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

DAVID BREWSTER, LL.D.

F.R.S. LOND. SEC. R.S. EDIN. F.S.S.A.

CORRESPONDING MEMBER OF THE INSTITUTE OF FRANCE; HONORARY MEMBER OF THE ROYAL IRISH ACADEMY; MEMBER OF THE ROYAL SWEDISH ACADEMY OF SCIENCES; AND OF THE ROYAL SOCIETY OF SCIENCES OF DENMARK, &c. &c.

VOL. VI.

NOVEMBER—APRIL.

JOHN THOMSON, EDINBURGH:
AND T. CADELL, LONDON.

M.DCCC.XXVII.

NOTICES TO CORRESPONDENTS.

THE two papers, which we learn by a letter from Professor OERSTED of Copenhagen were sent to this *Journal* by Dr FORCKHAMMER of Copenhagen have never reached us. If Mr FELDBORG, to whom they were sent, should see this notice, we trust he will forward the papers without delay.

A reply to Mr CHARLES BELL will appear in our next Number, together with a demonstration of his errors respecting the involuntary rotatory motion of the Eyeball, a doctrine which he still persists in maintaining.

We have received Δ's very excellent set of observations made at Rome on the 15th January; and also his interesting *Observations on the Climate of Naples*; and his *Remarks on Mount Vesuvius*, which will appear in next number. We shall be glad to hear from him as often as convenient.

We cannot refer our Correspondent J. R. to any work better than Mr Barlow's, published in 1823, and containing all the recent discoveries on electro-magnetism. He will be glad to learn, however, that a most complete account of the subject is now preparing for the EDINBURGH ENCYCLOPÆDIA, by Professor OERSTED of Copenhagen, the distinguished founder of this new science. It will appear under the head of THERMO-ELECTRICITY in vol. xvii. part ii. of that work.

We beg to acknowledge the receipt of the excellent sets of observations made on he 15th January by Mr Staveley of Nottingham, Mr W. Snow Harris of Plymouth, Mr Murdoch, Huntly Lodge, Mr Christison, Burdsyards, Dr Jackson, and Mr Macvicar at St Andrew's, Mr W. Edgworth, Edgworthstown, the Rev. R. Butler, Trim, county of Meath, and those made at Tubingen. We trust that these gentlemen and others who take an interest in such observations, will not forget those on the 15th of June next.

In answer to C.'s inquiry respecting the most complete Rain-Gage, we beg to refer him to the very ingenious one invented by Mr Donovan, and described in the *Dublin Philosophical Journal.* We regret exceedingly to observe that the circumstances of the times have obliged the proprietors of this excellent work to discontinue it. It contained many original and truly valuable articles, and was conducted with an honesty and candour of no ordinary kind.

Mr Foggo's valuable paper on the Dew Point Hygrometer will appear in next Number.

The interesting papers from our esteemed Correspondent in India will appear in next Number.

*** Our Correspondents are earnestly requested to transmit their Communications to the Editor before the 5th of March, the 5th of June, the 5th of September, and the 5th of December.

Authors and Booksellers who wish their Works noticed early in this *Journal*, are requested to transmit them through the Publishers. Books of Voyages and Travels are particularly requested, and will be returned when desired.

PRINTED BY JOHN STARK.

CONTENTS

OF THE

EDINBURGH JOURNAL OF SCIENCE.

No. XI.

NOTICES TO CORRESPONDENTS.

We have received our Correspondent Δ's Letter from Rome, and shall be glad to hear again from him when he returns to Scotland.

Mr E.'s Essay is too elaborate for our pages, and is more suited for a Medical Journal.

We would recommend it to M. to send his Model to the Society of Arts for Scotland, which holds its meetings twice every month in the Royal Institution. If it merits it, it may appear at the General Exhibition of inventions, which is to take place in May 1827.

We shall be happy to solve the difficulties mentioned by our Bristol correspondent so far as we can; but we cannot undertake to be expounders of scientific riddles.

M. D.'s observations on Vision cannot be inserted. If he will give us a personal interview with him, we shall demonstrate to him the fallacy of his experiments. The papers to which he alludes are certainly full of experiments and observations; but they are bad ones. Nature may be interrogated by a thousand and one experiments, and yet may not give a response worthy of being recorded.

We have received J. G.'s observations on the Mean Temperature of the Earth, containing new formulæ for determining the mean temperature of different points on the earth's surface. The author has committed a mistake in *considering the mean temperature as an angle, of which he gives the sine and cosine.* Owing to the accidental circumstance of the polar temperature being not far from 0°. and the equatorial temperature above 80°. in Fahrenheit's scale, the formulæ give tolerably correct results; but if he uses the Centigrade scale or Reaumur's, he will find that his formulæ are entirely inapplicable. We shall be glad to receive J. C.'s Meteorological Journal, or an annual abstract of it, as it promises to be a valuable one. In answer to J. C.'s query, we beg to state that correct indications cannot be obtained from hygrometers in frosty weather. Captain Parry found that with Daniell's hygrometer he could never obtain a deposit on the back of the instrument, below an atmospheric temperature of +6°. of Fahr.

Mr Nasmyth's description of an instrument for measuring the comparative expansibility of metals, will appear in our next number.

Mr Scouler's paper on the temperature of the North West Coast of America, will appear in next number.

Our Correspondents are earnestly requested to transmit their Communications to the Editor before the 10th of March, the 10th of June, the 10th of September, and the 10th of December.

CONTENTS

OF THE

EDINBURGH JOURNAL OF SCIENCE.

No. XII.

PLATE I.

Fig. 1.

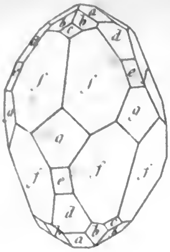
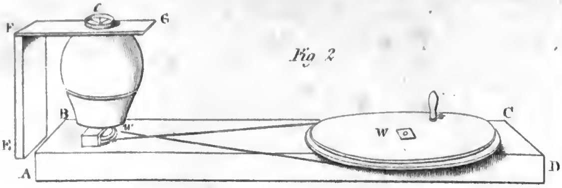


Fig. 2



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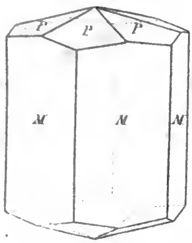

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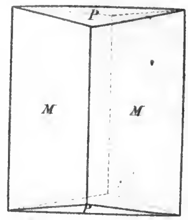
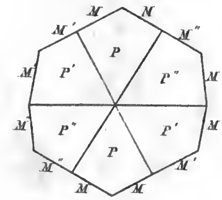


Fig. 5.



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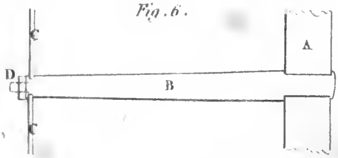

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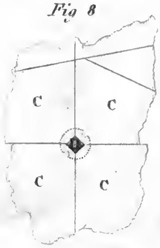


Fig. 7.

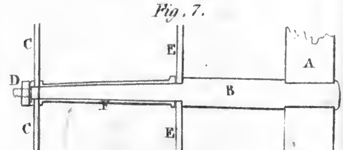


Fig. 14.

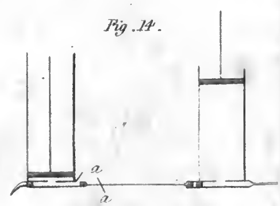
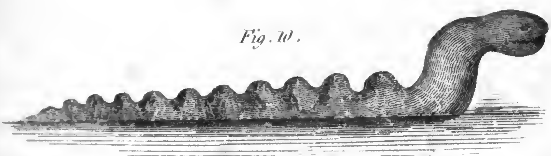


Fig. 10.



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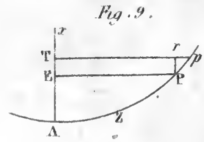


Fig. 12.

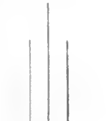


Fig. 13.

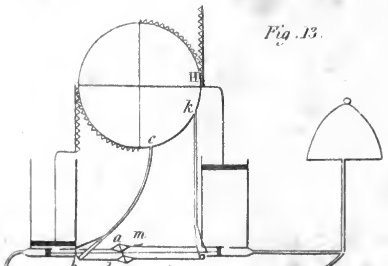
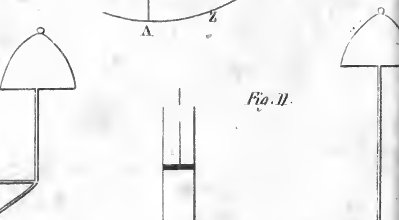


Fig. 11.



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ART I.—*Specimen of the use of Notation in the Analysis of Crystalline Forms.* By the Reverend W. WHEWELL, Trinity College, Cambridge. Communicated by the Author.

THE notation by which the faces of crystalline forms shall be designated, is, I believe, among persons who have paid an imperfect attention to the subject, looked upon as a matter not of great importance, nor offering any decisive principle of selection with respect to the different systems which have been proposed. It is probably taken for granted by most, that such a notation can only answer the purpose of *registering* the mode of derivation of crystalline faces in a manner easily understood and recollected; and that, therefore, simplicity and symmetry are the *only* merits which it can aspire to. This is, in fact, the case with respect to Hauy's notation; and though that system might perhaps be improved and extended, it could hardly be made subservient to any ulterior object.

If, however, we have a notation which indicates, by means of geometrical or arithmetical considerations, the law by which planes are derived, these indications may be used in finding the relations of the planes to one another, and the angles which they make. Such a notation is that of Weiss, which differs very little from a system which I had proposed in the *Philosophical Transactions*, (Part i. 1825,) without being aware that any similar method had been elsewhere brought forwards. And by means of either of these systems, we may, from the designation of the planes of a crystal, determine its form, and the other circumstances of its geometry. And conversely, from the angles made by its faces, or from other considerations, we may obtain the laws of derivation by which its faces are produced, as has also been shown in various cases by Mr Levy.

But the fact is, that it is possible to obtain, in almost all cases, the laws of crystalline derivation more simply. That is, not by knowing the magnitude of the angles which the faces make with one another, but by certain properties of the form, as the parallelism of some of the edges, the figure of some of the planes, &c.; and these considerations supersede the necessity of measuring the angles themselves almost entirely.

Now, in order to make these deductions, it is most convenient not to suppose all faces derived from *one* general law, under which the indices only make the difference, as is the case in Weiss's system, and in mine; but to conceive the forms derived by *two or three laws*, more simple, and less general; laws so selected, that such properties as are mentioned in the last paragraph may be found arranged in classes, and may thus enable us to make our inferences by reference to a small number of principles. This is the important and beautiful simplification which has been established by Mohs.

In order to facilitate our reasonings of this kind, it becomes proper to have a notation, declaring by means of which of the laws so classified our forms are obtained, and expressing also the primary or fundamental form from which the derivation is made. And this is the object of the notation which I shall propose, and which is different from that of Mohs in several respects, but subservient to his system.

The following instance is produced as a specimen of the reasonings above mentioned. And it will perhaps illustrate, more clearly than language can describe, how, with such a system, and such a notation, the determination of the laws by which crystalline faces are derived, becomes simple and easy. The requisite steps for this determination are these: The laws of derivation being explained, a few propositions are established as consequences of them, with respect to relations of the edges and faces. And by reference to these propositions, we are able, for each face, to trace the law by which it is deduced from the fundamental form. As my object here is to exemplify the mode of deduction only, and not to give an exposition of the method, I shall merely put down the steps by which each of the faces of a certain complicated figure may be analyzed, giving in the margin the enunciations only of the theorems which it is necessary to assume.

The notation which I shall employ is different from that of Mohs, but seems to me to be that to which Mr Mohs's naturally bends when we remove a few anomalies and arbitrary designations, and replace them by such modes of representation as the symmetry of the method, and the principle of avoiding any superfluous assumption plainly suggest.

The example which I shall take belongs to what has been called the *rhombohedral system;* which includes such figures as can be derived from a rhombohedron. These may be described generally as forming at each extremity of the figure 3-and 6-sided pyramids.

Let the equilateral 3-sided pyramid, which is formed by the faces of the fundamental rhombohedron, be called R.

Let any equilateral 3-sided pyramid, on the same base, and with an axis equal to p times the former be called pR.

Let any 6-sided pyramid be deduced from pR by three symmetrical faces of planes, each plane being drawn through an angle of the base, parallel to the next slant side; such, that if we draw from the angle corresponding to this slant side a perpendicular on the opposite side of the base, the portion of this perpendicular produced, which is intercepted by the plane, shall be m times the perpendicular. And let the form bounded by such planes be pRm.

When any of these figures is turned round its axis, through 180°, it is represented by pR$'$ on pR$'m$; and the forms are said to be *transverse* to the former ones.

Any 3-sided pyramid, or rhombohedron which can be deduced from R, may be represented by pR or pR$'$, and any 6-sided pyramid which can be deduced, may be represented by pRm, or pR$'m$.

Let now Fig. 1. of Plate I. represent a crystalline form, (for instance a crystal of carbonate of lime,) belonging to the rhombohedral system, in which it is required to obtain the law of derivation of each of the faces.

If we had the faces *c* only, the others being suppressed, and then produced, they would form at the upper extremity a three-sided pyramid. In the same manner, the faces *a*, *d*, *e*, respectively, would form three-sided pyramids, but transverse to the former, and therefore derived from R′. Let pR, p'R′, p''R′, p'''R′, represent the pyramids.

The faces *f* by themselves would form a 6-sided pyramid. In the same manner, the faces *b* would form a 6-sided pyramid. Let qRm, q'Rm' represent these pyramids.

The faces *q* are manifestly parallel to the axis, and agree with the faces of a rhombohedron, of which the axis is infinite. Hence they are represented by the symbol ∞ R.

Therefore we have the symbols corresponding to the faces thus,

pR,	p'R′,	p''R′,	p'''R′,	∞ R,	qRm,	q'Rm'.
c	*a*	*e*	*d*	*g*	*f*	*b*

and we have to determine p, p', q, m, &c.

To find p. We may assume one of the rhombohedrons which occur to be the primitive form; and it will be convenient to take for this the one of which the faces are *c*. Hence pR is R, and $p = 1$.

To find p′. If we had only the faces *c* and *a*, (suppressing *b*,) it is evident that the faces *a* would truncate the edges of the rhombohedron with faces *c*. Hence the latter rhombohedron being R, the faces *a* belong to $\frac{1}{2}$ R′ (A.) Therefore p'R′, is $\frac{1}{2}$ R′, and $p' = \frac{1}{2}$.

To find p″. If we suppose the faces *c* increased, till they intersect the faces *e*, * it will be found that the intersections will be parallel to the inclined diagonal of the rhomb *c*; and consequently the faces *c* will then be bounded by two parallel lines, and will truncate the edges of the rhombohedron, of which the faces are *e*. Hence *c* being R, *e* is 2R′ (A.) Therefore p''R′ is 2R′ and $p'' = 2$.

(A.) In combinations of forms pR, $2p$R′, or pR′, $2p$R the first truncates the edges of the second.

* In such a case as that of carbonate of lime the faces *e* may be enlarged by cleavage.

To find q. If we suppose all the faces suppressed besides c and f, we shall have a 6-sided pyramid, terminated by a 3-sided pyramid, and the faces c of the 3-sided pyramid will be rhombs, in consequence of the parallelism of the lines which bound its faces. Hence, c being R, f is Rm (B;) and $q = 1$, m being still undetermined.

To find m. The faces e manifestly truncate the alternate edges of the pyramid whose faces are f, (namely, the more acute edges.) Hence e being 2R′, and f being Rm, we have the relation $\frac{3m-1}{4} = 2$, (C.) Therefore $m = 3$, and qRm, which designates f, is R3.

To find m′. The faces b intersect the faces f, in lines which are horizontal, (the axis being vertical.) Hence f being R3, b is qR3, (D,) and $m' = 3$, q' being still undetermined.

To find q′. The faces a manifestly truncate the alternate edges of the pyramid of which the faces are b, (the more acute edges.) Hence a being $\frac{1}{2}$R′, and b being q'R3, we have the relation $\frac{3.\,3-1}{4}q' = \frac{1}{2}$. (C,) and $q' = \frac{1}{4}$. Therefore q'Rm', which designates b, is $\frac{1}{4}$R3.

To find p‴. If we suppose all the faces to be suppressed besides b and d, since the intersection of b and d is parallel to the intersection of b and b, it is manifest that the edges of the rhombohedron whose faces are d, are replaced by the pairs of faces of the pyramid b, (namely, the pairs which meet at the more obtuse angles.) Hence b being $\frac{1}{4}$ R3, p''' R, which is d, will be determined by the relation $\frac{3.3+1}{2}.\,\frac{1}{4} = p''' = \frac{5}{4}$ (E.) And d will be $\frac{5}{4}$ R′.

(B.) In combinations of forms, pR, pRm, the faces of pR are rhombs, terminating the pairs of faces of pRm.

(C.) In combinations of forms pR′, qRm, the former will truncate the acute terminal edges of the latter, if $p = \frac{3m-1}{4}q$.

(D.) In combinations of forms qRm, q'Rm, (m being the same in both,) the edges of combination are horizontal.

(E.) In combinations of forms pR′, and qRm, the other terminal edges of the latter, in pairs, replace the edges of the rhombohedron pR′ if $\frac{3m+1}{2}q = p$.

Hence writing all the faces with their proper designations, the symbol of the crystalline form will stand thus.

$\frac{1}{2}$ R′, R, 2 R′, $\frac{5}{4}$ R′, ∞ R, R3, $\frac{1}{4}$ R 3
a c e d g f b

We have thus entirely determined the form proposed, without any information, except what is obvious to the eye on considering the figure. And in by far the majority of cases, similar considerations, combined with a few theorems in addition to those which we have referred to (A, B, &c.) will suffice for a similar solution of the problem.

The laws of the derivation of the faces being known, and the angles of the primary form (R,) the angles which any other faces make may be determined by formulæ depending upon the primary angles combined with the *indices* of the derived forms. And this is another important use of the system of notation of which we here speak.

The mathematical science of crystalline forms, has therefore for its object, 1*st*, To show the kind of forms produced in each *system* by the *laws of derivation* above-mentioned: 2*d*, To discover and demonstrate such *theorems*, with respect to these forms, as may be useful: 3*d*, To *classify* the combinations of these forms, and to show how, from the properties of these combinations, we may, by means of the theorems just mentioned, form certain *rules* for obtaining their indices of derivation: 4*th*, To establish *formulæ*, by which we may find the angles made by any planes of a crystalline form, the indices being known. These branches of the science being properly developed, we shall be able to apply to all crystals of which the faces are sufficiently exhibited, a process of analysis similar to that explained in the above instance.

ART. II.—*Comparative Effect of Rotation of a Solid Iron Ball, and Hollow Iron Shell, in producing the deflection of a Magnetic Needle.* By PETER BARLOW, Esq. F. R. S., Mem. Imp. Ac. Petrop. &c. Communicated by the Author.

IT appears from the theory of M. Poisson,* relative to the phenomena which have been observed in the rapid rotation

* An account of this theory is given in our last Number, p. 328.

of iron bodies, that, although (according to the results of some of my first experiments) the attraction of a solid ball and hollow shell have the same power on the needle when at rest, yet, if they are both put in rapid motion, their attracting power is no longer equal, notwithstanding their diameters, distance, and velocity of rotation, be precisely the same. This very singular result seemed to furnish the means of submitting this theory to the test of an *experimentum crucis*, and Mr Babbage being in Paris at the time this deduction was made, he wrote to me, at the request of M. Poisson, to make the experiment.

I accordingly procured one of our largest iron balls, a sixty-eight pounder, 7.87 inches in diameter, and a hollow spherical case shot, of exactly the same diameter, weighing just one half the former, or thirty-four pounds; but as I could not conveniently suspend the solid ball in the form I had adopted in my former rotatory experiments, I had another apparatus constructed, which is shown in Plate I. Fig. 2, where ABCD is a thick plank secured well to the floor, W a long wheel turning on its axis, and *w* a small wheel fixed to an upright axis, to the upper part of which was screwed a short wooden cylinder, having a hemispherical cup exactly the diameter of the ball and shell, and into which they were placed when submitted to rotation. The floor was cut away beyond AB, and an upright prop FE was driven securely into the earth, and the table FG fixed to the upper part, projecting over the ball upon which the compass *c* was placed, which was thus relieved from any shaking from the motion of the ball or shell. This apparatus was fixed on the magnetic meridian, and, in order to increase the apparent effect, the needle was reduced in directive power by a powerful bar magnet placed in the meridian beyond the table.

Every thing being thus arranged, the following experiments were made:—

With the Ball.
Rate of Rotation, 640 *per minute.*

Experiments.	Reading of the needle with the ball at rest.	Deflection, motion to the left.	Deflection, motion to the right.	Mean deflection.
1	0° 0′	27° 0′	29° 0′	28° 0′
2	+1 0	28 0	29 0	28 30
3	—0 30	28 0	29 30	28 45
4	0 0	28 30	29 0	28 45
5	0 0	27 30	29 30	28 0
6	+1 0	27 30	29 0	28 15
7	—0 30	27 30	29 0	28 15
8	+1 0	28 30	29 0	28 45

General mean deflection, 28° 24′.

With the Shell.
Rate of Rotation 640 *per minute.*

Experiments.	Reading of the needle with the shell at rest.	Deflection turning to the left.	Deflection turning to the right.	Mean deflection.
1	+0° 30′	14° 45′	15° 0′	14° 52′
2	0 0	15 0	15 0	15 0
3	+1 0	15 30	15 0	15 15
4	0 0	15 30	15 30	15 30
5	—0 30	15 0	15 0	15 0
6	+0 30	15 30	15 30	15 30
7	+0 30	15 0	15 0	15 0
8	0 0	15 0	15 0	15 0

General mean deflection, 15° 5′

Under like circumstances, therefore, the deflection of the
ball was - - - - - 28° 24′
Do. of the shell - - - 15 5
Which is very nearly in the proportion of their respective masses.

These results were observed under more favourable circumstances than those I sent to M. Poisson; and although, from the heavy and cumbrous nature of the apparatus, they cannot be said to possess all that accuracy which is necessary for submitting a refined mathematical theory to experimental test yet the difference is so marked as to leave no doubt of the main fact, that a very different result is obtained when the bodies are in motion, notwithstanding their equal powers when at rest, which is, indeed, all I engaged to ascertain. I have not at present had the pleasure of seeing M. Poisson's numerical deductions, nor any sketch of his theory beyond what was contained in your last number; it will therefore be very gratifying to me if it should be found, when the theory and experiments are compared, that the agreement is as close as from the nature of the operation we have any just reason to expect.

Royal Military Academy,
23d October 1826.

Art. III.—*On the Females of Pheasants which assume the plumage of the male.* By M. Isidore Geoffroy Saint-Hilaire. *

The name of *Faisans Coquards* is applied by sportsmen to those pheasants whose plumage is tarnished and discoloured, but in its colours resembles that of the male. It was long believed, and an inspection of their colours naturally led to the idea, that these *faisans coquards* were males suffering under sickness or in a bad state of plumage; on the contrary, it is now nearly half a century since we have been aware of the facts that these birds are females; a circumstance partly detected by those who have reared them in a tame state, and observed their developement, and partly by anatomical dissections. The true sex of these pretended males was ascertained both by Vicq-d'Azyr and Mauduit.

Mauduit, the author of the ornithological department of the *Encyclopédie Méthodique*, is hitherto the only writer who has furnished us with information on this interesting fact.—(See Article *Ornithologie* of that work, t. ii. p. 3.)

" One fact in their history," says this philosopher, " known to sportsmen, but I believe not mentioned by naturalists, is too important to be omitted. Aged females, who have pro-

* Translated from the *Annales des Sciences Naturelles.*

bably obtained the age of five or six years, not only cease to be prolific, or are so in a very slight degree, but assume a plumage which becomes more and more similar to that of the male the older they grow, so that they resemble males with dull and discoloured plumage."

He informs us afterwards, that he dissected a *coquard* about 1770; that Vicq-d'Azyr subsequently dissected many, and that all were females, in which the ovary was, to use his own words, "so much obliterated as to elude their search." He also adds, that a ranger of the forest of Saint Germain had discovered that old pheasant hens which had ceased to lay acquired a good deal of the male plumage. "This fact," he observes in conclusion, "has doubtless escaped observation in *faisanderies*, because *there* only young females are kept; but the phenomenon has been since verified in the female of the golden pheasant of China, (*Phasianus pictus*, L.) because these rare birds are preserved as long as possible."

Such are the observations of Mauduit, who, it is evident, has confined himself to the change of plumage; and no one since his time has bestowed any attention upon this interesting physiological phenomenon, which has even been noticed in very few works devoted to ornithology. I am, therefore, induced to publish some analogous facts which I have collected, and which I regard as sufficiently interesting, and more complete, from being the experience of a greater number of years. By means of this advantage, I shall be enabled to bring forward various details connected with the change of plumage, and to show that the passage which Mauduit had only seen to be partially effected, is sometimes full and complete.

My observations have been made upon the pencilled pheasant (*Phasianus nycthemerus*,) the collar'd pheasant (*P. torquatus*,) and the common pheasant (*P. colchicus*.)

1. *The common Pheasant.*—The female of this species was reared in the *faisanderie* of the museum. She ceased to lay at the age of about five years, and the change of plumage began to be developed about the same period. It became first apparent on the belly, which acquired a more yellow tint, and upon the neck, the colours of which became more lively; in a

short time the whole body exhibited a change. The following year the colour of the feathers assumed much more of the liveliness and splendour of those of the male bird, and from that time it might be said that the hen resembled a cock-pheasant whose plumage was dull and discoloured. The third year, however, exhibited the change so much more perfectly, that it became impossible not to commit mistakes in regard to the sex, when the plumage alone was regarded, above all, when no male pheasant was by ; for the resemblance was very great, yet not entirely complete.

Such was the state of the plumage of this female at eight years of age ; she partook freely of her food, and enjoyed good health, and every thing appeared to favour the anticipation of perfect male plumage the following year. By some accident, however, she was killed. She had always lived like the other hen pheasants with the cocks, but after the change had become visible in her plumage, she became altogether an indifferent object to them. She herself, at the same time, neither sought them nor avoided them, but associated with them in manner and exterior.

At the time of her death, her plumage was so near that of the male, that persons accustomed to see and even breed pheasants, were deceived, and pronounced it a dead male pheasant. Nevertheless, the resemblance was not complete, as we shall see by the following observations.

2. *The pencilled Pheasant.*—The present species excited much interest, inasmuch as the observations were more complete, having been continued for four years and a half. The preceding example I have brought forward chiefly to assist in illustrating the general circumstances attending a change of plumage, and the period of time necessary for its perfect developement.

This female had been reared in company with a male at a country house of an old friend of my family, M. Montard, notary in Paris, but in her old age was presented to the museum.

She did not begin to exhibit any change till she was eight or ten years of age ; much later, therefore, than the common pheasant I have noticed. Another remarkable circumstance is, that she had ceased to lay eggs three or four years before the change became apparent; whereas the common pheasant ceased to lay and to assume the change about the same time. Some white feathers which appeared among the brown ones of the perfect state, announced the first approach towards a masculine character in the plumage. The passage was more conspicuous the following season; but the change could not in reality be affirmed to have been effected till the third year. In the fourth year, the resemblance became complete; the tuft and the tail were even elongated to the masculine proportion, while they acquired the brightest colours; and this fact deserves notice, that we not only see the colours change, but their natural proportions likewise. In the fifth year, the similarity was identical, and the hen-pheasant was to all appearance a cock ornamented with the most brilliant plumage.

The male bird lived till the period when the change began to appear in the female; and, probably, in consequence of being his only companion, he did not then regard her with indifference. She, on the contrary, fled from him, appearing sometimes annoyed by his presence. Nevertheless, when the male died, she seemed to be weary of her solitary situation, and on this account was presented to the museum, where she was kept for some time. But the infirmities of old age coming on, and her death appearing to be not far distant, she was killed, in order that her skin might be preserved before the feathers became injured by the effect of some disease. At this time she had lived thirteen or fourteen years, and four years and six months had elapsed since the change in the plumage commenced. She resembled a male minutely in the finest state of plumage,—a fact which any one may convince himself of, by inspecting the specimen prepared from the skin, in the zoological galleries of the museum.

Care has been taken, also, to preserve the sexual organs; their dissection demonstrated, by the side of the *persistent* ovary, two little bodies, apparently the vestiges of the last *ovules* which escaped from the ovarian sac. The *aduterum* of an ovate form was very distinct. It is important to note the presence of the ovary, on account of the observations of Mauduit and Vicq-d'Azyr on this subject. The feathers of the years preceding the last moult were preserved by those who first possessed the bird, and it is owing to this circumstance, as well as to the memoranda with which they furnished me, that I have been enabled to bring forward many of the above details.

3. *The Collared Pheasant.*—The female of the collared pheasant, whose history we have now to relate, was reared like the preceding, by a private individual near Paris, and was in like manner presented to the Museum in its old age. The donor mentioned that she had produced eggs several times with him; nevertheless, as the change of plumage was already far advanced, and she presented rather the characters of the male than the female, it was thought necessary, after her death, to ascertain the actual sex, by a dissection of the genital organs.

The colours were in effect very similar to those of the male, as may be seen by consulting the specimen itself, in the galleries of the museum. Yet the upper wing and tail covers were red like the rest of the body, the collar less marked, and the belly much less black than in the male; so that the resemblance was by no means so exact as in the preceding example. Thus we should not have admitted this case, which we did not examine in the living state, and consequently did not trace the developement, if it had not excited in another respect considerable interest. The spur—a character peculiar to the male sex—was present in this bird, and even almost as large as in a vigorous perfect male.

We find, therefore, that the spur itself is not, among pheasants, the exclusive property of the male, but exists occasionally in the female; and that a hen-pheasant may, after a certain lapse of time, not only become clothed with the exact plumage of the male, but acquire all the external characters, the trifling developement of the red circum-orbital membrane remaining the only index of its true sex.

The voice of the old female changes at the same time as her plumage, and becomes, as has been long known, like that of the male. Country people are well acquainted with this fact in the common fowl.

It ought, however, to be here remarked, that it is by no means rare to see the spur developed, as an anomaly among the females of species, where the males only are ordinarily furnished with that organ, especially among common fowls. But in this case, besides the spur being mostly much smaller, it has generally the appearance of an anomalous organ. Thus the two spurs are very unequal, and sometimes even, when one heel is armed with a very large spur, the other is altogether without any. It consequently happens, that a female may often be distinguished from the male, though in other respects resembling him, by the anomalous formation of the spur.

As the pheasant can be domesticated like the common fowl, and approximates to it very nearly in organization, it is natural to conclude, that the spur would present similar phenomena. And so it proved in the hen of the collared pheasant, the left spur was developed much more than the right; it was slender, and the surface, as it were, tuberculated.

Be this as it may, the possibility of the complete change of plumage in one species—a fact neither observed by Mauduit, nor by any other ornithologist—being well established, are we authorized to conclude, that it may equally take place in other species, not only of the pheasant, but of other genera? I conceive we can scarcely hesitate to answer in the affirmative, as far as the species of one genus are concerned, since we have seen the change perfected in one instance, and partly perfected in two others. Taking analogy for our guide, we should be tempted to extend very considerably this conclusion; and there are, indeed, many circumstances which come in support of it. Thus many travellers have descriptions, which can only be explained by the supposition that they have spoken of females more or less clothed with male plumage. M. Dufresne, who is at the head of the zoological laboratory of the museum, has assured me, that the females of the genus *Ampelis* resemble the males in old age. M. Florent Prevost has witnessed the commencement of a change of plumage in many females of *Fringilla*; and the same observation has been made upon the female of the *Rouge-queue*, *

* This name has been applied by the French to several birds; and as the author does not give the scientific name, we are afraid to fix upon any particular individual.

and upon that of the common starling. Lastly, we may remark, that analogous facts prevail, even in animals of a very different organization, not to mention the human race. Among women, after the cessation of the catamenia, the chin and upper lip become furnished with a true beard,—a phenomenon which no one can deny to be of a similar nature with the developement of the plumage in the hen pheasant.

We should be wrong, however, notwithstanding these remarkable analogies, to pronounce this phenomenon to be a general fact; for there are birds in which it has never been observed. Thus, though the number of pea-hens is considerable in the menagerie of the museum, and though these birds are always suffered to die a natural death, and consequently often of old age, it has never occurred that a change of plumage was remarked; whereas, in the pheasant it is so frequent that I could have cited many more instances. Twelve or fifteen years ago, a female of the common species nearly completed her change in the museum, and I have seen it often myself commenced in the hen golden pheasant.

It is worthy of remark, that the peacock and the pheasant, though differing greatly in the point on which we have been comparing them, belong, nevertheless, to the same group, Gallinaceæ, and are even nearly related genera, a fact which renders the example more striking.

It remains also to be noticed, that the *young male* pheasant and the *hen commencing her change*, are similarly situated in regard to plumage; it is the same in both, and both in a certain period, more or less distant, will acquire the perfect adult male plumage. The same change will therefore be effected in each bird, and it would be natural to suppose, that it would take place in the same manner, differing only in rapidity, the male in a few months passing through that which occupies the female a certain number of years. This, however, is not the fact. It will be sufficient to compare the descriptions given by ornithologists of the young male, with the details I have brought forward belonging to old females, to perceive, that, in both cases, the change is effected in a different manner, and that in fact it is almost impossible to determine whether a hen, in whom the change has commenced, has the plumage of a young cock of such or such an age. It is remarkable, that such a diversity should exist among circumstances tending to produce the same end.

The observations of Mauduit had already shown, that hen pheasants resembled the males in their old age; that the change in the plumage is gradually produced, and more decided, as age advances; and that the ovary is so much obliterated in many of such females, as to be no longer perceptible. It should be presumable, that those in whom the ovary had thus disappeared, were the examples in which the plumage was most changed, which is not the case; for this organ was not found in females imperfectly resembling males, while I have seen it, in the instance we have described, where the resemblance was absolutely perfect.

To these facts my observations have contributed the following additional ones:—that the change of plumage commences in some females later than in others—that it may either manifest itself some years after the female ceases laying, (though it depends more or less directly on this phenomenon,) or concide with that cessation—that it occurs usually in the fourth year, when the change is perfected, and that the female has then not only the colours, but the splendour of the male—that, like him, she may exhibit spurs—that the progression from dull, to the brilliant plumage of the adult male, is effected differently in the young male and in the old female, although the result be precisely the same;—and lastly, that the change of plumage in old females among birds, is not a general fact; and that, because it has been remarked in one genus, it does not even certainly exist in other genera of the same family; while, on the other side, many other distant groups appear to afford examples of this remarkable phenomenon.

