository for books or papers, which I believe was never yet known to be injured by fire in a house.

But whatever may be the qualities of this substance, that is not the purport of my present communication. What I have in view is, to detail a method whereby it can be more effectually detached from its solid bed.

I have for many years suspected that the plan usually adopted was wrong, that of igniting, from three to ten feet of gunpowder, at the top of a tube whose diameter did not exceed one to two inches at most. I conceive that this mode of igniting the powder, gives the greatest power to the weakest part, for the clay, or material with which the whole is to be compressed, is by no means equal to the resistance of the solid block, consequently, it will give way first, and the advantage of the explosive power of the gunpowder will be imparted to the upper side of the block and very little to the lower, so that a few splinters will be thrown off, without one particle being detached below the centre of the gunpowder.

It is this circumstance that emboldens me to speak, having observed it on several occasions; and although I cannot prove from actual experience what I have to recommend, yet the thing seems plausible; at all events it will answer the purpose of igniting the powder at the bottom of the charge, and that with more certainty and safety than is done by any of the methods that are at present followed.

It is to be done in this manner. According to the depth of the bore, a copper tube is to be made, so as to reach to the bottom, of the diameter of a quarter to half an inch. This tube is then to be provided with an iron rod, or, if the bore is of great depth, it would require to be made of steel in case of bending, but in either way it must be made of such size as will move easily up and down in the tube; and the lower part of this rod (perhaps to the extent of one to two inches) should be made of copper, with a small hole drilled up through the centre of it, sufficient to admit the stem of a glass ball, as will be better understood by the outline, Plate VI. Fig. 1. This glass ball, which is exactly the same with common crackers that are stuck into the candles and explode by the water being converted into steam by the heat of the flame, but instead of water, it is filled with sulphuric acid, which, on being crushed, the acid immediately comes in contact with a detonating powder, which fires the lower part of the column of gunpowder, and the full effect is given to its expansive power at the part where it is wanted to exert its force.

This detonating powder is composed of equal parts of gunpowder and oxymuriate of potass, carefully mixed together with a small quantity of water. To those who are not acquainted with such a mixture, it may be proper to mention, that, if the two articles are mixed together in the dry state, and rubbed down into a powder in any way, the whole will explode, unless water be added so as to make it into a kind of paste, after which it is to be spread out on some paper or cloth, and left to dry, after which it easily crumbles down between the fingers into a fine powder, which should be kept in a bottle, as it is easier set fire to than gunpowder.

When this powder or priming is to be used, the tube with its ramrod is to be placed into the bore down to the bottom, that is, as far as the gunpowder goes; then the powder is put in as usual, and the whole process completed in the ordinary way, by hammering down clay, or broken tiles, or bricks, with this great difference that the pricker (as the workman term it) acquires no movement, for it is by it that almost all the accidents happen in our quarries. Now, in this case, the tube remains firm in its place, and does not require to be moved at all, but the ramrod can be moved or withdrawn at pleasure. When this is done, a small quantity (a tea-spoonful) of the detonating powder is to be poured into the tube, after which one of the glass globes is to be fixed into the end of the ramrod, and is gradually lowered down into the tube till it come in contact with the powder, after which all is now ready for the explosion; and this is effected by a simple blow, such as is produced by the hammer of a gun lock, whereby the glass ball is broken. The sulphuric acid instantly lays hold of the potass, and the chlorine is set at liberty to act on the charcoal and sulphur of which the gunpowder is composed, whereby inflammation is instantly produced, and the charge set on fire from the bottom.

This part of the plan, as is before hinted, I have never actually put in practice; it has only been done with a model, but there is no doubt whatever of its answering the purpose for which it is intended. The second part of the plan is to take advantage of the explosive or repulsive power of the charge, by calling to our aid one of the mechanic powers, so as to divide the rock at the bottom of the bore. Now, this is to be done in a very effectual manner by means of the wedge. In order, however, to effect this, the bore must be somewhat different from the common. After having been carried to the depth which the workman judges proper for his present purpose, another bore must be carried down 18 inches or two feet, of less than half the diameter of the original bore, and this will be better understood by an inspection of Fig. 2. When this part of the process is completed, the next operation is to apply the wedge; which is accomplished by a cone of steel, at first dead hardened, but afterwards brought back to spring temper. This cone, Fig. 3. it is unnecessary to say, must be in proportion to the size of the bore at its base in diameter, and its apex of a size so as to enter at least one inch into the lower chamber or bore. When the charge is to be made, the cone is to be lowered down, till it meet with the resistance at the bottom of the bore, as represented in Fig. 4. Then the gunpowder is to be put in, and the whole completed in the usual way, or according to the plan that I have stated, but as that has not been put in practice, I can only state the result of the common mode of charge with the cone.

Having been informed by the quarrier that a two inch and an half bore would be the most proper size to try the effect of it, I gave orders to have the cone made exactly of these dimensions at its base. But, on attempting to pass it down, by means of a piece of cord, into the aperture, I found, to my surprise, that it did not proceed quite one-third of the depth of the bore; consequently, to my great disappointment, it could not be used at this time; but as all things were prepared for the destruction of the rock, I remained till the *blast* was made, by which there was a great alteration in the appearance of the rock; for, instead of being one solid body, it was now a heap of confusion, of fragments more or less in magnitude, all of which seemed to have been thrown off not lower than two-thirds of the depth of the bore.

This last circumstance gave me great encouragement to procure another opportunity of trying the effect of the wedge or cone.

After a lapse of several months, the quarrier called upon me, and said that he had now another opportunity of trying the *new method*, as he called it; accordingly, I gave him instructions to make his bore to the depth that he thought right, and then to measure the diameter of it at the bottom, for I had not learned till now that no man could make a cylindrical bore to any extent in stone. That as it went down it became narrower, in other words, it became quite oval, and therefore unfit for my purpose. Now, on reflecting on this circumstance, it occurred to me that means might be devised to obviate this circumstance, either by employing a *jumper* (as the workmen call these tools) of a different construction originally, or, after the bore is made with the common tools, to use the one that I would recommend; and an inspection of Fig. 5, 6, will show what I mean. By persevering in the same manner that the first tool was used, the bore will at last be made quite cylindrical. But as this does not seem to be of any great consequence in regard to the general result, seeing that the inconvenience of an oval bore can be easily obviated by the smallest attention on the part of the operator, I have not given myself any trouble on this score.

Next day the workman called and mentioned that the depth of the bore was nine feet, and its diameter at the bottom was two inches, while at top it measured half an inch more and rather better. Accordingly I got the cone made very exactly to his measurement at the bottom, but, on arriving at the quarry, and lowering it down by means of a string, I found that it would not descend more than seven feet; and, to add to my mortification, I found that the lower bore was not more than nine inches in depth, instead of eighteen, as I had directed.

However, with all these disadvantages, I was desirous to have the experiment tried, more especially as the first objection accorded with my own ideas respecting the proper position of the cone, that it should be at least two feet from the bottom of the large bore; this, however, I intended for a second experiment, so as to compare the difference, if any, but necessity made it the first.

Accordingly, matters being all prepared, the cone was let down into the bore, and forced down to twenty inches from the bottom, a small piece of flannel was put down upon it, in order to prevent any of the gunpowder from passing into the lower chamber, that is, below the cone. The charge which the workman informed me was used for such a depth of bore, was nine pounds weight of gunpowder, but I requested him to use only six, which quantity was had recourse to, and every thing else conducted in the ordinary way.

At last the usual signal of the blowing of a horn was given to all in the great cavity of the quarry below, as well as all in the surrounding quarries, to keep at a distance. Fire was then communicated to the match, and in about a minute the whole went off with less noise than I could have conceived, considering the quantity of gunpowder; but the proprietor of the quarry made a remark, before I had time to speak on the subject, "that he was sure that this was a good blast from the hollow sound." Being at a considerable distance from the rock, we could not discover what had actually taken place, but from the altered appearance we could foresee great demolition of it.

On our arrival, by very rugged and uneven paths, we found most extraordinary devastation indeed! a mass of rock exceeding, according to the workmen's measurement, one hundred tons, was thrown off to the distance of three feet from the solid rock, and a quantity of fragments, none less than a ton, and many of them equal to twenty, were thrown to a considerable distance beyond this great mass, and one piece, from the upper surface of the rock, was thrown into the air directly upwards, in the most beautiful circular direction, to the distance of one hundred feet, as was judged by those who witnessed it. All these detached blocks were measured by the workmen in the rough way that they are accustomed to do, and they were calculated to be about another hundred tons. But the most remarkable circumstance (to the quarriers) was the immense *split* or rent given to the whole rock in every direction, for it was traced to twelve feet beyond the bore, an occurrence which they had not witnessed before. From this unexpected occurrence they had no great trouble in separating a large quantity of this rock by the simple use of the mechanical power of the lever and wedge, by means of which some very fine blocks of stone were separated to the extent of another hundred tons. Thus showing, in the most incontestible manner, that this plan is more efficient than any that has been proposed or put in practice; and that, by a little perseverance, so as to become more perfect in the plan, the blowing of rocks may be rendered as safe as the letting off of a fowling piece.

The cone was not found for six weeks, because, being buried among the great masses of stone, it could not be got at until these were worked up and removed; when brought to me it was, by the violent percussion, broken in two, and its surface rubbed and scratched as if it had been soft lead.

The shortness of the lower bore seemed to be the cause of its breaking, for the workman informed me that he found it fast in the bottom of the lower tube, consequently this points out the propriety of having it fully of the dimensions that I have before stated. And, whether the cone be used or not, it seems to me to be a matter of great importance, that the gunpowder (whether inflamed at the top or bottom) should not be allowed to go to the bottom of the bore, but have a certain space filled only with common air, which can be done in a variety of ways, and therefore requires no explanation from me. By the adoption of this plan, I have no hesitation in saying, that half the quantity of gunpowder will be saved, and that the same, if not a greater effect, will be produced, than is at present effected by such an enormous quantity of gunpowder, as a pound to the foot of depth of bore.

Thus I have detailed all that has occurred to me as far as I have gone, yet I am aware that my method is not yet perfect; nevertheless it is satisfactory to know, that the principal part is quite conclusive as far as respects the destructibility of the rock, in a greater degree than has hitherto been done.

The whole process, therefore, may be summed up under the three following heads, viz.

1. To inflame the gunpowder at the bottom of the charge, by means of sulphuric acid, charcoal, and sulphur. 2. To take advantage of the propelling power of gunpowder, as is done with a cannon-ball, only reversing its mode of action, and instead of a spherical, to apply one of a conical form, by which the full effect of the wedge is given in every direction at the lower part of the charge, but particularly downwards. 3. And, in the last place, to add to the effect of the whole, to insure a fourth part of the depth of the bore at the bottom to be free from the gunpowder, so that when inflammation ensues a red-heat may be communicated to the air in the lower chamber, whereby it will be expanded to such a degree as to have the power of at least one hundred times the atmospheric pressure, and thereby give this additional momentum to the explosive power of the gunpowder.

Explanation of the figures before alluded to. Fig. 1 of Plate VI. is meant to represent the tube with its ramrod, the lower part of which is drilled with a small hole, as represented at A, of sufficient size to admit the end of the ball B, containing the sulphuric acid, which end, if too small for the aperture, is to be wound round with a little thread, so as to remain fast when once introduced. The dotted line represents the portion of copper that may be proper at the bottom of the ramrod. Fig. 2 can barely convey the idea that it is a bore carried down through a solid rock of two inches in diameter, and to the depth of nine feet, yet at C we may easily conceive that it will assume the figure, as represented by the dotted line, and at D, some conception may be formed of the lesser bore that has been before-mentioned. Fig. 3 represents the steel cone, which must be made in proportion to the size of the bore, and, with respect to itself, five times the diameter of its base in length to the apex is to be the length of the cone, but at the apex a fifth part is to be cut off, being of no use. Fig. 4 is intended to show the bore down through the rock, with the cone let into it as far as the lower or small bore. Fig. 5 shows the proposed plan of a jumper for producing a circular bore through the whole extent or depth of the tube; and Fig. 6 is another for the same purpose, either of which may be used according to the workman's fancy of their utility.

2. *Description of a Self-Generating Gas Lamp.* Communicated by the Inventor.

The oil vessel of this lamp is represented at A, Plate VIII. Fig. 3. B is the tube by which the oil is admitted, C is the generator, D is a hollow vessel, where the heat from the burners F, underneath, is collected, the dotted lines are projecting ridges on it, within the generator, to prevent the oil running down and collecting at the bottom of the generator. E is a circular piece of iron to collect and retain the heat. G are tubes to conduct the gas from C to F. L is a tube to supply the vacancy in A with gas, as the oil is discharged into C. H is a metal heater to fit into D.

To use the lamp, fill A partially with oil, alcohol, or any fluid from which gas is produced, and having made the metal-heater H red-hot, place it in the bulb D; after it has continued a minute or two, turn the stop-cock I, allowing the fluid to drop slowly on the heated bulb D, below, by which it will be converted into gas. When it is found to escape in sufficient quantities from the burners at F, set it on fire, remove the heater, and a beautiful bright flame will be supported by its own heat as long as there is oil in A.

It may be found necessary to replace the first heater by a second, when the lamp is used for the first time, to expel more effectually the atmospheric air from the generator and tubes. The heat collected in D will be found sufficient to generate gas to a third burner if required, as it is an indisputable fact, that most bodies in a state of combustion give out much more heat than is requisite to support an equal body of flame, and it is quite evident by fire spreading so rapidly in all combustible substances, if not checked. X. X.

3. *On the Composition of the Mosaic Gold, or Or-Molu,* discovered by Messrs Parker and Hamilton.

The resemblance of this alloy to pure gold has attached to the discovery of it an importance of no ordinary kind. Although it is an alloy of zinc and copper, yet great care and experience are necessary to its production. The following is the exact method given by the patentees.

Take equal quantities of zinc and copper, and melt them at the lowest temperature at which copper will fuse. Having mixed them perfectly by stirring, add zinc in small portions till the alloy in the crucible assumes a yellow colour like brass, then continue adding the zinc till the colour changes to a purple or violet, and becomes perfectly white, which is the colour necessary to its perfection. It may then be cast into ingots, or into any required form, and when cold, it will have the appearance of an alloy of fine gold and copper.

The great art in making the alloy consists in working with the lowest temperature, for if the temperature is too great the zinc will fly off in fumes, and the product will be spelter or hard solder. From this cause it is difficult to make the alloy preserve its character when remelted. The alloy consists of a hundred parts of copper, and of from fifty-two to fifty-five parts of zinc.

4. *Account of a Patent Substitute for Leather.* Invented by Mr THOMAS HANCOCK.

In a former patent, Mr Hancock proposed to form a substitute for leather, by depositing caoutchouc in a fluid state upon loose fibres of wool, cotton, or flax, felted or matted together. In the present patent, he uses a *woven cloth,* made of wool, cotton, or flax. When this cloth is stretched upon a flat surface, the composition to be presently described is spread over it. Above the composition, a uniform layer of wadding, made of cotton, flax, wool, silk, or hair, is to be laid, and the whole pressed between a pair of rollers, in order to force the fluid composition among the fibres. It is then to be dried at a temperature not exceeding 80° or 90° of Fahrenheit.

Mr Hancock has given us the two following compositions, to be used according to circumstances.

First composition.—Dissolve two pounds of caoutchouc in one gallon of oil of turpentine and highly rectified coal tar. Add six ounces of black resin, two pounds of strong glue size, and one pound of yellow ochre, whitening, or powdered pumice.

Second composition.—Dissolve 1½ lb. of caoutchouc as before, and having melted and mixed one pound of glue size and resin in a steam bath, add the dissolved caoutchouc to it, stirring while mixing them. The whole must then be strained through a sieve.

The *first* of the above compositions must be used when a cheap and stiff substance is required, and the proportions may be one-third part whitening or glue; but when a strong and pliant substance is wanted, the *second* composition, in which the caoutchouc predominates, is to be preferred.

A substance like leather may be formed by joining together several thicknesses before they are dry. When leather for the soles of shoes is required, Mr Hancock proposes to use, as the groundwork, wool and cotton in equal quantities. For pipes, straps, &c. he proposes chopped hemp and cotton or flax; and when smooth surfaces are wanted, the substance must be pressed between polished metallic plates.

5. *Account of an Improvement on Ropes.* By Mr THOMAS HANCOCK.

This invention, also secured by patent, consists in soaking the strands of strand ropes and cordage in the juice of the tree called *Hevœa,* which grows in South America and in the East Indies. It has the consistency of cream when it first flows from the tree, and, with the exception of its not being heated, it is used in the same way as tar. Several coats may be laid on the outer surface of the cords before the preceding coat has dried. The ropes are then placed in a drying room till they cease to be sticky. When thus made, they will last much longer than ordinary ones.

6. *Method of making Impressions on Steel Plates.*

A mould having been formed of the object to be impressed upon the steel, a mixture of one pound of brass, and five ounces of pewter, in a fused state, is poured upon the mould. The piece of steel to be impressed being wetted with turpentine, it is covered with blotting paper, and the whole is enveloped in earth in order to preserve the polished surface of the steel from oxidation by the air. The steel being brought to a red heat, is taken out of the fire, and the earth being removed, the composition cast is imprinted upon it by a powerful pressure. In a similar manner may impressions be executed on brass, or any of the metals.—Hollander's *Metallurgico-Technological Journal,* quoted by Mr Newton in his *Journal of Arts.*

7. *Description of Improved Axletrees.* By Mr WILLIAM MASON.