Having given the facts regarding the change of plumage in the hen-pheasant, as detailed by M. Saint-Hilaire, it may be proper to state, that such changes of plumage are by no means confined to this species of bird. In a paper on this subject in the Wernerian Transactions, by Mr John Butter, (vol. iii. p. 183,) which M. Saint-Hilaire does not appear to have seen, a number of facts are recorded of the plumage in female birds changing in age to that of the male. Mr John Hunter had previously noticed this change in the hen-pheasant and pea-hen, in a Memoir published in the Philosophical Transactions, also unnoticed by M. Saint-Hilaire; and Mr Butter has collected a number of instances, not only among the *Gallinæ*, but also among the *Palmipedes* and *Waders*, of similar changes. A figure of the common domestic hen in the plumage of the male, illustrates Mr Butter's paper; and the circumstance of the female of this species when aged, essaying to crow like the cock, is a fact known in every poultry-yard in this country. A vulgar prejudice permits not the change in plumage to be carried further; for a *crowing hen* being accounted unlucky, the death of the animal always follows this incipient change. A specimen of a pea-hen beginning to assume the male plumage, is, we believe, in the Museum of the University of Edinburgh. Mr John Hunter regards this change in the female plumage as monstrous; but Mr Butter, with more appearance of truth, is disposed to consider "that this change of plumage in old hens, is not confined to one, two, or three different species, but that probably the same disposition is common to numbers of the feathered race;"—"and that the change is almost always natural, produced either by the effects of age, of sterility, or other causes which tend to work some changes in the constitution of birds."

Art IV.—*On Zinkenite, a New Mineral Species.* By Dr Gustavus Rose. Communicated by the Author.

The shape of the crystals of Zinkenite most nearly resembles Plate I. Fig. 3, which is a regular six-sided prism (M,) terminated by obtuse six-sided pyramids, (P,) whose faces are set on the edges of the prism.

The following are the principal measures of the angles, calculated from the admeasurement given = 150° 36′, upon the supposition of the prism being a regular one.

M on M = 120° 0′.
P on M = 102° 42′.
P on P (adjacent) = 165° 26′.
P on P (over the apex) = 150° 36′.

The faces marked *M* are usually deeply striated in a longitudinal direction; the inclined faces, though not streaked, are uneven, and by no means smooth. The fracture is uneven, and does not present any traces of cleavage. The lustre is very bright metallic; the colour of the crystals themselves, and of their powder, is steel-grey.

The hardness is between 3.0 and 3.5, a little more considerable than that of calcareous spar. The specific gravity I found = 5.303, at a temperature of 10° R. Another experiment gave 5.310, at a temperature of $10\frac{1}{2}$°.

The crystals are aggregated in groups presenting a columnar composition; they occur on massive varieties of the same species, in massive quartz. Their length often exceeds half an inch, their breadth two or three lines, but frequently they are also very thin, and form together fibrous masses.

When heated alone before the blowpipe on charcoal, the Zinkenite briskly decrepitates, and melts as easily as the grey antimony. Small metallic globules are formed, which are entirely volatile, on the blast being continued, while the charcoal is covered with a white coating of oxide of lead, and at a little greater distance from the globules with a white perfectly volatile coating of oxide of antimony. In the mattress it decrepitates and melts; near the assay a small quantity of the same kind of black sublimate is formed, as when we treat the grey antimony in the same manner; at a little greater distance, a yellow substance is deposited, which becomes white on cooling, and may be entirely volatilized. When heated in a glass tube, it decrepitates and melts; a dense white smoke fills the tube, and is condensed in the colder parts of the tube, but this deposit cannot be entirely volatilized. Near the assay a melted yellow mass of oxide of lead is visible. The air passing through the tube has a strong smell of sulphurous acid. With soda, the mineral yields many globules of metallic lead.

Zinkenite is found in the antimony mine of Wolfsberg, near Stolberg, in the south-eastern part of the Hartz.

Several years ago, the specimens of the mineral described above, were given to me by Mr Zinken, the director of the Anhalt mines; in compliment to him, I propose the name of

Zinkenite. Mr Zinken himself has given an account of most of its characters in his "*Description of the Eastern Hartz,*" along with some experiments by the blowpipe, proving the mineral to contain sulphur, antimony, and lead, with a little copper. I had delayed publishing the description of the species, chiefly because I expected to receive a farther supply of specimens, which might have allowed of a more exact determination of the regular forms. I am inclined to think that the six-sided prism *M* is not a regular one, but an assemblage of several individuals, after the same law, which occurs in arragonite. The exact admeasurement of the angles is very difficult, particularly on account of the numerous longitudinal striæ. In some crystals, however, where these striæ begin only at some distance from the edge, I constantly found the angle to exceed 120°, and the mean of two, the most distinct I met with, was 120° 39′. If no attention be given to the striæ, the angles will be found varying from 118½° to 124½°. The crystalline form of each of the individuals, taken separately, seems therefore to be a rhombic prism of 120° 39′, (*M*) terminated by two planes (*P*,) making over the edge an angle of 150° 36′ with each other. They are set on the obtuse edges of the prism, as in Fig. 4. The mode of their regular composition is represented in Fig. 5. Two individuals are joined to a third in such a manner, that their planes *M′* and *M″* coincide with the planes *M* and *M*, of that individual to which they are attached. Supposing the individuals to be prolonged beyond their faces of composition, a form will ensue, resembling a six-sided prism; but on two faces, opposite to each other, there will be slightly salient angles of 178° 3′, while the six angles are each equal to 120° 39′. Of the six terminal edges between the faces marked *P*, four are equal to 165° 30′ each; and two others slightly differing from them correspond to the obtuse salient angles formed on two of the lateral planes of the prism. The inclination of *P* on *M* is = 102° 42′. I found by measurement 102° 34′—102° 49′. The difference among the terminal edges would be decisive, if we were not prevented from observing it, by the unevenness of the faces. Generally I could measure only one of them, and in no instance all the six; they were found about 165° 40′ to

165° 50′. With a somewhat higher degree of precision, I sometimes found the inclination of two faces over the apex = 150° 36′, as is given above. Besides the alternation of particles of the individuals, the striæ may likewise be owing to some additional faces, which replace the acute edges of the prism, and have therefore nearly the same situation as the faces of the six-sided prism.

Zinkenite bears a high degree of resemblance to the grey antimony, though it is at once distinguished from it by the bright cleavage of the latter, parallel to the short diagonal of a rhombic prism of about 90½°, by its lower degree of hardness, which is equal only to 2.0, or the hardness of rock-salt, and by its lower specific gravity, which, according to Mohs, is only = 4.620. As to colour, hardness, and fracture, it greatly resembles Bournonite, but it differs in its regular form, though belonging to the same system of crystallization, besides some slight, yet easily perceptible shades, even in the colour, which is darker in Bournonite, and approaches to blackish lead-grey, while the hardness is somewhat lower, only 2.5 to 3.0 of the scale of Mohs, a little below calcareous spar.

ART. V.—*On the Case of a Lady Born Blind, who received Sight at an Advanced Age by the Formation of an Artificial Pupil.** By JAMES WARDROP, Esq. F. R. S. Edin. Surgeon Extraordinary to the King.

THE lady, whose case forms the subject of this paper, was observed, during the first months of her infancy, to have something peculiar in the appearance of her eyes, and an unusual groping manner, which made her parents suspect that she had defective vision. When about six months old, she was placed under the care of a Parisian oculist, who performed an operation on both her eyes, with a view to afford her sight. The operation on the right eye was, however, followed by

* This Article is abridged, though very slightly, from the original Memoir, which will appear in the next part of the Philosophical Transactions. —ED.

violent inflammation, and a collapse of the eye-ball, thus causing a complete destruction of the organ of vision. The operation on the left eye, though equally unsuccessful in attaining its object, was not followed by any alteration in the form or size of the globe.

From the above early period she had continued totally blind, being able merely to distinguish a very light from a very dark room, but without having the power to perceive even the situation of the window through which the light entered; though in sunshine or in bright moonlight, she knew the direction from whence the light emanated. With regard therefore to the degree of sight, this lady was more completely blind than the boy in the celebrated case related by Mr Cheselden, in the 35th volume of the Transactions of the Royal Society; for in that instance the boy knew black, white, and scarlet apart from one another; and when in a good light he had that degree of sight, which generally continues in an eye affected with cataract; whereas in this lady, the pupil being completely shut up, no light could reach the retina, except such rays as could pass through the substance of the iris.

When she was placed under my care she had reached her forty-sixth year. The right eye-ball was collapsed, but the left retained its natural globular form. The cornea of this eye was transparent, except at one point near its circumference, where there was a linear opacity, which had probably been the cicatrix of the wound made during the operation in her infancy. The anterior chamber of the eye was of its natural capacity, but I could not distinguish any vestige of a pupil, some streaks of yellow lymph being deposited in an irregular manner over the central part of the iris. There was every reason to believe that the retina was sound; for though she could not perceive objects, nor had any notion of colours, yet the circumstance already mentioned of her being able to distinguish between a very light and a very dark chamber, and between a gloomy day and sunshine, rendered it probable that the nerve was in a sound and natural state. Under this impression, I thought that the restoration of her sight by making an artificial pupil was practicable, and certainly well worthy of a trial. Accordingly, on the 26th of January, I introduced a very small needle through the cornea, passing it also through the centre of the iris; but I could not destroy any of the adhesions which had shut up the pupillar opening. After this operation she said she could distinguish more light, but she could perceive neither forms nor colours.

On the 8th of February, a second operation was performed, which consisted in passing a sharp edged needle through the sclerotica, bringing its point through the iris into the anterior chamber, repassing it into the posterior chamber at a small distance, and then dividing the portion of iris thus included between the two perforations of the needle. Only a very slight inflammation followed,—the light became offensive to her,—she complained of its brightness, and was frequently observed trying to see her hands; but it was evident her vision was very imperfect; for although there was an incision made in the iris, some opaque matter lay behind this opening, which must have greatly obstructed the entrance of light.

On the 17th of February, a third operation was performed, which consisted in still further enlarging the opening in the iris, and in removing the opaque matter, by a needle introduced through the sclerotica. This was followed by a very slight degree of redness. The operation being performed at my house, she returned home in a carriage, with her eye covered only with a loose piece of silk, and the first thing she noticed was a hackney coach passing, when she exclaimed, "What is that large thing that has passed by us?" In the course of the evening she requested her brother to show her his watch, concerning which she expressed much curiosity, and she looked at it a considerable time, holding it close to her eye. She was asked what she saw, and she said there was a dark and a bright side; she pointed to the hour of 12, and smiled. Her brother asked her if she saw any thing more? she replied, "Yes," and pointed to the hour of 6, and to the hands of the watch. She then looked at the chain and seals, and observed that one of the seals was bright, which was the case, being a solid piece of rock crystal. The following day I asked her to look again on the watch, which she refused to do, saying, that the light was offensive to her eye, and that she felt very stupid; meaning that she was much confused by the visible world thus for the first time opened to her. On the third day she observed the doors on the opposite side of the street, and asked if they were red, but they were in fact of an oak colour. In the evening she looked at her brother's face, and said that she saw his nose; he asked her to touch it, which she did; he then slipped a handkerchief over his face, and asked her to look again, when she playfully pulled it off, and asked, " What is that?"

On the sixth day, she told us that she saw better than she had done on any preceding day; " but I cannot tell what I do see; I am quite stupid." She seemed indeed bewildered from not being able to combine the knowledge acquired by the senses of touch and sight, and felt disappointed in not having the power of distinguishing at once by her eye, objects which she could so readily distinguish from one another by feeling them.

On the seventh day she took notice of the mistress of the house in which she lodged, and observed that she was tall. She asked what the colour of her gown was? to which she was answered, that it was blue: " so is that thing on your head," she then observed; which was the case: " and your handkerchief, that is a different colour;" which was also correct. She added, " I see you pretty well, I think." The tea-cups and saucers underwent an examination: " what are they like?" her brother asked her. " I don't know," she replied; " they look very queer to me; but I can tell what they are in a minute when I touch them." She distinguished an orange on the chimney-piece, but could form no notion of what it was till she touched it. She seemed now to have become more cheerful, and entertained greater expectation of comfort from her admission into the visible world; and she was very sanguine that she would find her newly acquired faculty of more use to her when she returned home, where every thing was familiar to her.

On the eighth day, she asked her brother, when at dinner, " what he was helping himself to?" and when she was told it was a glass of port wine, she replied, " port wine is dark, and looks to me very ugly." She observed, when candles were brought into the room, her brother's face in the mirror, as well as that of a lady who was present; she also walked, for the first time without assistance, from her chair to a sofa which was on the opposite side of the room, and back again to the chair. When at tea, she took notice of the tray, observed the shining of the japan work, and asked "what the colour was round the edge?" she was told that it was yellow; upon which she remarked, "I will know that again."

On the ninth day she came down stairs to breakfast, in great spirits; she said to her brother, "I see you very well to-day;" and came up to him, and shook hands. She also observed a ticket on a window of a house on the opposite side of the street ("a lodging to let;") and her brother, to convince himself of her seeing it, took her to the window three several times, and to his surprise and gratification, she pointed it out to him distinctly on each trial.

She spent a great part of the eleventh day looking out of the window, and spoke very little.

On the twelfth day she was advised to walk out, which recommendation pleased her much. Mr —— called on her, and she told him she felt quite happy. Her brother walked out with her as her guide, and took her twice round the piazzas of Covent-Garden. She appeared much surprised, but apparently delighted; the clear blue sky first attracted her notice, and she said, "it is the prettiest thing I have ever seen yet, and equally pretty every time I turn round and look at it." She distinguished the street from the foot pavement distinctly, and stepped from one to the other like a person accustomed to the use of her eyes. Her great curiosity, and the manner in which she stared at the variety of objects, and pointed to them, exciting the observation of many bystanders, her brother soon conducted her home, much against her will.

On the thirteenth day nothing particular took place till tea-time, when she observed that there was a different tea-tray, and that it was not a pretty one, but had a dark border; which was a correct description. Her brother asked her to look in the mirror, and tell him if she saw his face in it? to which she answered, evidently disconcerted, "I see my own; let me go away."

She drove in a carriage, on the fourteenth day, four miles on the Wandsworth road; admired most the sky and the fields, noticed the trees, and likewise the river Thames as she crossed Vauxhall bridge. At this time it was bright sunshine, and she said something dazzled her when she looked on the water.

On the fifteenth day, being Sunday, she walked to a chapel at some distance, and now evidently saw more distinctly, but appeared more confused than when her sight was less perfect. The people passing on the pavement startled her; and once when a gentleman was going past her, who had a white waistcoat and a blue coat with yellow buttons, which the sunshine brought full in her view, she started so as to draw her brother, who was walking with her, off the pavement. She distinguished the clergyman moving his hands in the pulpit, and observed that he held something in them; this was a white handkerchief.

She went in a coach, on the sixteenth day, to pay a visit in a distant part of the town, and appeared much entertained with the bustle in the streets. On asking her how she saw on that day? she answered, "I see a great deal, if I could only tell what I do see; but surely I am very stupid."

Nothing particular took place on the seventeenth day; and when her brother asked her how she was? she replied, "I am well, and see better; but don't tease me with too many questions, till I have learned a little better how to make use of my eye. All that I can say is, that I am sure, from what I do see, a great change has taken place; but I cannot describe what I feel."

Eighteen days after the last operation had been performed, I attempted to ascertain by a few experiments her precise notions of the colour, size, forms, position, motions and distances of external objects. As she could only see with one eye, nothing could be ascertained respecting the question of double vision. She evidently saw the difference of colours; that is, she received and was sensible of different impressions from different colours. When pieces of paper one and a half inch square, differently coloured, were presented to her, she not only distinguished them at once from one another, but gave a decided preference to some colours, liking yellow most, and then pale pink. It may be here mentioned, that when desirous of examining an object, she had considerable difficulty in directing her eye to it, and finding out its position, moving her hand as well as her eye in various directions, as a person when blind-folded, or in the dark, gropes with his hands for what he wishes to touch. She also distinguished a large from a small object, when they were both held up before her for comparison. She said she saw different forms in various objects which were shown to her. On asking what she meant by different forms, such as long, round and square, and desiring her to draw with her finger these forms on her other hand, and then presenting to her eye the respective forms, she pointed to them exactly : she not only distinguished small from large objects, but knew what was meant by above and below; to prove which, a figure drawn with ink was placed before her eye, having one end broad, and the other narrow, and she saw the positions as they really were, and not inverted. She could also perceive motions; for when a glass of water was placed on the table before her, on approaching her hand near it, it was moved quickly to a greater distance, upon which she immediately said, "You move it; you take it away."

She seemed to have the greatest difficulty in finding out the distance of any object; for when an object was held close to her eye, she would search for it by stretching her hand far beyond its position, while on other occasions she groped close to her own face, for a thing far removed from her.

She learned with facility the names of the different colours, and two days after the coloured papers had been shown to her, on coming into a room the colour of which was crimson, she observed that it was red. She also observed some pictures hanging on the red wall of the room in which she was sitting, distinguishing several small figures in them, but not knowing what they represented, and admiring the gilt frames. On the same day, she walked round the pond in the centre of St James's Square, and was pleased with the glistening of the sun's rays on the water, as well as with the blue sky and green shrubs, the colours of which she named correctly.

It may be here observed, that she had yet acquired by the use of her sight but very little knowledge of any forms, and was unable to apply the information gained by this new sense, and to compare it with what she had been accustomed to acquire by her sense of touch. When, therefore, the experiment was made of giving her a silver pencil case and a large key to examine with her hands; she discriminated and knew each distinctly; but when they were placed on the table, side by side, though she distinguished each with her eye, yet she could not tell which was the pencil case and which was the key.

Nothing farther occurred in the history of this lady's case worthy of notice till the twenty-fifth day after the operation. On that day she drove in a carriage for an hour in the Regent's Park, and on her way there seemed more amused than usual, and asked more questions about the objects surrounding her, such as "What is that?" it is a soldier, she was answered; "and that, see! see!" these were candles of various colours at a tallow chandler's window. "Who is that, that has passed us just now?" it was a person on horseback: "but what is that on the pavement, red?" it was some ladies who wore red shawls. On going into the Park, she was asked what she saw particularly, or if she could guess what any of the objects were. "Oh yes," she replied, "there is the sky, that is the grass; yonder is water, and two white things;" which were two swans. On coming home along Piccadilly, the jewellers' shops seemed to surprise her much, and her expressions made those around her laugh heartily.

From this period till the time of her leaving London on the 31st of March, being forty-two days after the operation, she continued almost daily to gain more information of the visible world, but she had yet much to learn. She had acquired a pretty accurate notion of colours and their different shades and names; and when she came to pay me a farewell visit, she then wore a gown, the first of her own choice, with the light purple colour of which she seemed highly gratified, as well as with her cap, which was ornamented with red ribbons. She had not yet acquired any thing like an accurate knowledge of distance or of forms, and up to this period she continued to be very much confused with every object at which she looked. Neither was she yet able, without considerable difficulty and numerous fruitless trials, to direct her eye to an object; so that when she attempted to look at any thing, she turned her head in various directions, until her eye caught the object of which it was in search. She still entertained however the same hope which she expressed soon after the operation, that when she got home her knowledge of external things would be more accurate and intelligible, and that when she came to look at those objects which had been so long familiar to her touch, the confusion which the multiplicity of external objects now caused, would in a great measure subside.

ART. VI.—*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. (Concluded from Vol. V. p. 288.)

NOT being able to prevail upon the Tartars to allow them to proceed a step further, the travellers unwillingly began their return (27th of July.) They again traversed the *Këúbrang* pass, and repeated their barometric measurement of it with the same result; halted at *Rishí Talam,* 15,200 feet high, two miles from their former stage at *Zongchin,* and proceeded by the *Gangtang* pass to *Rishí Irpú,* on the *Hóchó* river.

At the limit of vegetation (16,600 feet above the sea) it commenced snowing, and they were involved in a dense haze: the guides missed their way, knew not how to proceed, and became alarmed. They halted, therefore, for a while; and, the clouds clearing away for an instant, Messrs Gerard got sight of a *shaghar,* or pile of stones, the bearing of which they took; and being surrounded by mist, steered towards it by a pocket compass. The ascent was steep, and they often scrambled over sharp-pointed rocks. They proceeded a mile and a half, guided by the compass; and the lower clouds clearing away, they found themselves within half a mile of the *shaghar.* The summit of the pass was measured barometrically, 18,295 feet above the sea.

A stream, that unites with the *Táglá*, lay upon the left the greater part of the way ascending the pass; they descended it along the *Hóchó*, which comes from the left, where there is a great expanse of snow. They followed its course to *Rishi Irpú*. The valley is generally half a mile broad. The river is picturesque: in one part a clear and shallow stream, in another it thunders over rocks in a succession of sparkling cascades. There are several arches of snow over it. In several places its course was partly arrested by rocks from above. It is concealed for a considerable space by a huge pile of stones, and it forces its way underneath, bursting forth in a large body of water. In other places it forms large deep lakes, and leaps over the embankments, with tremendous noise, in sheets of white spray.

Limestone, which had been the prevailing rock since they first met with it in the vicinity of *Zongchen*, near the *Táglá*, became more rare as they approached *Irpú*, and disappeared near that place. It is there succeeded by mica slate.

Next day they proceeded down the valley of the *Hóchó* to *Dábling*, a place visited likewise in the preceding year, in sight of the *Setlej*, and of the village of *Púí*, on its banks. By the way they passed the highest cultivation yet seen, consisting of barley, phápur, and turnips, at an elevation of 13,600 feet above the sea. A little lower, the ground was covered with thyme, sage, and many other aromatic plants, besides juniper, sweet-briar and gooseberries. At *Púí* there are vineyards and groves of apricots: at *Dábling*, much cultivation, and plantations of apricots and walnuts.

After a halt of four days for astronomical observations, during which time the temperature was warm, varying from 61° at sunrise to 85° at noon, the wind blowing very strongly from the S. W., and the sky frequently obscured with light clouds attended with a little rain; they moved (4th August) along the banks of the *Setlej*, or in the bed of the river, to *Namgía*. On the right margin of the river, the mass of rock (granite) is so steep, and the fracture so fresh, as to give it the appearance of having been recently broken.

Several temporary huts, perched high among the crags across the river, are the summer residence of the hunters of *Hango*, who roam among the rocks in quest of deer.

Kháb, a village of but two houses, a mile from *Namgía*, is immediately opposite the junction of the *Lí* or *Spíti* river, one of the largest tributaries of the *Setlej*, having its source in *Ladak*. The cheeks of the gulf (solid granite) seem perfectly mural for many hundred feet; one of the arms of the *Pargéúl* mountain limits the left side of the channel of the *Spíti*. The contrast between the two streams is striking: the *Spíti* issues from its almost subterraneous concealment in a calm blue deep body, to meet the *Setlej*, which is an absolute torrent, thundering over the stones in deafening clamour.

Namgía, containing eight houses, is the last or most eastern village in *Basehar:* the houses are built of granite, but their structure ill accords with the durability of the materials. The want of forests, to supply the timber necessary to give union to the walls, is the source of the bad workmanship: the granite blocks resist the mountaineer's rude implements.

The mountains on every hand are of stupendous height. Those immediately at the back of the village exclude the sun till eight o'clock; and the consequent deficiency of solar heat retards the ripening of the crops. They were here very backward: harvest was yet a month distant.

It had been determined to renew an attempt of penetrating eastward, beyond the boundary of British influence, into the upper valley of the *Setlej*. Accordingly they marched to *Shipkí*, in Chinese Tartary, by the *Píming* pass (13,518 feet,) the boundary between *Basehar* and Chinese Tartary. There could scarcely be a better defined limit: in front the face of the country is entirely changed; eastward, as far as the eye can see, gravelly mountains of a very gentle slope succeed one another. No rugged cliffs rise to view, but a bare expanse of elevated land, without snow, and in appearance like a Scotch heath. Just beyond the *Setlej*, the mighty *Pargéúl*, an immense mass, rises to 13,500 feet above the bed of the river, more than 21,000 above the sea. To the east of it, in the same granitic range, are several sharp pinnacles, nearly as high, being more than 20,000 feet above the sea: on the S. W., at the back of the town of *Shipkí*, is an enormous mass

20,150 feet high, crowned with perpetual snow. The *Shírang* mountain, over which the road to *Gárú* leads, exceeds 18,300 feet in actual height above the sea: yet only one small stripe of snow could be detected on it with the telescope.

Shipkí had been twice before (in 1818 and 1820) visited by the same travellers. They now received a letter from the *Garpan* of *Gárú* (in reply to one sent by them from *Zinchin*,) prohibiting their advance eastward. At the same time the local authorities were instructed to furnish no provisions at any price.

Messrs Gerard returned to *Namgía* by the lofty pass of *Kóngma* (16,007 feet above the sea:) it is the usual resting-place for beasts of burden. Furze and grass extend considerably higher on each side; and springs rise, which form a lake at the distance of 150 yards.

Intending to explore the valley of the *Lí* or *Spíti* river, and penetrate by that route as far as might be found practicable, they crossed the *Setlej* by a *jhólá*, or bridge of suspension, made of twigs twisted together. The bed of the river is here 8600 feet above the level of the sea; the breadth of the stream is 75 feet.

From the *Setlej* the path leads up the face of a granite range to *Taz-hi-gang*, perched amidst ruins of a frightful bulk, at the height of 11,850 feet above the sea. The temple and residence of the Lamas are still 500 feet higher. Ascending upon loose rocks to the highest point of the road (13,200 feet,) they turned the extremity of the range; and leaving the *Setlej* behind, bent their course to the north, having the *Lí* or *Spíti* on the left, about 5000 feet below, and almost a complete precipice. The road continued at a general height of 13,000 feet, upon granite, crumbling into sand, and producing a few bushes of juniper and furze.

A fine prospect suddenly opened: a village (Nákó) in the heart of abundant cultivation already yellow, with a broad sheet of water, surrounded by tall poplar, juniper, and willow trees of prodigious size, and environed by massive rocks of granite.

Separate measurements, at three different times (1818, 1820, and 1821,) by excellent barometers, and the boiling point of water, determine the height of *Nákó* a little more than 12,000 feet above the level of the sea: yet there are produced most luxuriant crops of barley, wheat, phápur (polygonum?) and turnips, rising by steps to nearly 700 feet higher, where is a Lama's residence, inhabited throughout the year. The fields are partitioned by dikes of granite. At *Taz-hi-gang* they are enclosed by barberry and gooseberry bushes.

The seasons are similar to those of our northern latitudes, the grain being sown in March and April, and reaped in August and September. Snow generally falls towards the end of October. It seldom exceeds two feet in depth, but does not leave the ground for nearly six months. Want of moisture in the air prevents its earlier descent, since the beginning of October is winter, under a clear sky. In the middle of October 1818, the thermometer at sunrise was seldom above 20°; now (in August) the temperature was 75° at noon, and never below 52°.

The effects of particular exposures and localities towards the developement of vegetation cannot be more strongly contrasted than between this and *Namgía*; for, although here 3000 feet higher, the crops were much further advanced. Vast extent of arid surface on every side reverberates a surprising warmth, and favours an early harvest.

The leaves of poplar are given to cattle. Besides these, junipers and a few willows are the only trees at this elevation. Firewood is of furze *(tama)* alone, and it is scarce.

Messrs Gerard were desirous of verifying by trigonometric measurement the elevation of their old high station on *Pargéúl*, just above *Nákó*. In 1818, Captain G. made it 19,411 feet by three barometers, which agreed exactly (14.675 inches.) In 1820 two other barometers were taken to this spot, and they showed 14.67 inches. The result of the trigonometric measurement now gave 7,447 feet above the former camp, which being 11,995 feet, makes the extreme height of the peak 19,442 feet above the level of the sea, differing 31 feet from the barometric measurement.

They proceeded along the banks of the *Lí* to *Chango*. Part of the road traversed a plain studded with enormous masses of rock, seeming, as Captain G. remarks, to have been under water at no very distant period. The road then lay along the bank of a rivulet, over water-worn stones of many sorts, and crossing the stream, enters the plain of *Chango.* The village is fully 10,000 feet above the sea; but this elevation does not prevent its enjoying a sultry summer, the temperature rising to 80° in August. The situation is pleasant, unlike the rude and sterile character of the country. The seasons are at least a month earlier than at *Nákó:* seed-time begins in March, and harvest in July and August. Snow falls from November to March, but it is seldom a foot in depth; and in April and May, rain is frequent. The grain crops are those noticed at *Nákó*, with *ógal?* millet, and fine fields of turnips, pease, and beans, all well tasted. There are likewise many apricots.

The plain lies east and west, in a dell, through which flow two streams, that no sooner escape from their dark and winding passages, which are bounded by lofty and inaccessible crags, nearly perpendicular, than they are conducted in tamer conduits, by the industry of man, to the fields, which rise one above another in terraces. This glen is terminated on the north and south by bare thirsty ridges, on which nothing animate appears. On the west is the *Lí* or *Spíti* river, flowing in a tranquil expanse of bed. On the east, at the head of the plain, is a high-peaked mountain, on whose summit rests snow.

The next march was to *Changrezhing* by the *Chárang lama* pass, of which the elevation is 12,600 feet. Here limestone was again met with, as well as clay-slate, &c. Pebbles imbedded in clay, and small rounded stones are numerous, all having the appearance of having been acted upon by water, although the *Spíti* is nearly 3000 feet below this level, and no rivulet is near. The *Chálá-dókpó*, a considerable stream from the eastward, extremely muddy, and rushing with inconceivable rapidity between perpendicular cliffs of granite and mica-slate, at an altitude of 11,400 feet above the sea, was crossed by a wooden bridge. The breadth of the stream was 25 feet.

Changrezhing is a dependency of *Chango*, where are a few ruinous houses, inhabited in summer. Its height is 12,500 feet above the sea. The grains cultivated are wheat, barley, phápur, and Siberian barley. The rocks in the vicinity are granite, gneiss, and mica.

Having understood that Chinese were at a short distance in front to stop them, Messrs Gerard did not move their baggage, but advanced to meet the opposite party. They crossed two rivulets, near which they saw the black currant in the highest perfection, and larger than any which they had hitherto met with. They found fifty Tartars awaiting their arrival a mile S.W. of *Chúret*, the first Chinese village. Not being able to prevail on them to allow of their proceeding, they returned to *Changrezhing*.

In the afternoon they visited the confluence of the *Spíti* with the *Zangcham* or *Paráti* river, which comes from the N.E. The last is the larger river, being 98 feet broad; the *Spíti* (from the N.W.) but 72 feet; the former rushing with great fury and noise, the latter flowing with a more gentle current. The elevation was found to be 10,200 feet above the sea.

A mile from *Changrezhing*, proceeding towards the river, they got among the crags and water-worn passages, whence it was no easy matter to extricate themselves. Captain G. remarks, that they were evidently on the former bank of the river: the whole bank was a concreted rubble, hardened by the air on the retiring of the waters. After descending a series of difficult steps or ledges, each seeming to have once been the bank of the river, they arrived at its bed. The distance from *Changrezhing* was three miles and a half.

They proceeded by the *Chóngbá* pass (11,900 feet above the sea,) and crossing the *Spíti* by a good bridge of three fir trees planked over, to *Shïálkhar*, where there is a fort in a commanding situation, on the brink of the channel. The walls are of loose stones and unburnt bricks, with houses all around the inside. It is in the parallel of 32° N. lat. The river is here 10,000 feet above the sea. The climate resembles that of *Chángo*. The grain crops are the same; and apricots are plentiful, and of very superior flavour.

Lárí, the first village in *Spíti*, a dependency of *Ládák*, is distant about eleven miles to the N.W. Messrs Gerard wished to visit it, but the *Spíti* intervened, and was then unfordable, and there are no bridges. For the same reason they could not see the hot wells between the *Spíti* and *Zangchám*, four miles north of *Shïálkhar*. They are in great repute in this quarter, and diseased people resort thither from long distances, either to bathe in them, or drink the waters.

The travellers proceeded along the glen of the *Spíti* to *Lakh*, which is 12,900 feet above the sea, whence they descended into the bed of the *Yúlang* river, a middling sized stream, rising among perpetual snow in the west. It is increased by rivulets from either side; and above the ford, a stream gushes from the brow of the mountain, and is precipitated into it in a transparent cascade. Hence the angle of ascent was 34°, rising 2000 feet perpendicular, in a distance of one mile, over hard gravel. Difficulty and danger in a thousand forms attend the traveller's progress: when he clings to the bank, he frequently brings away a piece of it. In some places there are many large stones amongst the gravel, which it requires much caution to avoid setting in motion, for one displaces others, so that sometimes a space of 100 yards of gravel and stones moves downwards at once, and the larger stones, bounding over the slopes, are showered to the bottom amidst much confusion and noise. Now and then nitches for the point of the foot were cut; and Messrs Gerard, not taking off their shoes, as their followers did, were often obliged to grasp the nearest person's hand. They reached the top without accident, much wearied with climbing, and rested upon the verge of the gulf, and enjoyed a refreshing breeze at the height of 12,700 feet, blowing over an extensive tract, which resembles a heath. Thence they descended to the village of *Liu*, which occupies a slip of land on the right bank and in the bed of the *Spíti*, embosomed by sterile masses, glowing under the ardor of a tropical sun. From this the climate acquires a delicious softness. On the east is a solitary rock 60 feet high, which was formerly the site of a fort now in ruins: southward, the plain is washed by a stream called *Lipak*, falling into the *Spíti* a bowshot distance.

They halted on the 15th August, on account of rain. In the evening, when it cleared, they visited the *Spíti*, which is here broad. It was measured 258 to 274 feet wide. The river is rapid, and at this season appears to contain a greater body of water than the *Setlej*. The snow had within two days descended on the granite range of mountains across the *Spiti*, to 16,000 feet. At *Náko*, judging from the heights before determined, it was certainly not under 18,500 feet.

Crossing the *Lipak* under the village, by a firm and well raised *sango*, they resumed their journey, (16th August) and ascended, by a steep path over granite and mica slate, to the height of 11,600 feet above the sea, and proceeded at this level for a mile, winding round sharp projections of rocks into recesses, in and out again, where the pathway bordered upon precipices of 2000 and 3000 feet. They turned their backs upon the *Li* or *Spiti*, and its deep abyss, and entered the *Chóling* dell, which sends its waters to that river.