The object of this contrivance is to prevent the wheel of a carriage from coming off by accident. For this purpose, the end of the axletree terminates in a screw, upon which a nut is screwed in nearly the usual way. In the screw, as well as in the nut, there are several semicircular grooves cut across the threads in the direction of the axis of the screw. The consequence of this is, that when the nut is screwed home, a cylindrical hole is formed whenever two semicircular grooves come opposite each other. Into these holes a pin or bolt attached to a collar is introduced, so as to lock together the nut and the screw.—See Newton's *Journal of the Arts,* June 1826, p. 309.

8. *Account of the Vitruvian Cement for building and other purposes.* An invention communicated to Mr J. P. BEAVAN by a Foreigner.

This cement, for the exclusive privilege of manufacturing, which a patent has been obtained, consists in mixing together, and sifting through a very fine sieve, one part of pulverised marble, one part of pulverised flint, and one part of chalk; to this is added one other part of lime, which has been slacked at least three months. The whole being made into a thin paste with water, is spread as thinly as possible over a rough coarse ground, and reduced by the trowel to a smooth surface. When dry, its surface may be made perfectly smooth and shining with pulverised Venetian talc.

When the cement is to be applied to buildings, the rough ground for receiving it should be prepared as follows. Mix together equal parts of the coarsest river sand, and the sand which is pulverised from millstones, and add a third part of lime which has been slacked for about three months. These are then to be made into a paste with water, and when it is about to be used, add a fifth part of very fine sifted lime, and apply it as a common plaster.—See Newton's *Journal of the Arts*, July 1826, p. 372.

9. *Mr Samuel Morey's New Vapour Engine.*

Mr Morey has taken out an American patent for this invention. The vacuum in the cylinder is produced by firing an explosive mixture of atmospheric air, and the vapour of common proof of spirits mixed with a small portion of spirits of turpentine. A working model has been set in motion and kept at work without raising the temperature of the fluid which yields the vapour, higher than that of blood heat.—Franklin's *Journal.*

10. *Account of the Performance of one of Mr Perkins's Steam-Engines.*

The following very interesting observations on Mr Perkins's steam engine are taken from the last number of Mr Newton's *Journal of Arts.*

Mr Perkins's system of generating high steam has recently been applied to the Cornish single stroke pumping engine by Mr Samuel Moyle, civil engineer, from Cornwall. Although the engine is not yet complete in all its parts, yet enough has been done to prove its great power and safety. As to the economy of the fuel, although undoubtedly great, nothing decisive is yet known, owing to the imperfection of the injecting pump, which occasionally failed in giving the full supply of water, upon which the proper supply of steam wholly depends. Enough, however, has been done to establish the important fact, that the higher the steam is used the greater is the gain. Steam used at forty-two pounds per inch, or at three atmosphere's pressure, without condensation in the cylinder, is undoubtedly not likely to do more, if so much, as the condensing engine using steam at three or four pounds per inch pressure. The eduction side of the piston has not only to overcome the pressure of the atmosphere, but the friction of the steam rushing from the cylinder through the eduction pipe, which will amount to at least half an atmosphere more, making twenty-one pounds resistance: add the friction of the piston, piston-rod, and valves, then there will be very little more pressure, if any, on the inch than when low condensed steam is used. It would appear, that about two-thirds of the forty-two pounds pressure on the inch is lost by the resistance on the eduction side of the piston. But as you increase the pressure of the steam the gain is almost wholly on the induction side of the piston, since the resistance to the escape of the steam is very little more, whether you work with 500 pounds per inch or forty-two pounds per inch.

The following statements will show the power and safety, although not the amount of the saving of fuel. This engine, with a nine and one-third inch piston diameter, and six and a half feet stroke, lifted a column of water forty inches diameter, and forty feet high, making fourteen six and a half feet strokes per minute, consuming not more than 120 pounds of coals per hour. But as the engine never worked more than two hours at any one time, it is impossible to say what the actual saving of the fuel would be. After the engine is completed, and worked day after day without interruption, then the economy in the fuel will be clearly ascertained. The area of the pump being twenty times larger than the area of the steam-engine cylinder, and the water being lifted forty feet high, it balanced the weight or power of twenty-five atmospheres; but as the friction, &c. must be added to the power required to lift the water, it was found necessary to raise the steam to about thirty-two atmospheres to give a lively stroke to the pump.

The safety of this engine has been proved by the frequent openings or fractures which have taken place (without injuring any one) in the experiments made in generating high steam. The maximum of high steam has not yet been ascertained, but, undoubtedly, the higher it can practicably be used, the greater is the economy. The greater portion of the gain in high steam appears to be owing to its expansive property. The higher the steam is raised the sooner the stroke can be cut off; of course more is gained by expansion. The highest Mr Perkins has ever used his steam for his steam-engines, is 800 pounds to the inch, or about fifty-seven atmospheres. That the gain goes on in a geometrical ratio, his experiments on the steam-gun have fully demonstrated. In some of these experiments, a pressure of 1600 pounds to the square inch has been used with perfect safety, and was found to project musket balls of the same weight and distance one quarter farther into the target than the strongest gunpowder. Mr Perkins has made another very curious discovery in experimenting on high steam, namely, that temperature does not always show the true power of the steam, although the steam is in contact with the water from which it is generated; but we cannot be so particular on this point as we could wish, on account of Mr Perkins not having completed his patent for the remedy.

We feel great pleasure in adding to the above, the testimonials of two gentlemen, Messrs Hornblowers, whose names are well known in connection with steam engines.

"We, the subscribers, have, for some time past, been employed as practical engineers at Perkins and Company's steam-engine manufactory, in applying Mr Perkins's system of generating high steam, to the Cornish single-stroke pumping engine, of which we have had nearly twenty years' practice. From what we have witnessed, we are perfectly satisfied that no danger can be apprehended from explosions. Its *great power is established by the fact of its having lifted a column of water* 40 *feet high, and* 40 *inches diameter, with a* $9\frac{1}{3}$ *inch piston.* As to the economy of fuel, which is evidently great, we cannot exactly say, owing to some parts of the engine being incomplete, especially the injection pump, The longest the engine has worked at any one time was two hours: at that time it was making 14 strokes per minute, 6½ feet stroke, and lifting a column of water 36 feet high, and 40 inches diameter, consuming not more than 100 lbs. of coals per hour. We also certify, that Mr Perkins's flexible steel piston is quite tight, although at times working at a pressure of fifty atmospheres." *

11. *On the method of preparing Catechu in Bundelkund in India.*

At the season when the sap flows most copiously, a few Gónds take up their temporary residence in some solitary glen where the Khair tree† (Khadira) abounds. All the implements they require are a hatchet, a few earthen-pots, and the convenience of water. The tree, after being felled, is barked and chipped, whilst the sap is flowing; and, in the meantime, the earthen-pots, half filled with water, are ranged in rows over fires; the chips, as soon as cut, are thrown into the water, and boiled until the inspissated juice acquires a proper consistency. The liquor is then strained, and suffered to cool, and it soon coagulates into a mass, which is the Catechu, the quality of which depends very much upon the freshness of the tree from which it is obtained.—Captain Franklin's *Memoir of Bundelkund*, in the *Trans. Royal Asiatic Society*, vol. i. p. 276.

12. *On a new method of manufacturing Glass.* By M. LEGNAY.

Take 100 parts of dried sulphate of soda, 656 parts of silica, 9340 of lime which has been exposed to the air, and mix them well. When the furnace and pots are heated to a full red, this mixture must be put into the pot in small balls. The mouth of the pot being stopped up, it is then put into the furnace, and as soon as the materials have sunk, more of the same mixture must be put in, till the pot is filled with a melted vitreous substance, and a strong fire must be kept up to have the mass completely fused, and as soon as possible. When the fumes diminish, small portions must be taken out, to see if the glass is sufficiently refined, which generally happens in about 22 hours. The glass is then fit for use, and may without risk continue double the time in the furnace.

The following other proportions have also been given:

1. Well dried Muriate of Soda, - -	100 parts.
Silica, - - - -	123
Lime, - - - -	92

This will be sufficiently refined in 16 hours.

2. Dried Muriate of Soda, - -	100
Slacked Lime, - - -	100
Sand, - - - -	140
Chippings of Glass of the same quality, -	50—200
3. Dried Sulphate of Soda, - -	100
Slacked lime, - - -	12
Powdered Charcoal, - - -	19
Sand, - - - -	225
Broken Glass, - - -	50—206

* A report on Mr Perkins's engine was made to the Institute of France on the 31st July last, by M. Gerard.

† The Mimosa Catechu, which grows in great abundance in Bundelkund.

4.	Dried Sulphate of Soda,	100
	Slacked Lime,	266
	Sand,	500
	Broken Glass,	50—200

See the *Description de Brevets,* or the *Annales de l'Industrie National.*

13. *Description of an Improved Mortise Lock.* Invented by Messrs JOHN and THOMAS SMITH, Darnick. Plate VI. Fig. 7, 8.

A is the spring-bolt, cranked inside to avoid the key of the lock bolt, and to bring its nose and tail into the same line.

B, the tumbler, or follower, of hardened steel, made to work upon the breech CC, which is of brass, and fixed to the bell by the tenor CC.

E, a piece of brass, with an oblong hole through it, to admit of the tail F working through it, to keep the bolt in its proper place, and diminish the friction.

The spring G, and player H, are brought to the fore end of lock, which allows it to be narrowed at the other end.

In the lock-bolt and night-bolt, there is little difference from the common lock.

The advantages of a lock constructed upon this plan, are the following, viz.

1st, It is less bulky than the common lock, easier put on, and does not weaken the door so much.

2d, There is less friction in the working, from the spring being placed to *draw,* in place of *pushing,* as in the common lock. The slide at F also contributes much to diminish the friction.

3d, It works with perfect equality whichever way the handle is turned, from the tumbler being placed exactly in the line of the centre of the bolt; which it is evident the common lock can never do, from the tumbler being placed so far from the bolt. In the common lock there is a difference, in most cases, of between 30 and 40 per cent. between the turns of the handle, which is the reason of the bolt coming readily back when the handle is turned the one way, and often sticking fast when turned the other way.

This we conceive to be the principal advantage of our lock.

ART. XXVIII.—ANALYSIS OF SCIENTIFIC BOOKS AND MEMOIRS.

Deutschland's Flora. By FRANC. CARL. MERTENS, and W. H. J. KOCH.

WE shall take the opportunity, whilst we notice the commencement of this long expected work on the Plants of Germany, to offer a few observations on the state of botany in that vast empire, including, as it does, within its limits, above 10° of latitude, and 24° of longitude; bounded by Italy on the south, the Adriatic Sea in lat. 45°, and a part of Turkey; on the north by Denmark and the Baltic Ocean; on the west by France, Holland, and a small portion of the North Sea; and on the east by Russian Poland: thus comprising a superficies of above 220,000 square miles.

This great extent of country, too, possesses much variety of soil and climate. The Sudetic chain of mountains rises in Westphalia, and stretches southerly till it reaches the Carpathian Alps on the frontiers of Poland and Hungary. In the south the Alps of Tyrol seem to vie with those of Switzerland, which they join on the east. Near the centre of Germany is another lofty range of hills, which, taking a semicircular direction, appears to form a natural boundary to Bohemia and the neighbouring countries. Many of the mountains have an elevation which reaches far above the line of perpetual snow, and, consequently, produce a vast variety of highly curious Alpine plants; whilst in the vallies of the south, both the climate and its productions resemble those of Italy. Even in the northern parts the summers are warmer than in Britain, although the mean temperature may not be equal; and, taking a given space in the same degrees of latitude, we find a vegetation both more abundant, and more varied than is to be found in our island. In the north of Germany, sandy plains abound, and heaths: and the Prussian dominions may be considered, upon the whole, to possess a poor and sterile soil. Saxony is generally fertile; but Wirtemberg, Bavaria, and the Austrian dominions are the most diversified, some parts being exceedingly rugged and mountainous, whilst others have very extensive tracts of deep and fertile soil. The rivers are numerous, and some of great magnitude, and the forests of Germany have been celebrated ever since the invasion of the country by the Romans.

Situated in such a country, we must not wonder if the Germans early devoted their attention to the study of plants. *Cuba,* a physician of Frankfort, was the first who published figures on wood, along with his descriptions of 509 vegetables, about the end of the 15th century. But in what concerns the early attention that was given to botany by the Germans, I shall translate what Mirbel has said in his "*Naissance et Progrés de la Botanique;*" since it is much better than anything I could myself offer upon the subject.

"It must be confessed," he says, "that since the time of Theophrastus, botany, far from advancing, may be said to have retrograded. A greater number of plants were indeed known by name, but there was less acquaintance with their organization, and the art of observing was lost. This was the result of injudicious methods, much more injurious, as Malpighi observed, to the developement of the intellectual faculties, and, consequently, to the progress of science, than even the ravages of barbarians."

"At length the light burst forth; the evil was seen, and a remedy sought out. The works of *Otho Brunfels,* of *Jerome Tragus,* of *Antoine Musa Brassarol,* of *Leonard Fuchs,* and of some others, but little consulted now, show the return of genius to the study of nature. The greater number of these authors combated stoutly the false opinions of their day. "Our blind respect for the ancients," said they, "is an insurmountable obstacle to the progress of botany. We never find any but the plants of Theophrastus, of Dioscorides, and of Pliny; notwithstanding that botanists have not known the hundredth part of the plants which covered the globe. Theophrastus never went out of Greece; Dioscorides, more curious to discover the medical properties of vegetables than to describe their forms, has generally left only incomplete notes for the botanist; and Pliny has copied, without judgment and without remark, the authors which have preceded him. We cannot apply to the plants of Germany or of France, the names under which the ancients designated those of Italy, of Greece, and of Asia. The hand of the Creator has varied almost infinitely the productions of the vegetable kingdom. There is scarcely a spot, if we may so say, which does not offer some plant unknown elsewhere. Before studying the species of foreign countries, (of which we generally see nothing but specimens disfigured in the Herbaria,) let us examine those of our native soil. The true means of knowing them, is to traverse the plains, the vallies, and the mountains. Libraries alone are insufficient to form botanists. To what do our subtle reasonings, upon the nature and quality of species, lead us? We are not even able to distinguish one from another. And what a shame for us to quote continually the Arabian authors, who neither knew how to observe nature, nor to comprehend the books of the ancients; whose texts they have corrupted, and who have filled their own writings with the grossest errors."

Induced by reflections similar to these, there appeared many men in Germany during the sixteenth century, whose names deserve to be commemorated as having contributed to advance the science in question.

Otho Brunsfels, the son of a cooper at Mayence, himself a schoolmaster, and afterwards a physician at Strasburgh, published in the latter city, about the year 1532, his "*Herbarium vivæ Icones*," in folio, with many wood engravings, and is deservedly reckoned by Haller among the restorers of botany.

Fuchsius,* a professor of Ingolstadt, and afterwards at Tubingen, edited at Basle his *Historia Stirpium*, in folio, 1542. Here likewise are many excellent wood-cuts, scarcely inferior to those of *Brunsfels*. In 1552 appeared *Valerius Cordus*' "*Historia Plantarum*." The author himself, who had carefully investigated the country about Wittinberg, dying from an accident at the early age of twenty-nine, left his MSS., containing many new species of plants, for posthumous publication. This was undertaken by *Conrad Gesner*, one of the most learned men of his time, and who has been complimented as the "greatest naturalist the world had seen since the time of *Aristotle*;" but who, although thus connected with the

* It is not, perhaps, generally known that the common English name given to the *Digitalis purpurea* is a corruption of that of this author. The generic name (*Digitalis*) was first applied to this plant by *Fuchsius*, from the resemblance of the flowers to the fingers of a glove; thence the plant was called *Digitalis Fuchsii*, (Fuch's Digitalis) by succeeding writers; and from that its English appellation of *Fuch's* or *Fox's Glove* was derived.

progress of botany in Germany, yet being a native of Switzerland, and professor at Zurich, does not so properly come within our province.

Thal, Joachim Camerarius, Jungermann, and *Rauwolff,* who travelled in the east, flourished during the same century ; each in his turn being instrumental in advancing the knowledge of botany at that early period.

In the seventeenth century we have *Rudolph Jacob Camerarius,* professor at Tubingen, who seems to have been one of the first who made experiments upon the sexes of plants, and ascertained that the pistil was imperfect, unless acted upon by the stamens. *Rivinus,* too, of Leipzig, in his great work, "*Introductio generalis in Rem Herbariam,*" published between 1690 and 1699, established a *method* that was long followed in that country ; and this depended upon the corolla, which he considered the perfection of the plant. During this century, however, few other botanists of eminence could be mentioned ; and in botanic gardens, at least in what deserved that name, which now began to be established in all other countries of Europe, Germany seems to have been particularly deficient.

In the eighteenth century, Germany boasts of her *Dillenius,* who published at Giessen, where he was professor at the university, several botanical memoirs, and his celebrated "*Catalogus Plantarum sponte circa Gissam nascentium :*" but, as is well known, his most valuable works, "*Historia Muscorum*" and "*Hortus Elthamensis,*" appeared after he came to reside in Britain. *Buxbaum,* * also, who travelled to Constantinople, gave to the world, in 1740, his "*Plantarum minus cognitarum Centuria.*" *Ludwig* of Leipzig, too, and *Gleditsch* of Berlin, may be mentioned as supporting systems in botany, which were soon forgotten in that which was established about the same period by the immortal Swede.

We could here, did the limits of our article allow of it, mention many eminent men, whose labours served materially to advance the science of botany in the dominions of Germany, at the beginning, or during the middle of the eighteenth century, such as *Haller,* who was for a long time professor of anatomy and botany at Gottingen. *Schreber,* author of *Fl. Lipsiensis ; Schoeffer,* who first published coloured figures of the Fungi ; and *Scopoli,* † a native of the Tyrol ; but we must hasten to speak of the state of botany nearer our own times.

* After whom *Buxbaumia* is named ; and justly too ; for, besides his merits as an author, he was the first to dsicover this curious moss. He was anxious, he too tells us, to call this after his father, " sed venit in mentem," he says " vulpes qui deridebatur ab aliis, quod uvas non pro se, sed pro ægrota posceret matre."

† This learned man, in his admirable "*Deliciæ Floræ et Faunæ Insubricæ,*" has made two curious mistakes, the one at Tab. xx. where the *Physis intestinalis* is represented as a new genus of *Vermes,* but which is nothing more than the trachea of a Guinea fowl, (*Numidia meleagris*) which some wicked students pretended had been vomited by a woman in the hospital :—And again at Tab. xxiv where a plate of insects is dedicated, with some propriety, perhaps, to *Mr Benjamin White,* an eminent natural history bookseller of London. Mr White had, however, for a sign of the literary character of his shop, a large gilded head of *Horace* over his door in Fleet Street. Hence the address was, Mr B. White, *at Horace's Head,* Fleet

And here we must mention one individual, *Nic. Jos. Baron von Jacquin*, who flourished both during the time of Linnæus, and long after; and who thus, beginning his career while systematic botany was yet in its infancy, or indeed scarcely known, lived to see it fixed upon a firm and solid basis, whilst he himself aided materially in its establishment. He was born at Leyden, and studied at Antwerp, Louvaine, Rouen, and Paris. Along with *Gronovius*, he received instruction in botany under *Adrian von Royen.* At the invitation of *Van Swieten*, physician to the empress, he was invited to go to Vienna, where he became a physician, and gave lectures on Hippocrates, devoting his leisure time to botanizing around the city, and to visiting the newly formed Imperial Garden of Schoenbrun.

It was here the Emperor Francis I. became acquainted with him, and loved and esteemed him, as every one else did who had the happiness of his acquaintance. He received orders to draw up a catalogue of the plants of the Schoenbrun Garden, according to the method of Linnæus, which he was thus the means of introducing to Vienna. This, too, he did so satisfactorily, that he was directed to make a voyage to the West Indies, along with the gardener Schott, in order to collect plants and animals from that part of the New World. He returned to Vienna in 1739, and wrote his "*Historia Stirpium Americanum.*" In 1763, the Empress Maria Theresa appointed him counsellor of the mines, and professor of chemistry and mineralogy at Schemnitz. In 1768, he became professor of botany and chemistry at the University of Vienna in the room of Languier; and in every department to which he was called, he showed himself to be most profound, both as a man of science and a scholar. He now published his *Hortus Vindobonensis*, 3 vols. in folio; "*Flora Austriaca*," 5 vols. in folio, and his "*Miscellanea Austriaca*" and "*Collectanea.*"

Leopold II. confided to him the direction of the famous garden of Schoenbrun; where, finding that he had leisure for such publications, he edited, under the auspices of the emperor, the splendid and justly celebrated works, "*Hortus Schoenbrunensis*," "*Icones Plantarum rariorum.*" "*Monographia Oxalidum*," &c. Towards the close of his life, he gave an account of the parts of fructification of the *Asclepiadeæ*, and was much occupied with the *Stapeliæ*, of which singular family of plants he published a history in a folio volume, between the years 1806 and 1815, this being the last of his works. Indeed, so much was he interested in these vegetables, that in his dying illness, after having for many days lain without speaking, and without motion, he inquired one fine morning in August, "if there were any *Stapelias* in flower."

The mortal career of this excellent man was closed in 1818, at the age of ninety years and eight months, at his house within the garden of Schoenbrun: where, for some time past, he had constantly resided, amidst a vege-

Street. But Scopoli, probably from his ignorance of the English language, had the impression that *Mr Horace Head* was a partner in the firm, and, therefore, determined to dedicate the plate to the two individuals jointly. The artist indeed added to the blunder, and inscribed upon the copper-plate "*Auspiciis Benjamini White et Horatii Head, Bibliopol. Londinensium.*"

tation unknown to Europe, till his travels and his extensive correspondence caused it to be introduced.

He is succeeded in the professorship, and in the garden, by his son *Joseph Francis*, who is publishing the "*Eclogæ Botanicæ*," in the same style of splendour as that with which so many of his father's works have appeared.

The same city, Vienna, boasts the "*Plantæ rariores Hongaricæ*" of *Waldstein* and *Kitaibel* in three vols. folio, a work which has made known to us a great number of plants that have recently been discovered in that interesting country; and the labours of *Host*, author of a *Flora Austriaca*, and of a work on "*Grasses* and *Cyperaceæ*," in four vols. folio, (which, for the execution of the plates, can scarcely be exceeded,) who is also now engaged in a publication of equal or greater interest, on the "*Willows*" of Austria: indeed, we have been promised the appearance of the first volume of this latter work, of 100 coloured plates, in the course of the last year, 1825.

Upon the occasion of the marriage of a Princess of the House of Austria with the Crown Prince of Brazil, the Austrian Government sent out two naturalists, *Dr Mikan* and *Dr Pohl*, to investigate the botany of Brazil. The result of their researches has in part been published by *Mikan*, in his "*Deliciæ Floræ et Faunæ Brasiliensis*:" whilst *Dr Pohl* has prepared for publication 100 drawings of *Brazilian plants*, and *Mr Schott* is engaged in editing the *Brazilian Ferns*. *Trattinich*, besides many other botanical works, has lately given to the world, as part of a *Species Plantarum*, under the title of "*Synodus Botanicus*," a monograph of the *Rosaceæ* in 12mo. Nor must we omit to mention, among the botanists of the Austrian capital, *Mr Ferdinand Bauer*, the most beautiful designer of plants that probably ever lived.

The botanic garden of Vienna, the oldest we believe in Germany, was established by order of Maximilian, and the direction of it was given to *L'Ecluse* (or *Clusius*) to whom our gardens and shrubberies are indebted for the introduction of the *Cherry Laurel* (*Prunus Lauro-Cerasus*) and the *Horse-Chesnut* (*Æsculus Hippocastanum*) which he received, among many other plants, from the imperial ambassador at the Porte in 1576. "All the rest of the cargo perished, but *Clusius* bestowed the greatest possible attention to preserve and increase these; for, unlike many selfish collectors, he delighted to disperse his treasures among those who took pleasure in their acquisition; and it is but just that his memory should be perpetuated along with those two beautiful trees, with which all botanists of taste ought for ever to associate his name, thus giving him a monument more lasting than brass or marble." *

In 1580 a botanic garden was formed at Leipzig by the Elector of Saxony; at Giessen in 1605, and again at Altorf in 1625, both through the interest of *Jungermann*; at Jena in 1629; since which period the German universities have each possessed their botanical institutions; and, what has perhaps contributed still more towards the advancement of a knowledge of plants, many of the German princes and nobility have carried to the

* See *Smith's* Life of *Clusius* in *Rees' Cyclopedia*.

highest degree of luxury the art of cultivating exotics. Among these latter is particularly deserving of mention the garden of *Prince Esterhazy* at Eisenstadt in Hungary, of which we have the following account in the *Bot. Zeitung* for 1820. " On a hill facing the south, are erected two long ranges of twelve of the most beautiful stoves, of various sizes, and varying in temperature according to the nature of the plants they contain. At a short distance from these, and facing the east, is another house filled with *Ericas*, which the prince's gardener Mr Nurnmaÿer has raised, mostly from seeds that have been received from England. There are besides many frames and pits for raising plants, fruits, and pine-apples. The order, neatness, and luxuriance of the inmates of these houses is truly astonishing; and, upon entering, one fancies himself transported to the native country of the plants themselves. In the middle of one, by a large cistern of water is an artificial rock clothed with beautiful ferns, and backed by a specimen of *Chamærops humilis*, twelve feet high. The water is filled with the choicest aquatics. *Desmanthus natans* rises to the height of two or three feet above the surface, crowned with its pretty tufts of flowers, and rambles over the *Mimosa natans*, whose leaves and flower-buds alone appear above the water. Here also is *Nelumbium speciosum*, with its magnificent leaves, and many species of *Nymphæa* in full flower, together with *Aponogeton distachyon* and *natans*. Around the rock-work is a walk, on each side of which are planted *palms*, delighting the eye with their luxuriant growth and their elegantly formed foliage. In this division we found many *Cacti*, especially one which excited our admiration, a *Cactus melocactus* (or *Turk's-Cap torch-thistle,*) which was purchased in Paris for the sum of 1000 florins. It is unquestionably one of the largest in Germany, of an oval shape, measuring at the base 3 feet in circumference, at the middle 3½ feet, and at the top 1½; the height is 2½ feet. Two great compartments are filled with New Holland plants, among which were many in blossom."

Vienna, however, with its University Garden and the Imperial one of Schoenbrun, for a long time held a pre-eminent rank, not only in Germany but among similar establishments throughout the continent; and the magnificent works to which they have given birth have been a still further means of rendering them celebrated.

A neighbouring German city, Munich, the capital of Bavaria, which, a few short years ago, scarcely numbered a single botanist within its walls, now possesses attractions of no ordinary kind; and the writer of this article deeply regrets that a severe illness, which attacked him at Paris in the early part of the present year, prevented him from fulfilling the plans he had formed on leaving home, of visiting that interesting city, and becoming personally acquainted with the botanists and the state of science there. We must now therefore content ourselves with giving all we know on the subject, either from our correspondence, or from the German literary journals, * or from our acquaintance with the works that have been published there.

* Particularly the *Botanische Zeitung*, where the botany of Munich is a frequent and favourite theme with some of its contributors.

The late king, Maximilian Joseph, it is well known, delighted to patronize every thing connected with the sciences and the fine arts, so that Munich now boasts of possessing some of the noblest museums in the world. In our department, the aged and respectable *Schrank* deserves to be first mentioned, since to him the country is indebted for the state of perfection to which the botanic garden has arrived, as well as for a "*Flora of Bavaria,*" and the "*Plantæ rariores Horti Monacensis,*" in folio, with coloured plates executed in lithography. This art, which, besides having been invented in Munich, is there carried, we believe, to its highest degree of excellence, is nevertheless not well calculated to represent the more delicate forms, and especially the analysis of the parts of fructification of plants. Such at least may be inferred from the figures of the work in question; but other botanical figures, which we shall now mention, come much nearer to the effect of copper-plate engravings than any we have yet seen. We mean the "*Monographia Palmarum Brasiliensium,*" and the "*Nova Genera et Species Plantarum in itinere Brasiliensi,*" &c. by *Spix* and *Martius* and *Zuccarini.*

When the emperor of Austria sent naturalists to Brazil in the suite of the princess of that family, the king of Bavaria appointed other two gentlemen, *Dr T. Bapt. von Spix* and *Dr C. F. Phil. von Martius,* to go, under the protection of the Austrian embassy, to explore the Brazilian territories. They embarked at Trieste for Rio de Janeiro. From that capital they went to St Paulo, Ypanema, Villa Rica, and the Coroados Indians on the Rio Xipoto. Severe illness, induced by the climate and fatigue, compelled them to rest for a time in the captaincy of Maranham, whence they proceeded to the island of St Louis and Para. At the Amazon River they had attained the chief object of their wishes; and setting out on the 21st of August 1819, proceeded along the bank of the stream (amidst a chaos of floating islands, falling masses of the banks, immense trunks of trees, carried down by the current, the cries and screams of countless multitudes of monkeys and birds, shoals of turtles, crocodiles, and fish, gloomy forests full of parasitic plants and palms, with tribes of wandering Indians on the banks marked and disfigured in various manners, according to their fancies,) till they reached the settlement of Panxis, where, at the distance of 500 miles up the country, the tide of the sea is still visible and the river, extending to the breadth of a quarter of a league, is of unfathomable depth. * They then journeyed to the mouth of the Rio Negro. At the town of Ega, on the Rio Zeffe, the two travellers separated *Dr Martius* proceeded up the Japura over rocks and cataracts, and at length arrived at the foot of the mountain Arascoara, which is separated from Quito only by the Cordilleras. *Dr Spix* continued by the main stream, and, passing through a country unhealthy in the extreme, abounding in savage men and venomous insects, at length arrived at the mouth of the Jupary, on the frontiers of Peru, when he heard the language of the Incas. They both returned to Para in April 1820, after having traversed the continent of

* See the first part of the interesting travels of these gentlemen, English Edition, 2 vols. 8vo, p. xii.

South America from 24° south latitude, to the equator, and under the line from Para to the eastern frontier of Peru. An immense store of information has been acquired, and very extensive collections in every department of natural history made, all which have safely reached Munich, and are deposited in a noble building expressly fitted for them, called the Brazilian Museum, and of which *Spix* and *Martius* themselves have the direction.

Nor are these treasures to remain there unemployed. *Drs Martius* and *Spix* are engaged with the noble work on *Palms,* above alluded to, in which above ninety species will be represented and described on an Atlas folio paper; and *Dr Martius,* in conjunction with *Dr Zuccarini* on the "*Nova Genera et Species Plant.*" of which we possess four Fasciculi, in large 4to, with coloured plates: some of the early ones representing several species of that beautiful and curious genus *Vallosia.* Separate monographs will be given of the genera *Melastoma, Rhexia,* and *Eriocaulon.* A "*Prodromus Floræ Brasiliensis*" is likewise in a state of forwardness, in which will be included every species of plant that is known to be a native of the country, and the whole will be arranged according to the natural orders. The *Lichens* will be described by *Dr Eschweiler* (already known as the author of a new arrangement of this family, and a *Monograph of the Genus Rhizomorpha*;) and among them the *Graphideæ* and *Trypthcliæ* will form prominent features; whilst to *Dr Hornschuch* of Griefswald is committed the publication of the *Mosses.*

The hall of the Academy of Munich contains the Herbarium of *Schreber,* which occupies two spacious rooms, and for extent is compared to that of Willdenow at Berlin. The royal library, containing a vast collection of books in every department of botany, is open every day for the use of the public.

The venerable *Dr Hoppe* gives an interest to the town of Ratisbon. This excellent man is indefatigable in exploring the botanical treasures of the Alps in the south of Germany and we have given very full and interesting extracts from him and *Hornschuch's* "*botanical Travels in Carniola*" &c. in the earlier volumes of our journal. Ratisbon, too, has a Royal Botanical Society. At Gefrees, near Bayreuth, resides *M. Funck,* an apothecary, who has published the beautiful "*Moss Pocket-book.*"

Anspach seems to have no botanist to replace *Gleichen* and *Schmidel.* Bonne upon the Rhine possesses one of the most eminent and most indefatigable of the German botanists, and one from whose correspondence and communications we have experienced both pleasure and instruction, *Dr C. G. Nees von Esenbeck.* His "*System of Fungi*" in 1 vol. 4to, with numerous and beautiful plates; his "*Handbuch der Botanik;*" his various memoirs in the "*Botanische Zeitung;*" "*Horæ Physicæ Berolinenses,*" "*Nova Acta Acad. Cres. Leopold;*" his translation of all the works of our *Brown,* together with his notes appended to them, will alone suffice to point him out as a man of deep research, well-versed in every department both of practical and theoretical botany, and possessed of the most gentlemanly mind and feelings. His brother, *Dr Th. Fr. von Esenbeck junior* is also an excellent botanist, has the charge of the botanic garden of Bonne, and is preparing a " *Flora Bonnensis et Coloniensis.*"

Leipzig has had a worthy successor to the great *Hedwig*, in *Dr Schwaegrichen*, the present professor of natural history there, and who is still labouring very successfully to increase our knowledge of the *Mosses.* He adheres rigorously to the system established by his predecessor.