The mountains have an extremely sterile and parched aspect. No grass covers them; and a few tufts of aromatic plants are all the vegetation they here present. The appearance of a village and green fields was singularly refreshing. Those of *Chulang* and *Hara* were passed, to encamp at *Hango*.

This village is 11,400 feet above the sea, situate at the head of a dell in the bosom of cultivation. There are a few poplars, but no apricots. The luxuriance of the crops can scarcely be exceeded. The ear of the Siberian barley showed so large and full, that the average of eight picked casually was seventy-eight fold. Most of the fields were yellow, and a few had been cut

The glen runs east and west, and has a nearly level surface. A stream flows on each side of it, and one through the middle; and the supply of water never fails.

The mountains around are limestone: the same had been observed at *Chóling*. Those on the north are steep and naked; on the south more gently inclined, and they are covered with grass and furze.

The march of the next day was to *Súngnam* by the *Hangrang* pass (14,800 feet above the sea.) The limestone is broken by the action of the weather into a gravelly surface, thickly clad with furze, juniper, and short grass, the arid pasturage of the cattle. Horses were seen loose, feeding at the height of 15,000 feet above the sea.

From the pass the view extended to the elevated range between the *Setlej* and *Indus*, from N. 15° E. to N. 10° W. It is most probably a continuation of the lofty range seen from *Kéúbrang*. It was so completely covered with snow, that not a rock could be distinguished by a telescope of large magnifying power.

Limestone disappears, and clay-slate is frequent, near *Sungnam*. This populous place, in the valley of the *Darbung*, had been already visited by Messrs Gerard (in 1818.) It is 9350 feet above the sea. At this place, where they halted for several days, (17th to 28th August) Captain Gerard remarks: "The situation is fine, in a glen bounded on the north and south by lofty ranges of mountains, the passes through which are nearly 15,000 feet above the sea. On the N.W. up the course of the *Darbung*, is a high pass to *Spiti*; and to the S.E., the *Setlej*, at the distance of several miles. For the space of five miles, this valley presents a sheet of cultivation. There are two crops here, and the grains are barley, *ogal?* and *phapur?* there is plenty of pease, beans, and turnips; and wheat and Siberian barley thrive at great elevations upon the slopes of the dell. Around the village are vineyards, and orchards of apples, apricots, and walnuts.

"In this neighbourhood the pine, to which we had long been strangers, begins to raise its head; it is stunted in growth, and thinly scattered upon the surrounding mountains.

"We stopped here till the 28th August, and at times we were somewhat incommoded by the heat. During our halt the temperature of the open air ranged from 60° to 82°. For two or three hours after sunrise low clouds were seen hanging about the hills, but they dispersed as the day advanced. In the evening, and during the night, dark clouds charged with thunder appeared towards the N. W., but there was scarcely any rain. About 1 P. M. an easterly wind sprung up, and it increased in violence till 5, when it subsided till 9 P. M.

"Snow falls in November, and covers the ground more or less until March; but it is seldom two feet in depth."

From *Súngnam* the travellers proceeded to visit the *Má-*

nerang pass, and thence to *Mánes*. I continue to transcribe Captain Gerard's account of this excursion, in his own words, unabridged.

"The road from *Súngnam* to *Rópá* (four miles) lies in the dell along the bank of the *Dárbúng*. Fields and hamlets are scattered on either hand; and apricots and apples occur at every step. The glen is about a bowshot in breadth, and the mountains on each side are crumbling clay-slate and limestone, bearing a few dwarf pines. Near the village of *Shibé* is a copper mine, which was formerly worked. The height of *Rópá* is 9800 feet: so the seasons and productions are similar to those at *Súngnam*.

"We had with us twelve days' supplies, which, from the goodness of the roads, were transported upon horses, mules, and asses. Here, however, we were obliged to exchange our carriage for sheep; and the adjustment of the loads occupied so much time, that we found it necessary to halt for the night.

"The next day we proceeded to a resting-place for travellers, named *Pamachin*, (ten miles and three quarters.) At first the road was level for a short way, and it led through fields of beans and bowers of apricots: then there was an ascent of two miles and a half, latterly steep; but the path was good to *Tómókëu* pass, 13,400 feet high. The surrounding hills are slaty, and crumble away at the surface, which is almost naked, a few dwarf pines and juniper bushes occurring now and then.

"Below this the first branches of the *Darbúng* are concentrated. The streams are amongst perpetual snow, and rush down from different directions in clamour and foam to unite their waters.

"The next four miles are of an extraordinary nature, scarcely to be described: rugged cliffs, banks of hard gravel much inclined to the river, mural precipices, and sharp pointed rocks succeed one another.

"After a series of difficulties and dangers, we descended to a considerable stream, which we crossed by a wooden bridge, and proceeded upon level soil to *Súmdó*, a few huts occupied by the shepherds and their flocks. Hence to camp, a distance of two miles, the path was nearly plain, and we passed through a belt of birches at the immense elevation of 14000 feet.

"It is so named, after the species of juniper called *Páma*, (which is the only wood for fuel found in the vicinity) and is 13,700 feet above the sea.

"This was a very fatiguing march for loaded persons. *Sumdó* is the usual stage, and the next does not cross the pass; but it had been snowing for some days upon the heights around, and our guides preferred crossing the chain on the second day from *Rópa* for fear of bad weather.

"Part of the baggage arrived during the night; and from this time forward, the tent, with some other things, were lost sight of.

"The *Darbúng* is here much reduced in size. The cliffs rise from the water's edge in wild disorder, and every year marks them with decay. Their sharp summits crumble away by frost and snow, and large portions of rock are precipitated into the bed of the river.

"The following day we marched to *Sopona*, a halting-place for travellers, distant eight miles and three quarters.

"The road lay upon the bank of the *Darbúng*, which it crossed thrice by immense arches of snow, covered with heaps of stones that had fallen from above.

"The mountains are of limestone, and end in peaked summits of many curious forms, inclined to the north at various angles. Not a trace of vegetation meets nourishment there; and the snow cannot find a rest, but is hurled down, together with the rock itself, and is exhibited at the bottom in accumulations of a frightful magnitude.

"We had now come two miles and three quarters, and the dell was terminated, and close round. The *Darbung* is lost among the fields of snow where it is generated, and the whole space on every side is floored with ice and frozen snow, half hid under stones and rubbish. In some places the snow is of incredible depth, and lies in heaps. Having accumulated for years together, it separates by its gravity, and spreads desolation far and wide.

"We had never before observed such enormous bodies of snow and ice, nor altogether so wonderful a scene. So rapid and incessant is the progress of destruction here, that piles of stone are erected to guide the traveller, since the pathway is often obliterated in a few days by fresh showers of splinters.

"Our elevation was now upwards of 15000 feet, although we had but ascended in company with the river, against its stream. Here only began our toils, and we scaled the slope of the mountain slowly; respiration was laborious, and we felt exhausted at every step. The crest of the pass was not visible, and we saw no limit to our exertions.

"The road inclined at an angle of 30°, and passed under vast ledges of limestone. The projections frowned above us in new and horrid forms, and our situation was different from any thing we had yet experienced.

"Long before we got up, we were troubled with severe headachs, and our respiration became so hurried and oppressive, that we were compelled to sit down every few yards, and even then we could scarcely inhale a sufficient supply of air. The least motion was accompanied with extreme debility and a depression of spirits, and thus we laboured for two miles.

"The last half mile was over perpetual snow, sinking with the foot from three to twelve inches, the fresh covering of the former night. The direct road leads in the centre of the gap, but we made a circuit to avoid the danger of being swallowed up in one of the deep rents, which were now covered up with the new snow.

"The day was cloudy, and a strong wind half froze us. The rocks were falling on every side, and we narrowly escaped destruction. We twice saw large blocks of stone pass with incredible velocity through the line of our people, and between two of them not four feet apart.

"We reached the summit of the pass named *Mánerang* at half past 2 P. M. Its elevation is 18,612 feet by barometric measurement. There is here a very circumscribed spot, where is a *shaghár*, or pile of stones, free from snow.

"Leaving the pass, we travelled over snow, and descended gently for a mile. The wind blew with great violence, and benumbed us; but the sun shone bright, and caused a reflexion that affected our eyes, but did not inflame them much, for at this season the snow is soft and somewhat soiled, but in winter, when it is frozen and sparkles like diamonds, the inflammation is very distressing and painful.

"After quitting the great snow-bed, the road became extremely rough and difficult, leading over the scattered wrecks of the cliffs and patches of melting snow, and along the edge of a stream in a channel of solid ice.

"The adjacent ridges are wholly limestone, without a vestige of vegetation; they are even deserted by the snow, and exhibit an enormous extent of pure rock, and shoot into slender summits of a great variety of forms.

"We encamped at the foot of the slope that stretches from the pass, where the glen takes a regular shape; the stream spreads out and ripples upon sand and pebbles; the mountains slant away, and some stunted vegetation appears at their bases.

"The elevation of the camp was 15,200 feet above the sea.

"At sunrise of the following day the thermometer was at 31°; but the night must have been colder, for the dew which fell upon our bed-clothes (we had no tent) was so completely frozen, that in the morning our blankets were as tough as the hardest leather.

"We proceeded towards *Manes* (distant six miles and a quarter) through the dell that leads to *Manerang* pass, along the bank of a rivulet which has its source amongst the snow-beds in that direction. There is a good deal of soil and bushes, and we passed fine crops of wild leeks at the height of 15,000 feet.

"Three miles and a half from camp we came to an open valley, being an expanse of sand and pebbles. We followed the stream till it entered a lake upwards of a mile wide; and here, leaving it to the right, we proceeded to *Mánes*, winding through low gravelly hills covered with *támá* bushes.

"*Mánes* is a large village (of about fifty houses) in two divisions, separated by a stream. It is elevated 11,900 feet above the level of the sea, and lies on the right bank of the *Spiti* river, 400 or 500 feet above its bed.

"Around the village is some level soil, bearing crops of wheat and barley, and *(awá)* Siberian barley, which do not extend higher than 12,000 feet above the sea. The grains were almost ripe, and there were a few poplars in the vicinity."

After a halt of a day at *Mánes,* where the temperature varied (1st September) from 52° at sunrise to 81° at the hottest time of the day, Messrs Gerard proceeded to *Téngdi,* a small village in the district of *Pinu,* comprised in the province of *Spiti.* They kept along the right bank of the river, a little above the stream, and then descended into the bed of the *Spiti* river, to the village of *Sólak.* The dell is frequently a mile across, and the river winds through it in many channels, among islands of sand and pebbles, which are covered with barberry and other bushes. The fort of *Dankar,* opposite this, is a considerable place, containing about forty houses, which, as at *Shiálkhar,* are inside. The walls are partly stone, partly mud, and the position is among rugged projections of gravel. Its altitude is not less than 13,000 feet above the sea. Above the fort two rivers unite; the largest, which has a bridge of ropes over it, rises in the *Párálásá* range on the N. W., and is called either *Spiti* or *Kunjom;* the other, also a large stream, is named *Pinu;* its principal branches have their sources near *Tari* pass, on the S. W.

Near *Solak,* where a meridian altitude of the sun was taken, is the highest latitude Messrs Gerard reached in this journey, viz. 32° 5′ 34″.

The best road crosses the *Pinu* at this place, and proceeds on the other side; but the stream was not fordable. It was attempted, but the current was found to be much too rapid. They had no choice but to encounter the difficulty of a most frightful descent. In one place is a notched tree from rock to rock, for the passage of a chasm: beyond this, a line of rocky ledges excavated for the toes to enter: above the crags overhang, and beneath is a precipice more than 100 feet deep. Unloaded people get over with the utmost difficulty; the baggage therefore was lowered by ropes. Immediately beyond this they came to an inclined rock, 100 feet high, which they had to climb over: it was nearly smooth, and could scarcely be ascended barefooted. The path continued dangerous for a mile and a half farther, upon hard gravel sloping steeply to the river. The dell is from a quarter to half a mile wide, and is occupied by sand and limestone pebbles: the mountains on either side are of limestone, sharp at the summits, but crumbling below.

Téngdi is 12,000 feet above the level of the sea: the houses are two stories: the lower half built of stone; the upper of unburnt bricks; the roofs flat: and on them the firewood, collected with great labour, is piled. Not a single tree is near, and the few prickly bushes seldom exceed three inches in height. The climate here is cooler than at *Mánes*. The temperature at sunrise was 45°, and in the middle of the day 78°.

The district of *Spiti*, which comprises *Pinu* as well as *Manes*, is situate between Chinese Tartary, *Ladak*, *Kulu*, and *Basehar*, and pays tribute to each. The inhabitants are all Tartars, and follow the Lama religion. There are lead mines. The villages are from 12,000 to 12,500 feet above the level of the sea. Toward *Ladak* the habitations must be still more elevated, and the country very barren, and the climate inhospitable.

It was the intention of Messrs Gerard to have gone on towards *Ladak*, and returned by the *Tari* pass, which is the most direct road. But entreaties and the offer of a douceur of 150 rupees were unavailing: the *Lafa*, or chief person, would not hear of their proceeding onwards, or attempting the *Tari* pass.

After a fruitless negociation, which lasted two days, they returned to *Manes*, and thence to *Sópóna;* and again (7th September) by the *Maneramg* pass to *Pamachan*, *Sumdó*, and *Rópa*. The barometric measurement was repeated with nearly the same result. The *Darbúng* river was only half its former size, for a few days had brought on winter, and the stream was now but slowly and scantily supplied amongst the ice. The snow had not descended more than 400 feet lower, since they last crossed the pass, but the great fields had a new thick covering frozen hard. Shortly after leaving the pass it began to snow, and continued till they arrived at *Pamachan*. Upon the old snow-beds it lay at 14,500 feet; but what fell upon the ground, melted at 16,000 feet.

Súmdo is about 12,500 feet above the level of the sea.

They crossed the *Dárbung* under the village of *Geöbung*, and ascended the face of a thinly wooded hill to the elevation of 13,500, where they encamped at the distance of a mile from any kind of fire-wood; but the spot afforded water. The upper limit of the pines in this neighbourhood is 12,300; the juniper scarcely extends 100 feet higher. At sunrise the thermometer was 39°. Every thing around was covered with hoar frost.

They ascended the *Runang* pass, 14,500 feet above the sea; the mountains are of clay-slate; and the creeping juniper, as if it had found a congenial soil, spreads its roots higher than the pass.

Descending from the zone of frost, they travelled several miles upon an undulating tract much indented, but preserving a height above the limit of trees; and leaving the populous villages of *Kanam* and *Labrang* at a profound depth below on their left, they descended into the dell in which *Lipe* or *Lidang* is situate. The village is considerable, the houses entirely built of *Kélú* pine, small, compact, and exactly resembling cisterns.

The bottom of the dell stands 8700 feet above the sea; the vine is cultivated; and there are orchards of fruit trees around. A few of the grapes were now (10th September) ripe, and the apples, which are the largest observed in *Kunawar*, are of a delicious flavour.

The mountains are clay-slate, granite, gneiss, and mica-slate.

The travellers proceeded by the *Werang* pass, (13,000 feet above the sea) crossing the *Késhang* river (a large and very rapid torrent forming a series of waterfalls) by a good wooden bridge, to *Pangpa* or *Pangí*, 2500 feet above the *Setlej*, and 9200 feet above the sea. There is here very little soil or level ground: the houses are crowded together; and the vineyards, fields, and pasture lands, belonging to the village, are miles distant.

The march was through a fine wood, large beds of juniper, and fine forests of pine, most part of the way. The upper limit of the pine was observed at 12,000 feet, the highest birches at 12,500 feet, and the rhododendron at 12,700 feet.

This day, (11th September,) Captain G. observes, terminated their adventures amidst frost and desolation. They bade farewell to the serenity of a Tartaric sky and its charms. "Before us," he says, "we beheld dark clouds; we already felt the moist warmth of the periodical rains, and wished ourselves back among the Tartars, their arid country, and vast solitudes."

The rest of the journey follows the course of the *Setlej,* until it emerges from the mountains into the plains of Hindusthan.

They now entered the lower *Kunawar,* and crossing, by a *sango,* the *Malgun,* a rapid torrent passing to the *Setlej,* they traversed a pine forest along a belt of highly cultivated land interspersed with orchards and the richest vineyards: in the midst of which is *Chíní,* a large village, contiguous to which are seven or eight others. The soil slopes gently to the *Setlej,* and is loaded with fine crops. It is the most extensive plain in lower *Kunáwar,* and forms a striking contrast with the heavy woods and rocky cliffs which overhang it. Just opposite are the huge *Raldang* peaks.

Here, on both sides of the river, grapes attain the greatest perfection. Some are dried on the tops of houses; some made into spirits; the rest eaten ripe. Eighteen varieties, distinguished by separate names, derived from colour, shape, size, and flavour, are cultivated in *Kunawar.*

From *Chini,* the road assumes very rugged features; many rude balconies, flights of steps, and notched trees occur. The soil is crowded with countless varieties of gay flowers and many odoriferous plants. Cumin is plentiful, and forms an article of export to the plains.

The height of this spot is 10,200 feet. The rocks are granite and gneiss, forming a succession of precipices, with a solitary tree here and there. The path is narrow, and skirts the brink of the abyss, looking down upon the *Setlej,* 4000 feet below.

Rógi, where they halted, is 9100 feet above the level of the sea. Towards the *Setlej* there are vineyards, and around the village, apricots, peaches, and apples.

Thence they ascended to the height of 10,900 feet through a forest of straggling pines, of the species called *Ri* or *Niora* (Mr Elphinstone's *Chilguza.*) It does not here flourish to the westward of *Wanghu.* The road rises and falls upon sharp pointed rocks, and now and then a flight of steps occurs. Opposite is the confluence of the *Baspa* with the *Setlej.* Its waters make a very considerable addition to this far-travelled river. The road descends precipitously (2600 feet) to *Rungar,* a small stream. The face of the hill is unwooded, but beautifully diversified with wild flowers, and clothed with rich pastures for thousands of sheep. Hence to *Miru* or *Mirting,* a small village 8550 feet above the sea, the path ascends and descends amidst dwarf pines and oaks.

The *Yula,* a considerable stream which rises amongst the snow in the N. W. and falls into the *Setlej,* was crossed 1200 feet below the village. On its banks are many fertile fields. Thence the road ascends through a wood of oak and holly, which affords shelter to many varieties of pheasants; passes the village of *Urni,* and arrived at *Tholang,* a village containing fifty-five families, and agreeably situated on both banks of a rivulet. It is 7300 feet above the level of the sea. The whole of the rocks in this tract are gneiss. In several spots the ground had been torn up by bears in search of the honey of the field-bee, which is here common.

At a short distance from *Chegaon,* the road passes under a natural arch of granite formed by the contact of two immense blocks. The travellers then descended to the *Setlej,* and continued for several miles along its banks, sometimes a little elevated above it, more frequently dipping down to the edge of the stream, which is very rapid. The rocks on both sides are worn into many caves, which re-echo the roar of the river with tenfold noise.

A very dangerous ascent was next encountered along the face of smooth ledges of granite, very steeply inclined to the *Setlej.* In these the nitches for support scarce admitted half the foot, and were cut at very inconvenient distances.

Arriving at the summit, the road again descended into an abyss 1200 feet deep. The distance was but half a mile, which shows the steepness of the slope.

The *Wangar,* a mountain torrent, here tears its way amongst vast masses of granite with frightful velocity and noise. The cascades formed by the rocks in its bed, throw up the spray to an amazing height, washing the crags which are loaded with a rank vegetation. In the dell of this torrent lies the secluded district of *Wangpó*, containing seven small villages.

The *Wangar* is formed by two streams. One called *Surch*, rises amongst the snow; the other, which retains the common name, proceeds from the foot of *Tári* pass.

Pinu is about four marches from *Wangpó;* and it was by the *Tari* pass Messrs Gerard intended to return, could they have prevailed on the *Lafa* to concede to their wishes. The pass is not reckoned so high as *Manerang*, and probably does not exceed 17,000 feet.

After crossing the *Wangar* by a wooden bridge, the road continues along the edge of the *Setlej* for half a mile to *Wangto*, where there is a bridge of ropes across the river. Its breadth within the banks (which are of granite) is here 92 feet. It is the narrowest point: the average breadth in this part is from 250 to 300 feet. The bed of the river is 5200 feet above the sea.

Messrs Gerard stopped in a large natural cave till three o'clock, and having seen their baggage across, proceeded to *Nangánéö*, by a very steep and rugged ascent, and then along a well cultivated hill face.

The journey was troublesome and fatiguing. It rained, slightly at first, but latterly poured down in torrents.

Nanganéo is a tolerably sized village, 6900 feet high (above the sea.) A few grapes are cultivated in this district, but owing to the periodical rains, do not thrive. Pear-trees, bearing large and abundant fruit, are frequent near the villages. The fruit is dried upon the tops of houses, and forms part of the winter stock.

Proceeding towards *Taranda*, the travellers passed through a beautiful wood of stately pines, many of them from 20 to 27 feet in girth; the pines are called *Kélu* by the natives. This timber is almost everlasting. It resists the attack of insects, and is therefore used in the construction of temples, houses, and granaries. It seldom occurs below 6000 feet, nor above 12,000 feet from the level of the sea.

Leaving the forest, they descended by a narrow rocky path, among dark thickets of oaks, holly, yew, and horse-chesnut. They here crossed the *Saildang* torrent, by three rude alpine bridges, over as many large and very rapid streams, which flow, or rather rush from their sources in the *Himalaya* to the southward, descending, in a succession of cascades, to the *Setlej*, a couple of miles below the bridges.

After crossing the *Saildang*, there was a mile and a half of very steep ascent, which required some agility to surmount, without slipping down the precipice. Rank grass, from 8 to 10 feet high, concealed the intricacies of the path, and rendered it necessary to pick the way with the utmost caution. Thence to *Taranda* the road led through woods of pine. It rained heavily all day, and the baggage did not arrive till sunset.

Taranda is 7100 feet above the sea. Gneiss and mica-slate appear to predominate here, and granite is not so frequent. Nearly opposite this, to the south, the *Himâlaya* mountains may be said to end.

The travellers halted for a day on account of rain, and proceeded on the following (18th September) to *Suran*, a tiresome journey, made more disagreeable and fatiguing by incessant rain.

They crossed the *Chaunde*, a large and impetuous stream, by a dangerous *sango* of two thin spars, one much lower than the other, and traversed a dark forest of oak and holly. Inclined rocks, and soil drenched with rain aggravated difficulty to danger. In fording a rapid stream, in which they were completely drenched, many of the loads were soaked with water. Some of the geological specimens were rendered useless by the writing on the paper envelopes being effaced ; and the whole of the botanical collection, with the exception of very few plants, was entirely destroyed.

Maniati ghati, the ordinary stage between *Taranda* and *Suran*, parts *Kunawar* from *Dasau*, another of the great divisions of *Basehar*. The country westward assumes a more civilized appearance: villages are more thickly studded, cultivation more abundant, and not so circumscribed by huge masses of rock. Numerous rills trickle down from the mountains, and afford ample supplies for the fields, which are chiefly rice.

Súrán, 7250 feet above the level of the sea, is the summer residence of the *Basehar Raja* and his court. The climate is fine. Three miles from this, near the *Setlej*, are hot springs. Formerly human sacrifices were offered at a remarkable temple sacred to *Bhima Cali*, the patroness of *Basehar*. They have been disused since the British conquest.

The travellers halted four days (19th to 22d Sept.) on account of incessant rain, waiting for the reconstruction of a *sango* over the *Manglad* torrent, which had been washed away by the flood. The temperature was stationary at 50° during the rainy weather, but rose to 64° when the weather cleared. They now resumed their journey, crossed the *Manglad* by a crazy bridge of two spars connected by twigs. The stream was frightfully rapid. The ascent from the dell, steep as the descent to it, was more difficult; the path lying upon mica wet with rain, and slippery at every step.

Next day (23d Sept.) brought the travellers to *Rampúr*, the capital of *Basehar*. It is on the left bank of the *Setlej*, 3300 feet above the sea, in lat. 31° 27′, and long. 77° 38′. The houses are of stone and slated, and some are very neat. The spot is hot and unhealthy in summer, and as cold in winter. Under the town is a rope bridge of 211 feet across the *Setlej*, leading to *Rúlú*. On the opposite summit of the range, which is lofty, are three forts, crowned with huge towers and battlements, which give them an imposing appearance.

Following the banks of the *Setlej*, and crossing *Nawagari*, a large stream, by a well-constructed wooden bridge, they found the dell expand at *Dattanagar*. Hitherto the valley of the *Setlej* has been narrow, confined between abrupt mountains. It now forms a flat, three miles wide, well watered by canals, and bearing luxuriant crops.

A few miles further they forded the *Bëari* torrent, and finally emerged from the glen of the *Setlej* by a very fatiguing and steep descent of 4000 feet perpendicular height; and, three miles further, by a winding road through woods of oak, yew, and horse-chesnuts; and arrived at *Kótgarh*, where the survey terminates.

ART. VII.—*Account of a Method of fixing the Glass in painted Windows without the interruption of Astragals.* By JOHN ROBISON, Esq. F.R.S. Edin. Communicated by the Author.

DEAR SIR,—A method has occurred to me of fixing the glass of painted windows without the usual interruption of the astragals of the sash, which so disagreeably divide the picture. I subjoin a slight sketch and description, from which you will judge whether the thing be sufficiently deserving of notice to merit a place in your *Journal.*—I am, my Dear Sir, very truly yours,

JOHN ROBISON.

I propose that there should be a cast iron frame or grating filling up the whole opening of the window; that this frame should be mounted with a set of hammered iron studs, similar to one or other of those in Plate I. Fig. 6.; these studs (projecting like the teeth of a harrow) to be so placed as to correspond with the corners of the panes; their form to be as represented in the drawing, with a stout square or round shank; their inner ends having a shoulder $\frac{5}{8}$, a neck $\frac{1}{4}$, and a screwed point with a circular nut $\frac{5}{8}$ths in diameter.

The panes of glass should be prepared by having a small portion ($\frac{1}{4}$ of an inch) cut off from each corner, so that if four of them were laid close together on a table, there would be a square aperture (at the point where the four corners meet) just large enough to allow the passage of the neck of the stud. See Fig. 8.

It will be evident, that with this preparation each pane would be firmly supported at its four corners, by means of the studs and the screwed nuts; and that, to an eye placed inside the window, nothing of the support would appear on the picture, excepting the small nuts at the intersections of the panes, many of which may be contrived by the painter to form parts of the subject. The edges of the panes would, of course, be in immediate uninterrupted contact.

As the shadows of the outer frame would have the same disagreeable effect during sunshine as those of the wire guards, which are sometimes placed outside, I should suggest, that between the frame and the painted glass there should be a screen of ground-glass. In this case the form of the stud would require to be as in Fig. 7, by which the panes of ground-glass would be fixed in the same manner as the painted ones, and the effect of the shadows so much dispersed as to be nearly invisible to an eye inside of the building.

9, *Atholl Crescent*,
20th November 1826.

ART. VIII.—*Account of a Voyage to Madeira, Brazil, Juan Fernandez, and the Gallipagos Islands, performed in* 1824 *and* 1825, *with a view of examining their Natural History.* By Mr SCOULER. Communicated by the Author. (Continued from vol. v. p. 214.)

SINCE leaving England we enjoyed an almost uninterrupted course of fine weather, but from the beginning of February, when we left the northern tropic, till our arrival in the Columbia River on the 8th of April, we were exposed to the N.W. gales, which at this season render the approach to the shores of New Albion extremely dangerous. During the stormy weather many albatrosses were seen near the vessel; and on the 17th February we succeeded in procuring several individuals. It is a remarkable circumstance, that in works on Zoology this bird is always mentioned as peculiar to the southern hemisphere. Although the occurrence of the bird in the N. Pacific has attracted but little attention, it was ascertained long ago by Mr Menzies, and is recorded in Vancouver's Voyage. It is also worthy of notice, that though the albatross is so common in both sides of the tropics in the Pacific, no one, as far as I am acquainted, has ever detected it in the Northern Atlantic Ocean. After repeated examinations and dissections, we could detect no difference either in its external appearance or internal structure, from that of the *D. fuliginosa*, taken off the coast of Tierra del Fuego.

5th March.—While off this coast, we had a further confirmation of the opinion of Peron, formerly mentioned, with regard to the distribution of marine Zoophytes. While in lat. 43 N. E. the sea was covered with immense fleets of the *Medusa velella* of Gmelin, extending in every direction around us, a circumstance which did not occur during any other period of our voyage; and the obstinacy with which these little animals continue in the same situation, is well illustrated by the fact, that they were seen by Captain Vancouver in the same latitude, more than thirty years since.*

3d April.—The sight of Cape Disappointment cheered us with the anticipation that our voyage would speedily be at an end, and the probability of coming to anchor before sunset threw an air of cheerfulness over every individual. But the object of our wishes was not yet to be gratified, and the gentle breeze which had carried us on, soon augmented into a severe gale, and we were obliged to give up the attempt, and wait for a more favourable opportunity. After experiencing another storm, in addition to the many we had already encountered, our next attempt was more fortunate, and on the 8th April we were securely anchored in Baker's Bay. On approaching the coast, Cape Disappointment is the most remarkable object, and its steep sides are seen at a great distance. On advancing nearer the shore, similar rocks are seen to line the coast for a great way to the northward. The southern side of the coast consists of the low sandy beach of Point Adams, and is the usual residence of a tribe of Indians, distinguished for their hostility to all visitors.

9th.—Impatient to acquire some knowledge of the vegetable productions of the country, which was for some months to be the field of our labours, we proceeded to make a short excursion along the banks of the river, but as we had as yet seen none of the natives, prudence required that we should not wander too far. On leaping from the boat, the first object which attracted our notice, was the *Gualtheria shallon* growing in abundance among the rocks, and covered with its beautiful roseate flowers. We then entered a forest of gigantic pine trees, among a brushwood of *Menziesia ferruginea* and

* Vancouver saw these Zoophytes about the same period of the year, in lat. 35° 25′ N., and we found them in the same parallel, but they extended as far north as lat. 43°.

different species of American currant, and the beautiful *Trilliums* and *Smilacinae* were beginning to expand their blossoms, and the *Mosses* and *Jungermanniae*, nourished by the winter rains, were covered with capsules. On our return we collected a few specimens of a small *Polypodium*, which is probably new to the American Flora.

The appearance of vegetation differed considerably from that to which we had been previously accustomed. The whole country appeared one continued pine forest; but on a closer examination, we found many places, which, from their marshy nature, refused support to the larger trees. These were covered by various grasses, and abounded in willows, and various kinds of currant. In more open places, as along the banks of the river, different kinds of brambles abound, many of them peculiar to this part of America, and equally distinguished for the beauty of their flowers, and the flavour of their fruit. But nothing is more worthy of notice than the verdure which is found throughout the year under the shade of the pine trees. This appearance arises from the *sallal (Gualtheria shallon)* whose evergreen leaves ornament these otherwise sterile situations, while they form the important article of support to the natives. At the time of our arrival there was no snow on the ground, and it is rarely seen even in winter. Vegetation at this time (April) was little more forward than in England at the same season, but it soon advanced with a rapidity unknown in England.

10th.—This morning we were called on deck by the agreeable intelligence that several canoes were approaching, and in a short time we had five of them around the vessel, containing several families of Indians. Our interesting visitors were of a light olive complexion, and small stature, seldom exceeding five feet six inches. Their long straight dark hair extending down their shoulders, and careful extirpation of their beards, made them appear much younger than they really were. Their foreheads were remarkably flat, and their cheek-bones rather prominent. Several of them were clothed in articles of European manufacture, as shirts, blankets and stockings, which they wore without shoes; others had only their native dresses. The individuals of this last class had only a robe made of the skins of a species of marmot, (*Arctomys*) ill adapted either for the purposes of comfort or decency, and a broad sugar-loaf shaped hat, which protected their shoulders from the rain. In addition to the skin robe, the women had petticoats made and plaited, which reached to their knees. An old Indian, clothed in a large blanket, and his wife, were permitted to come on board. They were at much pains to give us some idea of their consequence, and for this purpose, they had a few English words, which with them denoted every thing. They were well provided with arms of different kinds; and in addition to bows and arrows, every canoe possessed several fowling-pieces and daggers of different shapes. We regaled these people with bread and molasses, with which they were highly delighted; and after remaining three hours, during which they behaved in the most peaceable manner, they left us, and proceeded up the river.

11th.—We landed this morning in Baker's Bay, with the intention of travelling across Cape Disappointment to the ocean, that we might have an opportunity of studying the marine productions of the N. Pacific.

In this journey, we experienced much difficulty, not only from the steepness of the rocks, but also from the numerous pools of fresh water, which, being too deep, obliged us to take a most circuitous route. On arriving at the ocean, we found the primary object of our enterprise defeated, as the coast consisted of almost perpendicular rocks, against which the waves beat with great violence, and scarcely afforded a sea-weed or shell. In these rocks we saw many deep caverns, most of them filled by the tide at high water. Here the eagle (*Falco leucocephalus,*) takes up his retreat; and the frequent appearance of these animals devouring their prey augments the wildness of this dreary scene. Our excursion was not altogether useless, as we made a very considerable collection of acotyledonous plants, and obtained some curious species of land shells in the woods. From the great abundance of *Musci* and *Jungermanniæ* on the north-west coast, we had been led to expect a corresponding variety of new species, but in this we were disappointed, and most of the species we found were common to Europe; but, from the moisture and mildness of the climate, they acquired their full developement; and we found many of them in a state of fructification, whose capsules are but rarely seen in Europe.

12th.—To-day we landed at Fort-George, which is situated on the south side of the river about eight miles from the ocean, and werereceived with much kindness by the company's servants who remained there; but we were informed, that most of the people are at present employed in building another fort in a more convenient situation at Point Vancouver, about eighty miles farther up the river. At the same time we learned, that the different tribes that inhabit the banks of the Columbia were at present engaged in war, a circumstance which would oblige us to confine our excursions to the neighbourhood of the fort. The history of this commotion may be interesting, as it unfolds a very frequent cause of war among the Indians of the N. W. coast. The chief of the Chunooks, whose village is situated in the vicinity of the fort, had acquired much wealth and influence from his invariable kindness towards the settlers, was the leader of this war. This old chief, Comcomby, had two sons, who, from their amiable conduct, and their desire to acquire such knowledge as would enable them to improve their countrymen, were much esteemed by the Europeans, and possessed in a high degree the affection of the Indians. The youngest of them, named Schalachun, was the destined heir of his father, who had bestowed on him his own name, was affected with a pulmonary disease, and his brother was soon after seized with the same complaint. These young men he committed to the care of a neighbouring chief, who was thought to possess great skill in medicine, but in spite of all his knowledge, both the chiefs fell victims of an incurable disorder, and the ignorant natives thought the medical chief had procured their deaths by enchantments. Another son of Comcomby's resolved to punish the medical chief, and caused him to be assassinated as he was going to visit the fort; and in consequence of this cruel deed, the different tribes took up arms, some to punish, and some to protect the murderers. The day on which we landed at the fort, friends of Comcomby were preparing to attack the other party; but in spite of their superior numbers, they were repulsed with disgrace.