Dr Schultes, professor at Landshruth, in conjunction with the late *Dr Römer* of Zurich, commenced a " *Systema Vegetabilium*," with very full descriptions and synonyms, and which would have proved highly useful to the botanical student, had it been carried on to its completion : but the death of Römer has probably put a stop to the publication, which has yet reached, in five thick volumes 8vo, no further than to the end of the class Pentandria. If this work is too full and too minute in its descriptions and synonyms for general use, we think that *Sprengel* of Halle, in his new edition of the *Species Plantarum*, has fallen into the opposite extreme ; for here we have a work so entirely confined to mere *generic* and *specific* characters, and those extremely short, that we have not even a reference to a single figure to help us in our investigation, nor to any book where we may find the plant described. Every one knows, that, in the present state of the science, it is utterly impossible to ascertain many species of plants, especially in the extensive genera, such as *Erica, Solanum, Convolvulus, Campanula*, and a hundred others, by a simple differential character of two, or at most, perhaps, three lines in length. Reference at least should be given to some full description to aid us upon such an occasion, and upon no account should the synonyms of the first author be omitted. Here we have only the two or three first letters of the author's name, such as *Br. Sm.* &c. but in which work of these writers the plant is noticed, we are left in ignorance. Persoon's " *Synopsis Plantarum*" we consider a model for such a book, and a very little more space and no more labour, would have been required to have accomplished this desirable object. With these exceptions we are anxious to give our highest praise to this useful work. Here is brought together all that has been described by other authors, and many new plants are introduced which have come to our author's knowledge : and he seems, in a very great variety of instances which have fallen under our observation, to have judiciously reduced a considerable number of doubtful species, and referred them to their proper places.*

Berlin must now claim a little of our attention, for it was the residence of *Willdenow*, over whom the mantle of Linnæus seems to have been thrown, and who was destined to accomplish, what no one else has been able to do, the publishing a " *Species Plantarum*," arranged according to the method of the illustrious Swede : so that until the completion of *Römer* and *Schultes*' or of *Sprengel's* work, or of *De Candolle's Systema, Willdenow's System* will still be the principal book of reference for all botanists. Other great names, too, are intimately connected with the

* This *Systema* has extended as far as the end of the class Tetradynamia, and to two thick and very closely-printed octavo volumes.

capital of the dominions of Prussia, such as *Link, Rudolphi, Weiss, Hayne, Humboldt,* and *Kunth, Von Buch* and *Chamisso,* and *Schlechtendal,* together with *Count Altenstein,* the patron of science in Prussia.

The Botanic Garden of Berlin has arrived at a very high degree of perfection, and M. Otto is unwearied in his endeavours to increase the collection from all parts of the world. A publication upon the plants which have flowered in it, somewhat similar to the *Hortus Berolinensis* of *Willdenow,* the "*Icones Plantarum;*" &c. has been begun by *Link* and *Otto,* but we fear has come to a premature end with the fifth Number. *Hayne* labours upon the medicinal plants, *Rudolphi* upon vegetable physiology, as likewise does *Horckel. Link* is further engaged upon an *Enumeratio Plantarum Hort. Berol.,* of which one volume is already published; and conducts a work on the plan of our late *Annals of Botany,* under the title of "*Jahrbucher der Gewachskunde,*" of which four Numbers have appeared. Two botanists, *Olfers* and *Sellow,* have been sent to collect plants in Brazil, and the latter has now proceeded for the same object to Buenos Ayres.

Dr von Chamisso, who is appointed assistant-director of the Berlin Botanic Garden, is engaged in publishing the result of his botanical collections, made by him during the voyage round the world under Captain Kotzebue, and is at present occupied with the *Grasses* and *Cyperaceæ.* His Herbarium is extremely rich, and the liberal use he makes of it is highly deserving of imitation. Thus, *Dr von Schlechtendal,* so advantageously known as the author of "*Animadversiones Botanicæ in Ranunculaceas Decandollii,*" and who is now preparing for the press a "*Flora Berolinensis,*" has published the new species of *Ranunculus; Count Sternberg* * of *Saxifraga; Kaulfuss,* as we have mentioned in another part of the present volume, the *Ferns; Hornschuch* has undertaken the *Mosses; Agardh* the *Algæ;* and *Ehrenberg* the *Fungi.*

The Herbarium and Library of *Willdenow* † having been purchased by the Prussian government, and attached to the university, it is intended to form with them the foundation of a great National Botanical Museum, *Dr Schlechtendal* being appointed to the charge of it. Here are, besides the Herbarium of *Bergius* from the Cape, of Chamisso, so rich in the plants of the north coast of Asia, of North and South America, and Behring's Straits, the private Herbarium of *M. Otto* and that of *von Buch,* which is reckoned almost complete in the vegetable productions of the Canary Isles.

The limits of our article, already too much extended, and yet, we are aware, sadly deficient in the notice of many excellent botanists and many

* The excellent author of "*Revisio Saxifragarum,*" and a more learned work on the "*Vegetable Remains of a former World.*"

† The grave of Willdenow is in the burying-ground of the church in the new town. A small hillock is raised over his remains, and it is shaded by a weeping Ash. Upon a stone fixed in the wall of the church is the following simple inscription, "Here rests Dr Carl. Ludwig Willdenow, Knight of the Third Order of the Red Eagle, Regius Professor of Natural History and Botany, Director of the Botanic Garden, &c.—Born at Berlin, August 22, 1765; died there July 10, 1812."

able works, will not allow us to enlarge on this favourite topic as we would wish. Nevertheless, we must not omit to mention the names of a few more individuals who are now engaged in raising still higher the botanical fame of Germany. Our excellent friend *Dr Hornschuch* is the professor of natural history in the university of Griefswald, Prussian Pomerania, and devotes a large portion of his time to the cultivation of what we consider to be his most favourite pursuit, *botany*. He has already been mentioned as the author, jointly with *Dr Hoppe*, of a Tour in the Southern Countries of the Austrian dominions, and is engaged in publishing the *Mosses* of *Chamisso* and *Spix* and *Martius*; but that which will most tend to raise his celebrity, is the "*Bryologia Germanica*," published in conjunction with *Dr Nees von Esenbeck* and *Sturm*. If we differ from these authors in any important particular, it is in their raising, too frequently, what we consider to be varieties, to the rank of species, and thus by rendering it impossible to define clearly the characters of the individuals, they add to the difficulty of the tyro in his investigation. The first volume, which includes only those mosses which are destitute of peristome to the capsule, is all that has been yet published. The second we anxiously expect; and we are rejoiced to hear that *Dr Hornschuch* has promised to the world a complete *Species Muscorum*, for which he must be furnished with very abundant materials. This gentleman, too, is a great contributor to one of the many excellent scientific journals of Germany, the "*Flora, oder Botanische Zeitung welche Recensionen, Abhandlungen, Aufsätze, Neuigkeiten und Nachrichten, die Botanik betreffend, enthalt*:"—in fact, an "*Annals of Botany*," published by the Royal Botanical Society of Ratisbon, in weekly numbers. We know of no work better calculated to encourage and diffuse a love of botany than this cheap little work, which has extended to many volumes, having a great deal of original matter and numerous notices, from which we have selected much that has been useful to us in the present article.

Treviranus of Breslau has gained reputation by his writings on the *Sexual System* of plants: *Reichenbach* of Dresden by his "*Lichenes Exsiccatæ*," his "*Icones Plantarum rariorum*," "*Hortus Botanicus*" and "*Monographia Aconitorum*;" *Lehmann* of Hamburg by his admirable monographs of *Primula*, *Nicotiana*, and, above all, of the *Asperifoliæ*; *Steudel* of Efsling by his useful "*Nomenclator Botanicus*," which has been elsewhere more particularly mentioned by us: *Meyer*, * *G. F. W.* of Gottingen, by his "*Primitiæ Floræ Essiquebensis*;" and *Ernest Meyer*, also of the same place, by his *Monograph of the Junci*, and his "*Plantæ Surinamensis*;" *Röper*, of the same town, by his work on the *Euphorbiæ*; *Sturm* by his numerous and excellent botanical plates, executed at Nuremberg; and, lastly, we shall mention *Sieber* and *Helsinborg* and *Bojer*, who have done themselves great credit by their labours in collecting plants in many and distant regions. The former, besides visiting Crete, spent

* This author is now preparing a *Flora of the Kingdom of Hanover*, on the plan of the *Flora Danica*.

some time in the *Mauritius, New Holland,* at the *Cape,* in *Trinidad,* &c; and on his return has published beautiful specimens, under the titles of *Floras* of the separate countries. *Helsinborg* and *Bojer* have directed their attention principally to the plants of the *Mauritius, Madagascar,* and the opposite eastern coast of *Africa,* in which latter country *Helsinborg* has fallen a sacrifice to the unhealthiness of the climate. *Bojer* still remains at the Mauritius.

We must now devote a brief space to the work immediately under our review, *Mertens and Koch's Flora of Germany,* or, as the title expresses it, "*T. C. Röhling's Deutschland's Flora neu Bearbeitet von Mertens und Koch.*" Much as the botany of Germany had been explored, and numerous as were the partial Floras of the country, it was to be regretted that there did not exist one work including a full and complete account of all the plants of Germany, similar to our *Flora Britannica* and *English Flora. Roth's* "*Tentamen*" was manifestly very imperfect. *Hoffman's* "*Flora Germanica*" is little more than a synopsis. "*Schrader's Flora Germanica*" promised to make up every deficiency, but, (from what cause we know not,) the first volume, extending to the end of the third class, has, in the space of twenty years, been succeeded by no other. It was left for the authors now immediately under consideration, to commence such an undertaking; and it is not a little remarkable, that the two first volumes made their appearance in Germany nearly at the same time with those of the "*English Flora*" of our Smith; a work with which, perhaps, it may best be compared for general plan and arrangement. It is entirely in the German language. The first volume is devoted to some introductory matter, an Alphabetical Dictionary of *Terms,* and a general view of the Artificial and Natural Arrangement.

The second volume, all we believe that has yet been published, commences with the description of the *genera* and *species,* classed according to the Linnæan system, comprising the first four classes, and is concluded by a very copious index both of species and synonyms. Each class is headed by an enumeration of the genera, with their full characters, and, as in Smith, the name of the natural order to which they belong; so that, by referring to the character of that order in the first volume, the student will become well acquainted with their arrangement in both systems. It will be most to our purpose, in the few observations we shall here offer, to confine ourselves to the second volume of the work, and to the mention of such plants as, from their identity with those of our own island, may be likely to be most interesting to the British botanist.

Of such, the first class contains *Hippuris* and *Zostera; Chara* as well as *Callitriche* being removed to the *Diclinia.* In *Diandria* we have *Salicornia* and *Lemna.* With the *Salicornia herbacea* the authors unite, as we have done in the *Flora Scotica,* the *S. procumbens* of *Smith.* The spicate *Veronicæ* are, with propriety, much reduced in point of number of supposed species. *Circæa Lutetiana* and *alpina* are kept distinct, and the *C. intermedia* mentioned as a variety, but of which species the authors seem doubtful. *Sprengel* is perhaps correct in considering them all the same.

In the third class are some excellent observations upon the *Grasses,* both in allusion to their divisional characters, and to the arrangement of Palisot de Beauvois. *Scirpus multicaulis* of Smith, though not found in Germany, is mentioned as a distinct species, but nearly allied to the *Sc. uniglumis* of *Link.*

The *Alopecurus fulvus* of Smith is supposed to have an affinity with *Alop. paludosus,* the *A. subaristatus* of *Michaux.* The genus *Gastridium* is adopted for *Milium lendigerum.* It is rightly suggested that the name *Agrostis stolonifera* should be abolished; it being indeed scarcely possible to ascertain precisely what Linnæus meant by it or by his *Agr. alba.* Under this latter species, our authors have a host of names, which others have considered distinct plants; and we are glad to find how nearly they agree with our own opinion, expressed in the *Flora Scotica,* on the same subject. Thus we have under *A. alba* the *Agr. stolonifera, varia, &c.* of *Host; ambigua* of *Roem.* and *Sch., decumbens, gigantea* and *patula* of *Gaudin; coarctata* of *Hoffm.; capillaris* of *Poll.; compressa* of *Willd.;* and *parviflora* of *Schrader. Arundo Phragmites,* is made *Phragmites vulgaris. Molinia* of *Schrank* is taken up for the *Melica cærulea.* In the genus *Glyceria* of *Brown,* these authors not only, like *Smith,* place, besides the *Gl. fluitans,* the *Poa distans, maritima* and *aquatica,* but also the *Aira aquatica* of *Linn.* of which *Sir James Smith* has also observed that, in natural affinity, it comes near to *Gl. fluitans, maritima,* and *distans. Poa badensis* and *Molinieri* we are glad to see united with *Poa alpina.*

There are some excellent remarks upon the *Festucæ* of various authors. But this *genus* requires a complete revision, and many supposed species must be abolished. *Festuca vivipara, Sm.* is made a variety of *F. ovina. Bromus multiflorus, Sm.* is brought as a synonym to *Br. grossus* of *Desf.*

We should recommend that our *Parietariæ* be more attended to. Most of the continental authors make two species, which Willdenow distinguished as *P. officinalis et judaica;* to the latter, under the name of *P. diffusa* M. et K., our plant of *Smith* and *Flora Londinensis* is referred; but we are almost sure of the existence also of what *Mertens* and *Koch* have called *P. erecta,* whether or not it be well characterized as a species. The observations upon various species of *Potamogeton,* as well as indeed the whole volume, we confidently recommend to the attention of the British botanist; for there is so much care and attention bestowed upon all the descriptions and remarks, and so much research displayed in the investigation and determining of the species of other authors, that we conceive MM. Mertens and Koch to have rendered an essential service to the botany of Great Britain and the European Continent in general, as well as to their own country. *Mertens* is a professor at Bremen, and has been long known for his profound knowledge of the *Algæ. Koch* is, we believe, a physician at Kaiserslautern.

During the present year, there has been published at Nuremberg a "*Compendium Floræ Germanicæ.*" The first volume in 12mo, now before us, extends to the end of the class Polyandria. It is arranged according to the Linnæan system.

Art. XXIX.—SCIENTIFIC INTELLIGENCE.

I. NATURAL PHILOSOPHY.

ASTRONOMY.

1. *Correct Elements of the first Comet of* 1825.—In vol. iii. p. 175 of this work, we have given M. Shumacher's elements of this comet. The following elements have been calculated by M. Nicolai at Manheim, and M. Schwerd at Spires.

	Nicolai.	Schwerd.
	D.	D.
Passage of Perihelion - -	1825, March, 30 .5693	30 .51573
Long. of Perihelion - - -	273° 55′ 21″	273° 59′ 25″
Long. Asc. Node - - -	20 5 53	20 2 42
Log. of shortest dist. - -	9 .94896	9 .948743
Inclination - -	56° 41 17″	56° 35′ 4″
Motion - -		retrograde.

Shumacher's *Astron. Nach.* No. 81, 83.

2. *Correct Elements of the Second Comet of* 1825.—In this *Journal,* vol. iii. p. 175, vol. iv. p. 376, 377, and vol. v. p. 178, we have given various elements, &c. of this comet. The following are those calculated from Dr Olber's observations by M. Cluver for Altona.

	D.
Passage of Perihelion - -	1825, December, 16 .88510
Long. Perihelion dist. - - -	0 .1186417
Long. Perihelion - - -	321° 22′ 33″
Long. of Asc. Node - - -	217 2 17
Inclination of orbit - - -	36 53 34

Shumacher's *Astron. Nach.* No. 84.

3. *Elements of the Comet discovered by M. Pons.* The following elements are calculated by M. Peters for long. 30′ 30″ east of Paris, and by M. Clausen at Altona.

	Peters.	Clausen.
	D.	D.
Passage of Perihelion -	1825, August, 27 .1805	30 .579
Long. of Perihelion - - -	346° 34′ 44″	345° 13′
Long. of Node - -	206 48 2	207 38
Log. shortest dist. - - -		0 .04688
Log. of Perihelion dist. - -	0 .68290	
Inclination of orbit - -	35° 17′ 27″	34° 43′
Motion - -		direct.

Shumacher's *Astron. Nach.* No. 89.

4. *Fourth Comet of* 1825.—The following elements are computed by M. Hansen for Seeberg, and M. Halaschka for Prague.

	Hansen.	Halaschka.
	D.	D.
Passage of Perihelion	1825, December, 11 .29767	10 .56132
Long. Asc. Node - -	215° 39′ 18″	215° 48′ 8″
Long. of Perihelion - -		319 11 57
Long of Node—Long. Perihelion -	257 21 3	

	Hansen.	Halaschka.
	D.	D.
Inclination of orbit -	33 35 10	33 27 48
Log. Perihelion dist. - -	0 .0924	0 .0959
Eccentricity - - -	0 .9817	
Revolution - -	556 years	
Motion - - -		direct

Shumacher's *Astron. Nach.* No. 90.

5. *Dimensions of the Terrestrial Globe.*—The following dimensions have been deduced by M. Puissant from the measures taken in France and India.

Flattening at the Poles - - - $\frac{1}{305,65}$

Semiaxis a = 6376920 metres
———— b = 6356076
Quarter of the Meridian = 10000401 metres.

6. *La Lande's Astronomical Prize adjudged to Captain Sabine.*—At the public sitting of the Academy of Sciences, held on the 5th June 1826, the medal founded by M. De La Lande was adjudged to Captain Sabine, for his work entitled, *Account of Experiments to determine the Figure of the Earth, by means of the Pendulum vibrating Seconds in different Latitudes;* a work with which our readers are in some degree acquainted, by the extracts from it which we have inserted in this *Journal.*

7. *Rates of Mr French's Chronometers at the Royal Observatory.*—The following were the mean daily rates and extreme variations of two chronometers by Mr French, during their trial at the Royal Observatory, from May 1, 1825, to April 30, 1826.