Although the people of the Company never interfere in the quarrels of the natives, except to recommend peaceful measures, we did not like to venture much into the woods, as it would not be prudent to meet the Indians in their present irritated state.

Fort-George is a square building, consisting entirely of wood, and situated about 100 yards from the river. It is surrounded by palisades, and furnished with bastions. The principal gate looks towards the river, and opens into a large court. On the west side are the stores and warehouses, and opposite to them the houses of the people, and the shops of the merchants. On the south side, is the mess-room, and the apartments of the gentlemen. They have cleared about eighty acres of land around the fort, on which they raise fine crops of potatoes, and the banks of the river afford plenty of pasture for their cattle. The hogs, which thrive remarkably well, were brought from the Sandwich Islands, and the horned cattle from California. The Indian village is situated a little to the west of the fort, on a sandy beach, and may contain about twelve houses, each of them holding from fifteen to thirty inmates.

14th.—While at the fort, we had an opportunity of seeing the war-dance of the Indians. About fifty of them paraded from a small hill in the vicinity of the fort, to the house of their chief. They were dressed and painted in a most hideous manner, and had many different kinds of arms, as fowling-pieces, pistols, bows, arrows, and daggers. Some had their faces painted black, and their hair powdered with the down of fowls; others were painted with alternate lines of blue, red, and black. Their war-dress consisted of tanned elk skins, resembling a shirt without sleeves. The leader of the procession carried a stick, to which was suspended a number of large shells, (*Pecten maximus,*) which he incessantly rattled. They moved one abreast, and in a most tortuous manner, occasionally firing a fowling-piece, and giving one of their war shouts. As they are by no means careful in what direction they fire, accidents frequently happen, and before this dance was finished, one of their own number was killed in consequence of their thoughtlessness

On reaching the shore, they formed a circle round their chief, and continued the dance for some time longer.

15th.—In this day's excursion, we met a number of Indians in the wood, chiefly women and children, who were employed in collecting vegetables, as the young shoots of different species of *Rubus* and *Rosa*, and, above all, the tender shoots of the horse-tail, (*Equisetum arvense*,) which attains a large size, and is much esteemed by the Indians. We saw plenty of *Menziesia ferruginea*, but not yet in flower; we found various species of *Trillium* and *Smilacina*; but no plant we found gave us more pleasure than the *Hookeria lucens*, not only on account of its beauty, but as it brought to mind our distinguished botanical preceptor, to whose instructions we had been so much indebted.

16th.—We had the pleasure of being introduced to Mr Macloughlin the chief factor of the Hudson's Bay Company, in the west side of the rocky mountains; a gentleman who, during our stay in the Columbia, rendered us every assistance, and took a friendly interest in all our researches. As Mr Douglas was to set out next day for Fort Vaucouver, in company with Mr Macloughlin, we agreed to make an excursion to Tongue Point (six miles from the fort) before we parted. In this journey we had to penetrate through dense brushwood, and climb over steep rocks, but we succeeded in acquiring many interesting plants and animals. We filled our boxes with various species of *Claytonia* and liliaceous plants; our pockets and handkerchiefs were filled with mosses and land shells; the number of ravens on the banks of the river showed there were specimens to be got there, and on examining the pools we found fresh water crustacea and shells.

The appearance of the rocks we saw gave us some idea of the structure of the surrounding country. As our time was chiefly occupied with botany and zoology, we could only devote a short portion of our time to the other branch of natural history; but I may here mention the few geological facts we detected. There are no high mountains in the vicinity of Fort George; and the country consists of sloping hills, of gradual ascent, and regular outlines. From the soft nature of the rocks of the Columbia, which are rapidly disintegrated by the winter rains, and the great rise of the river during the summer months, great quantities of sand are deposited in different situations. In this manner the islands of the Columbia are formed, and the numerous sand banks and shoals which render the navigation of this river exceedingly disagreeable. Some of the islands are from two to three miles in extent, and would afford the most favourable soil the Columbia possesses for agricultural purposes, if this were not inundated for two months every year. It is probable that all the mud and sand of the Columbia is not employed in forming islands and shoals, but that part of it is carried to the ocean, and by the efforts of the westerly winds, is deposited to the north of Cape Disappointment, there helping to protect the rocks from the further encroachment of the sea. The nature of the rocks in the vicinity of Fort George and Fort Vancouver appears to be calcareous, and rocks of this character seem to prevail from the cascades to the ocean. I have never been nearer than sixty miles to the cascades, but from the specimens of the rocks brought down by Mr Douglas, it is easy to ascertain that many of them are calcareous. In addition to the calcareous rocks brought from the cascades, he also procured many beautiful specimens of petrified wood, retaining their fibrous texture in a very evident manner. The rocks in the vicinity of Fort George were more within the sphere of my observation, and from that station I obtained a complete series of specimens. They are generally of a dark bluish colour, and in some places, particularly to the north of Cape Disappointment, very soft, and contain many caverns. Those between Tongue Point and the ocean are more hard, and consist of limestone, containing many masses of a spherical form and much harder consistence than the rock in which they are imbedded. They vary in size, from that of a hazel nut, to the magnitude of a cannon-ball, and when broken do not exhibit any traces of a crystalline structure. The quantity of fossil shells was very great, although the species were not very numerous. The shells I obtained were all bivalves. The largest was a species of *Pecten* in a good state of preservation, and by no means uncommon. Two other shells were very frequent, but it was difficult to ascertain to what genus they belonged. The occurrence of saline springs is not rare, and they are the favourite resort of the wild animals of the country. Several of the rivulets which run through this limestone deposit a small portion of ferruginous matter, indicating that iron enters into the composition rocks. Numerous sandstone veins traverse the limestone, and it is of a coarse granular texture, and very friable. The breadth of these veins is about three feet, and they resist the action of weather longer than the limestone, which is often worn away, while the veins remain, having the appearance of small dikes.

29th.—Since the 16th I have been employed in exploring the vegetable and animal productions of the country in every direction; but as the progress of spring did not keep pace with my wishes, I set out for Fort Vancouver, where the difference of soil would produce a corresponding variety of plants. Our party consisted of about thirty Canadians and Iriquois, furnished with five canoes. As the wind was favourable, our little fleet made a prosperous voyage, and when we landed in camp for the evening, we found ourselves at Cook Point, about thirty miles from Fort George.

Next morning we were detained to gum our canoes, which gave some leisure for collecting plants, which was the more to be prized, as the marshy place where we were detained abounded in grasses and *Cyperaceae*. One of the men was so fortunate as to kill a beautiful species of water snake, which had wandered too far from the river, and had the pleasure of adding this rare animal to my collection. On dissecting him, after preparing the skin, I found a large bull frog, and many elytra of *Dytiscus marginalis* in his stomach. During our first day's voyage the scenery was of little interest, consisting of low alluvial land, covered with willows and rushes, but as we advanced, the banks of the river became more steep, and were covered on both sides with gigantic pines and cedars, and on many of the most verdant spots the Indians had fixed their summer abodes, and were busily employed in the sturgeon and salmon fishery. As the sun was now set in the valley of the Columbia, and his last rays served to show us the snowy summits of Mount Saint Helens, we prepared our encampment in the stillness of this immense forest, only enlivened by one of those beautiful and plaintive Canadian songs, of which the various dangers of a voyager's life affords so many interesting subjects. While in this situation, we were surprised at the arrival of a canoe from Fort Vancouver. It belonged to a Canadian who was carrying his child to Fort George, where he heard there was a surgeon, to obtain some medicines. As the poor child was in the last stage of an inflammation in the bowels, medical aid was of little advantage, and after giving him what assistance our circumstances would admit of, he continued his journey to the fort, where the child died a few hours after his arrival.

2d May.—On rejoining my botanical associate, we spent several days in making excursions around the new fort. This establishment is constructed on the same plan as that of Fort George, already described, but the situation is much more delightful. The fort is built in the centre of a large and very level prairie, already covered with fields of potatoes and peas, and the produce of the farm would have been more varied, if the seeds which were sent from Canada had arrived in time. The margins of this prairie abounded in the beautiful *Phalangium esculentum*, whose roots are so much used by the Indians as a substitute for bread, while the tubers of a species of *Sagittaria*, which grows on the marshy banks of the river, affords an agreeable substitute for potatoes. In the neighbouring woods we found some of the choicest plants the N. W. coast can boast of.

The *Linnæa borealis*, a plant always agreeable to the botanist, grew here in great profusion, and I afterwards found it equally common in the woods of Observatory Inlet, the northern limit of our voyage. The subjoined list of the plants that were known to us may give the botanist some idea of one day's excursion, not above four miles from the fort.* In such a situation my time passed rapidly away with a constant, though pleasing uniformity. We usually spent the forenoon in botanising, and during the remainder of the day our time

* Calypso borealis
Corallorhiza innata
Berberis aquifolia
——— nervosa
Collinsia verna
Phlox linearis
Myosotis, *Nov. Sp.*
Sanicula, *Nov. Sp.*

was fully occupied in arranging and drying the plants we had already obtained.

On the 11th May, we set out on our return to the coast, as the ship was to sail in a few days to visit some of the islands to the north of Nootka. During our voyage down the river, we landed at a village where the inhabitants were employed in the salmon-fishery, and here I detected a curious custom, which I afterwards learned prevailed among all the Columbian tribes. In order to have some employment during our day's journey, I selected a few salmon and carp for dissection, but of these the Indians quickly dispossessed me; and, after extracting the hearts of all the fish they had caught, I was allowed to select as many as I pleased. Their reason for this practice was, that if their hearts were not extracted and laid aside, the other salmon would take offence, and leave the river. We encamped this evening on a fine dry beach, and while supper was preparing, we collected a few plants; *Dalibarda repens*, *Pyrola umbellata*, and a species of *Heuchera.*

12th.—We arrived at Tongue Point early this afternoon, so that we were only about six miles from the place of our destination. The few minutes we spent here were not useless, for we had scarce leaped ashore, when a beautiful and new species of *Mimulus* attracted our attention, growing among mosses from the moist rock. This beautiful plant, perhaps the smallest of the genus, is not more than an inch and a half in height, and one solitary flower rises from the slender scape. On arriving at the fort, we heard of an accident of a melancholy nature. Two Indians, who were crossing the river in a canoe, expired within a few minutes of each other, probably from apoplexy, and from the circumstance of all exertion in the canoe suddenly ceasing, the natives set out to ascertain the reason, and brought the bodies of their unfortunate countrymen ashore. Although it was an hour since the accident had happened, I was anxious to ascertain if medical interference could be of any service, but the diminished temperature of the bodies, and the absence of any indication of remaining life, soon convinced me that all attempts would be useless. The frequency of such occurrences among the Indians is very remarkable, but it will be unnecessary to say more on this subject at present, as I have reserved every thing relating to the history of the Indians as the subject of a future paper.

From this period till the first of June, when we embarked on our voyage to the more northern parts of this coast, our botanical labours suffered little intermission; and, as a good understanding had at last been restored among the Indian tribes, our excursions were more extensive, and we traversed the forests with little apprehension. Thus the time passed away amid constant occupation till the vessel sailed for the more northern parts of the coast, and Mr Douglas set out on a journey of several hundred miles to the interior.

Previous to our leaving the Columbia, we hired an Indian, who, although at present residing near the fort, was a native of some place in the Gulf of Georgia, to act as an interpreter among the natives of that part of the coast. He was proud of his office, and for several days before we sailed he was constantly on board the ship, as he was afraid he should be left behind, and lose so favourable an occasion of raising his consequence among the people with whom he resided.

On the 1st of June we set out on this part of our voyage, and on the 8th we saw the mountains of Nootka about ten leagues distant; but as we did not at present intend to visit that harbour, we continued our voyage for Queen Charlotte's Island, where, after a tedious passage, we arrived on the 23d. The well-known ferocity of the natives of this part of the coast required us to be much more cautious in landing than among the more timid natives of the Columbia. Off this part of the coast we caught great quantities of sea-weed, (*Fucus pyriformis*,) which was continually floating past us, and a careful examination of it afforded numerous specimens of corallines and other marine animals.

24th.—A canoe was seen paddling towards us from a small village, and they came on board with no signs of apprehension or surprise. We learned that the name of the village was Skeedans. The contrast between these people and the Columbian Indians was astonishing; they were tall, handsome, and of a much lighter complexion, and had strong mustaches. The superior size and weight of the paddles of their canoes was alone sufficient to convince any one how superior they were to the southern Indians in muscular power. Every article they had with them indicated a high degree of ingenuity, and the number and distinctness of the figures carved on their clay pipes was admired by every one. Conscious of their superiority, they treated our interpreter with the most decided contempt. None of their heads appeared to have been compressed, from which we inferred that that custom was unknown here. Their conduct was, on all occasions, bold and decided, often approaching to quarrelsome. Their language appeared to have no resemblance to that of the Columbian or Nootka Indians, at least our interpreter did not understand them.

26th.—We are off Skittegass, a harbour much frequented by the American traders, and where we saw many Indians, all of them clothed in European blankets, and well provided with fire arms. Many of them knew a number of English words, and a young man among them could carry on a conversation in broken English with tolerable facility. This acute Indian cheerfully agreed to continue with us while we remained in this part of the country, and from him we derived much information. The chief of Skittegass, he told us, was called Eastacanna, and was by no means friendly to white people, and embraced every occasion of plundering them he could obtain. This hostile disposition is probably encouraged by the unreserved trade in spirituous liquors, which the private adventurers who visit this island carry on, and cannot fail to be productive of the worst effects. At the trading posts of the Hudson's Bay Company, a very different system is pursued. No rum is ever sold, the Indians are peaceable and friendly, and the traders traverse the country with safety. When they commence trading with the Indians, the demand is not for rum, but for that innocent luxury tobacco. At Queen Charlotte's Island, not only rum, but even wine was demanded, and they were offended when we refused to give them either.

On the 29th we were becalmed off Dundas Island, which we took this opportunity of visiting. It was surrounded by steep rocks, which rendered landing rather difficult. We were accompanied by our new friend, proud of the European clothes with which we had equipped him, and anxious to show his gratitude by rendering himself useful. The island appeared to be uninhabited, and abounded in pine trees, and our progress was disagreeable from the abundance of *Aralia erinacea*, * whose spines tore our hands. Among the rocks we found numbers of curious sea animals, particularly a *Chiton* of very large size, measuring six inches in length. I also found some curious species of *Saxifraga* and *Potentilla.* We had also the good fortune to kill a fine white-headed eagle, one of the most abundant of the accipitrine tribe on the north-west coast. After returning to the ship, a favourable breeze soon sprung up, and we continued our progress towards Observatory Inlet. During our passage up the inlet, several canoes attempted to come to us; but, as the wind was favourable, we did not wait for them, and they showed their displeasure by many angry and menacing gestures. On the approach of night, we had much difficulty in selecting a proper anchoring-place, on account of the excessive depth of the water, and were at last obliged to anchor in thirty fathoms water, and to secure ourselves still farther by a line fixed to one of the trees on shore.

30th.—At sunrise, we landed to take a view of the country, which we expected to do without much hazard, as the news of our arrival would not yet be sufficiently spread among the Indians. On penetrating across a little point of land, we found a stream of excellent water descending from the mountains, and forming a little cascade, where it fell into the sea. We wandered about with little apprehension, as no traces of Indians could be detected. Under the shade of the pines, we found *Corallorhiza odontorhiza*, and the beautiful *Pyrola uniflora* in great abundance. On the coast we found many marine plants, and among them the *Glaux maritima*, a plant

* *Aralia erinacea,* Hooker's MSS.—A. caule spinosissimo, foliis subpalmatis acutissimis, lobis incisis, petiolis nervisque spinosis, umbellis globis in racemis dispositis. This curious but undescribed plant was discovered by Mr Menzies, and there are fine specimens of it collected by him in Dr Hooker's herbarium, under the above-mentioned name. It is disagreeably plentiful in the woods about Queen Charlotte's Island, and those of Observatory Inlet.

which appears to be very universally spread through the northern regions of Europe and America. Our dream of security was, however, speedily dissipated, and botanical researches were interrupted by the news, that several canoes were making for the ship, and, of course, prudence required that we should return. These people, our interpreter informed us, belonged to a powerful tribe called the Nass Indians, and were governed by five smokets or chiefs. Their language, manners, and dress were the same as those of Queen Charlotte islanders, with this limitation, that they were far from being so cleanly in their dress and persons. We saw here that strange method of deforming the women, long ago noticed by the early navigators. All the women above fourteen years had a large oval piece of wood introduced into a transverse incision made in their lower lip. At first the incision appears to be small, and is gradually enlarged, using larger pieces of wood, till, in many of the old people, the lower lip projected beyond the nose, and gave them a most ridiculous appearance when eating. They readily sold us these pieces of wood, and when they saw the interest we took in examining them, they offered to supply us with any quantity we might require. These lip ornaments, as we called them, were of a somewhat oval shape, rounded and smooth at the extremities, and slightly hollow on their upper and lower surfaces. A specimen which I procured was two inches and a quarter in length, and three quarters of an inch in breadth, and was not above the average size. *

1st July.—We proceeded up Observatory Inlet, with the intention of anchoring in Salmon Cove, which Captain Vancouver formerly occupied, while his boats surveyed the neighbouring coast. Both sides of Observatory Inlet were bounded by mountains of remarkable steepness, and entirely of primitive formation. The valleys, or rather ravines, were often the channel of some mountain-torrent, which, after passing a number of cataracts, descended to the ocean. In most situations, these mountains were covered by fir-trees of small size

* Some tribes to the north of Queen Charlotte's Island are said to have a more disgusting modification of the custom, by introducing the lip ornament into the upper lip.

and stunted growth, in others, the durable nature of the granite refused support to the smallest vegetable. The little valley around Salmon Cove has a beautiful verdant appearance, and a small brook supplies it with abundance of excellent water. The channel of this stream is everywhere covered by aquatic mosses, particularly *Fontinalis antipyretica* and *F. squamosa,* and among them I found one of the rarest and most beautiful of the *musci* of America, which, from the remarkable structure of its capsule and operculum, will doubtless form a new genus. *

2d.—Our excursions were very limited in this fine situation, as our Skittegass interpreter, Tom, was at great pains to dissuade us from venturing too far; and he assured us that we would soon be visited by all the canoes of the Nass Indians, who were a treacherous people, and had killed many of the Americans who had incautiously ventured ashore on this coast. These circumstances, we afterwards learned from an American trader, were strictly correct, and that the natives of Queen Charlotte's Island and the neighbouring continent uniformly attacked the ships which visited them whenever it was in their power. Next morning, the assertions of our friend Tom were verified, and about thirty canoes, containing about 200 Indians, visited the vessel. Being amply prepared against any attack, we endeavoured to gain their good will by treating them kindly; we purchased what goods they had to dispose off; permitted the chiefs to come on board, and gave them presents of tobacco, and feasted them on bread and molasses, of all things the most delicious to an Indian palate. In return for this usage, they behaved with great propriety, and even with some honesty, for some of the tin dishes in which we had given them molasses were returned next day, when we thought they had been stolen. However, with all this seeming good will on their part, they gave us a specimen of their dexterity, by stealing a heavy sounding-lead, and a few other articles of little importance. These Indians were remarkably acute traders, and extremely selfish, and never, in one instance, did they give any present in return for those we presented them; while the natives of the Gulf of Georgia never vi-

* *Scouleria,* Hooker's MSS.

sited us without bringing a present of salmon or berries. As they had their families in their canoes, we had some opportunity of examining their mode of living. They appeared to have a great predilection for all kinds of oily food, and to live principally on fish and marine animals. Seals are very common, and they were very fond of the fat of that animal. In their canoes we observed a kind of square cake which they eat after soaking it in oil. On procuring a few specimens, I found there were two distinct kinds. The one consisted of various species of dulse (*Halymenia*,) compressed into a cake, and probably used as a substitute for salt. The other cake was of a more firm consistence, and was made from the inner bark of some tree, beaten very fine and then dried. This cake was eaten after soaking it in oil. As this kind of bread is probably similar to that used in times of scarcity in the northern parts of Europe, and prepared from the pine, it may serve to allay hunger without affording much nourishment, like the earth eaten by the Indians of the Orinoco, mentioned by Humboldt. It seems to be very generally used among these tribes, as it is mentioned by Mackenzie in his journey to the Pacific Ocean.

5th.—To-day we removed to a small harbour about five miles farther up the inlet than Salmon Cove, but the incessant rain and the presence of the Nass Indians detained us on board. As the weather improved, we made a boat excursion a few miles farther up the inlet. The country was more verdant and the land less precipitous, and afforded many curious plants. I was particularly anxious to procure a species of lily, which must be very abundant in the woods, as the Indians eat great quantities of its roots. After some search, I found a few specimens, but unfortunately the season of flowering was past, so that we had to rest satisfied with the capsules. From the time of this excursion till the 12th, the constant heavy rains and dense foggy weather confined us in our present situation, and prevented my wandering far into the woods. On the 12th, the weather became more settled, and on following the tract of an Indian path for half a mile, we arrived at a spacious bay, bounded on one side by granite rocks, on the other by a sandy beach, and abounding in aquatic fowls. I never was in a situation where more *Acotyledonous* plants were to be collected with less trouble. The rocks, even to the water's edge, were covered with various species of lichens and mosses, and the *scutæ* of the *Peltidœas* had a beautiful appearance when contrasted with the dark colours of the *tripe de roche* (*Gyraphoræ*,) and without rising from the rock on which I was seated, I collected upwards of twenty species of cryptogamic plants. I quitted with regret this favoured cradle of cryptogamic vegetation, but found the phenogamous plants equally curious, though less abundant. On our return, we observed the remains of an Indian lodge, which consisted of a few poles, supporting a covering of dried branches, while the sides were open. There remained also a number of fish-hooks of a curious construction, which will be afterwards mentioned.

18th.—We now returned to Salmon Cove, which well merits its name. The quantity of salmon around us was astonishing, so that it was not possible to let a stone fall from the vessel without it touching some of them. On landing, I proceeded about three miles into the country, along the margins of the rivulet. Every pool was filled with salmon, and many of them were continuing their progress up the shallow water. On my return I killed a number, which I brought to the ship. Encouraged by my success, a party of the men were sent to procure more fish, which they easily did, and I availed myself of the opportunity of going farther into the country, which abounded in marsh plants; but the most interesting specimen was two plants belonging to the natural order of Saxifrages, and on returning to the ship I found my prize was the *Romanzowia Unaloschensis* of Chamisso. The salmon which we found on this coast were those named hunch-backed by Captain Vancouver. At the spawning season the difference of configuration between the male and female fish is so great, that at first sight they could scarcely be suspected to belong to the same species. The female had little remarkable in its appearance, being the usual shape of salmon. The body of the male was remarkably compressed, and the back very sharp, from the arched appearance of his dorsal swelling; when cut into, it was found to be composed entirely of cellular matter. The snout was very long, and furnished with long teeth, the upper jaw curved down, and projected more than an inch beyond the lower. In almost every individual the colour was paler on one side than on the other.

We remained in Observatory Inlet till the 24th; and it is remarkable, that as soon as the Indians had disposed of the goods, they seldom returned to the vessel, and showed but little curiosity, no doubt arising from the frequent opportunities they have of trading with other vessels. The natives of other parts of the coast were constant in their attendance on us, and much more tractable. On the afternoon of the 26th, we landed our interpreter near his native village, although this interesting Indian would cheerfully have accompanied us to England, and had often spoken to us about taking him there. From his friendly and ingenuous conduct, we had formed a high opinion of him, and in his manners we probably witnessed those of most of his countrymen, as there must be far less variety in the habits of savage than of civilized life. He was remarkably cleanly, and expressed on all occasions an unequivocal contempt for our Columbian Indian, and often wished us to punish him for being so inattentive to cleanliness. He eagerly adopted every thing civilized in the dress and manners of those about him; and unlike his countrymen, he would never use tobacco, and had a happy aversion to rum. With all his good qualities, poor Tom had an unfortunate propensity for pilfering, a crime of which we have many extenuating circumstances, when an Indian is the culprit. No circumstance shows the superiority of those islanders over the Columbian and Nootkan Indians, than the facility with which they adopt the improvements of civilized life. Around Skittegass, the potato is now pretty extensively cultivated, and they brought us plenty to sell. One cannot but rejoice at this symptom of commencing civilization, which, if persevered in, will limit their wanderings, and give them better ideas of property, and teach them that more is to be gained by cultivating their fertile soil, than in following salmon up every creek, or spending days in the uncertain support of the chase. The Indians of the Columbia, who enjoy far greater opportunities for improvement than those of Skittegass, have as yet steadily refused to cultivate the ground, in spite of the example and encouragement of the settlers, and have refused to grow the seeds that were offered them, while their pride urged, as an apology for their indolence, that it was the work of slaves to cultivate the ground.

We now continued our voyage to the south, intending to visit Nootka and De Fuca's Straits previous to our return to the Columbia. And, on the evening of the 30th, a Nootkan canoe came off to us, entreating us to visit their harbour ; but, as the night was approaching, we gave them some presents, informing them we would return next morning. Although the merit of making this part of the north-west coast known to Europeans undoubtedly belongs to Captain Cook, it had been visited before his time by a Spanish navigator named Juan Perez ; but as this circumstance was unknown to Captain Cook and to the public, he is entitled to all the honour of the discovery. Perez, after leaving the coast of California, discovered Queen Charlotte's Island ; and, on the 9th August 1774, he landed at Nootka, which he called Port San Lorenzo. The name of Nootka, imposed by Captain Cook, has no affinity to any word employed by the natives ; and the Spanish naturalist Mozino, who remained a considerable time at this place along with Quadra, says, that the native name is Yucualt, which, I think, is in all probability the true name ; for the natives of the eastern side of Quadra and Vancouver's Island gave their part of the island the name of Yucualtatch. We had scarcely come to anchor in Friendly Cove when old Macuinna came on board with two of his sons, and we received with pleasure perhaps the only chief alive who remembers Captain Cook. He behaved in a friendly manner, and gave us a present of those beautiful shells which the north-west Indians value so much as an ornament. The natives call them *hyaquass*, and they are not only the jewels, but the currency of the country ; and with a sufficient supply of these shells we may purchase any thing the country affords. The method of ascertaining their value is to string forty of them on a thread, and to measure off a fathom, and the number of shells that remain over this measurement fixes the value of the hyaquass. Macuinna was a stout old man, clothed in a robe made of racoon skins, and his hair had lost none of its original blackness. His sons were young men of much more pleasing features than himself. The oldest, about twenty years of age, bore his father's name, a practice which seems to be general among these tribes, as the chief of the Cheenooks on the Columbia had also bestowed his name and authority on his favourite son. The second son of Macuinna was about eighteen, was called Soodoo, and was the most cheerful and amiable of the family. Notwithstanding all the apparent friendship of Macuinna, we could not but look with disgust on this wily savage, whose subjects murdered the crew of a merchant vessel not many years ago, in the place where we now were. He affected to speak with respect and gratitude of Quadra, Vancouver, and Mr Mears, and readily recognized the portrait of the last-named gentleman. But all the kindness these enlightened men had shown him, has failed in taming his savage temper, and allowing the question of his anthropophagism to remain unsettled, enough remains to render his character disagreeable. I have seen the narrative of an unfortunate seaman, who spent several years of a dangerous captivity among the Indians of Yucualt. The ship to which this man belonged was captured by Macuinna, through the culpable negligence of the captain, and only two of the crew were spared, who afterwards made their escape on board another vessel which visited this harbour.

From the narrative of these men, which contains many interesting facts, it appears that very little provocation was given on the part of the captain, and that the cause of the disaster was the desire of the Indians to possess the property of the vessel, encouraged by the success a neighbouring tribe had experienced in cutting off the numerous crew of the Tonquin of Boston. The capture of two vessels within the space of ten years, has no doubt augmented the boldness of the Indians, but, with a moderate degree of caution on the part of commanders of ships, no such catastrophe could possibly happen. Although, during the earlier periods of the fur trade on the north-west coast, Nootka was much frequented by trading vessels, it is at present but seldom visited. It produces but few beaver-skins, and the sea-otter is more plentiful farther north, so that there is but little inducement to visit it. Macuinna is not the miniature Montezuma that Humboldt supposes; his authority, like that of every other tyee or chief, is confined to his own tribe, and his influence among his neighbours depends solely on his wealth, and the number of his people. The ascendancy he formerly possessed, arose from the almost complete monopoly of European trade, which the fortunate situation of his tribe enabled him to maintain; and even at present the canoes of strangers were allowed to visit us with much suspicion, and sometimes they were driven away. The only other people we saw at Nootka, were the Wickananish, the Cleyoquats, and Nittinats, who differed in nothing from Nootkans.

31st.—To-day the whole village of Macuinna seemed in motion, preparing to visit the vessel, and we soon had upwards of twenty-five canoes around the ship, or, as they called it, *tyee mamatly*, and the chief and his sons remained on board the whole day. With the exception of old Macuinna, the Nootkans were in a state of happy ignorance with regard to rum and tobacco. The chief was perpetually teasing us in our turn for rum, an article which we were determined not to give him, believing such conduct one of the best ways of maintaining a good understanding between us. While in this situation, we obtained all the good fare Nootka could afford, salmon, flat-fish, venison, chamass, and sallal. *

1st August.—We landed near the ship, and as it was not safe to travel far among Indians of so suspicious a character, I contented myself with amassing such plants as the neighbouring rocks afforded. A short time after our return to the vessel, some hooks were stolen from the boat; but on informing Macuinna that we were resolved to procure the articles which were carried off, a canoe was dispatched, which quickly returned with the property

My herborizing yesterday had attracted the notice of the natives, and several of them brought plants to sell in their canoes. To encourage this disposition, I bought them all, and, by this means, ascertained that some of the vegetables brought by the Spaniards still existed in a degenerate state. In this situation, I also obtained specimens of the *Fucus pyriformis*, a plant much more plentiful in the southern hemisphere. This

* *Chamass* is the root of a plant resembling the wood hyacinth, and *sallal* is the berries of the *Gualtheria shallon*, which are of the size of black currants, but have a much sweeter taste.

plant, which had attracted the notice of the illustrious Cook, is probably the longest vegetable known, and is often many hundred feet in length. It is remarkable, that a slender sea-weed should exceed in length the tallest of the giants of the forest,—the pines of the north, and the palms of the tropics.

All the Indians of Nootka have flat heads, rather more conical in their shape than the sculls of the Columbians. They are extremely fond of painting, and draw lines of various colours over their eyebrows and cheeks, and then lay on a layer of powdered mica, which gives them a fearful appearance. Their heads are powdered with the down of fowls. When unpainted, the higher ranks are very cleanly, and seem to be frequent in their ablutions.

Our stay at Nootka was too short to enable us to acquire much knowledge of the customs of its inhabitants, and much of what we learned has been long known to the public. It is, however, interesting to know that their language is merely a dialect of that spoken on the Columbia, so that our interpreter could easily make himself understood. Their manners differ very little from those of the Columbians, and it is highly probable that they are the ramifications of a single nation. Although the knowledge of uncivilized tribes acquired by the short visits of navigators is highly curious, there are many facts which can only be acquired by a closer view, and a longer residence among them. In this manner, Mozino, the botanist who accompanied Quadra, obtained much interesting matter; but my acquaintance with his researches is confined to a few extracts in different works.

(*To be continued.*)

Art. IX.—*A Chemical Essay on the Art of Baking Bread.* By Hugh Colquhoun, M. D.*

The leading object of Dr Colquhoun in the chemical part of his interesting paper, is to determine the nature of what is termed the panary fermentation; and of the three chief constituents of wheaten-flour, starch, gluten, and the saccharine

* Extract from the *Annals of Philosophy* for September.

principle, to ascertain which is essentially concerned in that process. The researches of Dr C. have led him to the opinion, that the fermentation in dough, so far as it is useful to the baker, is solely owing to the resolution of the saccharine principle of the flour into carbonic acid and alcohol, in consequence of its being brought into a situation predisposing it to pass into the vinous fermentation.

If the saccharine fermentation be suffered to exhaust itself in any dough, a new fermentation of a different kind (the acetous) will succeed it; but it is the latter which is injurious to the bread, while the former is the source of all the benefits which the best fermentation can confer.

Dr Colquhoun proves, in the first instance, that the starch and gluten are not concerned in the fermentation. Starch, he observes, "evinces no tendency to undergo any decomposition by mere exposure for a few hours to the moderate temperature used in the preparation of dough; and even moist gluten, in the short period necessary to commence and complete the fermentation of dough, would sustain no change in its appearance or chemical properties, though exposed either *per se*, or mixed with yeast, to the temperature just mentioned; yet the fermentative process in dough is strong under these very circumstances. Besides, it is certain, that if spontaneous decomposition, either of the starch or the gluten, always of comparatively tardy excitement, were once commenced and left unchecked in circumstances so favourable to decomposition as in the baking process, with respect both to moisture and temperature, it would of necessity continue with regular and unabated energy, so long as a particle of either substance remained unaltered. But in dough, though the fermentation commences *soon after* the mixture of yeast and hot water with the flour, and goes on actively and in full vigour for a given period, varying from twenty-four to forty-eight hours, it *suddenly stops short*, while yet it is *quite obvious*, that much of the starch and of the gluten remains *untouched*. In fine, it may be mentioned, as conclusive of this question, that when fermentation has thus ceased in dough, neither the addition of fresh yeast, nor of fresh starch, nor of fresh gluten, nor of all the three combined, has the smallest effect in renewing the process of fermentation. And it has been ascertained by M. Vogel, that in baked bread there exists pretty nearly the same quantity of gluten as in common wheaten-flour, and that of the starch, three-fourths remains entire; while the other fourth is only converted into a gummy matter, similar in appearance and properties to torrefied starch, a change which could have no effect in infusing a gaseous body into the bread. It seems, therefore, to be a point scarcely admitting of additional proof, that it is neither the starch nor the gluten which is concerned in the ordinary fermentative process which takes place in dough."

The mucilaginous and albuminous principles of wheat-flour exist in such small proportion that they cannot be supposed capable of causing fermentation. The only remaining constituent, therefore, is the saccharine matter, a principle contained in wheat-flour to the amount of five per cent., and which, from its strong tendency to ferment, will readily account for the phenomena. In confirmation of this view, Dr C. made the following experiments. "After suffering the fermentative process to exhaust itself in a mass of dough, and the dough to be brought into that situation in which the addition neither of yeast, nor starch, nor gluten, had produced any effect on a similarly ex-fermented mass, I tried the renewal of a little yeast to the dough, along with a small addition of the other constituent of the flour, the saccharine principle. On adding common refined sugar in these circumstances to the amount of four per cent., the *process of fermentation immediately recommenced*, and in its *appearance*, *activity*, and *duration*, was just a repetition of the previously exhausted process of fermentation. After a lapse of about *the same period*, it, in the same manner, *totally ceased.*"

This experiment, taken in conjunction with the foregoing, seems to leave no doubt that the saccharine principle is the true and only cause of the fermentation. Dr C. mentions one fact, however, which at first sight appears contradictory; namely, that a loaf of well-baked bread contains nearly as much saccharine matter as is contained in wheaten-flour previously to fermentation. Thus M. Vogel found 3.6 per cent. of sugar in good bread. Dr C. explains this circumstance in two ways. In the first place, the baker never allows the whole sugar to be destroyed, lest the acetous fermentation should set in. As soon as the fermentation has proceeded a certain length, and before all the sugar is decomposed, its progress is arrested by the heat of the oven. In the second place, Dr C. is of opinion, that some of the starch is converted into sugar during the baking. Pure dry starch does not indeed undergo this change; but if any part of a loaf enters the oven in the state of gelatinous starch, then saccharine matter is actually formed at the expence of the starch. This was proved by an experiment, in which wheat-starch was gelatinized by hot water, and mixed with dough. The bread so formed had an unusually sweet taste. Dr C. thinks it probable, that, in the common process of making dough, a portion of starch is converted into the gelatinous state.

Having established that the fermentation of bread is merely an instance of the vinous fermentation, during which saccharine matter is resolved into alcohol and carbonic acid, Dr C. of course infers, that the production of an acid, when the process is allowed to continue too long, is owing to the acetous supervening on the vinous fermentation. He also suggests, as a probable circumstance, that a little lactic acid is produced as well as vinegar.

Dr C. has also discovered an easy and certain method of destroying the acescency of dough, when the fermentation has accidentally proceeded too far, without giving any unpleasant flavour or noxious quality to the bread. A quantity of ordinary loaf-dough, when just fit for the oven, was put aside in a warm situation. The acetous fermentation was soon established, "and at the expiration of twenty-four hours, upon opening up the dough, which was still in a state of strong fermentation, a very acid odour was plainly perceptible. The taste was also distinctly, though weakly, acid. After taking two pieces, weighing five ounces each, from the general mass, it was once more set aside. Into one of the portions thus chosen were kneaded ten grains of the common carbonate of magnesia, and then both were, after the usual manner, baked in the oven. The difference between the two loaves, when baked, was most striking. The bread which had been made from the sour dough alone had a taste distinctly perceptible of acidity, and a smell so sour as must have rendered it almost unsaleable, while that which contained the magnesia presented not the slightest indications of any kind of sourness, and appeared in all respects an excellent loaf."

"To vary the experiment, an attempt was made to correct the acidity of the dough after standing twenty-four hours longer in a warm place, and when it had become strongly acid. "Four portions of this dough were now taken, all of which were baked after the usual form, but with this difference in their composition, that one was put into the oven made of the same dough just as it stood; a second had four grains, and a third eight grains of the carbonate of magnesia kneaded up with them, and to the fourth was added sixteen grains of the common crystallized carbonate of soda. The first loaf, when baked, possessed, in a very rank and strong degree, both a taste and smell of acidity. In the second, the acidity remained faintly perceptible, especially in the smell. In the third, the loaf had no acid or other disagreeable property whatever. In the fourth, there was no acid taste, but a slightly acid smell."

"These results appear quite decisive. For thus the exhibition of eight grains of the carbonate of magnesia to five ounces of dough, or about thirty-two grains to the pound, which is about fifty-two grains to the pound of flour, proved amply sufficient to correct an acidity which had been allowed to proceed to an extreme hardly ever known in practice. And indeed in the great bulk of instances a much smaller quantity would be found completely sufficient; so that, in all probability, three ounces of carbonate of magnesia to every 100 pounds of flour would be found to serve the purpose, provided a due incorporation of the magnesia were effected thoughout the substance of the bread."

In the second part of this interesting essay, published in the *Annals of Philosophy* for October, Dr Colquhoun makes some remarks on the processes for introducing an elastic fluid into dough, which has not undergone the panary fermentation. One of the methods which have been recommended for this purpose, namely, the use of water charged with carbonic acid gas, was found quite ineffectual as well for exciting fermentation, as for causing the dough to expand, in the process of baking, into a light spongy bread. The subcarbonate of ammonia, on the contrary, a substance frequently employed by bakers for rendering dough porous, afforded very favourable results; and the experiments made by mixing dough with an alkaline carbonate or the carbonate of magnesia, and then decomposing the salt by means of an acid, were likewise satisfactory. The bread made with the latter, though decidedly inferior to common loaf-bread, was light and porous when compared to that made with unfermented dough.

But the most novel facts contained in the second part of the essay regards the manufacture of gingerbread, the formation of which is thus described: "The ingredients are flour, treacle, butter, common potashes, and alum. After the butter is melted, and the potashes and alum are dissolved in a little warm water, these three ingredients, along with the treacle, are poured among the flour which is to form the basis of the bread. The whole is then thoroughly incorporated together, by mixture and kneading, into a stiff dough. Of these several constituents, the alum is found by the baker to be the least essential, although it is useful in having a decided tendency to make the bread lighter and crisper, and in accelerating the tardy period at which the dough is in the most advantageous condition for being baked into bread. For it is one of the most remarkable parts of the present system of manipulation, that gingerbread-dough, however thoroughly kneaded, almost invariably requires to stand over for the space of from three or four to eight or ten days, before it arrives at that state which is best adapted for its rising to the fullest extent, and becoming duly gasified in the oven. And experience has shown, that it may be allowed to stand over even for the period of several weeks, rather with advantage than loss in this respect. It is true, that, from causes not well understood by the baker, the dough of gingerbread becomes thus matured and ripe for the oven, on some occasions much more speedily than on others; but, in general, if the dough were fired at an earlier period than has just been mentioned, the baked bread would more or less resemble in compactness a piece of wood, in proportion to the time by which its baking had been prematurely hastened."

Of the several ingredients which enter into the constitution of gingerbread, Dr Colquhoun has proved that the only ones which are essential for rendering it light and spongy are treacle and carbonate of potash, and there can be no doubt that their mutual action consists in the evolution of carbonic acid gas. But in order to establish this point with certainty, "the substitution of carbonate of soda, and of carbonate of magnesia for carbonate of potash, was tried, and it invariably turned out that the bread in these cases expanded just as well in the oven, as when an equivalent quantity of carbonate of potash had been employed. And when, on the contrary, in place of these substances, there was mixed up with the dough either caustic potash or caustic magnesia, the bread never expanded in the slightest degree in the process of baking, whether the dough was baked when recent, or after being kept a considerable time. From this it resulted, that the presence of an alkaline carbonate was clearly essential to the gasifying of the gingerbread-dough; and it seemed almost a necessary inference, that the rising of the bread during the baking is produced by carbonic acid gas, and that this gas is developed in consequence of some mutual action which takes place between the treacle and the alkaline carbonate."

The evolution of carbonic acid gas, under these circumstances, can alone be attributed to the presence of a free acid in treacle. "That such an acid does, in a greater or less degree, always exist in treacle, seems proved by the fact, that, of many specimens which were examined in the course of the experiments just mentioned, all possessed distinct traces of acidity, and to an extent sufficient to enable them to communicate a red colour to vegetable blues; but the amount of uncombined acid present in all these cases appeared to be very trifling, and it was difficult to ascribe to its sole agency the production of effects so striking. It cannot be doubted, however, that this uncombined acid must operate to a certain extent in producing a decomposition of the alkaline carbonate; and it may be conjectured also, that the superiority in the expanding power of *old* dough is occasioned either by the additional acidification of a small quantity of the treacle, to which it would be disposed during the keeping, by its state of mixture with the flour, or by the circumstance, that the carbonic acid gas, disengaged by the uncombined acid contained originally in the treacle, has thereby more leisure to penetrate into the system of the dough, and to produce a more complete separation of its particles. And it may be mentioned, as a circumstance in support of this explanation, that though the period of keeping requisite in the preparation of gingerbread-dough is generally from five to ten days, it is sometimes materially less, and that without the manufacturer's being able to assign any cause for the variation. But this, of course, might be readily accounted for on the supposition, that treacle generally contains a variable quantity of uncombined acid, and that this ingredient is the true agent in developing carbonic acid gas within the dough, by its action upon the alkaline carbonate, Upon the whole, therefore, it seems not improbable, that the mutual action of the potashes and treacle, out of which results the gasifying of gingerbread-dough, consists in the treacle containing a litle uncombined acid, which, uniting with the potashes, sets carbonic acid gas at liberty, and thereby renders gingerbread light and elastic."

"In the course of performing these experiments, the details of which have been subjoined in a note to p. 278, and the results of which have led to the above conclusions, it was impossible not to be impressed with a sense of the inconveniences that often arise to the baker from the delay occurring in the process, and of the injury which may not unfrequently accrue to the consumer, from the deleterious nature of one of the ingredients which is essential in the present system. This is the carbonate of potash, which it is always necessary to use in such a quantity as gives a distinct disagreeable alkaline flavour to the bread, whenever this is not disguised by mixture with some aromatic ingredient. Nor can there be much doubt, that if gingerbread, as now made, were eaten in any considerable quantity, it would prove injurious to any delicate constitution, in consequence merely of the large amount which it contains of this alkaline substance; and if such a consequence as this may follow, even in the case of the most carefully baked gingerbread, it is plain that, in the hands of a careless or unskilful mechanic, the employment of such an ingredient is extremely inconvenient. It appeared, therefore, to be a very desirable matter to procure some substitute, which, while it formed an equally well-raised bread, might save the delay of the baker, be less disagreeable to the palate, and quite harmless to the constitution; and, accordingly, it was not without experiencing very considerable pleasure, that after having made various trials, a mode of compounding and preparing the dough was actually found out, which appears to unite all these advantages. The substitute which proved the most perfectly successful was a mixture of common carbonate of magnesia and tartaric acid; and in mixing up the dough, there will be found a practical expediency in employing a considerably larger quantity of the alkaline carbonate than is strictly necessary to neutralize the acid. But the shortest and simplest mode of explaining how this process is found to work, will be to quote an example of its use: the following statement is therefore submitted, of the mode of preparing what will be found in practice to be a very good dough, particularly for that kind of thin gingerbread, well known under the name of Parliament cakes.

"Take a pound of flour, a quarter of an ounce of carbonate of magnesia, and one-eighth of an ounce of tartaric acid; let the butter, treacle, and aromatic ingredients, be added in the same manner as at present. The use of alum will not be found of any advantage, and will be better dispensed with; as it is in itself an unwholesome substance, and any good effects which it can produce are in all probability completely supplied by the tartaric acid. It is necessary that the alkali employed, the magnesia, should be uniformly diffused throughout the whole mass of the dough, an object which will be always best effected by intermixing it, bruised to an impalpable powder, with the flour, previously to the addition of any other ingredient. After these have been well mingled, dissolve the tartaric acid in a small quantity of water, and, having melted the butter, pour it, the treacle, and the acid solution, into the mixture of flour and magnesia. Let the whole be incorporated into a mass of dough by kneading, and then set aside the dough, for a period varying from half an hour to an hour. It is then fit for being baked into bread. The delay of at least half an hour has the practical benefit of giving full time for the acid to act upon the alkaline carbonate, so as to render the dough loose and short, or, as a baker would say, to bring it into a state of strong fermentation. The dough prepared in this manner, should never be kept longer than two or three hours before being put into the oven, from which it will in due time be obtained, in the state of a light, spongy, pleasant bread.

"By the method now proposed, not only is the delay avoided which is so inconvenient in the system at present practised, but there is no unpleasant flavour discernible even when the bread is not at all confected with sugar or spices, and there is no ingredient in it at all injurious to the most delicate constitution. The expence of making gingerbread in the manner above stated is a trifle greater than that in which carbonate of potash is employed. The difference, however, is so extremely small, as scarcely to make any sensible addition to the price of even the most ordinary kinds of gingerbread.*

"As a matter of curiosity, the mode now mentioned as having been successfully employed in rapidly gasifying the dough of gingerbread, was tried upon the dough of plain bread, to see whether it might there have the effect of proving a complete substitute for the common yeast-fermentation. The result was in the highest degree favourable, and the biscuit which had been the subject of the experiment was as light and pleasant as if it had been prepared upon the fermentation-system. This experiment was more, however, a matter of curiosity, as already mentioned, than of much practical utility; for although the present process of the baker is slow and somewhat tedious, yet it is also cheap, and simple, and sure; and it is only in those comparatively rare cases, when, either from want of yeast, or from deficiency of time, it would be impossible to have recourse to fermentation, that the use of the process here suggested might be a matter of some advantage to the manufacturer. It should not be omitted to mention, that the presence of the neutral salt, the tartrate of magnesia, necessarily formed by that union of the acid and alkali which furnishes the supply of car-

* "Tartaric acid may now be purchased at 4s. 6d., and carbonate of magnesia at 1s. 4d. per pound: it is obvious, therefore, that the cost of the quantity of these materials necessary to convert seven pounds of flour into gingerbread, will amount to only about 5d."

bonic acid gas, was found to impart to the simple bread a slightly vapid taste; but the addition of a very trifling quantity of sugar is quite sufficient to conceal this. There is subjoined in a note, the process followed in preparing biscuit with these ingredients, which is indeed so simple, as scarcely to require any particular explanation.

"Such is the mode of preparing a well-raised gingerbread, which, out of a variety of trials, seemed by far the most successful, and the most advantageous, both to the manufacturer and to the consumer. But there are various other ingredients which may be effectually enough employed for the same end, and some of which deserve to be mentioned, as tending to throw light upon the rationale of the process, which is, in principle, the same in every case.

"Thus, for example, the bitartrate of potash, instead of tartaric acid, may be employed, along with the carbonate of magnesia. When this substance is used, there is a degree of sourness, just perceptible to the palate, in the flavour of the bread, and which it is not impossible that some tastes might regard in the light of an improvement. Another method, and quite an effectual one, is to use the carbonate of magnesia alone, without any acid admixture, only to an extent doubly or trebly greater than when it is conjoined with tartaric acid; and the result will be that the dough becomes as speedily fit for being baked, and yields as spongy and as light a bread. If again the carbonate of potash, along with an equivalent quantity of sulphuric acid, be intermixed with dough, it has the effect of fitting it for the oven as speedily as any of the other methods above-mentioned. But it communicates to the bread a taste decidedly bitter.

"There have now been detailed a few of the modes, in which much delay and trouble may be saved to the manufacturer by his employing the mutual action of an acid and of an alkaline carbonate, which shall take a speedy effect, and generate a due supply of carbonic acid gas within the dough, after it is made. It is only, however, the first mentioned substitute for the present noxious ingredients of carbonate of potash and alum which can be considered the best adapted for practice, both as being in itself the most convenient and simple, and also as possessing the advantage of containing no element in the least degree prejudicial to health. The others have been quoted principally to show the true nature of the action which takes place in gingerbread-dough, in the present tardy process, as well as in the other methods. There is yet another process of gasification, however, which should be mentioned, as it is occasionally resorted to in the manufacture of this kind of bread, as well as in that of many others, and with the same complete success. This is by using the sesqui-carbonate of ammonia, whose efficacy and the nature of whose action in expanding all kinds of dough in the process of baking, have already come under our notice. If this salt be employed in the proportion of half an ounce to the pound of flour, the dough containing it, however recent when baked, will always form itself into a good light bread; and it is on this account a very common practice with the baker to add a certain quantity of it to his ordinary gingerbread-dough, when he is under the necessity of employing it in its recent state, before it has been sufficiently matured by keeping. The bread so formed is found to possess an extremely agreeable flavour, and it is also marked by the peculiarity of having the upper surface unusually dark and glossy. In this bread, also, as in others similarly aërified, there remains always a certain trace of ammonia, which would be plainly perceptible, but for the confections which disguise it."

Art. X.—*Observations on the Comet of* 1825, *and on the Changes which take place in the figure of the tail, tending to establish the existence of a rotation round its axis.* By Mr James Dunlop, Paramatta. Communicated by Sir Thomas Makdougall Brisbane, K. C. B. F. R. S. London and Edinburgh.

On the 21st July 1825, I discovered a body, nearly in the parallel of 44 Taurus, which I strongly suspect to be a very small comet; the nebulosity is exceedingly faint. I can perceive rather a condensation near the south following extremity; the nebulosity is perhaps two minutes in length, and nearly one minute broad.

PLATE II.

W.H. Lizars sc.

July 27th.—At $17^h\ 30'$ mean time, I got a very distinct view of the comet; the tail extends about $15'$ in length, and about $4'$ or $5'$ broad at the extremity; the tail is bright at the sides, with a dark space in the middle.—I can perceive a bright point in the head or nucleus.

Sept. 8th.—At $14^h\ 13'$ mean time, the comet is very bright, and greatly increased in splendour, but the dark space in the tail does not exist.

Sept. 12th.—At $15^h\ 40'$ mean time, comet rapidly increasing in splendour. The head is round and well-defined, the tail is about $2\frac{1}{2}°$ in length, with a dark space in the middle, and rather suddenly bright at the sides. This is the first time that I have seen the head round and well-defined.

Oct. 2d.—I expect the comet will eclipse η Eridani, a star of the third mag.

At $4^h\ 41'$ sidereal time, the comet is north, following the star.

At $4^h\ 49'$ the nucleus is still distinct, and very near the star, but I can see nothing of the head, and a considerable portion of the tail is also invisible, the star being very near the centre.

At $4^h\ 57'\ 36''$, the nucleus of the comet must be exactly, or very near in the line of the star. I think this must be very near the moment of the comet's conjunction or transit over the star.

At $5^h\ 6'$ I can see the small point or nucleus of the comet preceding the star, and very near it. It is merely a point of a dusky red colour. I cannot estimate its diameter at more than one-third of a second. The head of the comet is still invisible, and also part of the tail.

At $5^h\ 10'$, the nucleus of the comet is still very distinct, but the head is still invisible.

For about the space of two minutes of time, I could perceive the star very sensibly diminish in splendour, and assume a more dull and planetary aspect, the straggling rays being sensibly cut off.

About $4^h\ 56'\ 39''$ or $41''$, the star made a very sudden tremor, perhaps $3''$ or $4''$ of a degree up and down in the telescope—or, as it were, staggered in its march through the field—as if the telescope had been slightly touched by the hand, or a slight tremor from the wind, but neither of which I think was the case, but that it was the instant of the small nucleus passing over the star.

Oct. 4th.—At 12^h 0′ mean time, the tail of the comet is 10° or 11° long, and about $2\frac{1}{4}$° broad. The nucleus of the comet is sensibly nearer the preceding side of the head, and not in the centre, as I have formerly observed it.

Oct. 5th.—At 9^h 30′ mean time, the comet is north following 417 Cetus, about one minute of R.A. in time, and about 20′ north of the star; the tail is about 10° in length, and perhaps 2° broad at the extremity. The tail is brightest in the middle and continues for about 3° or 4° from the head, without very sensibly varying in breadth. It passes north following of ϱ Ceti, where it begins suddenly to increase in breadth, and the 363 Ceti is involved near the preceding side of the tail, where the faintness commences; but nearly in the direction of ε Ceti, there is the appearance of a second branch forming, which at present is not more than one fourth of a degree in length. (See Plate II. Fig. 1.)

Oct. 7th.—At 11^h mean time, the tail of the comet is about 9° in length, and very faint towards the extremity, and is divided into five bars or branches, with a dark space between each. The principal branch is rather preceding the central line of the tail, and is considerably the longest and brightest; the branch on the following side is longer than that on the preceding side, as about 7° to 3° from the head to where the branches separate is about one degree. The light of this space in the neck is nearly uniform, but not equal in brightness to the head. The head seems much more condensed than it was on Wednesday, (the 5th) and much brighter, but the tail, as a whole, is fainter and shorter. (See Fig. 2.)

N. B.—The tail is nearly due north, probably rather preceding.

Oct. 9th.—At 12^h mean time, the tail of the comet is north preceding. The branches do not exist, neither does the tail spread so much at the extremity; as on the 7th, it is pretty bright for about two degrees from the head, then breaks off faint, suddenly.

Oct. 10th.—At 11^h 37′ mean time, the tail is fully 11° or 12° in length, diverging very suddenly for about $2\frac{1}{2}$° from the head; the following side of the head is not so well-defined as the preceding side, and the nucleus is not in the centre of the head, but certainly in the preceding side of it, which side is sharply defined. The broadest part of the tail is little more than one degree, and the position of the tail north rather preceding.

At 12^h 17′ mean time, the tail very gradually diminishes in brightness from the head to the faint extremity, which may be about 11° in length, and one degree broad; the narrowest part of the tail is not immediately joining the head, but about one degree distant, where it diverges rather suddenly to about $2\frac{1}{2}°$ from the head, and remains nearly of the same breadth to the faint extremity; the tail is north preceding. (See Fig. 3.)

Oct. 12*th.*—At 11^h 21′ mean time, the tail of the comet is singularly curved concave towards the east, or following side, and fully 7° in length; there is a considerable branch on the preceding side, about three degrees in length, and also a short branch about one degree in length on the following side; the head is much condensed, more so indeed, than ever I have seen it; the tail is about 7° or 8° long, and somewhat less than 2° broad. (See Fig. 4.)

At 13^h 27′ mean time, the tail is certainly more suddenly curved close to the head, and the principal branch is divided into two; the preceding branch is brighter, and considerably increased in length; and the following short branch is more filled up towards the principal branch; the tail seems rather broader, and is certainly shorter than it was at 11^h 21′.

At 14^h 17′, the general appearance much the same as at 12^h 27′; the tail is about 3° broad at the extremity of the branches, and not more than 7° in length, the tail is evidently much broader than it was at 11^h 21′, and shorter; but the branch on the following side has increased considerably in length. (See Fig. 5.)

Oct. 14*th.*—At 8^h 10′ mean time, the tail of the comet is certainly much longer than it was on the 12th, and very different in appearance; it is fully 10° in length. The head is less bright, and the nucleus or (condensed part) is neither so bright, nor so large. The preceding side of the tail is strongly marked, bright, and well-defined for about $3\frac{1}{2}°$ from the head, where a faint narrow branch strikes off at a considerable angle, and nearly equal in length with the principal branch; also a very considerable nebulosity exists on the following side, shooting out from the head about one degree in length. The tail is nearly a straight line from the head to where the branches separate, when it curves off suddenly concave on the following side. (See Fig. 6.)

At 9^h $20'$ mean time, the general appearance much the same as at 8^h $10'$. The faint narrow branch preceding is rather fainter at the extremity, and the nebulosity or branch on the following side is much brighter, and about a degree and a half in length; also on the preceding side of the head a new branch is growing out. This side of the tail is not so sharply defined as at last observation; the head is bright, but the tail is fainter towards the extremity. (See Fig. 7.)

At 10^h $25'$, the collecting matter has extended at least 2° on the following side, is considerably broader, and appears separating to form another branch; also the formation of another branch on the preceding side is rapidly advancing, and the nebulosity is extending to a greater distance round the head.

At 12^h $0'$, the general appearance much the same as at last observation. The following new branch is about 3° in length, and the preceding fully $1\frac{1}{2}$°; they are not yet separated from the principal branch or tail. The head is certainly not so much condensed, or so bright; the tail, also, is fainter than it was early in the night; it appears, as it increases in length and breadth, that the cometic matter becomes more thinly spread, and no new supply of luminous matter; the head is larger, but sensibly less condensed near the centre.

At 13^h $0'$, the head and tail much broader and fainter, the branches shooting out on each side from the head, are evidently formed, and beginning to be detached from the body of the tail. The narrow and condensed tail from the head to where the original branches separate, is now a broad, faint, gradual light, about $25'$ broad.

The tail is about 11° in length, and 3° broad at the extremity of the original branches, but it is not so much curved as it was early in the evening. (See Fig. 8.)

Oct. 15*th*.—At 9^h $5'$ mean time, the tail runs out straight from the head about 11° or 12° in length, with three branches on the following side, and a new branch is shooting out from the head on the preceding side.

At 10^h $15'$, general appearance much the same; the new branch is increased in length, but is yet much fainter than any of the others.

At 10^h 40′, the new branch on the preceding side is fully 2° in length, and the nebulosity is extending to a greater distance round the head. (Fig. 9.)

Oct. 18*th.*—At 11^h 13′ mean time, the tail of the comet is about 12° in length; the following side is slightly concave near the head; there is a small branch about half a degree in length, shooting out on the following side from the head. The comet is pretty bright, although the moon is present. (Fig. 10.)

Oct. 19*th.*—At 10^h 40′ mean time, although the moonlight is very considerable, I can trace the tail of the comet 8° or 9° in length. It is composed of a principal or central branch, with a smaller and fainter branch on each side, proceeding from the head; the branch on the preceding side is brighter and longer than that on the following side, rather less than two degrees from the head. The rays of the tail seem to cross each other, and diverge much the same as the rays of light through a convex lens. Fig. 11. will better explain it. A note to the observation says,—I have no doubt as to the apparent crossing of the rays near the head.

Oct. 20*th.*—At 10^h 36′, the moonlight is too strong to permit satisfactory observations; the tail appears really to be shorter than it was last night, and I am convinced it is. It appears pretty bright for about 3° from the head; and for about 2° it is faint and difficult to trace its existence. Again, towards the extremity it appears brighter, and I am sensible of its existence for about 7°, but cannot trace it farther. There are also branches, about 3° long, shooting out on each side from the head, but cannot say which is the longest; they are both very faint. (See Fig. 12.)

Oct. 21*st.*—At 10^h 32′ the comet is pretty bright; the head and tail of a regular figure; but the clouds prevent me from making such observations as I could wish. See the figure.

Oct. 24*th.*—At 10^h 40′ the comet has decreased considerably. I cannot trace the tail above $3\frac{1}{2}$° in length; the head is pretty bright, and the nucleus is in the centre of the head; and the tail is of a uniform figure, but cannot trace it more than 3° in length.

At 11^h 15′ the appearance much the same.

Nov. 1*st.*—At 10^h 33′ the comet pretty bright; the tail about 7° in length, and one half degree broad. About $1\frac{1}{2}$° from the centre of the head the rays of the tail cross each other, and diverge gradually to the extremity; two branches shooting out from the head, one on each side of the tail, and about 2° in length. (See Fig. 13.)

Nov. 2*d.*—At 10^h 50′ the tail is very bright, and about 7° in length, with a branch on the preceding side, about 2° long, and another on the following side, about $1\frac{1}{3}$°. The tail is more connected with the following side, which is the shortest; also on the following side of the head there is a quantity of thin cometic matter protuberant from the general round form of the head. (See Fig. 14.)

Nov. 7*th.*—At 8^h 56′, comet pretty bright; can trace the tail for nearly 9° in length; the nucleus is very bright. Between 2° and 3° from the head the tail becomes very narrow. (See Fig. 15.) The wing or branch on the following side is longer and more detached from the body of the tail than that on the preceding side.

Nov. 8*th.*—At 9^h 46′ the comet is very different in appearance from last night, the head is not round, or at all formed, it only resembles a blunt point, from which the tail gradually spreads in breadth, and diminishes in density, but continues bright at the sides, and dark in the middle from the head through the whole length of the tail. A very faint cloudiness surrounds the head, and extends along the tail on each side about 2°. The length of the tail is about 10°, and 1° broad at the extremity. (See Fig. 16.)

The preceding is a copy of my Journal of Observations on the comet, and also on the changes which I observed to take place in the figure of the tail.

The different appearances which it presented are worthy of attention, and I trust these observations will be of service to compare with similar observations made in Europe, and also at the Cape of Good-Hope.

By comparing the annexed figures, (which were drawn with care, and afterwards compared with the comet,) a periodic return may at least be suspected. Figures 1, 6, and 10, are very similar, and may be suspected to be returns of the same epoch; and Figures 2, 5, and 9, together with that of October 21, which was hastily taken from a view of the comet through an opening of the clouds, may also be suspected to be returns of another epoch; and also figures 8, 12, 14, 15 and 16, to be returns of another epoch,—and the singular appearances on October 19th and November 1st, or Figures 11 and 13, are very similar, and are probably returns of the same epoch.

These four epochs agree to prove something like a rotation, or a regular succession of the same appearances; and if we take the observations of the 18th, 19th, 20th, and 21st of October, or Figures 10, 11, 12, and October 21st, the period must be at least eight days, or less than one day.

Or the observations of October the 5th and 10th, Figures 1 and 3, would give a period of somewhat more than five days, as Figure 3 is evidently short of the epoch of Figure first; also the observations of the 7th and 12th October, Figures 2 and 5, would give a period of more than five days, as Figure 5 is evidently not so far advanced as the epoch of Figure 2.

But the observations of the 14th October show that the change of figure is very sensible in a short time, and the observations of the 14th at 13 hours mean time, Figure 8; and the observations of the 15th at 9^h $5'$ Figure 9, plainly show that the body must have made a revolution and somewhat more in 20^h and $5'$ of time; for it is very evident that Figure 9 is farther advanced from the epoch of Figure 6 than Figure 8 is, and consequently the period of a revolution must be less than 20^h and $5'$, by a quantity equal to the difference between Figures 8 and 9.

From October 5th, at 9^h $30'$ to the 18th at 11^h $13'$ gives sixteen revolutions, and the time of revolution 19^h and $36'$.

From October 5th at 9^h $30'$ to the 14th at 8^h $10'$ gives eleven revolutions, and the time of the revolution 19^h and $31'$.

From October 7th, at 11^h $0'$, to the 15th at 10^h $15'$, gives eleven revolutions, and the time of the revolution 19^h and $35'$.

From October 14th, at 13^h $0'$, to November 7th, at 8^h $56'$, gives twenty-nine revolutions; and the time of each revolution 19^h $42'$.

From October 19th, at 10^h $40'$, to November 1st, at 10^h $33'$

gives sixteen revolutions; and the time of the revolution 19^h $30'$.

From October 20th, at 10^h $36'$, to November 2d, at 10^h $50'$ gives sixteen revolutions; and the time of the revolution 19^h $31'$.

From October 7th, at 11^h $0'$, to November 8th, at 9^h $46'$ gives thirty-nine revolutions; and the time of the revolution 19^h and $39'$.

By taking a mean of all these, it gives 19^h and $36'$ for the approximate time of the rotation.

General Remarks.

The tail has been subject not only to continual, but (from the observations) to periodic changes of appearance, and also the changes about to take place first made their appearance at the head of the comet, sometimes shooting out from one side, and sometimes from both, but generally made their appearance first on the following side of the head.

If these changes are occasioned by a rotation on its axis, the tail of the comet must be dependent on the nature of the materials of which the surface of the comet is composed, which must be very irregularly scattered on some parts of its surface to produce the different appearances which the tail has presented; and if such be the cause, the change of appearance in the tail may be more remarkable in some comets than in others of equal magnitude, from the position of its poles with respect to the earth, and the irregularity of its surface.

But what may be the cause of these periodic changes in the figure of the tail I do not pretend to say. The observations are given in candour as they were made, and I leave it to those who may have made similar observations on the tail, and are better qualified to investigate the subject than myself.

Similar appearances were observed by Le P. Cysat, in the tail of the comet of 1618; by Hevelius, in the tails of the comets of 1652 and 1661; and by Pingré, in the tail of the comet of 1769. As this will again appear about the latter end of 1835, or beginning of 1836, it will afford an opportunity, at no very distant period, of investigating more minutely the changes which take place in the tails of comets, which may lead, not only to suspect the cause of the change which takes place, but to more satisfactory conclusions concerning the nature of the tail itself.

JAMES DUNLOP.

PARAMATTA, NEW SOUTH WALES,
Feb. 3, 1826.

Observations on the Comet, made at Paramatta, New South Wales, in 1825.