		No. $\frac{20}{3912}$.		No. 975.	
		Mean Daily Rate.	Extreme Variation.	Mean Daily Rate.	Extreme Variation.
1825.	May,	+ 4.75	1″.3	+ 2″.71	1″.4
	June,	+ 4.30	1 .7	+ 2 54	1 .5
	July,	+ 4.14	1 .6	+ 1 93	2 .8
	August,	+ 4.43	1 .4	+ 2 30	0 .9
	September,	+ 4.50	0 .9	+ 2 36	1 .1
	October,	+ 4.65	1 .2	+ 2 79	1 .4
	November,	+ 4.57	1 .2	+ 2 92	1 .6
	December,	+ 4.36	1 .4	+ 2 51	1 .9
1826.	January,	+ 4.52	2 .2	+ 2 20	1 .4
	February,	+ 4.58	1 .3	+ 1 97	1 .3
	March,	+ 4.52	1 .5	+ 2 07	1 .4
	April.	+ 4.50	1 .1	+ 2 26	1 .1

8. *Probability of an Ethereal Medium in the Celestial Spaces.*—The singular fact of the diminution of the periodic time of the comet of Encke, which cannot be explained by the perturbations of the planets, has been

ascribed by Encke to the resistance of an ether diffused in space, which produces a diminution both in the periodic times and in the eccentricities. M. O. F. Mosotti, of the Italian Society, has endeavoured to calculate the resistance which a comet may experience from that cause, and by assuming for it a particular law of density, and taking into account the continual changes in the figure and volume of the comet as it approaches to or recedes from the sun, he arrives at the conclusion, " that on the hypothesis adopted, the comet may have experienced from an ether a resistance such as is required to make the calculus accord with observations, though the planets have not yet manifested the least effect of the existence of that ether. As nothing opposes the probability that the hypotheses which we have made, or some others analogous to them, are really correct; and as, moreover, the effect of the acceleration of the mean motion of this comet supports the opinion of the existence of an ether, a greater degree of credit will, no doubt, be assigned to the hypothesis. If the comet which we expect eleven years hence (in 1835) display corresponding effects, we shall then be authorized to regard the diffusion of an ether, in celestial space, as an admissible fact."—*Mem. Astron. Soc.* vol. ii. part i. p. 62.

9. *Change upon the figure of Saturn when emerging from the Moon's dark limb.*—Mr R. Comfield, with a Gregorian reflector, power 350, and Mr J. Wallis with a Newtonian reflector, power 160, when observing the emersion of Saturn, on the 30th October, noticed that the part of the ring which last emerged was rendered sensibly more obtuse, and at the instant after separation it approximated to a rectilineal boundary. When the eastern limb of the *globe* of Saturn emerged, Mr Comfield observed a similar effect upon it.

ACOUSTICS.

10. *Deafness arising from the Eustachian Tube.*—The Academy of Sciences, at their public sitting of the 5th June, have awarded a sum of two thousand francs to M. Deleau, author of different memoirs, for having brought to perfection the catheterism of the Eustachian tube, and for having cured, by this means, some individuals affected with that rare cause of deafness.

11. *Great distance at which Sounds are Heard.*—At Port Bowen Lieutenant Foster kept up a conversation with his assistant, at a distance of 6696 feet, or about one statute mile and two-tenths.—Captain Parry's *Third Voyage.*

OPTICS.

12. *Phosphorescence of the Glow-Worm, of the Fire-Fly, and the Lampyris Noctiluca.*—The following is the substance of a paper on this subject by Dr Todd, in the last number of the *Institution Journal.*

The light of the *female glow-worm* is of a light topaz colour, with rather a tinge of green. The hour upon a watch may be observed by it. The light of the *male* is of the same colour. It is confined to two very small round spots, and is seldom emitted spontaneously, excepting in certain sexual relations. The light, however, appears instantaneously by the least irritation or pain.

The *female* of the *Lampyris Noctiluca* excels all the rest in the beauty of its light. It is of a light bluish or greenish colour, and seems to envelope the whole of the insect. The *male fly* has a soft and delicate bluish light. The fire-fly produces two degrees of light, the one fainter than that of the glow-worm, but without intermission. The second is a vivid white light, intermitting instantaneously like vivid sparks of fire suddenly extinguished. Its power of illumination exceeds that of the glow-worm, and all other animal light, as it may be seen in the brightest moonlight. The intermitting light gives the appearance of a membranous veil being removed from the surface of the organ and suddenly drawn over it. The larva or even the ova of these insects give out light.

The glow-worm requires a mean temperature of 50° 7 for its appearance, and the others about 55° 7.

The power of emitting light resides in a peculiar adhesive matter like animal gluten. Carradori calls it a *white pasty matter*, and Maçaire a semilucid albuminous matter. It is said to be granular and organized, and according to Maçaire it is penetrated by nerves. When the matter has lost its vital properties, Dr Todd has found it incapable of affording light by any contrivance.

From these, and many other facts stated by Dr Todd, he concludes that the phenomenon is, in all its bearings, a vital action; and that external causes only influence it, as they affect the vitality of the animal, and the sensibility of the organ. This result, he conceives, places before us a new power of animal life, resembling nearly the phenomena of animal heat, viz. the power of separating light from its combinations with matter.

Dr Todd is disposed to agree with Reaumur, in supposing that it is by means of this light that the sexes distinguish each other in the season of sexual intercourse.

13. *Remarkable Phosphorescent Stone.*—At a very recent meeting of the Philomathic Society, M. Becquerel exhibited a singular species of fluor spar, sent by M. Leman, and found in the granite rocks of Siberia. It shines in the dark with a very remarkable phosphoric light, which increases as its temperature is raised. Its light augments when it is plunged in water. In boiling water it is so luminous that the letters of a printed book can be seen near the transparent vase which contains it. In boiling oil the light is still greater; and in boiling mercury it emits such a light that we may read by it at a distance of five inches. M. Eyries mentioned at the same meeting the fact stated by Sir John Mandeville, that at the entrance of a town in Great Tartary were two columns surmounted by stones which shine brightly in the dark.—*Le Globe*, No. 98. August 8, 1826.

HYDRODYNAMICS.

14. *Prize of* 1828, *for the most important experiments on the Resistance of Fluids.*—The Academy of Sciences have just announced the following subject for the mathematical prize of 1828. The prize will be a gold medal, of the value of *three thousand francs*, and will be adjudged on the 1st Monday of June 1828. The memoirs must be sent to the secretaries of the Institute before the 1st of January 1828.

Almost all the attempts which have hitherto been made for discovering the laws of the resistance of fluids, are contrary to the first rule of experiments, by which we ought to endeavour to decompose the phenomena into their most simple elements. It has been most common, indeed, to observe the time employed by different bodies, in describing a given space in a fluid at rest, or the weight which keeps in equilibrium a body exposed to the impulse of a fluid in motion. But this can only make us acquainted with the total result of the different actions, which this fluid exerts upon each of the points of the bodies, actions which are very varied, and often opposite to each other. In this state of things, compensations take place, which mask the primitive laws of the phenomenon, and which render the results of experiment inapplicable to any other case but that which has furnished them. M. Dubuat, author of the *Principes d'Hydraulique*, appears to have been the first who perceived this defect; and, in order to avoid it, he endeavoured to measure the local pressures on the different parts of the surface of bodies, exposed to the impulse of a fluid in motion. His experiments, though small in number, and though not much varied, in so far as the form of the body is concerned, present, nevertheless, curious results. Under these circumstances, the Academy thought it would be useful to resume these experiments, with more perfect instruments, to multiply them, and to vary the circumstances still more. It has proposed, therefore, for the subject of the prize, the following programme:

"To examine in its details the phenomenon of the resistance of water, by determining with care, by exact experiments, the pressures separately sustained by a great number of points, properly chosen in the interior, lateral, and posterior surfaces of a body, when it is exposed to the impulse of a fluid in motion, and when it moves in the same fluid at rest; to measure the velocity of the water in different points of the current near the body; to construct from the results and observations, the curves which these currents form; to determine the point where their direction commences before the body; and, finally, to establish, if possible, from the experimental results, empirical formulæ, which might be afterwards compared with the experiments formerly made on the same subject."

15. *Dr Hare's Litrameter for measuring Specific Gravities.*—The object of this instrument is to measure the specific gravities of fluids, on the principle that, when columns of different liquids are raised by the same pressure, their gravity must be inversely as their height. Two barometer tubes, communicating with each other above, where there is a syringe to withdraw the air, their lower ends rest in two cups, containing the two fluids to be compared. The pressures upon the upper surfaces being then removed by the syringe, the fluids rise in each tube to heights which afford a measure of their specific gravities.—See *Franklin's Journal*, vol. i. p. 157.

MAGNETISM.

16. *Magnetic Declination at Bywell, in Northumberland, in* 1824.—Lieutenant Johnson has found the magnetic declination at this place,

in June 1824, to be 26° 50′ west. Bywell is in lat. 55° 1′ north, and long, 1° 59′ west.

17. *Magnetic Declination near St Petersburg in* 1824.—The magnetic declination near St Petersburg, in lat. 59° 58′ 31″ north, and long. 30° 19′ 45″ east, was found, by the late Professor Schubert, to be 7° 36′.

ELECTRO-MAGNETISM.

18. *On the Magnetising of Needles by Currents and Electric Sparks.*—On the 31st July last, M. Savary communicated to the Academy of Sciences a highly important memoir on magnetising needles by currents and electric sparks. The following are the leading points of this great discovery:

1. The direction of the magnetic polarity of small needles, exposed to an electric current, directed along a wire stretched longitudinally, *varies with the distance of the wire.*

2. This action is periodical;—that is, when the small steel needle, which is in relation with the wire, is magnetised in a certain direction, at a certain distance, the magnetism diminishes as the needle is removed, till at a certain distance it becomes nothing. At a greater distance it recovers its magnetism, but in a contrary direction, and it goes on increasing till it reaches its maximum at a particular distance. It then diminishes as the removal of the needle is continued, and again becomes nothing. The magnetism then resumes its first direction, which constitutes a new period. M. Savary has observed *three* periods.

3. The distances at which the *zero* and the *maximum* of magnetism take place vary with the length and diameter of the wire, and with the intensity of the discharge.

4. When a helix is used for magnetising, the distance at which the needle placed within it is from the conducting wire is indifferent, but the direction and the degree of the magnetism depends on the intensity of the discharge, and on the ratio between the length and size of the wire.

5. The maximum of intensity, which can be produced with a given wire, depends on the ratio between its size and length, so that it is only for a certain value of this ratio that we can obtain the degree of magnetism called the state of saturation. For all other ratios the maximum is less.

6. Any metal placed in the vicinity of the needle has a very powerful influence on the direction and degree of the magnetism.

7. These effects vary with the relative positions of the wire, the needle, and the metal.

8. The direction of the action of the metal depends on the intensity of the discharge, so that discharges different in intensity, develope in the metal a series of opposite states, analogous to the polarities of opposite signs, which small needles acquire at different distances from the conducting wire, or for different intensities of electricity.—*Le Globe,* No. 96, August 2, 1826.

METEOROLOGY.

19. *Meteorological Observations made on the 17th of July last.*—Our meteorological readers will be gratified to learn, that many of the meteoro-

logical schedules issued by the Royal Society of Edinburgh have been filled up with very valuable sets of observations, for every hour of the 17th of July last. In some of them the observations were made every half hour.

The day did not present any great variety of meteorological phenomena. There was, for example, almost no rain, and no indications of electricity in the atmosphere; but it possessed a different kind of interest. It was one of those summer days which may be considered the best which our climate affords. The curve which represents the progression of temperature, approximated very nearly to the character of the mean summer curve, and consequently the comparison of the phenomena observed at different places may be expected to afford very curious results.

20. *Mr Foggo's Elementary Treatise on Meteorology.*—Mr John Foggo junior, with whose knowledge of Meteorology the readers of this *Journal* are well acquainted, is at present engaged in an *Elementary Treatise on Meteorology*, which will speedily be published. A work on this subject has been long a desideratum, and we have no doubt but that it will be well supplied by Mr Foggo's work.

21. *Mean Temperature of the Sandwich Islands.*—The following meteorological journal of the year, from August 1821 to August 1822, was kept by the American Missionaries, we presume at Hawaii, in north latitude $19\frac{1}{2}$,° and west longitude $155\frac{1}{2}$°.

	Maxim. heat.	Minim. heat.	Mean Temp.	General course of wind.	Weather. Days.	Rain.
August, 1821.	88°	74°	79°	N. E.	1 Rain.	
September,	87	74	78	N. E.	5 Do.	
October,	86	73	78	N. E.	1 Do.	
November,	82	71	76	N. E.	1 Do.	
December,	80	62	72	N. & N. E.	2 Do.	
January,	80	59	70	Variable.	1 Do.	7 Cloudy.
February,	77	61	71	N. E.	4 Do.	10 Do.
March,	78	66	72	N. E.	5 Do.	8 Do.
April,	81	62	73	Variable.	5 Do.	12 Do.
May,	81	72	76	N. E.	4 Do.	30 Do.
June,	84	71	78	N. E.	6 Cloudy.	
July,	84	74	78	N. E.	5 Rain.	7 Cloudy.
Annual Results,	88	62	75°1			

Mean temperature, according to Dr Brewster's general Formula, viz. T = 86°3 Sin. D—$3\frac{1}{2}$° - - - -	74°.77
Mean temperature observed, - - - -	75 .1
Difference,	0.33

The thermometer was observed at 8 A. M., 3 P. M., and 8 P. M. Rain falls but seldom on the western shores of any of the islands, though showers are frequent on the eastern or windward sides; and on the mountains they occur almost daily.—Ellis's *Missionary Tour through Hawaii*, p. 7.

22. *Meteoric Stone from Castres.*—On the 18th July last the minister of the Interior presented to the Academy of Sciences a fragment of the metoric stone which fell at Castres. The colour of this stone, which was not at all deep, seemed to indicate that it is less ferruginous than most of those of the same origin.—*Le Globe*, 20th July 1826.

II. CHEMISTRY.

23. *On the Chemical Composition of Felspar and Serpentine.* By M. Peschier.—The researches of M. Peschier on titanium having led him to suspect its presence in felspar, he undertook the analysis of several varieties of that mineral; namely, of the adularia of St Gotthard; the green compact variety from Siberia; the glassy felspar of Drachenfels in Westphalia; the white felspar of Auvergne; and the andalusite, from the Tyrol. The following table contains the result of his analyses, which are compared with those of other chemists:

	Adularia.		Green Felspar		Glassy Felspar.		White Felsp.	Andalusite.	
	By Vauquelin.	By Peschier.	By Vauquelin	By Peschier.	By Klaproth.	By Peschier.	By Peschier.	By Brandes.	By Peschier.
Alumina,	20	20	17.02	15	15	14	20	55.75	19.75
Silica,	64	48.75	62.83	56	68	60.50	61	34	54
Lime,	·2	0	3	0	0	0	0	2.12	0
Oxide of Iron,	0	3.75	1	3	0.5	2.15	1.75	4	4.80
Potash,	14	14	13	10.40	14	3.80	0	2	0
Soda,	0	0	0	0	0	5.0	14.18	0	4.30
Titanium,	0	10	0	12	0	10	3.25	0	15.50
Water,	0	0	0	1	0	0.75	0.50	1	1
Total,	100	96.50	96.85	97.40	97.5	96.20	97.68	98.87	99.35

M. Peschier has also detected the presence of titanium in three varieties of serpentine. The first kind is the common spotted serpentine of Saxony. It is of a dull green colour, is soft to the touch, and has a conchoidal fracture.

The second is the common magnetic serpentine of the Upper Palatinate, which M. Humboldt observed between Goldchronach and Munichberg. It is rough to the touch, and has an irregular fracture.

The third variety is from the Vale of Aosta. Its structure is quite homogeneous; it has a moss-green colour, scaly fracture, and like the talcs is unctuous to the touch. It contains magnetic iron.

The results of M. Peschier, together with those of other chemists, are contained in the following table:—

Analysis of Serpentines.	Vauquelin.	Hisinger.	John.	Rose.	Knock.	Peschier.		
	Liguria.	Norway.	Localities not mentioned.			Saxony.	Palatinate.	Vale of Aosta.
Silica,	44	32	31.50	28	43	21.25	22	34.70
Magnesia,	44	37.24	47.25	34.50	33.5	29	29	28
Alumina,	2	0.50	3	23	trace	11	17	2.35
Lime,	0	10.60	0.25	0.50	6.25	0.15	2	1
Oxide of Iron,	7.3	0.60	5.5	4.54	14	7	12	6.25
Manganese,	1.5	0	1.50	0	0	1.5	2	1
Chromium,	2	0	0	0	0	0	0	0
Titanium,	0	0	0	0	0	5.25	6	8
Soda,	0	0	0	0	0	12	6	4
Water and Carbonic acid.	0	14.16	10.50	10.5	0	11.85	5.50	13.50
Total,	100.8	95.10	99.50	101.0	96.75	99.00	101.50	98.80

M. Peschier infers from his researches,

1. That titanium is one of the constituent principles of felspar and serpentine;

2. That the analysis of serpentine cannot be exact, unless the usual process for analyzing rocks is so modified as to separate the titanium;

3. That an alkaline principle exists in serpentine, as well as in the rocks with which they are analogous.

"In a word," concludes M. Peschier, "my researches demonstrate that most primitive rocks contain titanium as one of their constituent principles, and that this substance exists much more extensively in nature than is supposed."—(Extract from the *Ann. de Chim. et de Phys.* vol. xxxi.)