1825.	Sidereal Time.	Comet.	Diff. in AR.	Diff. in Declin.	No. of Obs.	Barometer.	Ther.
	h ′ ″		′ ″	′ ″		Inch.	
July 21.	1 54 20	South following 44 Taurus.	+ 7 30 0	— 1 6 24	1		
22.	1 30 14	S. following 44 Taurus.	+ 8 2 0	— 3 58 01	2		
23.	1 23 44	S. following 44 Taurus.	+ 8 33 65	— 12 34 12	6	30.088	39°
25.	1 45 19	N. preceding κ Taurus.	— 2 20 50	+ 26 3 04	3	30.113	43
26.	1 28 42	N. preceding κ Taurus.	— 1 55 93	+ 20 12 40	10	30.065	36.5
27.	1 59 19	N. preceding κ Taurus.	— 1 25 50	+ 14 25 02	3		
Aug. 7.	2 47 11	N. preceding 62 Taurus.	— 0 46 00	+ 6 49 32	1		
10.	0 58 50	S. following 62 Taurus.	+ 1 15 96	— 7 8 02	11	29.830	42
14.	1 43 3	N. preceding 2d υ Taurus.	— 1 38 46	+ 26 9 60	9	30.050	40
16.	2 14 34	N. preceding 2d υ Taurus.	— 1 33 60	+ 10 9 72	13	29.900	39
19.	3 7 57	S. preceding 2d υ Taurus.	— 0 38 545	— 14 46 50	10	30.230	39
Sept. 8.	1 11 17	S. preced. a star 7th mag. AR 46 decl. 15° 45′ N.	— 2 32 33	— 2 34 60	10	29.960	47
9.	4 31 26	N. preceding 48 Taurus.	— 2 56 25	+ 11 39 40	2	29.970	43
9.	4 34 57	Preceding γ Taurus.	— 6 54 30		1		
12.	2 42 39	N. preceding 184 Taurus.	— 0 37 80	+ 34 3 60	13	30.100	44
15.	0 34 56	S. following λ Taurus.	+ 2 25 56	— 26 23 26	15	29.860	50
17.	0 40 34	N. preceding 160 Taurus.	— 0 59 687	+ 11 45 0	16	30.080	43
19.	1 7 3	S. preced. a star 7th mag. AR 3h 44′ decl. 8° 34′	— 1 8 585	— 22 31 80	14	29.685	52
22.	0 28 46	S- preceding 29 Taurus.	— 0 55 76	— 9 14 60	22	29.812	48
24	2 19 12	N. preceding 12 Taurus.	— 2 33 62	+ 28 9 50	10	29.220	52.2
Oct. 1.	22 50 12	S. following 84 Eridani.	+ 2 10 175	— 6 39 70	4	29.630	61.3
2.	0 17 19	N. following ν Eridani.	+ 1 15 36	+ 22 7 60	13	29.640	55.2
4.	0 12 4	S. following ε Cetus.	+ 4 46 175	— 24 35 08	8	29.850	53
7.	23 32 19	S. preceding 369 Cetus.	— 2 47 70	— 12 46 80	7	30.100	49
9.	1 8 32	S. following 292 Cetus.	+ 2 3 086	— 5 7 82	7	29.800	54
10.	0 13 16	N. following δ Electrica.	+ 5 50 345	+ 1 1 00	7	29.840	52
				° ′ ″			
18.	0 9 30 18	AR on the Meridian.	Declination S.	40 24 49 76	Apparent place on the Meridian.		
20.	23 44 35 70	AR on the Meridian.	Declination S.	42 43 51 14			
25.	22 46 28 57	AR on the Meridian.	Declination S.	46 14 54 58			
27.	22 26 0 70	AR on the Meridian.	Declination S.	46 55 56 71			
28.	22 16 30 32	AR on the Meridian.	Declination S.	47 9 56 65			
30.	0 22 58	N. following δ Grus.	+ 0′ 49″233	+ 21 41 70	6	29.700	76.3
Nov. 1.	2 31 10	N. preceding δ Grus.	— 15 30 65	+ 17 19 21	2	29.900	69.5
7.	1 15 53	N. preceding σ Microscope.	— 7 36 95	+ 18 23 03	4	29.430	74
8.	23 51 43	N. following 27 Microscope.	+ 4 17 075	+ 15 49 62	4	29.740	62
19.	1 32 41	S. preceding 375 Sagittarius.	— 0 5 00	— 7 52 02	5	29.450	59
20.	0 38 12	N. preceding 375 Sagittarius.	— 2 24 33	+ 1 6 36	7	29.785	58
21.	0 46 14	N. preceding 375 Sagittarius.	— 4 44 37	+ 10 11 87	3	29.588	65
Dec. 9.	2 50 24	S. following δ Sagittarius.	+ 7 7 725	— 22 16 66	4	29.850	76
12.	2 13 17	S. following δ Sagittarius.	+ 4 23 66	— 4 57 65	5	29.704	78
16.	2 6 0	N. following δ Sagittarius.	+ 1 10 933	+ 16 14 00	3	29.850	65
20.	2 52 24	N. preceding δ Sagittarius.	— 1 35 58	+ 35 24 63	6	30.090	58.8
24.	3 3 36	S. preceding X Sagittarius.	— 10 18 60	— 9 5 37	3	29.955	69

Art. XI.—*Observations connected with the History of the Developement of Magnetism by Rotation.* By S. H. Christie, Esq. M. A., F. R. S. of Trinity College, Cambridge, Fellow of the Cambridge Philosophical Society, and of the Royal Military College. In a Letter to the Editor.

Dear Sir,

Mr Barlow's "Illustration of some facts connected with the Developement of Magnetism by Rotation," published in your last Number, requires some comment; and however much I may regret that the pages of your valuable *Journal* should be occupied with such matter, I must beg that you will insert a few observations: it must, I assure you, be something of more importance which can again call my attention to the subject.

If Mr Barlow, about the years 1819, 1820, &c. was engaged in a series of observations, in order to determine accurately the attractive power of circular iron plates, in different positions, and at different distances from a magnetized needle, and likewise, with precision, their strong and weak points of local magnetism, I can only say that I had no knowledge of the circumstance. At the same time, I cannot avoid expressing my surprise, that he should not have fallen upon the property in question, as no sooner had I found it necessary to note accurately the deviation of a needle due to each particular position of an iron plate upon an axis perpendicular to its plane, than I discovered the peculiar effect due to rotation. Referring to the experiments in which I was engaged when I first noticed this effect, Mr Barlow says, "Strictly speaking, however, these experiments were not a repetition of mine." I know not any latitude of speaking that could make them be so considered, since I am not even now aware of any which Mr Barlow has made at all similar to them,—mine having been made with particular views of my own, with an instrument expressly constructed in conformity with those views, and which had no reference to any views which Mr Barlow had taken of the subject.

Mr Barlow is not quite accurate in stating that the hypothesis which I suggested was deduced from a comparison of his results; the fact having been precisely as I have stated in your Number for June last.

As Mr Barlow did not adopt the idea of a sphere circumscribing the needle itself, until after I had explained to him my particular views of the subject, and as neither of us can claim any originality when we indicate the relative situations of two points by a radius, the angle which it makes with a plane, and that which its projection on the plane makes with a plane at right angles to this, I consider that the statement of your correspondent, " Mr Christie, adopting the views of his friend Mr Barlow," &c. is incorrect, and that therefore no courtesy could authorise it.

I know not whether, from what Mr Barlow has said of his having been in Edinburgh a short time before the publication of the report of our experiments in your *Journal*, and of information being derived from him, we are to consider him as the author of this report; but if such be the fact, candour required that, in his " Illustrations of some Facts," &c. he should distinctly avow it. For my own part, although I might have recollected that Mr Barlow was in Edinburgh at this time, I could not suppose that any statement, tending to influence the character of a report of the philosophical discoveries of others, as well as his own, could have been derived from him.

The explanation that Mr Barlow has given respecting the *detailed* account of his experiments, which, without even the slightest reference to their connection with mine, appeared in the *Edinburgh Philosophical Journal* for July 1826, and of the arrangement as to the time of our papers being presented, renders a clear statement of facts necessary.

When Mr Barlow, near the end of December 1824, or very early in January 1825, informed me that he had discovered some singular effects to be produced on a magnetised needle by the rotation of an iron shell near it, and mentioned some of them, I pointed out to him that these were simply a variation of the effects produced by the rotation of an iron plate, which I had exhibited to him three years before, those effects being, in my experiments, observed after rotation, and in his, during its continuance. He afterwards mentioned to me, that a polarising of the shell at right angles to the axis, would account for the phenomena he had observed; when I stated to him, that this was precisely the species of polarisation which, I had so long since informed him, would account for all the phenomena I had observed as due to the rotation of an iron plate. As Mr Barlow, notwithstanding this, was disposed to assign an origin to his experiments totally distinct from mine, neither "good fellowship, nor the interests of science," required that I should not include experiments on the rapid rotation of an iron plate in my paper. I, however, did not include them. My paper was given to Mr Herschel, in its original form, on the 20th of April; and on the 25th of April, I commenced a series of experiments, to ascertain myself, whether the effects produced during the rotation of iron are distinct from those observed after the rotation has ceased. This series was concluded on the 29th of April; and some time after, when I considered that both Mr Barlow's paper and my own had been read before the Royal Society, and when, in fact, I believe they had, I sent an account of these experiments as a supplement to my paper.* So that Mr Barlow, however unintentionally, is incorrect in stating that it was in the interval between making the arrangement, that my paper should be the first presented, and the reading of the papers, that this supplement was added to mine.† As I supposed that Mr Barlow's had been read, which it had, I certainly did not consider it was necessary that I should formally notice his experiments, more especially as I was aware that Mr Barlow did not allow he had been led to his results by those which I had previously obtained, although he had been in possession of the general facts three years previously.

As the magnetical effects produced by rotation at this time engaged a good deal of attention, on sending you in May

* Mr Barlow's paper was read on the 5th May, mine on the 12th May, and I have reason to think, that this account was sent after the 15th May.

† That this arrangement was not adhered to, appears from the date of the reading of the papers.

1825, a copy of my paper "*on the effects of temperature on the intensity of Magnetic Forces, and on the Diurnal Variation of the Terrestrial Magnetic Intensity,*" read before the Royal Society in June 1824, I thought it would be proper to call your attention to a note, in which I had mentioned the discovery I had some years before made, respecting the effects due to the rotation of iron, at the same time to give a brief notice (little more than the note itself,) of the principal of these effects, and likewise to state, that the same supposition of the iron being polarised in a direction perpendicular to the dip, would account both for the phenomena observed after rotation, and likewise those during its continuance. This was the only notice of these experiments which I sent to any Journal. I must therefore leave the responsibility of the "very injudicious remark" complained of, with whoever may have made it; at the same time stating, that I am not aware of the remark alluded to. Others must decide to whom the implied "want of candour" should be appropriated.

Having so frequently witnessed the application of Mr Barlow's correcting plate, I am, of course, perfectly aware, that all motion of rotation is prevented, when the plate is once permanently placed in its position; but should circumstances require its removal and replacement, its magnetism would, in particular situations, be materially affected by any rotatory motion given to it, when applied on the axis, although every point might be brought into precisely the same situation which it had previously. I am therefore still of opinion, that it would be advantageous, if the axis were so formed, that this motion of rotation, on applying the plate, should be prevented. I remain, Dear Sir, yours very truly,

S. H. Christie.

Royal Military Academy,
4th November 1826.

Art. XII.—*On the Diamond Mines of Southern India.* By H. W. Voysey, Esq.*

Having lately visited some of the principal diamond mines of Southern India, the few facts I have been able to collect re-

* Abridged from the *Asiatic Researches*, vol. xv. p. 120.

specting the geological relations of that gem, I take the liberty of laying before the Asiatic Society.

A knowledge of the matrix of the diamond has long been a desideratum in mineralogy. It has been hitherto supposed that this mineral was only found in alluvial soils; and a late writer infers, from some circumstances attending a particular diamond, which had passed under his examination, that the matrix of this precious stone was neither a rock of igneous origin, nor one of aqueous deposition, "but that it probably originates like amber, from the consolidation of perhaps vegetable matter, which gradually acquires a crystalline form, by the influence of time, and the slow action of corpuscular forces." *

The reasoning may apply with justice to the particular specimens which have fallen under the observation of Dr Brewster; but as it is fully ascertained that diamonds have, for two centuries at least, been found in *a rock* generally supposed to owe its origin to deposition from water, the application will of course be limited to the case of diamonds found in alluvial soils.

A considerable range of mountains called the Nalla Malla (Blue Mountains ?) lies between 77° and 80° of east longitude. Their highest points are situated between Cummum in the Cuddapah district, and Amrabad, a town in the province of Hyderabad, North of the Kistna, and vary in height from 2000 to 3500 feet above the level of the sea.

The outline of these mountains is flat and rounded, very rarely peaked, and as they run N. E. and S. W., the ranges gradually diminish in height, until, in the former direction, they unite with the sandstone and clay-slate mountains of the Godavery, near Palunshah. Their union is certainly not very distinct, but is sufficiently so to entitle them to be considered geologically as the same range. In a southern and south-west direction, they probably extend considerably beyond the Pagoda of Tripati. The most southern point that has fallen under my observation, is Naggery Nose, a well known seamark on the coast of Coromandel. Travellers to Hyderabad make a considerable detour for the purpose of crossing these mountains in their most accessible parts. Among the western

* *Edin. Phil. Journ.* vol. iii. p. 100.

passes on the Cuddapah road, are those of Bakrapet and Moorcondah on the bank of the Kistna, and those of Nakrikul, and Warripalli on the Ongole road, are among the eastern. The breadth of the range varies, but never exceeds fifty miles.

The geological structure of these mountains it is difficult to understand, and it cannot be easily explained by either the Huttonian or Wernerian theories; the different rocks of which they are composed being so mixed together, without regard to order or position, each in its turn being uppermost, that it is not easy to give a name so definite, as to apply in all places. I once thought the term "shistose formation" would be the most simple and untheoretical term; but as clay-slate is probably the most prevalent rock, I have determined on giving that name to the whole, observing, however, that by "clay-slate formation" I do not mean the Wernerian Thousheiffer, the fourth in order of his enumeration of primary rocks, but merely a collection of rocks which I conceive to have been placed in their present situation at the same period of time.

The "clay-slate formation," then, of the Nalla Malla mountains, consists of clay-slate; of every variety of slaty limestone, between pure limestone and pure slate; of quartz rock; of sandstone; of sandstone breccia; of flinty-slate; of hornstone-slate, and of a limestone which I call tuffaceous, for want of a better name, containing imbedded in it rounded and angular masses of all these rocks. All these vary so much in their composition, and pass into each other by such insensible gradations, as well as abrupt transitions, as to defy arrangement, and render a particular description useless.

It is bounded on all sides by granite, which everywhere appears to pass under it, and to form its basis.

Some parts detached from the main range, such as Naggery Nose, Worramallipet, and Nandigaon, a town in the Hyderabad frontier, with many others, have only the upper third of their summits of sandstone and quartz rock, the basis or remaining two-thirds being of granite. This range of mountains is intersected by the rivers Kistna and Pennar, and both appear to pass through gaps or fissures in it, which have been produced by some great convulsion, which, at the same time that it formed the beds of these rivers, gave passage to the accumulated waters of some vast lakes situated near the outlets.

The tortuous passage of the Kistna, for upwards of 70 miles, is bounded by lofty and precipitous banks, which, in some places, rise to 1000 feet above its bed; the opposite sides of the chasm corresponding in an exact manner. Ravines of this description are not unfrequent all over the range, and the exact correspondence of their opposite salient and re-entering angles, together with the abruptness of their origin, totally preclude the supposition of their being hollowed out by the action of running water.

Two of these remarkable chasms occur on the western road to the shrine of Maha Deo at Sri Sailam, and would be totally impassable to travellers, but for the once magnificent causeway and steps which wind down the precipice.

The only rock of this formation in which the diamond is found is the sandstone breccia. I have as yet only visited the rock mines of Banganpalli, a village situated about twelve miles west of the town of Nandiala.

The low range of hills in which these mines are situated appear distinct from the main range, but a junction of the north and south extremities may be traced with great facility.

The breccia is here found under a compact sandstone rock, differing in no respect from that which is found in other parts of the main range. It is composed of a beautiful mixture of red and yellow jasper, quartz, chalcedony, and hornstone of various colours, cemented together by a quartz paste. It passes into a pudding-stone composed of rounded pebbles of quartz, hornstone, &c. &c. cemented by an argillo-calcareous earth of a loose friable texture, in which the diamonds are most frequently found.

Some writers have miscalled this rock amygdaloid or wacken, and have described these mines as being situated on conical summits of that rock. The truth is, that the conical summits are artificial, and owe their origin to the sifting of the pounded breccia and pudding-stone, for the purpose of separating the larger stones preparatory to their being wetted and examined.

The hill itself is quite flat, and not a single conical elevation can be seen throughout its entire extent. In my journey from Nandiala on horseback, a view of the range for an extent of twenty miles N. and S. was constantly before me, and in no instance did I observe a deviation from the continued flatness.

I regret that, for many years previous to my visit to these mines, no fresh excavations had been made, so that I had no opportunity of ascertaining the mode in which the miners get at the breccia. I saw many holes under large blocks of sandstone, of about five feet average depth, most of them blocked up by rubbish. I was told that at that depth the diamond bed was found.

The miners are now content to sift and examine the old rubbish of the mines, and they are the more bent in doing this, from an opinion which prevails among them, and which is also common to the searchers for diamonds in Hindustan, and to those on the banks of the Kistna, Parteala, Malavilly, &c. viz. that the diamond is always growing, and that the chips and small pieces rejected by former searchers actually increase in size, and in process of time become large diamonds. I saw at the time of my visit in January 1821 about a dozen parties at work, each composed of seven or eight people. Each party was on the top of one of the conical eminences, and actively employed in sifting and separating the dust from the larger stones: these were then laid in small heaps, spread out on a level surface, wetted, and examined when the sun was not more than 45 degrees above the horizon. A party of boys was engaged in collecting and pounding scattered pieces of breccia. All the labourers were *dhérs*, or outcasts, and under no control or inspection. The misery of their appearance did not give favourable ideas of the productiveness of their labour.

The sandstone breccia is frequently seen in all parts of these mountains, at various depths from the surface. In one instance I observed it at a depth of fifty feet, the upper strata being sandstone, clay-slate, and slaty limestone. The stratification of the whole face of the rocks is here remarkably distinct, and may be traced through a semicircular area of 400 yards diameter. The stratum of breccia is two feet in thickness, and immediately above it lies a stratum of pudding-stone, composed of quartz and hornstone pebbles, cemented by calcareous clay and grains of sand. It is very likely that this stratum would be found productive in diamonds, and I have no doubt, that those found at present in the bed of the Kistna, have been washed down from these their native beds during the rainy season. In the alluvial soil of the plains, at the base of this range of mountains, and particularly on or near the banks of the river Kistna and Pennar, are situated the mines which have produced the largest diamonds in the world.

Among them are the famous mines of Golcondah, so called from their being situated in the dominions of the sovereigns of Golcondah, although they are far distant from the hill fort of that name, from which the province and Cootebshahi dynasty took their title. They were once very numerous, (at least twenty in number,) and Gani Parteala, situated about three miles from the left bank of the Kistna, was the most famous. They are now, with the exception of two or three, quite deserted; and the names of several of those mentioned by Tavernier are forgotten. In none have fresh excavations been dug for many years; although much ground remains unopened, and many spots might be pointed out for new and productive mines.

Even at Gani Parteala the search is confined to the rubbish of the old mines. At Atcur, Chintapalli, Barthenypard, and at Oustapalli, all situated within two or three miles of each other, there are no labourers.

The plain in which these villages are situated, is bounded on all sides by granitic rocks, which also form its basis. The average depth of the alluvial soil is about twenty feet.* Its upper portion is composed of that peculiar black earth which is called by Europeans "black-cotton soil,"† and is identical with that found on the banks of the Kistna, in other parts of its course; on the banks of the Godavery; and the Manjera;

* The greatest extent of the alluvium from the river's bank is about six miles, and the change to the red and gray soil, from the decomposition of the granitic rocks, is very distinct.

† This soil is easily fusible before the blowpipe. In 1820, I exposed it in a covered crucible to little more than a red heat, and it was converted into a light porous lava. Before the blowpipe it forms a vitreous globule.

Baen Ganga, and in the plain of Nandiala, arising from the decomposition of the basaltic trap rocks, in which all these rivers or their tributary streams take their rise. Beneath this upper stratum, it is mixed with masses and rounded pebbles of sandstone, quartz rock, jasper, flinty-slate, granite, and large amorphous masses of a calcareous conglomerate, bearing no mark of attrition from the action of running water. In this stratum the diamond and other precious stones are found. The excavations are of various size, but from fifteen to twenty feet deep.

The labourers are a little more under control than at Banganpali; and they pay a trifling duty to the Nizam's agent stationed in the village. The mode of search is precisely the same as that above described.

The mines of Ovatampalli, and of Canparti on the right and left banks of the Pennar, near Cuddapet, are in an alluvial soil of nearly the same nature; it is not quite so black, from the greater admixture of debris of sandstone and clay-slate.

In many parts of the plain of Nandiala, diamonds were formerly sought for, but the mines have for a long time ceased to be productive.

The failure of the mines of the Dekhin may perhaps be principally attributed to the cheapness and plenty of Brazil diamonds; otherwise, from the vast extent of the rock in which they are found in India, there are scarcely any limits to the search for them. It may be assumed then,

1*st*, That the matrix of the diamonds produced in southern India is the sandstone breccia of the clay-slate formation.

2*d*, That those found in alluvial soil are produced from the debris of the above rock, and have been brought thither by some torrent or deluge, which could alone have transported such large masses and pebbles from the parent rock, and that no modern or traditional inundation has reached to such an extent.

3*d*, That the diamonds found at present in the beds of the rivers, are washed down by the annual rains.

It will be an interesting point to ascertain if the diamonds of Hindostan can be traced to a similar rock. It may also be in the power of others more favourably situated than the writer, to ascertain if there be any foundation for the vulgar opinion of the continual growth of the diamond. Dr Brewster's opinion is rather in favour of it than otherwise. It is certain that in these hot climates crystallization goes on with wonderful rapidity, and I hope at some future period to produce *undeniable proofs of the recrystallization of amethyst, zeolite, and felspar in alluvial soil.*

Observations by the Editor.

Science has sustained a great loss by the death of Mr Voysey since the preceding paper was printed. He was geologist to the trigonometrical survey in India, under the late Lieutenant Colonel Lambton, and thus enjoyed the best opportunities of studying the geology and mineralogy of that interesting region. The undeniable proofs which, at the end of the above paper, he promises to produce, respecting the recrystallization of amethyst, zeolite, and felspar, in alluvial soils, will, we trust, be published by those who shall obtain possession of his papers. The information which Mr Voysey has given respecting the matrix of the diamond, is very important in reference to any theory of its origin; but we do not see that it, in any way, affects the probability of the conjecture which we had hazarded, and which Mr Voysey quotes at the beginning of his paper.

Art. XIII.—*On Magnetic Influence in the Solar Rays.* By S. H. Christie, Esq. A. M. F. R. S. of Trinity College, Cambridge, Fellow of the Cambridge Philosophical Society, and of the Royal Military Academy. In a Letter to the Editor.

Dear Sir,

In the accompanying paper, which I think may be interesting to you,* I have given an account of some ex-

* We intended to have laid before our readers an abstract of Mr Christie's very able paper; but the following letter, in addition to the new experiments which it describes, contains such a succinct and perspicuous summary of the principal results in the original memoir, that it supersedes the abstract which we had proposed to give. This new discovery of Mr Christie's must be regarded as one of very great value, and will no doubt lead to

periments, which led me to think, that the compound solar rays possessed magnetic influence, although it had not previously been observed. As this influence is indicated by the arc of vibration of a magnetised needle being more rapidly diminished when exposed to the sun than when in the shade; these experiments are easily repeated; I therefore, in the conclusion of my paper, ventured to state my opinion that these experiments would tend considerably to remove the doubts which, in consequence of repeated failures, had been entertained respecting the magnetic influence of the violet ray in Morichini's experiment. As my paper was read a few meetings before that of Mrs Somerville, it was highly gratifying to me to learn, that this opinion in favour of the results obtained by Morichini, was fully confirmed by the brilliant success with which her method of making the experiment had been crowned.

In making some additional observations in the spring of the present year, with an apparatus, in constructing which I had scrupulously excluded metal, an account of which is subjoined to the paper; I first noticed the singular fact, that, when a needle of copper or of glass, and I doubt not, of other substances, is vibrated by the force of torsion, the arc of vibration is also more rapidly diminished in the sun than in the shade; the effect, however, of the sun's rays being considerably greater on a magnetised needle than on the others. The copper, glass, and magnetised needles which I in this case made use of, were not all of the same weight, and the times of vibration were somewhat different; but supposing the effects proportional to the times, the terminal excess, (that is, the excess of the terminal arc in the shade above that in the sun, after the same number of vibrations commencing from the same point in each case,) would be, for the magnetised needle 13°.75; for the copper needle 5°.24; and for the glass needle 4°.71, showing a very decided difference in the effect of the sun's rays upon the magnetised needle. I afterwards, during the very hot weather of last summer, repeated these experiments with needles of magnetised steel, of unmagnetised steel,

highly important conclusions. Mr Christie's memoir will appear in the *Philosophical Transactions* for 1826.—Ed.

of copper, and of glass of precisely the same weight, the last three having been made to vibrate, by the force of torsion, in as nearly as possible the same time as the first, by the force of terrestrial magnetism. From these I obtained the terminal excess for the magnetised steel needle $11\frac{1}{6}°$; for the unmagnetised steel needle $7\frac{5}{12}°$; for the glass needle $6\frac{1}{3}$; and for the copper needle 5°. The excess of the temperature in the sun above that in the shade, varied somewhat in the four cases, being in the first 63°, in the second 73°, in the third 58°, and in the fourth 62°; and it is probable, that the effects might be slightly modified by this circumstance; but that the excess of the temperature in which the needle vibrated when exposed to the sun, above that when it was screened, was not the cause of the terminal excess with the magnetised needle, among other circumstances, appeared from this, that the terminal arc was considerably less when the needle vibrated exposed to the sun, than when screened by blue glass from its concentrated rays, although the temperature in which it vibrated was some degrees higher in the latter case than in the former. To whatever cause we are to attribute the singular fact, that any needle will come sooner to rest when vibrated exposed to the sun than when screened, the great increase which is observed in the effect when a magnetised needle is made use of, proves, I think, decidedly, that the compound solar rays possess a very sensible magnetic influence.

I have given you this short sketch of some of the observations which I have made since my paper was read, as I considered that you might feel a particular interest in this subject; and when you have leisure, I shall be happy to have your opinion, or any conjectures you may form as to the nature of the influence, the effects of which I have observed. I am, Dear Sir, yours very truly,

S. H. Christie.

Royal Military Academy,
4th November 1826.

ART. XIV.—*Account of the Expedition under Captain Franklin, and of the Vegetation of North America, in Extracts of Letters from Dr Richardson, Mr Drummond, and Mr Douglas.*

GLASGOW, *Nov.* 26, 1826.

EXTRACTS of letters from Captain Franklin and Dr Richardson, dated at their encampment at Fort Franklin, have already been laid before the public. In the communications that we have had from the latter gentleman, we shall therefore confine ourselves to the relation of such matter as relates to the vegetation of the country. We have the pleasure also to be able to give copies of letters from Mr Drummond, and from Mr Douglas, which we think will prove equally interesting to our readers.

W. J. HOOKER.

" FORT FRANKLIN, GREAT BEAR LAKE, 10*th Nov.* 1825.

" SINCE I wrote to you last, we prosecuted our journey with little intermission, until we arrived in this quarter. Captain Franklin continued his way down to the sea, and had the gratifying view of a boundless horizon, clear of ice. This, of course, has raised our hopes of success, and we look forward with some impatience to the lapse of the eight months of winter that are yet to come, that we may resume our operations. The nature of our voyage down the stream permitting us to land only twice a-day, unless when we had *portages*, has prevented me from botanizing beyond the encamping or breakfasting places. The additions to my list, therefore, since we entered the district formerly traversed, have not exceeded fifty species. Could I visit the Rocky Mountains, (which, in several places, come within a day's journey of Mackenzie River,) in the summer, I could doubtless obtain some novelties; but although I mean to make every exertion to ascend some of their ridges before I return, I am afraid it must necessarily be at too early a season for botanizing. Drummond remained on the Saskatchewan, and notwithstanding that the Indians, in that quarter, have been a little turbulent this year, which will oblige him to make his excursions with caution, I trust that the plans adopted will enable him to ascend the mountains in that latitude with safety, and hope that he will reap an abundant harvest. He is my main stay in the botanical and entomological departments, my attention being much directed to other objects. Our collections, previous to reaching Cumberland-House, being through a line of country not formerly visited by us, contain many plants, not in the published *Floræ* of America, but perhaps not above two or three undescribed species. They are, principally, owing to the season of the year, early flowering plants; and the *violets* are particularly abundant. I hope our specimens will illustrate that difficult genus, although I do not think we shall add to the number of its species. Drummond's mosses will probably be the most complete collection made in North America, and I hope nearly equal the British *Muscologia* in number of species.

"The following list contains those not gathered on the former journey.

"Sphagnum latifolium
Andræa rupestris
Phascum subulatum
crispum
Diphyscium foliosum
Gymnostomum pyriforme
truncatulum?
lapponicum
rupestre
Encalypta streptocarpa
rhaptocarpa
Weissia controversa
curvirostra
Grimmia affinis
Tortula subulata
convoluta
Trichostomum pallidum
microcarpum
Pterogonium, duæ species
Leucodon sciuroides
alterum
Dicranum longifolium
montanum
heteromallum
rufescens
Didymodon trifarium
glaucescens
inclinatum
Orthotrichum clavellatum
pumilum
Ludwigii
crispum?
Bartramia fontana
pomifornis
Bartramia crispa
Funaria?
Cynontodium flexicaule
Fontinalis capillacea, abundant fruit
Azzhenopterum heterostichum
Anomodon viticulosum
Bryum roseum
argenteum
punctatum
cuspidatum
marginatum
turbinatum
Hypnum triquetrum
abietinum, in fruit, both on Lake Superior and Bear Lake.
Hypnum dimorphum
polymorphum
rutabulum
cupressiforme
illecebrum
velutinum
incurvatum
prælongum
Halleri?
aureum
riparium
alopecurum
aduncum
stellatum
Silesianum
pulchellum
jilaceum
palustre

"In the neighbourhood of Fort Franklin I have found *Bryum squarrosum* abundant in fruit. I suspect also a new species of *Splachnum*, with a very slender and long seta, a small capsule about the size of the apophysis, and scarcely any stems. There is also a small moss in abundance, agreeing with Wahlenberg's description of *B. pulchellum atropurpureum*, but very unlike Funck's specimen of *B. pulchellum*. It has a smaller capsule, strongly resembling, as Wahlenberg remarks, *Weissia nigrita*. The above list does not include the mosses gathered by Drummond since we parted. When added to the former collection, it raises the number of mosses in these countries to upwards of 150, &c. and I trust we shall detect nearly as many more by the time we meet again.

"The *Callitriche autumnalis* of Wahlenberg grows in this lake, and is very unlike any I have seen in Britain, either in habit or fruit. It flowers under water. Captain Franklin has brought from Carey's Island, at the mouth of Mackenzie's River, some species described by you in Parry's Appendix, particularly the *Pyrethrum ?* with a large flower. I have also found a curious little *syngenesious* plant on the top of a hill in this neighbourhood. It has a leaf like a *Chrysanthemum*, with a very obtuse or rounded terminal lobe, and a single flower with a calyx like an *Erigeron*. It was shedding its seeds when I gathered it, so that I have not seen the corolla.

"*List of the Seeds inclosed.*

" 1. Ribes lacustre. Gravelly loam.
2. Ranunculus lapponicus, rich moist soil.
3. Viola in shady woods.
4. Potentilla pennsylvanica, rocky places.
5. Draba dry situations.
6. Ranunculus pennsylvanicus. Gravelly.
7. Aquilegia, in thickets, river banks.
8. Ranunculus.
9.
10. Ribes Hudsonianum. Woods.
11. Vesicaria arctica. Elevated barren spots.
12. A didynamous plant. Calcareous soil.
13. Ranunculus.
14. Polemonium ? Capsule three-valved, many seeded. Tube of corolla without valves, attenuating with the stamen. Deep sandy soil.
15. Tetradynamous plant. On argillaceous soil.
16. Heracleum.
17. Linum sibiricum. On limestone.
18. Primula farinosa. Clayey loam.
19. Sisymbrium brachycarpum. Waste places.

20. Tetradynamous plant. Dry places.
21. Anemone Hudsoniana. River banks.
22. Primula pusilla. Clayey loam.
23. Carex? Borders of lakes.
24. Primula Egalikcensis. Moist clayey soil.
25. Rumex. Bear Lake.
26. Xylosteum. Woods.
27. Gramen. Borders of lakes.

Seeds of the same plants have been sent to Mr Sabine and Dr Graham."

From Mr Drummond.

Dated Rocky Mountains, *April* 26, 1826.

"I take the liberty of addressing you from this quarter of the world, not to communicate any new discoveries of importance, but to inform you of my welfare, and to thank you for the opportunity you afforded me of exploring scenes so congenial to my inclination. I will endeavour to give you a rude idea of the kind of country I have seen, as the way we travelled afforded very few opportunities of seeing the productions. On landing at New York, I was first struck by the novel appearance of the trees growing about the city, such as *Platanus occidentalis*, and *Catalpa syringifolia*, with their curious seed vessels. The forests near New York consist mostly of *oaks* and deciduous trees. The public roads are lined by *poplars* and *willows*, probably introduced, but attaining a very large size. In the shade of the forests, I observed the two umbellate species of *Wintergreen* very common, *Mitchella repens*, &c.; in the marshes, *Pothos fœtida*, at that time in flower, with vestiges of numerous grasses and herbaceous plants new to me. Amongst the *Musci*, three or four species of *Leskea* were conspicuous; *Orthotrichum clavellatum*, and a moss resembling *Leucodon sciuroides*, also were previously unknown to me. The swamps were covered by *Juniperus Virginiana*, and the *Sarracenia purpurea* was common, growing amongst the *Sphagni*. The pine barrens are covered by *Pinus resinosa* and remains of numerous interesting herbaceous plants. There was little variation in the general appearance of the country, until we reached lakes Huron and Superior, where it becomes more mountainous, but the rocks appear very bare. It may be reckoned a subalpine country, by the cold caused by the lakes. On rocks near their shores, I observed *Grimmia ovata*, and *G. unicolor** in abundance; *Gymnostomum lapponicum*, (rare) *Pterogonium filiforme*, &c. *Aspidium fragrans*, *Woodsia ilvense*, &c. *Orthotrichum elegans*, *Ludwigii* and *crispum*, common; *Pinus Banksiana*, now made its appearance, and *poplars* in the more marshy grounds; *Primula pusilla* was seen plentifully in flower along the shores. A little above Fort-William, I observed *Woodsia glabella*, and I think a new species of *Pteris*. The *oaks*, *maples*, and *Acers* still continue, but are gradually giving place to *Pinus alba* and *Banksiana:* the general mosses in their shade, are *Hypnum crista-castrensis*, *Schreberi* and *abietinum*. In the marshes *H. nitens* is common; several species of *Lycopodium*, not found in Britain; *Ledum latifolium*, *Gualtheria procumbens*, *Linnæa borealis*, are very plentiful. In the marshes, are *Andromeda polifolia* and *calyculata*. The country continues broken by low hills and lakes, with much the same vegetation, until we reached lake Winnipeg, where it becomes an universal marsh, affording little but *willows* and *reeds*. On the limestone-rocks I observed *Gymnostomum tenue*, and a new species, *Weissia calcarea*, &c. The marshes continue past Cumberland-House, where I remarked *Bryum triquetrum* frequent. Although I remained there six weeks I collected very few plants, and those mostly common. The water of the lake, on which it is situated, rose unusually high, and overflowed the whole of the surrounding country. The wood now consisted entirely of the *white spruce*, *poplar*, and *willows*. I felt the effects of the high water severely in crossing the Saskatchewan, as the plants on its banks were entirely destroyed, and the haste with which we proceeded did not admit of our visiting the interior. The level of the plains at Carlton-House is about fifty feet above the river, which had there risen about twenty-five feet perpendicular. I found most of the plants in the plain out of flower, but observed that the *Diadelphous* tribes were numerous. The plains are in general sandy, and unfavourable to the growth of mosses. As the Indians about Carlton were very troublesome, I determined to proceed as far as Edmonton, about 400 miles farther

* This it should be recollected was discovered by Mr Drummond in Scotland.—H.

to the west; the opportunity which was thus afforded me of seeing the plants, though not in flower, gave me the means of judging what I had to expect afterwards. I am sorry to say it continues much the same all the way. I now resolved upon going to the mountains, as I was able to accompany a party bound for the Columbia. We here left the Saskatchewan, and crossed through a district, wooded with white spruce and poplars, to the Assinaboyne River, which is about 100 miles N. W. of Edmonton. I merely guess at the distance by walking. Here I observed several plants that had never occurred to me before, but nothing interesting. The party ascended the Assinaboyne Riverin canoes to the mountains, which are about 300 miles distant, but as the canoes were much loaded, it became necessary for some of us to endeavour to go by land, and I agreed to be one of them, as it offered me a chance of seeing that part of the country. We set off on the 1st October, but unfortunately we had a heavy fall of snow on the 4th, which put an entire stop to botanical research. We succeeded in reaching the mountains in ten days, without any accident of importance. The country is closely wooded the whole way, but the ground becomes more broken when approaching the mountains. I here observed a species of *Pinus* that I had not seen before, probably *P. taxifolius*. *P. Banksiana* is the principal wood. I here found an Indian hunter, whom I agreed to accompany during the winter, as the snow effectually prevented me from doing any thing amongst the plants. I however observed, in some spots that were bare, a good many interesting ones, *Menziesia cærulea*, frequent, *Arbutus alpina*, with red berries, also common; four or five species of *Pedicularis, Juncus triglumis* and *spicatus*, and two or three other species unknown to me; a plant much resembling *heath*, probably a *Hudsonia*, undescribed by Nuttall; four or five *Saxifrages*, some nondescript; several *Potentillas*, some of them new. *Dryas integrifolia* and *octopetala*, two or three kinds of *Draba* and *Alyssum*, not described; a beautiful *Pteris*, two or three species of *Artemisia*, nondescript. Among the mosses were few that were novelties to me, and none that I can consider alpine. *Splachnum angustatum*, and *mnioides* are plentiful, also a small *Gymnostomum*, apparently new, resembling *G. Donianum*, but not half so large, growing on sandstone. I saw *Bryum demissum*, with a few capsules; *Cetraria nivalis* and *cucullata* are common; and I have also observed *Dufourea arctica*. Thus I hope to be able, in some measure, to make up for the loss of time past. The winter has been unusually severe; the animals in consequence are poor and scarce, but I have always had enough to eat. I travelled along the foot of the mountains, for about 300 miles to the northward of the *Portage*, and returned here a few days ago. I have been reconnoitring some spots of ground that are bare of snow, and find that a few flowers will soon appear, such as *Saxifraga oppositifolia*, a *Draba* resembling *aizoides*, and a plant of which the genus is unknown to me, but it is perhaps a *Globularia*. I intend passing the summer amongst the mountains, and if possible crossing them in the autumn to the Columbia or Frazer rivers, spending the winter there, and then returning with a party from the Columbia in the spring as far as Carlton-House, where I would like to remain until the time I have to meet Dr Richardson at Cumberland-House, on the 5th of August 1827. There are very few insects in this part, and they are mostly the same as in Britain. I am now busily engaged in killing birds; but they do not appear to be numerous in this quarter, and during winter they totally desert it."

From Mr Douglas,

Dated Great Falls on the Columbia River, *March* 24, 1826.

"Sir,—You will, already, by the return of Mr Scouler, have been made acquainted with the most interesting details respecting the north-west part of America. His departure I greatly regretted, and felt very lonely for some weeks after he had sailed. The upper country appears to me an exceedingly interesting field, and differs so widely in its vegetation from that which prevails along the coast, that I have resolved to devote the whole of this year to its investigation. Though this measure be hardly authorized by Mr Sabine, who had enjoined me not to remain in this country after the departure of the ship, which leaves the mouth of Columbia in 1826, yet I trust that it will not incur his displeasure. I expect to be enabled to reach the rocky mountains in August, where, with what I can previously do, I hope to have a most splendid collection. During the past winter, I have on every occasion been picking up *Mosses* and *Jungermanniæ*, forming a collection of birds and other animals. I could have made my way to Montreal this season, and would gladly have embraced such an opportunity, but it was impossible to overlook such tempting prospects as now seem before me. I rejoice to tell you of a new species of *Pinus*, the most princely of the genus, and probably the finest specimen of American vegetation. It attains the enormous size of 170 to 220 feet in height, and 20 to 50 in circumference. The cones are from 12 to 18 inches long! I have one which is 16½ inches in length, and which measures 10 inches round the thickest part. The trunk is remarkably straight, and destitute of branches till within a short space of the top, which forms a perfect umbel. The wood is of fine quality, and yields a large portion of resin. Growing trees of this species, that have been partly burned by the natives, to save the trouble of cutting other fuel, (a custom to which they are greatly addicted,) produce a substance which, I am almost afraid to say, is sugar; but as some of it, with the cones, will soon reach England, its real nature can be easily and correctly ascertained. The tree grows abundantly two degrees south of the Columbia, in the country inhabited by the Umptqun tribe of Indians. The seeds are gathered by the natives in autumn, pounded and baked into a sort of cake, which is considered a luxury. The saccharine substance is used in seasoning dishes, in the same manner as sugar is in civilized countries. I shall bring home such an assemblage of specimens of this *Pinus*, as will admit of a very correct figure being made; and also a bag of its seeds. I am very desirous of procuring *Phlox speciosa*, and if in existence I trust to obtain it. There are very many curious liliaceous plants here.

"I heard of Captain Franklin's party from Cumberland Lake, on their way to Bear Lake, which is to be their winter residence. I learn that a Mr Drummond, probably the botanist of that name who has lived at Forfar, accompanies the expedition as a naturalist. He is on the opposite side of the mountains, towards Pene river. There is here a Mr Macleod, who spent the last five years at Fort Good-Hope, on the Mackenzie River. He informs me that if the natives, with whom he is perfectly acquainted, are worthy of credit, there must be a north-west passage. They describe a very large river that runs parallel with the Mackenzie, and falls into the sea near Icy Cape, at the north of which there is an establishment on an island, where ships come to trade. They assert that the people there are very wicked, having hanged several of the natives to the rigging; they wear their beards long. Some reliance, I should think, may be laid on their statement, as Mr Macleod showed me some Russian coins, combs, and several articles of hardware, very different from those furnished by the British Company. Mr Macleod caused the natives to assemble last summer, for the purpose of accompanying him in his departure for Hudson's Bay. The sea is said to be open after July. This gentleman's conduct affords a striking example of the effects of perseverance. In the short space of eleven months he visited the Polar Sea, and the Atlantic and Pacific Oceans, undergoing such hardships and dangers as perhaps were never experienced by any other individual.

"I shall endeavour to cross the continent in the spring of 1827; but if I fail in my intention, I shall take the earliest opportunity of sailing for England. My stock of clothing is very small, being reduced to two shirts and handkerchiefs, a blanket and cloak, and no stockings. It was impracticable to carry more, since the paper for containing specimens and other necessary articles form a burthen of considerable bulk.

"P. S.—Since writing the above, I have found *Phlox speciosa* of Pursh, a most beautiful plant; his description, however, will require a little attention. Also a fine new species, near *P. setacea*, and abundance of *Tigarea tridentata* with yellow flowers. I hardly know how to sit down to write, or upon what I shall first lay my hands.

"I am now in latitude 47½ degrees north, and longitude 119° west.

"*13th April.*"

From Mr Douglas to Mr Scouler,

Dated Priest's Rapid, on the Columbia River, lat. 48°. N. long. 117°. W., *April* 3, 1826.

" I regretted exceedingly the impracticability of seeing you before you sailed, which was owing to a hurt that I received on my knee when packing a box. This unfortunate accident has caused me some trouble ever since. Although unfitted by it for much exertion, I left Fort Vancouver on the 22d of October, for the purpose of seeing you on my way to Whitby's harbour, on the Cheecheelin river. On the evening of the following day, I put ashore at Oak Point in order to procure a little food, when an Indian gave me the letter from you, in which you stated your expectation of remaining a few days, and as the ship had been seen by some of the natives that very morning, I boiled my kettle and re-embarked without loss of time at eleven o'clock at night, expecting to reach the bay before day light. Unfortunately the wind was unfavourable, and my Indians so much fatigued, that we did not arrive till ten o'clock, when I learned, to my great disappointment, that your vessel had left the river but one hour before. I found Tha-a-muxci, (or the Beard Com Comley's brother,) whom you had seen and spoken to of me. He is a fine old man; at his request I shaved him, that he " might look like one of King George's Chiefs." He accompanied me all the way along the coast, and sixty miles up the Cheecheelin river, where I crossed a tract of land near Mount St Helen's to the Cow-a-lidsk river, which I descended to its junction with the Columbia. This was the most unsuccessful trip I have made. The season being late, and my knee troublesome, I was compelled to lie for three days at Cape Foulweather, in a hut made of pine branches and grass; and as I could not go out to shoot, I fared most scantily. However I killed during the excursion several species of *Procellaria* and *Larus*, and one *Colymbus*, but the excessive rain would not allow of my preserving any of them. The only plant which seemed worthy of notice was a new *Eriogonum*; I obtained also some seeds, among which were *Helonias tenax*, and a fine large-fruited *Carex*. This trip took twenty-five days, and reduced me to such a state of weakness that I could do hardly any thing more during the season. In the short interval of fair weather which now and then occurred in the course of the winter, I crawled to the woods in search of mosses, but my limited knowledge on that head does not allow me to say what they are. As nothing could be effected in the way of botany, I began forming a collection of birds; but here I experienced a sad hindrance from the state of my eyes, which, always weak, have lately been much impaired; and though I have felt no pain or inflammation, yet they have become so dim that I can hardly use the gun, which I could formerly do with considerable advantage. However, I am in possession of a species of *Pinus*, the finest of the genus, and hope soon to obtain better specimens, and plenty of ripe seeds. This is unquestionably the most splendid specimen of transatlantic vegetation. I have another species of *Mimulus, M. alba.* I left the ocean in the middle of this month, but though I could have crossed the continent and returned to England, I thought it incompatible with the interest of the Society which employs me, to neglect so interesting a field of discovery as that now before me, in the upper country towards the head waters of the river. Excuse this bad writing. I have little time, and less convenience for writing, my specimen board being the only substitute for desk and table; but then it contains some most interesting plants under it.

ART. XV.—*Notice respecting the Mean Temperature of the Equator*. By DAVID BREWSTER, LL.D. F.R.S. Lond. and Sec. R.S. Edin.

IN the seventh Number of this *Journal*, (p. 180.) we laid before our readers an abstract of the results obtained by Mr Atkinson, respecting the mean temperature of the equator. According to these results, which were deduced from the American observations given by Humboldt, the mean temperature of the equator at the level of the sea is 86°.55 of Fahrenheit, while Humboldt himself made it only 81°.5.

As the equatorial temperature must always be a fundamental element in meteorological investigations, I have examined the evidence in favour of this new result, and I have no hesitation in expressing the conviction, that the result given by Humboldt is founded on just views of the observations which he possessed;—that it is a near approximation to the truth,—and that the temperature of the equator cannot be placed higher than between 81° and 83° of Fahrenheit.

When Humboldt, in his admirable paper on Isothermal Lines, fixed the mean temperature of the equator at 81½°, he naturally gave a preference to observations made in the old world, where the distribution of temperature did not exhibit the same anomalies which occur in the New World. He accordingly used the mean temperatures of Senegambia, Madras, Batavia, and Manilla,* whereas Mr Atkinson, neglecting entirely the temperatures of the Old World, deduces his results solely from the American observations. Mr Atkinson is therefore not correct in stating, " that it appears, from data furnished by himself, that Humboldt has fallen into an error when he asserted that the mean temperature of the equator cannot be fixed beyond 81½°."

Having sometime ago received, through the kindness of Henry Harvey, Esq. a series of excellent meteorological observations made in Ceylon, I felt myself in a situation to throw some light on this important point; and in order to obtain still more general results, I wrote to Professor Moll of Utrecht, for the purpose of obtaining some of the recent observations made in Java. The following are the Ceylon observations.

	Mean Temp.
Trincomalee, - -	80°.56
Point de Galle, - -	81 .1
Colombo, - - -	80 .75
Kandy, † - - -	78 .5
Do. according to Dr Davy, -	79 .2

If we now deduce the equatorial temperature from these

* By the formula Eq. Temp. $= \frac{T}{\cos. L}$ where T is the mean temperature of any latitude L, the mean temperature of the equator, deduced from these four places, is exactly 81° .5.

† A correction of 5°.7 is added for altitude, according to Mr Atkinson's formula.

observations, either by the formula Eq. temp. $=\frac{T}{\cos. L.}$ according to the principle of my formula, or by the formula Eq. temp. $=\frac{T}{\cos.^2 L.}$ according to the principle of Mayer's formula, we shall obtain the following results:—

	Mean Temp. of Equator.	
	Eq. Temp. $=\frac{T}{\cos. L.}$	Eq. Temp. $=\frac{T}{\cos.^2 L.}$
Trincomalee, - -	81°.46	82°.37
Point de Galle, -	81 .55	82 .02
Colombo, - -	81 .34	81 .93
Kandy, - -	79 .14	79 .78
Do. according to Dr Davy,	79 .84	80 .49
Means,	80 .66	81 .32
Mean of both,	80°.99	

It follows, therefore, from the Ceylon observations, *that the mean temperature of the Equator is less than* 81½°.

The Batavian observations give the following results:—

	Mean Temp.
Batavia, as given by Humboldt, -	80°.42
Do. in 1758, Dr Kriel,* - -	78 .5
Do. near the sea-shore, according to Professor Reinwardt,	82
Do at Buitenzoig, 737 feet high,† -	81½

Hence, we obtain for the equatorial temperature,

	Mean Temp. of Equator.	
	Eq. Temp. $=\frac{T}{\cos. L.}$	Eq. Temp. $=\frac{T}{\cos.^2 L.}$
Batavia, - -	80°.90	81°.37
Do. Kriel, -	78 .96	79 .43
Do. Reinwardt, -	82 .48	82 .97
Do. Do. -	81 .98	82 .4
Means,	81 .08	81 .56
Mean of both,	81°.32.	

It follows, therefore, from the Batavian observations, that the equatorial temperature is not beyond 81½°.

The observations made at the Sandwich Islands in 1821, give,

		Mean Temp.
Hawaii, Lat. 19½°	(See our last Number, p. 370.)	75°.1

* See this *Journal*, vol. v. p. 269.

† A correction of 2½° is added for altitude.

from which we obtain,

	Eq. Temp. $=\frac{T}{\cos. L.}$	Eq. Temp. $=\frac{T}{\cos.^2 L.}$
Hawaii, -	79°.67	82°.40

Mean of both, 81° .04

Hence, it appears that the equatorial temperature is still below 81½°.

From these results we think there is reason to conclude, that the measure of the equatorial temperature, as given by Humboldt, is the best, taken as a general result, and that there is no occasion to modify any of the formulæ which have been founded upon it, for determining the distribution of temperature in different latitudes.

Art. XVI.—*On the Specific Gravity of several Minerals.* By W. Haidinger, Esq. F. R. S. E. (Concluded from Vol. III. p. 246.)

Order VII. Gem.

1. *Gahnite*, a crystal	4.232
2. *Corundum*, a red semi-transparent crystal,	3.909
3. *Corundum*, a brown nearly opaque prism, the adamantine spar of Werner,	3.921
4. *Corundum*, green, translucent fragments of crystals; faces of composition distinct, giving the appearance of cleavage in the direction of the fundamental rhombohedron,	3.949
5. *Corundum*, a white transparent crystal,	3.965
6. *Corundum*, green, translucent fragments of crystals, with a small conchoidal fracture,	3.966
7. *Corundum*, a blue transparent crystal,	3.979
8. *Topaz*, a large crystal from Mukla,	3.499
9. *Topaz*, from Altenberg in Saxony, (Pycnite,)	3.494
10. *Euclase*, a single crystal,	3.098
11. *Cordierite*, transparent, cut and polished,	2.583
12. *Rock-crystal*, found along with sapphire, in Ceylon,	2.690
13. *Opal-jasper*, cream-yellow, without lustre, and imbibing water, from Bohemia,	1.974
14. *Opal-jasper*, pale brown, with a faint lustre, and imbibing water, from Bohemia,	1.982
15. *Opal-jasper*, blood-red and brownish-red tints intermixed, from Candia,	2.060
16. *Opal-jasper*, of an ash-grey colour, from Gleichenberg, in Stiria,	2.075

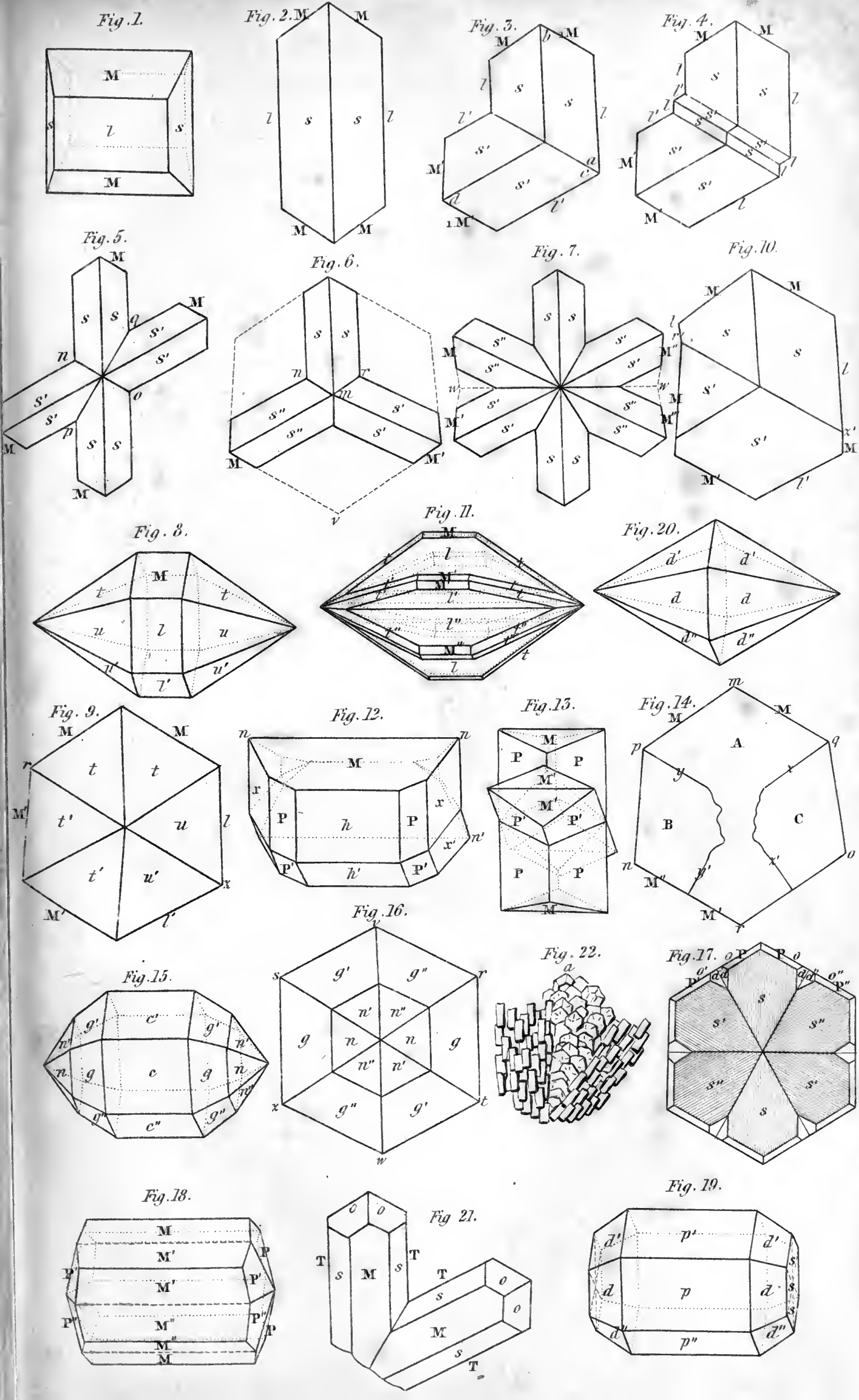
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.
Fig. 20.
Fig 21.
Fig. 22.

17. *Common opal*, approaching to the precious opal, of a milk-white tint,	2.079
18. *Common opal*, milk-white,	2.091
19. *Wood opal*, brown, from Hungary,	2.114
20. *Common opal*, yellow, from Hungary,	2.119
21. *Semi-opal*, with dendritic delineations, from Moravia,	2.207
22. *Opal-jasper*, yellowish-brown, from Telkebanya in Hungary, the well-known ironshot variety,	2.699
23. *Pitchstone*, of a brownish-red colour, from Meissen,	2.212
24. *Pitchstone*, dark leek-green, from Arran,	2.340
25. *Pitchstone*, of a brownish olive-green, from Zwickau in Saxony; the variety often containing anthrazite,	2.354
26. *Axinite*, crystals from Cornwall,	3.271
27. *Chrysolite*, a single crystal,	3.441
28. *Chondrodite*, from Ersby, in the parish of Pargas, Finland,	3.199
29. *Boracite*, a single crystal,	2.973
30. *Tourmaline*, a fragment of a crystal, nearly black,	3.069
31. *Idocrase*, of a yellowish-white colour, from Fassa in the Tyrol,	3.287
32. *Idocrase*, fragment of a crystal of the variety called Egerane,	3.399
33. *Helvine*, a very small quantity of fragments of crystals,	3.100
34. *Garnet*, of a liver brown colour, (occurring along with wax-yellow pyroxene of a sp. gr. of 3.278,) from Schwarzenberg in Saxony,	3.402
35. *Garnet*, white, hardness = 7.5, from the valley of Zem in Salzburg,	3.594
36. *Grossular*, a single crystal,	3.615
37. *Garnet*, red, hardness = 7.5, occurring along with the green varieties of granular amphibole, and pyroxene in the Bacher mountain in Stiria,	3.648
38. *Melanite*, a single crystal,	3.701
39. *Garnet*, red, hardness = 7.5, from the Saualpe in Carinthia, where it is associated with the omphacite of Werner,	3.723
40. *Garnet*, oil-green, hardness = 6.5,	3.762
41. *Garnet*, of a brown colour, hardness = 6.5,	3.769
42. *Pyrope*, large grains,	3.788
43. *Garnet*, red crystals, from the Tyrol,	4.098
44. *Garnet*, red translucent grains from Ohlapian in Transylvania,	4.125
45. *Almandine*, several crystals,	4.179
46. *Garnet*, nearly blood-red, the variety which is found with the chrysoberyl of Haddam,	4.208
47. *Staurotide*, crystals from St Gothard,	3.725
48. *Zircon*, small flesh-red crystals, from the Saualpe in Carinthia,	4.505

Order VIII. Ore.

1. *Sphene*, of a yellow colour, massive, from Arendal,	3.468
2. *Anatase*, a number of small crystals,	3.826

3. *Rutile*, a cleavable variety,	4.209
4. *Rutile*, the variety in small pebbles called Nigrine from Ohlapian, Transylvania,	4.249
5. *Rutile*, a dark-coloured fragment of a crystal,	4.277
6. *Prismatic Zinc-ore*,	5.432
7. *Octahedral Copper-ore*, a fragment of a crystal from Chessy,	6.052
8. *Pyramidal Tin-ore*, a large crystal from Cornwall,	6.960
9. *Wood Tin*, of a hair-brown colour from Cornwall, Hardness = 5.0...5.5.	6.519
10. *Tantalite*, from Skogböhle, in the parish of Kimito, Finland, Hardness = 6.0 (equal to that of prismatic Felspar.) Streak between hair-brown and clove-brown,	6.993
11. *Tantalite*, another specimen of the same,	7.075
12. *Cerite*, from Bastnaes,	4.912
13. *Cerine*, from Bastnaes,	4.173
14. *Chrome-ore*, massive, the variety from Unst,	4.575
15. *Axotomous Iron-ore*, from Gastein, in Salzburg, crystallized,	4.661
16. *Magnetic Iron-ore*, octahedrons, imbedded in chlorite,	5.094
17. *Magnetic Iron-ore*, octahedrons, imbedded in green talc,	5.128
18. *Magnetic Iron-ore*, cleavable masses, with a perfect conchoidal fracture, engaged in pale green talc,	5.170
19. *Iron-sand*, lustre imperfect metallic, fracture perfect conchoidal,	4.872
20. *Titanitic Iron*, from Egersund, in Norway,	4.779
21. *Franklinite*,	5.091
22. *Rhombohedral Iron-ore*, crystals from Elba,	5.229
23. *Rhombohedral Iron-ore*, bounded by the face of crystallization perpendicular to the axis of the crystals, and engaged in quartz. It presents smooth faces of composition, parallel to the faces of the fundamental rhombohedron, which are generally taken for cleavage. From Longbanshyttan, in Sweden,	5.251
24. *Red Hematite*,	4.921

The structure of this variety is very singular. It has a scaly appearance, but each of the particles consists of delicate fibres, diverging from one point, which in all is turned in the same direction. This is also the structure of the variety of prismatic iron-ore called Lepidokrokite, only that, in the latter usually a general tendency remains towards a distribution of the single particles in concentric layers.

25. *Brown Hematite*, with crystalline terminations,	3.806
26. *Brown Hematite*,	3.922
27. *Stilpnosiderite*,	3.611
28. *Lievrite*, a crystal,	3.994
29. *Pyramidal Manganese-ore*, crystals,	4.722

30. *Black Hematite,* (uncleavable manganese-ore,) 4.145
31. *Black Hematite,* from Wiesenthal, in Saxony, 4.150
32. *Grey Manganese-ore,* crystals, streak brown, 4.322
33. *Grey Manganese-ore,* soft, streak black, fragments of crystals, 4.452
34. *Grey Manganese-ore,* a massive variety, consisting of short fibres, 4.605
35. *Grey Manganese-ore,* crystals, from Jhelefeld, streak black, 4.626
36. *Grey Manganese-ore,* a massive variety, consisting of long delicate fibres, 4.787

Order IX. Metal.

1. *Native Arsenic,* in curved lamellar compositions, 5.766
2. *Native Antimony,* a massive variety, consisting of granular particles, 6.646
3. *Native Antimony,* cleavable masses, 6.667
4. *Native Bismuth,* from Altenberg, in Saxony, 9.737
5. *Bismuth,* melted, 9.612
6. *Amalgam,* a single crystal, from Moschellandsberg, 13.755
7. *Native Gold,* a rounded mass, of a fine gold yellow colour, 14.848
8. *Native Platinum,* large grains, 17.332
9. *Meteoric Iron,* part of the mass found at Elbogen, in Bohemia, 7.768

Order X. Pyrites.

1. *Prismatic Arsenical-pyrites,* a fibrous variety, from the Bannat, 5.960
2. *Prismatic Arsenical-pyrites,* thick columnar particles of composition, 5.960
3. *Prismatic Arsenical-pyrites,* massive, composition granular, 6.023
4. *Prismatic Arsenical-pyrites,* thick columnar individuals, extracted from a massive variety, 6.040
5. *Prismatic Arsenical-pyrites,* crystals, from Tunaberg, 6.208
6. *Axotomous Arsenical-pyrites,* disengaged from the serpentine, in which it is imbedded, from the same locality, 7.070
7. *Axotomous Arsenical-pyrites,* massive, from Reichenstein in Silesia, 7.228
8. *Axotomous Arsenical-pyrites,* crystalline, cleavable masses, from Schladming, in Stiria, 7.267
9. *Octahedral Cobalt-pyrites,* crystals, from Schneeberg, in Saxony, 6.340
10. *Octahedral Cobalt-pyrites,* the elongated crystals, usually imbedded in quartz, 6.430
11. *Octahedral Cobalt-pyrites,* crystalline fragments, showing traces of cleavage, 6.466
12. The *Grey Cobalt of Werner,* fragments of a massive variety, consisting of very small individuals, 6.568

13. The *fibrous White Cobalt of Werner*, 6.968

14. The same, reduced to a smaller size, and showing, therefore, that there are many small cavities in the mass, 7.064

15. The *fibrous White Cobalt of Werner*, botryoidal shapes, rather pure, 7.280

16. *Hexahedral Cobalt-pyrites*, crystallized in octahedrons, 6.298

17. *Hexahedral Iron-pyrites*, hexahedral crystals, from Littmitz, in Bohemia, 4.981

18. *Hexahedral Iron-pyrites*, the crystallized extremities of a globular imitative shape, 5.001

19. *Hexahedral Iron-pyrites*, admitting of a distinct cleavage in the direction of the planes of the hexahedron, from Freiberg, 5.010

20. *Hexahedral Iron-pyrites*, from the heap of the Donat mine near Freiberg. It is cleavable in the directions both of the hexahedron and of the octahedron, the latter, however, is more easily obtained, 5.031

21. *Prismatic Iron-pyrites*, a single crystal, from Schemnitz, in Hungary, 4.678

22. *Prismatic Iron-pyrites*, the crystallized extremities of a globular imitative shape, 4.787

23. *Prismatic Iron-pyrites*, twin-crystals, from Littmitz, in Bohemia, occurring with No. 17 on one specimen, 4.847

24. *Magnetic Pyrites*, a cleavable variety, from Bodenmais, 4.631

25. *Copper Pyrites*, massive, composition granular, 4.169

26. *Variegated Copper*, 5.006

27. *Nickeliferous Grey Antimony*, hexahedrons, bounded by planes of cleavage, 6.451

Order XI. Glance.

1. *Fahlerz*, massive, from the mine of Kurprinz, near Freiberg, 4.663

2. *Fahlerz*, crystals, from Schwatz, in the Tyrol, 4.798

3. *Fahlerz*, from Kapnik, 4.950

4. *Fahlerz*, crystallized, from Kremnitz, in Hungary, 5.104

5. *Prismatoidal Copper-glance* from St Gertraud, Carinthia, 5.739

6. *Bournonite*, a massive variety, from Clausthal, in the Hartz, 5.705

7. *Bournonite*, fragment of a large crystal, from Neudorf, in the Hartz, 5.763

8. *Vitreous Copper*, a compact variety, with conchoidal fracture, from the Bannat, 5.695

9. *Hexahedral Silver-glance*, a single octahedral crystal, from the mine Neue Morgenstern, near Freiberg, 7.223

10. *Lead-glance*, a compound mass of individuals, elongated in one direction, and presenting a radiated fracture, 7.456

11. *Lead-glance*, large cleavable individuals, Przibram in Bohemia, 7.522

12. *Lead-glance*, cleavable masses from the mine Junghohebirke, 7.526

13. Another variety of the same, 7.537
14. *Lead-glance*, hexahedrons obtained by cleavage, with striated surfaces, 7.535
15. *Lead-glance*, in small granular composition, nearly compact, from the Prussian dominions on the Rhine, 7.557
16. *Lead-glance*, hexahedrons bounded by faces of cleavage, from Bleiberg, in Carinthia, 7.568
17. *Lead-glance* of the same description, from Alston-moor, 7.570
18. *Lead-glance*, from the Junghohebirke mine near Freiberg; massive, composition granular, individuals somewhat larger than the preceding variety; the difference in the specific gravity probably depending upon a small admixture of copper pyrites, 7.417
19. *Prismatic Tellurium-glance*, laminae obtained by cleavage, 7.085
20. *Rhombohedral Molydena-glance*, cleavable, 4.591
21. *Grey Antimony*, crystalline masses from the Wolffsberg mine, in the county of Stolberg, 4.620
22. *Jamesonite*, from Cornwall, 5.564
23. *Jamesonite*, from Zinobanya, in Hungary, 5.717
24. *Jamesonite*, from Zinobanya, in Hungary, 5.798
25. *Tin-pyrites*, 4.463
26. *Brittle Silver*, a single crystal from Przibram, in Bohemia, 6.269

Order XII. Blende.

1. *Hexahedral Glance-blende*, a cleavable variety, 4.014
2. *Blende*, a massive variety, with a radiated fracture, from Przibram, in Bohemia, (the same which contains cadmium,) 4.027
3. *Blende*, a dodecahedron of a brown colour, obtained by cleavage, 4.078
4. *Red Silver*, the hollow six-sided prisms having the colour of dark red silver, from the mine of Kurprinz, near Freiberg, 5.422
5. *Light Red Silver*, cleavable masses, 5.524
6. *Dark Red Silver*, a cleavable variety from the Hartz, 5.831
7. *Dark Red Silver*, crystals from Beschert Glück, near Freiberg, 5.846
8. *Hemi-prismatic Ruby-blende*, a group of crystals, 5.234

Several specimens of this rare species are at present in the Wernerian collection at Freiberg. They had lately been found at the mine of Bräunsdorf, where they occur in the drusy cavities of the silver veins, accompanied chiefly with quartz.

9. *Cinnabar*, from Neumarktl in Carniola, 8.098

Order XIII. Sulphur.

1. *Realgar*, a single crystal, 3.556

2. *Orpiment,* small imbedded crystals, from Thajowa, in Hungary,	3.460
3. *Orpiment,* a massive, cleavable variety,	3.480
4. *Sulphur,* of a pure sulphur-yellow colour, from Sicily,	2.072

CLASS III. ORDER I. RESIN.

1. *Mellite,* several crystals,	1.597
2. *Amber,* honey-yellow,	1.111
3. *Retinite,* a nearly transparent variety, with a strong peculiar odour, from Halle, in Prussia,	1.079
4. *Bitumen,* of the consistency of wax,	0.828
5. *Bitumen,* of a black colour, and a splendent conchoidal fracture. Its streak is pale brown, nearly yellow,	1.073
6. *Bitumen,* hyacinth red,	1.160

CLASS I. ORDER IV.