In searching for titanium, M. Peschier has probably overlooked the presence of chromium in serpentine. We have analyzed the common serpentine from Zöblitz in Saxony, and that variety certainly contains chromium.

24. *Analysis of a New Mineral, (the Gay-Lussite.)* By M. Boussingault. —This mineral, which M. Boussingault has named Gay-Lussite, in honour of M. Gay-Lussac, is found in great abundance in a bed of clay covering the native carbonate of soda, called urao, at Lagunilla, a small Indian village in the neighbourhood of Merida. It occurs in irregular crystals, which, from their form, were at first taken for carbonate of lime. It has the lustre of the carbonate and sulphate of lime; but it scratches the latter, and is scratched by the former. Its specific gravity, as a mean of two experiments, is 1.939.

Exposed to heat in a small mattress, it decrepitates slightly, gives out a considerable quantity of water, and becomes opaque. Before the blowpipe, it decrepitates till it has acquired a red heat; and then, on throwing upon it the point of the blowpipe flame, it fuses rapidly into an opaque globule, which, when once formed, is infusible. The bead, when put into the mouth, is found to have a distinct alkaline taste. These characters alone are sufficient for distinguishing the Gay-Lussite from the carbonate of lime; and besides these M. Boussingault mentions the two following.

1. On placing a fragment of the mineral in a watch-glass, and letting a few drops of a solution of oxalic acid fall upon it, a slow effervescence takes place, and, after a few hours, a white powder forms, covered with minute crystals, which it is easy to recognise as the oxalate of soda.

2. The Gay-Lussite dissolves with brisk effervescence in nitric acid; and if the solution, when complete, is allowed to evaporate spontaneously, fine crystals of the nitrate of soda are always obtained, swimming in a solution of the nitrate of lime.

These and other experiments having satisfied M. Boussingault that the mineral of Lagunilla contained lime, soda, carbonic acid, and water, he next proceeded to the analysis. The quantity of carbonic acid was determined by the loss of weight which the mineral experienced when put into dilute nitric acid. The solution, so formed, was evaporated to dryness, the residue taken up by water, and the lime precipitated by carbonate of ammonia at a boiling temperature. The filtered solution was then evaporated and ignited to expel the salts of ammonia, and the soda was converted in the usual manner into sulphate of soda. The weight of the carbonic acid, lime, and soda, subtracted from the weight of the mineral which was employed, gave the quantity of water. This estimate was controlled by heating some of the crystals to a commencing read heat, when the water of crystallization was entirely expelled without any loss of carbonic acid. According to this analysis, the Gay-Lussite is composed (omitting one per cent. of alumina, the presence of which is obviously accidental,) of

Carbonic acid, - - -	28.66
Soda, - - - -	20.44
Lime, - - - -	17.70
Water, - - - -	32.20

or, giving to each of the bases sufficient carbonic acid for combining with them, of

Carbonate of soda, - -	33.96
Carbonate of lime, - -	31.39
Water, - - - -	32.20
Carbonic acid, - - -	01.45

M. Boussingault infers from these numbers, that the mineral of Lagunilla is a double carbonate of soda and lime, with eleven atoms of water of crystallization; or, since the crystallized carbonate of soda is composed of one atom of the anhydrous carbonate of soda, with eleven atoms of water, that it may be considered as a compound of one atom of carbonate of lime, combined with one atom of crystallized carbonate of soda. On this view M. Boussingault calculates the composition of the mineral to be

Carbonate of soda, - - -	34.76
Carbonate of lime, - - -	32.95
Water, - - - -	32.29

(Extracted from the *Annales de Chimie et de Physique*, (vol. xxxi.

25. *On Fecula and the different Amylaceous Substances of Commerce.*

By M. Caventou.—M. Caventou has ascertained several interesting facts relative to the chemical changes which are occasioned by heat in fecula, and has applied them ably in illustrating the nature of the different amylaceous substances of commerce, such as salop, sago, and arrow-root.

Fecula, or starch, is characterised by its insolubility in cold water, by forming a blue compound with iodine, and by dissolving in hot water, with a due proportion of which it forms a paste. Chemists generally regard this gelatinous mass as a hydrate of starch, but M. Caventou has taken a different view of its nature. For he finds that paste cannot by any means be reconverted into pure starch; and that on mixing it with a sufficient quantity of cold water, the greater part of it dissolves, a few opaque white particles alone remaining, which are found, on examination, to be unchanged starch.

The change in the constitution of starch, by which it is rendered soluble in cold water, is ascribed by M. Caventou to the influence of heat. When dry starch is exposed to a temperature somewhat above 212° F. it acquires a slight reddish tinge, emits an odour analogous to baked bread, and if exposed, after cooling, to the action of cold water, it is dissolved. The same effect is produced by boiling starch in water. M. Caventou regards this modified starch as identical with the substance which M. Saussure has described under the name of amidine. Its essential character is to give a blue colour with iodine, and to be soluble in cold water. The solution, when evaporated, does not form a paste, but yields a hard, transparent mass, like horn, which retains its solubility in cold water, and in which no trace of pure starch can be detected.

When dry starch is exposed to a still higher temperature than is sufficient for converting it into amidine, a more complete change is effected. It now dissolves with great facility in cold water, and gives a purple colour with iodine. A similar effect is occasioned by long-continued boiling in water.

Salop.

Salop, reduced to powder, forms with cold water a semifluid bulky gelatinous mass, which does not dissolve in that menstruum even by the aid of heat, and which has all the characters of bassorine. Cold water dissolved nothing but saline matters and a small quantity of gum. The solution did not give a blue colour with iodine, and therefore no amidine was present. Boiling water took up a minute portion of starch, the presence of which was detected by iodine. Hence it follows that salop is composed of bassorine, with a small quantity of gum and of starch.

Sago, Tapioka, and Arrow-root.

When powdered sago is macerated in cold water for twenty-four hours, it yields after filtration a perfectly clear solution, which forms a rich blue with iodine. On macerating the residue in a fresh portion of water for the same length of time, a solution is formed, which with iodine gives a blue colour like the foregoing; and by successive additions of cold water the whole of the sago may be dissolved. Boiling water dissolves it still more easily. The properties of tapioka are similar to those of sago.

It hence appears that sago and tapioka have the character of amidine. M. Caventou is of opinion that both substances originally exist in the plants from which they are extracted in the state of pure starch. Their conversion into amidine is explained by the fact that heat is employed in preparing them. Agreeably to this idea, M. Caventou has met with some specimens of sago, which are very sparingly soluble in cold water, and others which do not dissolve in it at all. In these cases it is supposed that so a low temperature was employed in the preparation, that the conversion of starch into amidine is only partially effected.

Arrow-root is exactly similar in its chemical properties to the starch prepared from the potato, and may be regarded as unchanged starch.

It follows from these researches that the amylaceous principle of the potato may be substituted for arrow-root, and that a substitute for sago and tapioka may be made from the same material, by converting it into amidine by means of heat.—(Extracted from the *Ann. de Chim. et de Phys.* vol. xxxi.)

26. *Muride, a New Substance, intermediate between Chlorine and Iodine.*—At the Academy of Sciences there was read on the 3d July a memoir by M. Ballart, on a particular substance contained in sea water, and which he proposes to call muride. It is of a blackish red colour, exhibits a disagreeable odour, similar to that of the oxides of chlorine; its taste is equally disagreeable, and it exerts on the animal economy a deleterious action highly energetic. It boils at 37° Cent., and consequently volatilises with a facility which forms a remarkable contrast with its density, which is considerable. It congeals at 18° below zero, and it does not conduct electricity. Relatively to its action on different simple bodies, muride is intermediate between chlorine and iodine.—*Le Globe,* No. 85.

III. NATURAL HISTORY.

MINERALOGY.

27. *Crystals of Sulphur in Galæna.*—The crystals of sulphur I found accompanying sulphuret of lead, in a vein of the latter, in sandstone, at Redpath, about five miles north of Wallington. Sometimes it occurs in cavities which appear from their shape to have once contained crystals of galæna, but which has been decomposed; indeed, where the sulphur occurs with the galæna, it appears to be a result of the decomposition of the latter.—*Note from W. C. Trevelyan, Esq.*

28. *Native Alum found at Calingasto, in South America.*—A formation of native alum occurs at the place which is situated among the mountains, and on the banks of the Rio di San Pian, about 40 leagues north of the commencement of the valley of Uspallota. Many specimens of the alum exhibit a fibrous texture and a silky bark. It is excellent, and is used in these provinces for all domestic purposes. The other day on my way to the Portillo, on the banks of a small rivulet, I saw there a formation of alum earth, where the alum is imbedded in earth in small round masses. —*Extract of a letter from Dr Gillies to W. C. Trevelyan, Esq.*

GEOLOGY.

29. *Notice of the Explosion of a Volcano in the Andes.*—I have just returned from an extremely interesting journey across the Cordilleras as far as the Pacific, by a pass call ed the Portillo, to the south of Mendoza, much

less frequented than the other pass. On the 1st of March, while approaching towards the chain in which is situated the pass of the Portillo, we were enveloped for upwards of two hours in a shower of ashes, which, on further inquiry, I found proceeded from a volcano which had exploded about two hours before, towards the centre of the Cordilleras. Owing to a pretty strong breeze, I was only able to collect a very small quantity of these ashes, but sufficient to identify it with some ashes which I had previously, on two occasions, collected at Mendoza, a distance of from 40 to 50 leagues from the volcano, which is situated near the pass of the Peuqueues. This volcano has been very active during the last year, and indeed, ever since the great earthquake which destroyed Valparaiso a few years ago.—*Extract of a letter from Dr Gillies to W. C. Trevelyan, Esq.* dated Mendoza, 11th April 1826.

30. *Singular Cascade of Lava.*—Near Keokoa Mr Ellis observed a curious phenomenon. It consisted of a covered avenue, of considerable extent, from 50 to 60 feet high, formed by the lava's having flowed over the edge of a perpendicular pile of very ancient lava, from 60 to 70 feet high. It appeared as if, at first, it had flowed over in one vast sheet, but had afterwards fallen more slowly, and in detached semifluid masses. These, cooling as they fell, had hardened, and formed a pile, which, by a continued augmentation from above, had ultimately reached the top, and united with the liquid lava there. It was evident that the lava had still continued to flow along the outside of the arch thus formed into the plain below, as we observed in several places the courses of unbroken streams, from the top of the cliff to the bed of smooth lava that covered the beach for several miles. The space at the bottom between the ancient rocks and more recently formed lava, was from 6 to 12 feet. On one side the lava was perpendicular and smooth, showing distinctly the different and variously coloured masses of ancient lava of which it was composed, some of a bright scarlet, others brown and purple. The whole pile appeared to have undergone, since its formation, the effects of violent heat. The cracks and hollows horizontally between the different strata, or obliquely through them, were filled with lava of a florid red colour, and much less porous than the general mass. This last bed of lava must have been brought to a state of the most perfect liquefaction, as it had filled up every crevice that was more than half an inch wide. It appeared highly glazed, and in some places we could discover small round pebbles from the size of a hazel nut to that of a hen's egg, of the same colour, and having the same vitreous covering, yet seeming to have remained solid, while the liquid lava with which they were mixed had been forced by subterranean fire into all the fissures of the ancient rock.

The pile on the other side, formed by the dropping of the liquid lava from the upper edge of the rocks, presented a striking contrast, but not a less interesting sight. It was generally of a dark purple, or jet black colour, glittering in the sun's rays, as if glazed over with a beautiful vitreous varnish.

On breaking off any fragments we found them very porous, and considerably lighter than the ancient lava on the other side. Its varied forms baffled description, and were equal to the conceptions of the most fertile imagination. The archway thus formed continued for about half a mile, occasionally interrupted by an opening in the fall of recent lava, caused by some projecting rock or elevation on the precipice above.—Ellis's *Missionary Tour through Hawaii.*

BOTANY.

31. *New Botanical Publication.*—Dr Hooker and Dr Greville are engaged in preparing for publication a work with numerous Figures, in folio, upon the New or Rare Species of Ferns, under the title of *Icones et Descriptiones Filicum Rariorum, &c.* The engravings will be executed in the same style as those in De Lessert's *Icones Selectæ,* and Humboldt's *Nova Genera ;* and the descriptions will be entirely in Latin. The first part is in a state of considerable forwardness.

32. *Lemna minor and gibba.*—The high degree and long continuance of the temperature of the summer of the present year has had an obvious influence upon vegetation ; and in no respect more remarkably than in the flowering of various plants. The singular genus *Lemna,* whose species are most rarely to be seen in flower in any part of the kingdom, and indeed were very long a desideratum in the botanical world, has been peculiarly favoured. We are not aware that the flowers have ever been observed in Scotland ; but on the 24th of July Dr Greville discovered those of both the above named species, in great abundance, in the ditch at the west end of Duddingston Loch. *Lemna gibba* has been seen in flower, we believe, in Great Britain, only by Mr Borrer, who observed it at Lewes, in Sussex. The stamens in this species do not appear together ; the second rarely becoming visible till the first has passed away. It appears to be certain, that temperature alone has influenced the flowering of these plants, as Dr Greville has regularly examined the same spot for several preceding years without success.

33. *Systema Orbis Vegetabilis.*—A work under this title has recently been commenced by the learned and ingenious Swedish philosopher Fries, in which he proposes to arrange the whole vegetable kingdom, according to the views entertained by him, Dr Nees ab Esenbeck, and some other naturalists. Our readers will recollect that the doctrines of affinity and analogy are very carefully studied and distinguished by the promoters of those views ; and it is certain that they have already contributed not only towards a more philosophical arrangement of natural bodies, but one also more tangible in practical investigation. M. Fries is well known by his laborious work on the *Fungi* : a tribe of vegetables, indeed, holding a low scale in creation, but capable of illustrating the advantages of the system pursued by the author. " M. Fries," observes Mr W. S. Macleay, " has been able to give so connected and symmetrical an outline of what he considers to be the natural distribution of *Fungi,* as, at least in my opinion, to merit the careful attention of zoologists as well as botanists." In the 14th volume of the *Linnæan Transactions,* Mr Macleay has successfully proved the same laws to be applicable to the natural distribution of insects ; and more recently, in the same *Transactions,* Mr Vigors has extended them, in an able manner, to the orders and families of birds.

In the present work, M. Fries confines himself to the genera ; which he intersperses with numerous and valuable observations. The first part, recently published, contains 448 genera of *Fungi*, Lichens, *Byssaceæ*, and *Algæ*; four great groups, which he arranges in two classes, FUNGI, and ALGÆ. The Lichens he considers as aërial *Algæ*. R. K. G.

IV. GENERAL SCIENCE.

34. *Notice respecting Mr Scouler's and Mr Douglas's recent Voyage to the North-West Coast of America.*—We mentioned in the number of our *Journal* for November 1825, the departure of Mr Scouler and Mr Douglas for the North-West Coast of America, and under what circumstances they went. We are enabled, through Mr Scouler, who has lately returned, to give a slight sketch of this voyage.

They embarked in a Hudson's Bay Company's ship at Gravesend on the 25th of July 1824, and arrived at Madeira on the 12th of August, where they spent two days in collecting plants and insects. At Rio de Janeiro they remained a fortnight, experiencing the utmost kindness from the inhabitants, especially from the English residents, and revelled in a tropical vegetation. From Brazil they proceeded round Cape Horn to the Island of Juan Fernandez, where they landed, and found inhabited only by a few adventurers, who make a livelihood by killing and curing the cattle, which are so plentiful there. All that remains of the Spanish colony, besides these cattle, are the battery and the church; for the place is scarcely visited by strangers, now that Valparaiso is thrown open by the independence of Chili. Thence they sailed to the Gallapagos, uninteresting in a commercial point of view, but abounding in natural, especially animal productions, which would merit much greater attention than our naturalists were able to bestow upon them. The mouth of the Columbia was the place to which they next steered their course; but the weather they encountered on approaching the coast of California was more changeable than any they had experienced in the former part of their voyage; and after six weeks of very severe storms, they at length came to an anchor in Baker's Bay, Columbia River, on the 8th of April 1825. As they had seen no natives during the first day of their arrival, they made a short excursion into the neighbouring woods, proceeding to the distance of some miles in a northerly direction, but still without seeing even the traces of Indians. The plant here which first attracted their attention, was the *Gaultheria Shallon*, crowned with its beautiful roseate flowers. From seeds of this plant, gathered as well by Mr Douglas as by Mr Scouler, individuals have been raised, perhaps for the first time in Britain, at the Botanic Garden at Glasgow. On the second day their impatient curiosity was gratified by the arrival of several canoes with Indians. These were, all of them, of moderate height, and few had straight limbs; they had high cheek-bones and flat heads, whilst many of the children were still bandaged about the heads with the boards which, by constant pressure upon the infant's skull, gives it that peculiar form which is characteristic of the principal families of the country. The dress of the people consisted of a broad sugar-loaved shaped hat, painted with different colours, and, for a cloak, their only covering, a robe made of the skins of a species of marmot, reaching from their shoulders to their ancles. This robe is common to the women as well as to the men;

but then the former had the addition of a straw petticoat, which descended below the knee. The few who had European dresses seemed very uncomfortable in their new costume.

From these people, however, no information could be obtained; nor till the afternoon of the same day, when a more intelligent visitor arrived, who was one of the company's Canadian servants, with whom, on the following day, they proceeded to Fort George, where they experienced every degree of attention from the governor, Mr M'Lellan. Hence it was that Mr Douglas made a voyage up the river to a new establishment, Fort Vancouver, 80 miles from the sea. He was followed soon after by Mr Scouler, together with a party from the Fort, consisting chiefly of French, Canadians, and Iroquois, in the company's service, and occupying five canoes.

They encamped the first night of the voyage upon a low marshy spot, which is annually inundated by the river, and where a beautiful water-snake was killed, a species of Hydrophis, in whose stomach was found a large bull-frog, with the elytra of a fine species of Dytiscus. Every where the banks of the river were tolerably thickly inhabited by a people who never till the ground, and who subsist almost entirely by fishing.

On the second day, the voyagers passed the famous Indian place of interment, named by Captain Vancouver Mount Coffin, and by the Canadians *Rochers des Morts*. These rocks, from which the place derives its name, appeared to be the cemetery, if one may so call it, of an extensive district. Owing to the dread, as well as the respect, which the Indians entertain for their deceased friends, they are accustomed to deposit them at a considerable distance from their dwellings. Here their bodies were placed in canoes upon the rocks, covered by boards fixed down with cords, and further secured by having great stones placed upon them. In the canoes were lodged many articles belonging to the deceased, particularly domestic utensils, as being their most valuable articles.

Fort Vancouver they found to be situated in a fertile prairie, abounding in many curious plants; and at this season (May) extensive tracts of country were almost covered with the blue flowers of the *Phalangium esculentum* of Nuttall, called kamass by the natives, with whom it is a favourite article of food. The plant a good deal resembles the common field hyacinth of our country. The root is about the same size, and, when roasted, has an agreeable and sweet taste. In botanizing in this agreeable spot, they were charmed with the little *Calypso borealis*, and the graceful *Linnæa borealis*, both of which are well known to be equally common in the northern parts of the continent of Europe. After this excursion, Mr Douglas made preparations for a journey into the interior as far as the falls of the Columbia.

In the month of June, Mr Scouler proceeded in the ship to the northward, visiting Queen Charlotte's Island, as well as Observatory Inlet. The Indians of these places speak a language totally different from that of the Columbian tribes. As to person, they are much taller, and a more muscular race of men than any the party had previously seen, and were far superior to their brethren of the south, both in industry and intellect. Many of them could speak a little English, which they had learned by their intercourse with the American traders. The disgusting custom of flattening the heads of their children was unknown here, but it was replaced by another equally strange, though confined to one sex only. The females had a large incision along their lower lip, in which they put an oval piece of wood, varying in size according to the degree of dilatation to which the wound has been subjected, so that it would seem as if some acquired deformity was necessary to complete the character of savage life. Previously to returning to the Columbia, the expedition visited Nootka and De Fuca's Straits. At the former place, the suspicious character of the natives prevented our naturalists from spending much time on shore. It is really painful to reflect, that the only savage chief of this country perhaps now alive, who was brought into notice by Captain Cook, is one of the most daring characters upon the coast. So late as the year 1816, this individual succeeded in capturing an American vessel, of which he murdered the captain and all the crew except two individuals, who, after several years' captivity, escaped on board a vessel which accidentally visited Nootka. This chief well remembers Mr Mears and Captain Vancouver, and even speaks with gratitude of them. Maquina, a well-known character, is a stout healthy old man, but is still the same importunate beggar that former visitors had found him to be. His tribe indeed is now seldom visited by traders, on account of the hostile character he acquired, and the poverty of the place, yielding very few furs.

The straits of De Fuca, and the gulf of Georgia, are still more rarely visited. The natives bear a considerable resemblance both to those of Nootka and of the Columbia. Their language is similar; and they adopt the custom of flattening the heads of their children. They appeared to our navigators to be a peaceable and hospitable race, occupying both sides of the coast in considerable numbers, and subsisting chiefly upon the hunchback salmon of Vancouver and Mackenzie, and upon a species of halibut. In the summer, they reside close by the water's edge, and there lay in a stock of dried salmon for their winter provision. They migrate into the interior about the latter end of the month of August, and return to the shore in the month of April.

On returning to the Columbia, Mr Scouler again saw Mr Douglas, who had made the most successful journey to the falls of the Columbia, at a distance of 250 miles from the coast. During this interesting route, he had the good fortune to detect, besides several new plants, the greater number of those found by Lewis and Clarke. This indefatigable young man, still under the auspices of the Horticultural Society of London, is fulfilling the mission of that valuable institution, by returning over land to the east coast of America. During the remainder of Mr Scouler's residence upon the North-West Coast, his attention was not wholly occupied by the botany and zoology of the country: he lost no opportunity of acquiring as complete a knowledge, as the nature of the circumstances would allow, of the manners and customs of the Indians; add to which he collected many articles of curiosity, such as the dresses, arms, domestic utensils, skulls of the natives, and a well-preserved mummy.

A more full account of the voyage of this zealous naturalist will be given in the present and succeeding numbers of our *Journal.*

Art. XXX.—LIST OF PATENTS GRANTED IN SCOTLAND SINCE FEBRUARY 16, 1826.

16. March 20. For a Series of Machines, and certain Implements for Cabinet Makers' Work. To W. Thomson and J. Thomson, Edinburgh.

17. March 31. For an Improvement in Cooking Apparatus. To William Erskine Cochrane, Middlesex.

18. May 6. For certain Improvements on a former Patent for an Engine for Effecting a Vacuum. To Samuel Brown, Middlesex.

19. May 6. For an Improved Apparatus for Spinning, Doubling, and Twisting Silk. To Henry Richardson Fanshawe, London.

20. May 6. For certain Improvements in the Manufacture of Steel. To John Martineau Junior, Middlesex.

21. May 9. For an improvement in the mode of propelling Vessels. To William Parr, Middlesex.

22. May 9. For a New Polishing Apparatus. To Joseph Alexander Taylor, London.

23. May 20. For an Improvement in Machinery, for Spinning and Twisting Silk and Wool, &c. To F. Molineaux, Somersetshire.

24. May 20. For Improvements in Machinery for Preparing, Drawing, Roving, and Spinning Hemp, Flax, &c. To Alexander Lamb, London, and William Suttill, Middlesex.

25. May 26. For an Improved Mode of Constructing Wheel Carriages, to be used on Rail-Roads. To Thomas Shaw Brandreth, Liverpool.

26. May 26. For an Improved Steam-Engine. To Joseph Eve, London.

27. June 12. For a Method of Applying Steam without Pressure to Pans, Boilers, Pipes, and Machinery, in order to produce, and regulate various Temperatures of Heat. To Richard Mee Raikes, London.

28. June 17. For a New Manufacture of Ornamented Metal or Metals. To Thomas John Knowles, Oxford.

29. June 26. For certain Improvements on Machinery, to be operated upon by Steam. To Francis Halliday, Surrey.

30. June 29. For certain Machines and Improvements on Machines and Instruments, or Tools, applicable to the performance of Cabinet Makers' Work. To W. Thomson, Edin. and Malcolm Muir, Glasgow.

31. July 12. For Improvements on Rotatory Steam Engines, &c. To Louis Joseph Marie, Marquis de Cambis, Middlesex.

32. July 21. For Improvements on Apparatus and Works for Inland Navigation. To Henry Anthony Koymans, London.

33. August 7. For Improvements in Machines for Carding, Slivering, Roving, or Spinning Wool, Cotton, &c. To Moses Poole, Middlesex.

34. September 5. For an Improved method of preparing Straw and Grass for Hats and bonnets. To J. Grey, and Jacob Harrison, Cumberland.

35. Sept. 9. For certain Improvements in Engines or Machinery, to be actuated by Steam. To Francis Halliday, Surrey.

36. Sept. 9. For an Apparatus for preventing the Inconvenience arising from Smoke in Chimneys. To the said Francis Halliday.

Art. XXXI.—CELESTIAL PHENOMENA,

From October 1*st* 1826, *to January* 1*st* 1827. *Adapted to the Meridian of Greenwich, Apparent Time, excepting the Eclipses of Jupiter's Satellites, which are given in Mean Time.*

N. B.—The day begins at noon, and the conjunctions of the Moon and Stars are given in Right Ascension.

OCTOBER.

D.	H.	M.	S.	
1	3	29		● New Moon.
2				Sun in mean distance from earth.
2	1	55	40	☌ ☽ α ♍ ☽ 48′ S.
2	2	33	4	☌ ☽ ι ♍ ☽ 38′ N.
2	22			☌ ☿ ν ♍
4	8	21	10	☌ ☽ κ ♎ ☽ 5′ S.
4	12	45	3	☌ ☽ λ ♎ ☽ 14′ N.
4	17	25	25	☌ ☽ 1 β ♏ ☽ 27′ S.
4	17	26	46	☌ ☽ 2 β ♏ ☽ 27′ S.
4	19	59	12	☌ ☽ γ ♏ ☽ 57′ S.
5	22	40	36	☌ ☽ ρ Oph. ☽ 4′ N.
6				☌ ☽ Ceres.
6				☌ ☽ ♂
6	19	34	2	☌ ☽ 1 μ ♐ ☽ 43′ N.
6	20	9	44	☌ ☽ 2 μ ♐ ☽ 26′ N.
7	1			☌ ☿ δ ♏
7	19	10		☽ First Quarter.
7	21	53	39	☌ ☽ d ♐ ☽ 48′ N.
8				☌ ☽ Georg. Sidus.
9	1	35	59	☌ ☽ β ♑ ☽ 11′ N.
11	23			☌ ♀ σ ♏
12	12			☌ Sup. ☿ and ☉
13				♀ Greatest Elong.
13	14	45		Georg. Sid. in □ ☉
13	21			☌ ♀ α ♏
14	16			☌ ♂ λ ♐
15	9	46		○ Full Moon.
18				♃ Stationary.
18				☌ ☽ δ ♈
19	19	38	3	☌ ☽ ι ♉ ☽ 38′ S.
20	11	59	47	☌ ☽ ζ ♉ ☽ 18′ S.
21	12	16	31	☌ ☽ ν ♊ ☽ 21′ S.
21	17	22	51	Im. I. Sat. ♃
21	23			☌ ☿ λ ♏
23	10	48		☉ enters ♏
23	14	50		☽ Last Quarter.
23	20			☌ ♃ ν ♍
24	10	32	24	☌ ☽ 1 α ♋ ☽ 23′ N.
24	11	45	22	☌ ☽ 2 α ♋ ☽ 3′ N.
24	22			☌ ♀ A Oph.
25				☌ ♂ and Ceres.
27	5			☌ ☿ 2 α ♎
28				☌ ☽ ♃
29				☌ ☽ ☿
29	12	51	20	☌ ☽ α ♍ ☽ 37′ N.
29	13	28	24	☌ ☽ ι ♍ ☽ 18′ N.
29	18			☌ ☿ ♃ ♐
30				☉ Ecl. Invis. Green.
30	13	22		● New Moon.
31				☌ ☽ ☿
31	18	10	56	☌ ☽ κ ♎ ☽ 9′ N.
31	22	26	52	☌ ☽ λ ♎ ☽ 18′ N.

NOVEMBER.

D.	H.	M.	S.	
1	2	58	21	☌ ☽ 1 β ♏ ☽ 22′ S.
1	2	59	40	☌ ☽ 2 β ♏ ☽ 22½′ S.
1	5	27	11	☌ ☽ ν ♏ ☽ 52′ S.
2	7	14	1	☌ ☽ ρ Oph. ☽ 11′ N.
3				☌ ☽ ♀
3	3	24	4	☌ ☽ 1 μ ♐ ☽ 50′ N.
3	3	58	33	☌ ☽ 2 μ ♐ ☽ 33′ N.
4				☌ ☽ Ceres.
4	4	53	58	☌ ☽ δ ♐ ☽ 55′ N.
5	7	55	10	☌ ☽ β ♍ ☽ 19′ N.
5	16	25	7	Im. II. Sat. ♃
6	5	25		☽ First Quarter.
6	10			☌ ♂ ♅
7	12			☌ ☿ δ ♍
8				☌ ☽ κ ♒
9				☌ ☽ κ ♓ ρ ν ♓
10				☌ ☽ δ ♓
13	17	32	41	Im. I. Sat. ♃
14				Visible Eclipse of the Moon. The particulars of this Eclipse are given at the end of this article, for Edinburgh and Greenwich.
16	1	55	49	☌ ☽ ι ♉ ☽ 40′ S.
16	18	16	9	☌ ☽ ζ ♉ ☽ 20′ S.
17	18	34	24	☌ ☽ ν ♊ ☽ 24′ S.
19	20			☌ ☿ A Oph.
20	17	42	55	☌ ☽ 1 α ♋ ☽ 20′ N.
20	18	57	33	☌ ☽ 2 α ♋ ☽ 5′ S.
21	0			☌ ☿ θ Oph.
21	19			☌ ☿ β Oph.
22	5			☽ Last Quarter.
22	7	13		☉ enters ♐
23				☌ ♀ φ ♐
25				☌ ♂ and Ceres.
25				☌ ☽ ♃
25	23	44	58	☌ ☽ α ♍ ☽ 49 S.
26	0	22	51	☌ ☽ ι ♍ ☽ 37 N.
28				Visible Eclipse of the Sun. The particulars of this Eclipse for Edinburgh are given in our last Number, p. 71, as computed by Mr George Innes.
28				☿ Greatest Elong. from Sun.
28	5	32	43	☌ ☽ κ ♎ ☽ 9 N.
28	9	47	0	☌ ☽ λ ♎ ☽ 18 N.
29	15	48	24	Im. I. Sat. ♃
29	18	2	51	☌ ☽ ρ Oph. ☽ 10½′ N.
30	13	40	6	☌ ☽ 1 μ ♐ ☽ 50′ N.
30	14	13	31	☌ ☽ 2 μ ♐ ☽ 32′ N.
30	17	20	23	Em. III. Sat. ♃

DECEMBER.

D.	H.	M.	S.	
1				☌ ☽ ♀ ☿

D.	H.	M.	S.	
1	14	19	4	☌ ☽ d ♐ ☽ 55′ N
2				☌ ☽ Ceres ☽ ♅
2	16	21	58	☌ ☽ β ♍ ☽ 18′ N.
3				♀ Stationary.
3	18			☌ ♂ θ ♑
5	19	13		☽ First Quarter.
6	17	41	57	Im. I. Sat. ♃
6				☿ Stationary.
7	15	53	25	Im. II. Sat. ♃
7	18	24	37	Im. III. Sat. ♃
9				☌ ♂ ι ♑
12				☌ ☽ 1 α ♉
13	7	57	44	☌ ☽ ι ♉ ☽ 39′ S.
13	23	32		○ Full Moon.
14	0	13	38	☌ ☽ ζ ♉ ☽ 19′ S.
14				☌ ♃ 38 ♍
14	18	26	14	Im. II. Sat. ♃
15	0	22	50	☌ ☽ ν II. ☽ 21′ S.
15	18			☿ Inf. ☌ ☉
17	23	16	10	☌ ☽ 1 α ♋ ☽ 26′ N.
18	0	31	5	☌ ☽ 2 α ♋ ☽ 15′ N.
20	8			☌ ☿ ϱ Oph.
20	11			♄ μ II.
21	18	35		☾ Last Quarter.
21	19	43		☉ enters ♑

D.	H.	M.	S.	
22	15	57	14	Im. I. Sat. ♃
22	14	21	28	Im. } IV. Sat. ♃
22	16	22	19	Em. } IV. Sat. ♃
23	8	23	17	☌ ☽ α ♍ ☽ 43′ S.
23	9	2	39	☌ ☽ ι ♍ ☽ 43′ N.
23	15	15		♀ Inf. ☌ ☉
24	10			♄ ☍ ☉
24	16			☌ ♀ 2 μ ♐
25	6			☌ ♀ 1 μ ♐
25	16	3	52	☌ ☽ κ ♎ ☽ 12′ N.
25	20	24	40	☌ ☽ λ ♎ ☽ 21′ N.
26				☿ Stationary.
26	1	0	8	☌ ☽ 1 β ♏ ☽ 20′ S.
26	1	1	27	☌ ☽ 2 β ♏ ☽ 20′ S.
26	3	30	32	☌ ☽ ν ♏ ☽ 50′ S.
27	1			☌ ☽ ☿
27	5	12	15	☌ ☽ ρ Oph. ☽ 11′ N.
27	23			☌ ☽ ☿
28	10	21		● New Moon.
29	1	15	57	☌ ☽ α ♐ ☽ 51′ N.
29	17	50	30	Im. I. Sat. ♃
30				☌ ☽ Ceres.
30	2	45	9	☌ ☽ β ♑ ☽ 12′ N.
31				☌ ☽ ν ♒

Times of the Planets passing the Meridian.

OCTOBER.

	Mercury.		Venus.		Mars.		Ceres.		Jupiter.		Saturn.		Georgian.	
D.	h.	′	h		h	′	h	′	h	′	h	′	h	′
1	23	33	2	55	5	6	6	51	23	22	17	54	6	58
5	23	44	2	58	5	4	6	41	23	11	17	40	6	49
10	23	58	3	1	5	1	6	28	22	56	17	22	6	26
15	0	8	3	4	4	58	6	14	22	42	17	5	6	7
20	0	19	3	6	4	55	6	2	22	27	16	45	5	49
25	0	31	3	8	4	52	5	49	22	11	16	26	5	30

NOVEMBER.

1	0	46	3	8	4	48	5	31	21	49	15	58	5	4
5	0	54	3	6	4	44	5	21	21	34	15	42	4	48
10	1	5	3	3	4	40	5	7	21	20	15	22	4	21
15	1	16	2	56	4	37	4	55	21	3	15	3	4	9
20	1	24	2	46	4	31	4	43	20	46	14	38	3	40
25	1	31	2	34	4	26	4	28	20	27	14	16	3	30

DECEMBER.

1	1	30	2	13	4	19	4	12	20	5	13	48	3	5
5	1	22	1	55	4	14	4	1	19	50	13	29	2	45
10	0	54	1	33	4	7	3	47	19	30	13	6	2	28
15	23	58	0	59	4	0	3	33	19	11	12	39	2	8
20	23	12	0	24	3	53	3	20	18	51	12	19	1	46
25	22	40	23	43	3	46	3	5	18	31	11	55	1	21

Declination of the Planets.

OCTOBER.

	Mercury.		Venus.		Mars.		Ceres.		Jupiter.		Saturn.		Georgian.	
	°	′	°	′	°	′	°	′	°	′	°	′	°	′
1	2	7 N	21	35 S	25	24 S	29	44 S	1	54 N	22	22 N	22	27 S
7	2	28 S.	23	26	25	29 S.	29	40	1	24	22	21	22	26
16	9	9	25	34	25	18	29	30	0	39	22	21	22	26
22	13	13	26	36	25	1	29	24	0	11 N	22	21	22	25
28	16	52	27	28	24	39	29	17	0	18 S	22	21	22	25

NOVEMBER.

1	19 1 S	27 37 S	24 13 S	29 6 S	0 36 S	22 21 N	22 22 S
7	21 46	27 46	23 32	28 53	1 3	22 21	22 20
16	24 39	27 23	22 13	28 30	1 41	22 22	22 8
22	25 37	26 50	21 20	28 12	2 6	22 23	22 17
28	25 43	26 10	20 13	27 55	2 30	22 25	22 15

DECEMBER.

1	25 26 S	25 38 S	19 23 S	27 42 S	2 38 S	22 25 N	22 11 S
7	24 15	24 34	18 2	27 20	2 58	22 26	22 8
16	21 17	22 37	15 48	26 42	3 25	22 28	22 4
22	19 48	21 11	14 13	26 12	3 40	22 29	22 0
28	19 54	19 43	12 34	25 42	3 54	22 30	21 57

The preceding numbers will enable any person to find the positions of the planets, to lay them down upon a globe, and determine their times of rising and setting.

The following elements and results for the lunar eclipse of November, have been calculated with the utmost care, from the tables of the sun by Delambre, and the lunar tables of Bürg; they agree very precisely with the times given in the Nautical Almanack, from Burkhardt's tables:

Apparent time of opposition at Greenwich, 14th November,	4h 9′ 9″.9
Sun's Longitude then from true Equinox, November 1826,	7s 21° 47′ 32″.5
Sun's Latitude, then - - - -	0″.19
—— horizontal parallax, - - - -	8″.90
—— horary motion, - - - - -	2′ 31″.24
—— semidiameter, - - - - - -	16′ 12″.41
Equation of Time, - - - - -	15′ 21″.41
Hor. dim. equation of time, - - -	0.41
Moon's Longitude from true Equinox, - -	1s 21° 47′ 32″.5
——— true Latitude, N. decr., - - - - -	0° 9′ 52″.8
——— equatorial horizontal parallax,* - -	53′ 51″.2
——— horizontal semidiameter,* - -	14′ 43″.7
——— augmentation semidiameter at end total darkness,	0″.73
———————————————— eclipse, - -	3″.44
——— horary motion in Longitude at ☋, - -	29′ 30″.373
———————————— how preceding, -	29′ 30″.457
————————————— following, -	29′ 30″.289
————————— Latitude, at ☋, - - -	2′ 27″.291
———————————— how preceding, -	2′ 27″.316
————————————— following, -	2′ 27″.266
Angle of Moon's relative Orbit, with Ecliptic, -	4° 45′ 41″.2
Horary motion of ☾ à ☉ in relative Orbit, - -	27′ 5″.15
Distance centres ☾ and Earth's shad. at the time of nearest approach,	9′ 50″.8

The following table presents the results of the calculation in which the diameter of the shadow has been increased $\frac{1}{60}$ for the refraction of the earth's atmosphere. The alterations of diameter, equations of time, &c. have been carefully attended to, and the longitude of Edinburgh reckoned 12′ 41″.4 W. in time.

* These results differing from the Nautical Almanack, the first about 1½″, the second about 1″, I took much trouble to find an error in my computation, but in vain; and having compared several numbers of the *Nautical Almanack, Conn. des Tems,*

and Innes, (solar eclipse) from Burkhardt, and also Innes from Damoiseau, I find considerable discrepancies, and therefore give mine only to one decimal place. The numbers I found were 53′ 53″.75, and 14′ 43″.69, and the former corrected to Greenwich latitude, 53′ 51″.17.

Phenomena.	Green. App. T.	Green. M. Time.	Edin. App. T.	Edin. M. Time.
Beginning,	2h 15′ 17″.8	1h 59′ 45″.6	2h 02′ 26″.4	1h 47′ 3″.2
Total Immer.	3. 23. 16 .8	3. 7. 45 .1	3. 10. 25 .4	2. 55. 3 .7
Ecliptic Opp.	4h 9′ 9″.9	3h 53′ 48″.5	3h 56′ 28″.5	3h 41′ 7″.1
Gr. Observ.	4. 10. 59 .4	3. 55. 38 .0	3. 58. 18 .0	3. 42. 56 .6
Total Em.,	4. 58. 40 .5	4. 43. 19 .4	4. 45. 59. 1	4. 30. 37 .0
End,	6h 6′ 48″.0	5h 51. 27″.4	5h 53′ 6″.6	5h 38′ 46″.0

Digits eclipsed on the north side of the earth's shadow, 17° 38′ 32″.0

Only the latter part of the eclipse will be visible at Greenwich. Δ.

Art. XXXII.—Register of the Barometer, Thermometer, and Rain-Gage, *kept at Canaan Cottage.* By Alex. Adie, Esq. F.R.S. E.

The Observations contained in the following Register were made at Canaan Cottage, the residence of Mr Adie, by means of very nice instruments, constructed by himself. Canaan Cottage is situated about 1½ mile to the south of Edinburgh Castle, about 3 miles from the sea at Leith, and about ¼ of a mile N. of the west end of Blackford Hill. The ridge of Braid Hills is about 1 mile to the south, and the Pentland Hills about 4 miles to the west of south. The height of the instruments is 300 feet above high water-mark at Leith. The morning and evening observations were made about 10 A.M. and 10 P.M.

MAY 1826.

D. of Week.	Day of Month.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
M	1	54	48	51	28	62	45	30.12	29.98	.04
T.	2	54	43	48.5	46	65	55.5	29.85	29.97	
W.	3	42	58	40	38	51	44.5	30.06	30.02	
T.	4	45	45	45	29	62	45.5	30.02	29.97	
F.	5	48	41	44.5	42	54	48	30.08	30.08	
S.	6	44	41	42.5	39	54	46.5	30.07	30.10	
S.	7	45	37	41	38	52	45	30.07	30.09	
M.	8	47	42	44.5	30	58	44	30.03	29.93	
T.	9	47	45	46	39	54	46.5	29.87	29.85	
W.	10	52	44	48	41	64	42.5	29.83	29.89	
T.	11	47	41	44	39	56	47.5	30.03	30.11	
F.	12	50	47	48.5	30	65	57.5	30.18	30.07	
S.	13	58	55	56.5	42	66	54	30.00	29.99	
S.	14	60	54	57	43	67	55	29.95	29.98	.06
M.	15	58	48	53	50	66	58	29.95	29.94	
T.	16	54	48	51	45	61	3	29.88	29.86	.06
W.	17	59	51	55	46	69	57.5	29.87	29.90	
T.	18	62	53	57.5	44	71	57.5	29.87	29.78	
F.	19	59	54	56.5	46	62	54	29.68	29.61	
S.	20	52	45	48.5	43	58	50.5	29.73	29.88	
S.	21	62	48	55	39	72	55.5	29.95	30.01	
M.	22	65	50	57.5	40	72	56	30.02	29.96	
T.	23	54	46	50	45	68	56.5	29.96	29.89	
W.	24	55	49	52	39	66	52.5	29.88	29.85	.13
T.	25	58	50	54	44	62	53	29.88	29.89	.03
F.	26	48	48	48	47	50	48.5	29.80	29.75	.38
S.	27	52	50	51	47	60	53.5	29.81	29.83	.45
S.	28	58	54	56	46	67	56.5	29.79	29.77	
M.	29	57	49	53	48	64	56	29.81	29.88	
T.	30	55	48	51.5	48	64	56	29.90	29.86	
W	31	59	53	56	39	69	54	29.77	29.68	.10
	Sum,	1660	14.65	1562.5	1280	1931	1605.5	927.71	927.37	1.25
	Mean.	53.55	46.93	50.4	41.29	62.29	51.79	29.926	29.915	

JUNE 1826.

D. of Week.	Day of Month.	Thermometer. Morn.	Thermometer. Even.	Thermometer. Mean.	Register Therm. Min.	Register Therm. Max.	Register Therm. Mean.	Barometer. Morn.	Barometer. Even.	Rain.
T.	1	62	46	51	49	69	59	29.73	29.75	
F.	2	60	48	54	59	65	52	29.78	29.78	
S.	3	60	52	56	45	66	54.5	29.85	29.86	
S.	4	59	47	53	46	65	55.5	29.93	30.08	
M.	5	59	55	57	39	61	50	30.11	30.10	
T.	6	65	55	60	52	65	58.5	30.10	30.12	
W.	7	60	51	57	53	65	59	30.16	30.17	
T.	8	59	51	55	52	61	58	30.21	30.17	
F.	9	56	52	54	46	62	51	30.15	30.00	
S.	10	63	53	58	49	66	57.5	29.97	29.98	
S.	11	65	59	62	49	73	61	29.99	30.00	.03
M.	12	75	65	69	57	79	65	30.08	30.06	
T.	13	71	61	67.5	57	79	68	30.07	30.01	
W.	14	65	59	62	53	70	61.5	30.00	29.85	
T.	15	65	46	55.5	53	67	60	29.76	29.99	
F.	16	56	52	54	51	61	56	30.15	30.16	
S.	17	65	56	60.5	47	70	58.5	29.99	30.05	
S.	18	65	49	57	52	75	62.5	30.05	30.22	
M.	19	65	53	59	47	74	60.5	30.26	30.31	
T.	20	65	56	60.5	46	74	60	30.32	30.35	
W.	21	67	51	60.5	46	69	57.5	30.38	30.39	
T.	22	63	53	58	52	66	59	30.38	30.31	
F.	23	65	61	63	52	77	61.5	30.51	30.51	
S.	24	77	66	71.5	50	87	68.5	30.30	30.23	
S.	25	79	61	71.5	50	86	68	30.18	30.11	
M.	26	79	66	72.5	49	87	68	30.06	29.97	
T.	27	74	67	70.5	51	80	65.5	29.89	29.81	.27
W.	28	78	68	72	66	82	74	29.81	29.89	
T.	29	76	65	70.5	65	82	73.5	29.93	29.98	
F.	30	76	65	70.5	56	82	69	20.96	29.98	
	Sum,	1992	1799	1895.5	1511	21.66	1838.5	901.85	902.01	.30
	Mean.	66.4	59.97	63.18	0.37	72.2	61.28	30.062	30.067	

JULY 1826.

D. of Week.	D. of Mon.	Thermometer. Morn.	Thermometer. Even.	Thermometer. Mean.	Register Therm. Min.	Register Therm. Max.	Register Therm. Mean.	Barometer. Morn.	Barometer. Even.	Rain.
S.	1	70	61	65.5	55	79	67	29.98	29.98	.07
S.	2	70	61	65.5	54	77	65.5	30.07	30.05	
M.	3	72	60	66	52	78	65	30.02	29.98	
T.	4	76	68	72	50	80	65	29.92	29.81	.06
W.	5	72	65	68.5	60	79	69.5	29.67	29.58	.10
T.	6	70	62	66.5	59	77	68	29.67	29.75	
F.	7	68	64	66	53	77	65	29.62	29.40	
S.	8	71	60	65.5	58	80	69	29.39	29.50	.03
S.	9	70	56	63	45	77	61	29.49	29.48	
M.	10	66	61	63.5	47	74	60.5	29.51	29.53	
T.	11	64	57	60.5	53	70	61.5	29.53	29.61	
W.	12	63	60	61.5	53	66	59.5	29.48	29.32	.35
T.	13	60	55	57.5	55	68	61.5	29.25	29.25	
F.	14	62	52	57	48	67	57.5	29.42	29.52	.03
S.	15	65	57	61	48	67	57.5	29.57	29.37	
S.	16	62	53	57.5	54	66	60	29.42	29.68	
M.	17	64	55	59.5	46	70	58	29.76	29.72	
T.	18	62	54	58	52	67	59.5	29.62	29.62	
W.	19	64	55	59.5	48	70	59	29.61	29.79	.50
T.	20	55	56	55.5	46	60	53	29.63	29.32	.96
F.	21	55	52	53.5	52	55	53.5	29.43	29.81	.41
S.	22	55	50	57.5	47	65	56	30.00	30.08	
S.	23	55	48	51.5	47	67	57	30.07	30.09	
M.	24	65	55	60	39	73	56	30.07	30.05	
T.	25	67	51	60.5	50	78	64	30.06	30.11	
W.	26	63	63	63	49	70	59.5	30.16	30.16	
T.	27	67	63	65	49	80	64.5	30.16	30.10	
F.	28	71	65	69.5	51	80	65.5	30.05	29.95	
S.	29	72	62	67	60	76	68	29.81	29.78	
S.	30	66	64	65	56	77	66.5	29.82	29.98	
M.	31	71	60	65.5	57	80	68.5	29.65	29.76	
		2047	1808	1927.5	1593	2250	1921.5	920.94	922.17	2.31
		66.03	58.32	62.18	51.39	72.58	61.98	29.708	29.744	

AUGUST 1826.

D. of Week.	D. of Mon.	Thermometer. Morn.	Thermometer. Even	Thermometer. Mean.	Register Therm. Min.	Register Therm. Max.	Register Therm. Mean.	Barometer. Morn.	Barometer. Even.	Rain.
T.	1	62	57	59.5	48	72	60	29.95	30.02	
W.	2	62	57	59.5	52	66	59	30.01	29.84	
T.	3	66	57	61.5	51	72	61.5	29.82	29.88	
F.	4	62	56	59	50	68	59	29.90	29.91	
S.	5	65	59	62	48	70	59	29.82	29.83	
S.	6	62	57	59.5	47	70	58.5	29.87	29.87	
M.	7	66	61	63.5	54	77	65.5	29.93	29.93	
T.	8	65	58	61.5	58	73	65.5	29.87	29.78	
W.	9	62	55	58.5	49	71	60	29.82	29.88	
T.	10	63	59	61	49	71	60	29.70	29.48	.02
F.	11	62	53	57.5	51	67	59	29.53	29.58	.02
S.	12	58	52	55	48	64	56	29.64	29.82	.03
S.	13	60	54	57	48	70	59	29.88	29.71	.02
M.	14	62	57	58.5	48	70	59	29.58	29.62	
T.	15	65	56	60.5	51	70	60.5	29.52	29.36	.20
W.	16	63	53	58	52	69	60.5	29.48	29.60	.03
T.	17	65	64	64.5	48	74	61	29 71	29.71	
F.	18	72	63	67.5	61	80	70.5	29.65	30.03	
S.	19	71	65	68	60	81	70.5	30.00	29.86	
S.	20	60	57	58.5	56	67	61.5	29.86	29.83	.45
M.	21	62	54	58	50	69	59.5	29.81	29.78	.07
T.	22	59	59	59	47	65	56	29.58	29.48	.09
W.	23	62	60	61	54	73	63.5	29.34	29.23	
T.	24	64	60	62	53	71	62	29.30	29.35	
F.	25	62	59	60.5	52	69	60.5	29.43	29.50	
S.	26	57	58	57.5	54	69	61.5	29.45	29.51	.21
S.	27	62	56	59	52	70	61	29.57	29.69	.05
M.	28	61	65	63.5	44	70	57	29.71	29.50	.22
T.	29	63	62	62.5	59	71	65	29.50	29.41	.27
W.	30	62	56	59	59	67	63	29.42	29.47	.12
T.	31	64	52	58	45	67	56	29.53	29.58	
		1954	1789	1871.5	1598	2203	1890.5	920.46	920.04	1.83
		63.03	54.48	60.37	51.58	71.06	61.32	29.692	29.679	

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