1. *Hemi-prismatic Natron-salt,* artificial crystals,	1.423
2. Another experiment gave	1.430
3. Another,	1.495
4. *Prismatic Natron-salt,* artificial crystals,	1.552
5. Another experiment gave	1.562
6. *Sal ammoniac,* fibrous masses,	1.528
7. *Rock-salt,* hexahedrons obtained by cleavage, from Aussee in Stiria,	2.257
8. *Sulphate of Copper,* artificial crystals,	2.213
9. *Sulphate of Copper,* a similar variety,	2.248
10. *Sulphate of Iron,* (the common iron vitriol,) with a slight admixture of sulphate of copper,	1.832
11. *Sulphate of Zinc,* artificial crystals of a reddish-white colour, from Goslar, in the Hartz,	2.036
12. *Sulphate of Magnesia,*	1.751
13. *Sulphate of Potash,*	1.731
14. *Alum,* artificial crystals,	1.753
15. *Alum,* artificial crystals,	1.778
16. *Borax,* artificial crystals,	1.716
17. *Glauberite,* fragment of a large crystal,	2.807

ART. XVII.—*Additional Testimony respecting the Sea-Serpent of the American Seas.* Communicated by DR HOOKER.

WHEN we remember the numberless impositions concerning Natural History, which at various periods have been detected, it is not surprising that doubt should be a principal, nay, a necessary, qualification of the student of Nature. Yet we cannot but think that the scientific world in general has been too incredulous concerning the sea-serpent, seeing the mass of concurrent testimony which has been adduced to prove its existence. It is certainly true that vague reports had been spread abroad with regard to this enormous animal long ere any just foundation was afforded for them, and indeed before we had heard of any who professed to have seen it. This may have very far conduced to produce that scepticism which now is perfectly unwarrantable. We are so accustomed, whenever the subject is introduced in conversation, to couple it with the preposterous fables of the *Kraken*, that it would be extremely difficult to break down the barriers against belief which prejudice has so long assisted to support. The accounts of the most credible witnesses have thus been rejected, although, "*to make assurance doubly sure*," the generality of them have been taken upon oath.

So many wonderful discoveries, both in the arts and sciences, have been made within the last century, that it is astonishing how the existence of the sea-serpent has been supposed either so marvellous or impossible. Time has satisfactorily proved the veracity of Bruce, and we must leave it to time to do the same office with regard to the beholders of this "wonder of the deep." Is this monster more disproportionate to the extent of the sea than the elephant to that of the land? or, it may be asked, has it a solid bulk, (even according to late most extravagant accounts,) nearly approaching in magnitude to that of the whale? Geology has been infinitely more fortunate than zoology in many respects; theories only partially sustained have been received; and while the recent discoveries of the *Plesiosaurus* and *Megalosaurus* have made demands upon our powers of credence far greater than the *serpent*, the descriptions of the latter animal have received very little trust, and even much ridicule and contempt. In general, however, it must be confessed, that people do not object to the extraordinary proportions of such a creature, so much as to what they consider the want of respectable and satisfactory evidence. We trust to advance, in the sequel, such additional evidence to that already presented, and of such respectability, as to confirm entirely the truth of the existence of such an animal,—an animal concerning which so many contradictory opinions have been hazarded as to its more immediate nature and structure; and which, from the mystery in which it has hitherto been wrapped, must be interesting to the most casual admirer of nature:—which must be interesting even from the element in which it lives; so vast, so unexplored in its inmost recesses. We can have so little information with regard to an animal which has so mighty a habitation, that it acquires a grandeur in our estimation far surpassing those which inhabit the earth. The monsters of the deep appear so independent of our influence, and so far removed from any connection with us, that any increase of our knowledge in reference to them must be highly gratifying.

It was during the year 1817 that it began to be correctly reported, that in the neighbourhood of Boston and Gloucester in America, an animal, in general construction nearly resembling a serpent, had been frequently seen. These rumours created a good deal of excitement, insomuch that, at a meeting of the Linnean Society of New England, it was determined more fully to investigate the matter. The Honourable Lonson Nash of Gloucester was appointed by a committee to gather together all the information which might be obtained.

It is unnecessary here to dwell at any length upon the evidence which his unremitting and meritorious exertions procured. From different quarters, individuals of the highest respectability communicated all the information which it was in their power to proffer, and all declared themselves prepared to take an oath upon the accuracy of their narrations. No testimony was received, excepting from those who professed to have been personal witnesses of the monster: no weight was given to their accounts deduced from the reports which were everywhere circulated:—the unadorned and unexaggerated style in which their statements were worded is of itself perfectly sufficient to win over all to unqualified trust. The witnesses, for the most part, unite in ascribing a vertical motion to the creature. Fifty or sixty yards was no uncommon distance between it and the spectators, and it was never seen except in weather the most calm and bright. But these facts, along with the various depositions, have been long laid before the public in the "Report of the Committee of the Linnean Society of New England," and it is our part now merely to adduce some corroborative circumstances which have lately occurred, and which *we* think puts the matter for ever beyond the possibility of a doubt;—facts which have already completely satisfied some highly scientific gentlemen, who before were entirely sceptical.

That which has been the principal inducement for us to present this imperfect paper to the public, is a letter which we have had the pleasure of seeing addressed to Robert Barclay Esq. of Bury Hill, Surry, from Mr Warburton, a gentleman belonging to the house of Barclay, Brothers, and Company, London. That gentleman, proceeding in his passage to America, on board the Silas Richards, New York packet, Captain Holdrege, had an opportunity of beholding this sea monster on Friday the 16th of June off St George's Banks. But his own plain statement must be presumed far more satisfactory to every candid mind, than any account extracted from his letter.

"*Pentonville*, 20*th September* 1826.

"Dear Sir,

"Having been informed by your grandson, Mr Robert Reynolds, that you were desirous of possessing a sketch of the sea-serpent as seen by me in crossing the Atlantic, and to have some account of the same; in compliance with your wishes, I have inclosed a rough pencil drawing (see Plate I. Fig. 10.) of the monster as it appeared during the time when its head was elevated above the water, and I shall state the particulars attending this novel exhibition.

"The captain and myself were standing on the starboard side of the vessel, looking over the bulwark, and remarking how perfectly smooth was the surface of the sea. It was about half-past six o'clock P. M., and a cloudless sky. On a sudden we heard a rushing in the water a-head of the ship. At first we imagined it to be a whale spouting, and turning to the quarter whence the sound proceeded, we observed the serpent in the position as it appears in the sketch, slowly approaching at not more than the rate of two miles an hour, in a straight direction. I suppose we were hardly going through the water so fast, for there was scarcely a breath of wind. I must premise that I had never heard of the existence of such an animal. I instantly exclaimed, why, there is a *sea-snake!* 'That is the sea-serpent,' exclaimed the captain, 'and I would give my ship and cargo to catch the monster.' I immediately called to the passengers, who were all down below, but only five or six came up, among whom was Miss Magee, the daughter of a merchant in New York. The remainder refused to come up, saying there had been too many hoaxes of that kind already. I was too eager to stand parleying with them, and I returned to the captain. In the same slow style the serpent passed the vessel at about the distance of 50 yards from us, neither turning his head to the right or left. As soon as his head had reached the stern of the vessel, he gradually laid it down in a horizontal position with his body, and floated along like the mast of a vessel. That there was upwards of 60 feet visible, is clearly shown by the circumstance, that the length of the ship was upwards of 120 feet, and at the time his head was off the stern, the other end (as much as was above the surface) had not passed the main-mast. The time we saw him, as described in the drawing, was two minutes and a half. After he had declined his head, we saw him for about twenty minutes a-head, floating along like an enormous log of timber. His motion in the water was meandering like that of an eel, and the rake he left behind was like that occasioned by the passing of small craft through the water. We had but one harpoon on board, and the ship's long-boat was, for the time being, converted into a *cow-house.* We had two guns on board, but no ball. Two days after we saw him, he was seen by another vessel off Cape Cod, about 200 miles from where he made his appearance to us. This intelligence reached New York about four days after we arrived there, and the description given exactly corresponded with the foregoing. I dined one day at the hotel of New York with Sir Isaac Coffin, who discredited the existence of such an animal, which was reported to have been seen by Captain Bennett of Boston about five years back; but as I assured him I had never heard previously even the report of such a monster, and that I was an *Englishman*, he gave full credit to it. The sketch I gave him also corresponded with the description that was circulated at that time. The humps on the back resembled in size and shape those of the dromedary. I remain, Dear Sir, yours respectfully,

"WILLIAM WARBURTON."

To the interesting facts above-mentioned, we are happy in having it in our power to add some extracts from a letter written by our excellent friend Dr Boott of Boston, now resident in London, whose brother had an opportunity of witnessing this remarkable animal. After some general remarks, Dr Boott proceeds to express himself in the following terms:

"All that I could collect upon the subject was sent to Sir Joseph Banks, with whom I had repeated conversations about the animal, and the respectability of the individvals who affirmed to the sight of him. The great mass of evidence is to be found in the pamphlet published by the Linnean Society of New England. The question as to the real appearance of a large serpent off the coast of Massachusetts, was put to rest by that publication. There could be no doubt of the fact, and the testimony of thousands who saw the animal *for one or two years afterwards*, must have been sufficient to satisfy the most incredulous.

"I believe I was one of the first who mentioned to Sir Joseph Banks, that a large serpent had been seen on the American coast; at all events, I distinctly remember that when I first spoke to him on the subject, he was incredulous, and showed me a plate of a similar animal in Pontopiddan's *History of Norway*. I myself had no doubt of the truth of the assertions of the early observers of it, for many of them were known to me, and I was anxious to convince Sir Joseph of the discovery of a new and remarkable animal. I therefore was in the habit of sending him every information I could collect respecting it. In one of my last visits to Boston, I gathered testimony from individuals, and from the public papers, and was happy to find, on my return to Europe, that Sir Joseph was satisfied of the existence of the serpent, though he continued doubtful of the relationship between the small snake, (Fig. 1. of the Linnean pamphlet) and the large serpent.

"During this visit I distinctly remember the news coming from Nahaut one morning, of the serpent being in the bay of that place, distant about sixteen miles from Boston. Many hurried down to see it, and among them my brother Mr James Boott. I was prevented from some cause leaving Boston. My brother reported that he distinctly saw a large serpent, about a mile from the shore; and that thousands were watching its motion on the beach and rocks. The first idea that occurred to my brother was that it was a horse swimming, its head at the time bearing a resemblance to that of the latter creature. He afterwards saw the undulating line of its back, and remained several hours watching the animal. Colonel Perkins of Boston, his wife, and family, were present at this time, as far as I recollect. I remember also that a letter appeared in the Boston Centinel soon after, published by an officer in the American navy, who reported that, on his return from a survey of some part of the coast, he saw, when out of sight of land, a large serpent. He was so near that he drew an outline of it, and that outline accompanied the paragraph. When you showed me Mr Warburton's figure on the card, I at first thought it was a copy of that in the Centinel. I can only add, for your own satisfaction, that *I* have no doubt of the existence of this remarkable animal.

"I remain yours affectionately,

"FRANCIS BOOTT.

"GOWER STREET, BEDFORD SQUARE,
"*London, Nov.* 4, 1826."

We sincerely hope that these few bare facts may satisfy all upon this much agitated question; at least we think they must remove the ideal connection between *our* serpent, and

"That sea-snake, enormous curled,
Whose monstrous circle girds the world."

It can now no longer be considered in association with hydras and mermaids, for there has been nothing said with regard to it inconsistent with reason. It may at least be assumed as a sober fact in Natural History, quite unconnected with the gigantic exploits of the *God Thor*, or the fanciful absurdities of the Scandinavian mythology. We cannot suppose, that the most ultra-sceptical can now continue to doubt with regard to facts attested by such highly respectable witnesses.

ART. XVIII.—*Description of an Instrument for Extracting and Condensing Air without the assistance of Valves or Stop-cocks.* By ANDREW BUCHANAN, M. D. Glasgow. In a Letter to the EDITOR.

DEAR SIR,

OBSERVING, in a recent number of one of the Philosophical Journals, an account of an air-pump without artificial valves, by Mr Ritchie of Tain, it brought to my recollection a model of an instrument which I have had beside me for many years, and of which, if you can spare a corner in your next number, I shall be obliged by your inserting a description.

The original form of the instrument, such as it has in the model just mentioned, is represented by Plate I. Fig. 11. It consists of two cylinders of the same size, each furnished with a piston. They are both open at the top, while at the bottom the vertical one communicates by a small opening with the body of the horizontal one, and the horizontal one itself communicates with the receiver by means of a conduit pipe.

The mode in which the instrument acts in extracting or condensing air is easily perceived by the inspection of the figure. Suppose both pistons at the bottom of their respective cylinders,—let the horizontal piston be drawn up, the air of the receiver will diffuse itself through the horizontal cylinder. Next, let the vertical piston be drawn up, and the air will in like manner diffuse itself through the vertical cylinder. The horizontal piston is now pushed down, and after it the vertical one. By this arrangement it is clear that the whole air contained in the vertical cylinder has been forced out and permanently excluded from the receiver; for, on the descent of the vertical piston, the air is forced from the vertical into the horizontal cylinder, and being prevented from returning into the conduit pipe, by the interposition of the horizontal piston, it makes its escape by the only remaining passage at the top of the horizontal cylinder. The different parts of the instrument are now in the same position as at first; the alternate motion of the pistons may therefore be repeated and continued, till the exhaustion of the air in the receiver be as great as required.

As the process of condensing air is the reverse of rarefying it, so it is performed by reversing the order of the motion of the two pistons. Supposing, as in the former case, both pistons at the bottom, the vertical one is first drawn up, and next the horizontal one. They are then made to descend in the same order, when it is obvious that a volume of air, equal to the capacity of the vertical cylinder, will be forced through the conduit pipe into the receiver. The pistons are now again at the bottom of the cylinders, so that the operation may be repeated as before.

In the year 1817, in drawing up an account of this instrument, I slightly modified its form. It is clear that there is no necessity for the horizontal cylinder being so large as the vertical one; on the contrary, the great size of the former is a disadvantage in working the instrument, without adding in any respect to its efficiency. I therefore diminished the horizontal cylinder both in length and diameter, and reduced the instrument to the form represented by Fig. 12.

I have not been able to devise any farther simplification of the instrument itself. The process of working it, however, is somewhat operose. This practical inconvenience may be obviated in various ways. By the following apparatus, the successive strokes of the two pistons are effected in the common air-pump by the partial revolutions of a wheel acting on the piston rods.

Fig. 13. is a delineation of this apparatus. It consists of two simple instruments wrought by the same moving power. The wheel has two quadrants opposite each other, furnished with teeth acting on the corresponding teeth in the upper half of the vertical piston rods. By this means, on turning the wheel a quarter round, the two vertical pistons receive a simultaneous motion in opposite directions. The two horizontal

pistons have a common piston rod, which is moved by two belts or cords attached at one end to the cross bar *a a*, in the middle of the rod. From this point of attachment the belts pass in opposite directions to the bottom of the vertical cylinders, where each passing over a pulley, ascends to be buckled to the moving wheel. The two buckles are placed one on each side, about an inch from the lower end of the toothed quadrant. The length of the belt *a b c* is equal to *G b d*, that is, to the length of the vertical piston rod, *plus* the distance between the bottom of the vertical cylinder, and *d* the point of nearest approach of the central bar *a a*, which point it occupies when the horizontal piston is depressed on that side. In the same manner the length of the belt *a e k* is equal to *H e f*. Knowing the length and attachment of the belts, it is easy to understand how the motion of the horizontal pistons is effected. In the position of the instrument represented in the figure, the wheel is turning in the direction *G c k H*, the motion of the vertical pistons is just finished, the belt *a b c* is relaxed, while the belt *a e k* is newly put upon the stretch. By turning the wheel a little farther in the same direction till the point *k* comes to *H*, the belt *a e k* will assume the position *f e k*, and the piston will be depressed in the horizontal cylinder on that side, while it is simultaneously raised in the opposite one. The wheel is now turned in the opposite direction; the vertical pistons move first, and when their motion is completed, the belt *a b c* being put upon the stretch, the horizontal pistons are moved back into the position represented in the figure. Thus are the two sets of pistons moved successively by turning the wheel a little more than a quarter round alternately, in opposite directions.

If it be wished to use the instrument as a condenser, the only change to be made consists in lengthening the belts, and shifting them each to the buckle on the opposite side, which will plainly have the effect of reversing the order of succession in the movement of the pistons.

As the ascending vertical piston has to contend with the whole atmospheric pressure, and does not, as in the common air-pump, receive any assistance from the descending piston, which is pressed equally in both directions, the force required to raise the vertical piston would be considerable when the exhaustion of the receiver was carried to a great length. To obviate this inconvenience, the horizontal piston rod might be made to work in air-tight leather collars at the top of the two horizontal cylinders, while the air coming from the receiver, on each stroke of the descending piston, would pass off by a discharging valve in the same situation. This construction is represented by Fig. 14. The valves require to be permanently raised when the instrument is used as a condenser. Your most obedient Servant,

ANDREW BUCHANAN.

40, GEORGE'S SQUARE, GLASGOW.

ART. XIX.—*Observations on the Mean Temperature of the Equatorial Regions.* By Baron ALEXANDER HUMBOLDT.

IN an interesting memoir on *the temperature of the different parts of the torrid zone at the level of the sea,* just published by Baron Humboldt in the *Annales de Chimie, &c.* for September last, he has entered into an examination of the equatorial temperature, in reply to the observations of Mr Atkinson, to which we have already referred in a former article. The importance of this part of his paper is such as to merit the particular attention of our meteorological readers.

"The question," says he, "of the equatorial temperature has been recently discussed in a memoir published by Mr Atkinson, in the second volume of the *Memoirs of the Astronomical Society of London* (p. 137-183,) and which contains very judicious considerations on several important points of meteorology. The learned author endeavours to deduce from my own observations, by employing the artifices of the most rigorous calculus, that the mean temperature of the equator is not less than 84°.5 Fahr. and not 81°.5, as I have supposed in my essay on isothermal lines. Kirwan made it 84°, and Dr Brewster in his Climateric Formulæ has adopted 82°.8. * (*Edinburgh Journal of Science*, 1825, No. vii. p. 180.)

* We have adopted 82°.8 as the equatorial temperature in the warm meridian passing through Africa; but have retained 81°.5, Humboldt's

If the equatorial temperature under consideration were that of the equatorial zone surrounding the whole globe, and bounded by the parallel of 3° north and 3° south, we must first examine the temperature of the equatorial ocean, for there is only one-sixth of the circumference of the globe which in that zone belongs to *terra firma.*

But the mean temperature of the ocean between the limits we have mentioned, varies in general between 80°.24, and 82°.4. I say in general, for we sometimes find between these limits *maxima* restricted to zones scarcely a degree wide, and whose temperature rises in different longitudes from 83°.7, to 84°.7. I have observed this last temperature, which may be regarded as very high in the Pacific ocean, to the east of the Galapagos Islands, and recently M. Baron Dirckinck of Holmfeldt, a well-informed officer of the Danish navy, who, at my request, made a great number of thermometrical observations, has found (in lat. 2°.5′ N., long. 81.°54′ W.) almost in the parallel of Punta Guascama, the surface of the water at 87°.1. These maxima do not belong to the equator itself. They occur sometimes to the north, and sometimes to the south of it, and often between the latitude of 2½°, and 6°. The great circle which passes through the points where the waters of the sea are the warmest, cuts the equator at an angle which seems to vary with the sun's declination. In the Atlantic ocean, we may sometimes even pass from the northern to the southern temperate zone, in the zone of the warmest waters, without observing the thermometer rise above 82°.4. The maxima are

According to	Perrins - - -	82° 76′
	Churrucca - - -	83 66
	Quevedo - - -	83 48
	Rodman - - -	83 84
	Dr Davy - - -	82 58
	Mean,	83° 26′

The air which rests upon these equatorial waters is from 1°.8 to 2°.7, colder than the ocean. It results from these facts,

measure for the temperature of the equator in America and Asia. This double measure is a necessary result of the isothermal lines being regulated by two poles of maximum cold.—Ed.

that over 5-6ths of the circumference of the globe, the equatorial aqueous zone, instead of presenting a mean temperature of 84°.5, has probably not one of 83°.3. Mr Atkinson himself admits, p. 171, that the union of the aqueous and continental parts tends to diminish the mean temperature of the equator. But in confining himself to the continental plains of south America, this philosopher adopts for the equatorial zone from 1° to 3° south, and upon different theoretical suppositions, 84°.56, or 87°.8. He founds this conclusion on the fact, that at Cumana, in lat. 10°.27, the mean temperature is 81°.68, and that, by the law of the increase of heat from the pole to the equator, an increase which depends on the square of the cosine of the latitude,* the mean temperature ought to be at least above 84°.56. Mr Atkinson finds a confirmation of this result, by reducing to the level of the equatorial seas several temperatures which I had observed on the declivity of the Cordilleras, to a height of 500 toises; and in employing corrections, which he believes to be due to the latitude, and to the progressive diminution of heat in a vertical plane, he does not dissemble how much a part of these corrections is rendered uncertain by the position of places in vast plains, or in narrow vallies.—*Mem. Astr. Soc.* Vol. ii. p. 149, 158, 171, 172, 182, and 183.

In studying in all its generality the problem of the distribution of heat on the surface of the globe, and in freeing it of the accessory consideration of localities, (for example of the effects of the configuration, the colour and the geographic relation of the soil; of those of the predominance of certain winds, of the proximity of seas, of the frequency of clouds and fogs, and of the nocturnal radiation towards a sky more or less serene,) we shall find that the mean temperature of a station depends on the different ways in which the influence of the meridian altitude of the sun manifests itself. This altitude determines at once the duration of the semidiurnal arcs, the length and the transparency of the portion of the atmosphere which the rays traverse before reaching the horizon; the

* The law of increase approaches much more nearly to that of the simple cosines of the latitude.—Ed.

quantity of the absorbed or heating rays (a quantity which augments rapidly when the angle of incidence, reckoned from the level of the surface, increases;) and lastly, the number of solar rays which a given horizon embraces. The law of Mayer, with all the modifications which have been introduced into it for thirty years, is an empirical law, which represents the generality of the phenomena by approximation, and often in a satisfactory manner; but it cannot be employed against the testimony of direct observations. If the surface of the globe, from the equator to the parallel of Cumana, was a desert like that of Sahara, or a savanna uniformly covered with grasses like the Llanos of Calobozo or of Apure, there would undoubtedly be an increment of mean temperature from 10½°. of latitude to the equator, but it is very probable that this increase does not amount to 2½° of Fahrenheit. M. Arago, whose important and ingenious researches extend to all the branches of meteorology, has found, from direct experiments, that from a perpendicular incidence to 20° of zenith distance the quantity of reflected light is nearly the same. He has found also that the photrometrical effect of solar light varies extremely little at Paris in the month of August, from noon to three o'clock, in spite of the changes in the length of the path described by the rays which traverse the atmosphere.

If I have fixed the mean temperature of the equator in round numbers at 81½°., it was to attribute to the equatorial zone, properly so called, from 3° N. to 3° S., the mean temperature of Cumana, 81°.86. This city, surrounded with arid sands, situated under a sky always serene, and whose thin vapours almost never resolve themselves into rains, possesses a more burning climate than all the places which surround it, and which are like it on the level of the sea. In advancing southward in America, and to the equator, by the Orinoco and Rio Negro, the heat diminishes, not on account of the elevation of the soil, which from the Fort of St Carlos is very little, but on account of the forests, the frequency of rains, and the transparency of the atmosphere. It is to be regretted that travellers, even the most laborious, should be so little in a state to advance the progress of meteorology, by adding to our knowledge of mean temperatures. They do not remain a sufficient time in the countries whose climate they desire to know, and they collect for the annual means only observations which others have made, and most frequently at hours and with instruments which are far from giving correct results. Owing to the constancy of the atmospheric phenomena under the zone nearest to the equator, a short space of time is without doubt sufficient to give approximately the mean temperature at different heights above the level of the sea.

I have always pursued this class of researches ; but the only precise result which I have been able to obtain, and which is deduced from observations made twice a-day, is that of Cumana. (Compare with respect to the degree of confidence which the mean temperatures merit, *Relat. Hist.* tom. i. p. 411, 547, 631-637, 584 ; tom. ii. p. 73, 418, 463 ; tom. iii. p. 314-320, 371-382.)

The true numerical elements of climatology can only be fixed by skilful persons established for a great number of years in different parts of the earth ; and, in this respect, the intellectual generation which is preparing itself in the free part of equatorial America, from the coast to 2000 toises of altitude on the back and on the declivity of the Cordilleras, between the parallels of the Isle of Chiloe and San Francisco in New California, will have the happiest influence on the physical sciences.

In comparing what has been known for forty years on the mean temperature of the equatorial regions with what we now know, we must be astonished at the slow progress of positive climatology. I do not know, at the present day, more than one mean temperature observed with any appearance of precision, between 3° north and 3° south lat., and it is that of St Louis de Maranham in Brazil, 2°.29′ S. lat., which Colonel Antonio Pereira found from observations made in 1821, three times a-day, (at 8^h A. M., 4^h P. M., and 11^h P. M.) to be 81°.32. (*Annaes das Sciences das Artes e das Letras,* 1822, tom. xvi. Plate II. p. 55-80.) This is still 0° 54 less than the mean temperature of Cumana.* Below $10\frac{1}{2}$° of lat. we know only the mean temperature of

* See a preceding notice on this subject in p. 117 of this Number.

	Lat.	Fahr.
Batavia, - -	6° 12′ S.	80° 42
Cumana, - -	10 27	81 86

Between 10½° of lat. and the extremity of the torrid zone, we have

	Lat.	Fahr.
Pondicherry, - -	11°55′ N	85°28
Madras, - -	13 4	80 42
Manilla, - -	14 36	78 08
Senegal, - -	15 53	79 70
Bombay, - -	18 56	80 06
Macao, - -	22 12	73 94
Rio Janeiro, - -	22 54 S.	74 30
The Havanna, - -	23 9 N.	78 26

And after the observations of Pereira,

Maranham, - -	2° 29′ S.	81° 32

It appears to result from these data, that the only place in the equinoctial region whose mean temperature exceeds 81° 86, is situated in 12° latitude. This is Pondicherry, whose climate can no more serve to characterise the equatorial region than the Oasis of Mourzouk, where the unfortunate Ritchie and Captain Lyon assure us that they saw, during whole months, (perhaps from the sand disseminated in the air,) the thermometer at 117° and 128°, can characterise the climate of the temperate zone in the north of Africa. The greatest mass of tropical land is situated between 18° and 28° of north lat., and it is in that zone also, thanks to the establishment of so many rich commercial towns, that we possess most meteorological knowledge. The three or four degrees nearest to the equator are a *terra incognita* for climatology. We are still ignorant of the mean temperatures of Grand Para, Guayaquil, and even Cayenne.

When we consider only the heat attained in a particular part of the year, we find in the northern hemisphere the most scorching climates under the tropic itself, and a little beyond it. At Abusheer, for example, in lat. 28½°, the mean temperature of the month of July is 93° 2. In the Red Sea we find the thermometer at noon at 131°, and in the night at 109°. At Benares, lat. 25° 20′, the heat reaches in summer 131°, whilst it descends in winter to 46° 96. These observations in India were made with an excellent thermometer for maxima, by Six. The mean temperature of Benares is 77° 36. *

The extreme heat which occurs in the southern portion of the temperate zone, between Egypt, Arabia, and the Gulf of Persia, is the simultaneous effect of the configuration of the surrounding lands, of the state of the surface, of the constant transparency of the air deprived of aqueous vapours, and the length of the days, which increase with the latitudes. Between the tropics, even great heats are rare, and generally do not exceed at Bombay 91° and at Vera Cruz 95°. It is almost needless to state, that in this note we have referred only to observations made in the shade, and far from the reflection of the ground. At the equator, where the two solstitial heights reach 66° 32′, the times of the sun's passing the zenith are distant from one another 186 days. At Cumana, the height at the summer solstice is 76° 59, and that of the winter solstice 56° 5′, and the times of passing the zenith, 17th April and 26th August, are distant 131 days. Farther to the north, at the Havanna, we find the solstitial height in summer 89° 41′, and of winter 43° 23′, and the distance of the passage (12th June and 1st July) 19 days. If these passages are not recognized with the same evidence in the curve of the month, it is because their influence is marked in some places by the occurrence of the rainy season, and other electrical phenomena. The sun is at Cumana during 109 days, or more exactly during 1275 hours, (from the 28th October till the 14th February,) lower than under the equator, but in this interval its maximum of zenith distance does not exceed 33°.55. The retardation in the sun's progress, in approaching the tropics, increases the heat of places situated farther from the equator, particularly towards the confines of the torrid and temperate zones. Near the tropics, for example at the Havanna, lat. 23° 9′, the sun employs twenty-four days to describe a degree on each side of the zenith; under the equator it requires on-

* Mr Prinsep makes the mean temperature of Benares in

1822	76°.81
1823	76 .40

and the greatest range from 111½° to 45°; the mean heat of a well thirty-six feet deep was 79°.71′.—Ed.

ly five days. Near the tropics, for example at the Havanna, (lat. 23°29,) the sun employs twenty-four days to describe a degree on each side of the zenith ; under the equator it employs only five days. At Paris, lat. 48° 50′, where the sun descends to the winter solstice, as far as 17° 42′ ; the solstitial height in summer is 64°38′. The sun is consequently from the 1st of May till the 12th August, during the interval of 103 days, or 1422 hours, as high at Paris as at Cumana at another epoch in the year. In comparing Paris to the Havanna, we find, in the first place, from the 26th March to the 17th September, during 175 days, or 2407 hours, the sun as high as it is in any other season under the tropic of Cancer. But in this interval of 175 days, the warmest month (July) has, from the register kept in the royal observatory from 1806 to 1820, a mean temperature of 65°.48, whilst at Cumana, and at the Havanna, where the sun descends, in the first place, to 56°5′, in the second, to 43°23′, the coldest month still gives, in spite of the long nights at Cumana, 79°.16, and at the Havanna 70°.16 of mean heat. Under all zones, the temperature of a part of the year is modified by the temperature of the seasons which precede it. Under the tropics the diminution of the temperatures is very inconsiderable, because the earth has received in the foregoing months a mass of mean heat, which is equivalent at Cumana to 80°.6, and at Havanna to 25°.5.

From the considerations which I have now explained, it does not appear to me probable that the equatorial temperature ever reaches 84°.56, as is supposed by the learned and estimable author of the Memoir on *Astronomical Refractions.* Father Beza, who was the first traveller who recommended observations at the coldest and warmest hours of the day, believed that he had found in 1686 and 1699, in comparing Siam, Malacca, and Batavia, "that the heat is not greater under the equator than under 14° of latitude." I am of opinion that there is a difference, but that it is very small, and masked by the effect of so many causes, which act simultaneously on the mean temperature of a place. The observations hitherto collected do not afford us any measure of a progressive increase between the equator and the latitude of Cumana."

PARIS, *September* 1826.

ART. XX.—*Notice respecting the hourly Meteorological Observations proposed by the Royal Society of Edinburgh, to be made twice every year, on the* 17*th July and* 15*th January.*

IN obedience to the request of several correspondents, we propose, in the present notice, to explain more fully than was done in the printed schedules, the method of making the meteorological observations proposed by the Royal Society of Edinburgh, and to subjoin a copy of one of the sets of observations made on the 17th July 1826.

The days of the year which have been fixed for these observations are the 17th July and 15th January, and it would be extremely desirable to have these observations repeated on the same days of these months for some years.

1. The first column of the schedule is intended for registering the state of the thermometer every hour of the day, from 1 o'clock A. M. to 12 P. M. of the 17th July, or the 15th January. The thermometer should be placed in a northern exposure, sheltered from the direct rays of the sun, and at some height above the ground. The times of the highest and lowest state of the thermometer should also be marked, if they do not occur at any of the hours of observation.

2. The second column is intended for registering the temperature of springs and deep wells, or the temperature of a river, or of the sea.

3. In order to obtain the force of radiation, a mercurial thermometer, having its bulb covered with black woollen cloth, or simply blackened with China ink, should be exposed on an open spot of ground, and a few folds of paper may be interposed betwen the soil and the instrument. The same result will be obtained by taking the temperature of an exposed patch of bare soil.

4. The barometer or sympiesometer, whose indications are to

be recorded in the fourth column, should not be placed in a hall or passage where it is exposed to a draught or current of air.

5. The best electrometer is Bennet's gold-leaf electrometer. The observations with it should be made in an open field, at a distance from trees and chimneys. Besides the tension of the electricity, as indicated by the extent of the divergence of the gold leaves, it is of importance to ascertain at what height above the soil it first becomes sensible, and in what space of time it acquires a fresh charge, after being touched by the finger or by a piece of metal. The galvanometer may be employed in these observations, as explained in this Number, p. 150. In the observations made in the Royal Observatory at Halle, on the 17th July, by Professor Gartz, Dr Weber, and Mr Hugel, an electrometer was employed, consisting of a gold-leaf freely suspended between two of Zamboni's columns, which could be placed at different distances, so that a lesser or a greater electrical force is necessary to move the gold-leaf, the nature of the electricity being determined by the leaf approaching to the column which had its positive or negative pole turned towards it. The electric force was measured by the distance of the Zambonic column which moved it.—See this *Journal*, No. vii. p. 124–127.

6. In order to observe the hygrometrical state of the air, cover the bulb of a thermometer with a piece of muslin or soft paper, and having wetted the bulb thus covered, observe, by comparing it with another thermometer, the descent of the mercury arising from the cold produced by evaporation. If the dry thermometer, for example, stands at 50°, and the wet one at 45°, the difference of these indications, or 5°, is the number to be inserted in the appropriate column. Observations with Saussure's and Daniell's hygrometer would also be desirable.—See this *Journal*, No. vii. p. 127.

7. If rain should fall, the quantity of it may be measured without a rain-gauge, merely by exposing a circular vessel to the shower, measuring the diameter of its aperture, and noting the depth of rain in inches, if the vessel is equally cylindrical, or the weight of the rain, if the lower part of the vessel is of an irregular shape.

8. The velocity of the wind may be easily ascertained by measuring the distance to which a light body, such as a feather or a piece of paper, is carried in any number of seconds. Its direction may be found by a wind-vane, or by the smoke of a chimney. The existence and direction of currents in the higher regions may be detected by the motions of the clouds.

The remaining columns of the table must be filled up according to the judgment and knowledge of the observer. Mr Howard's nomenclature of clouds should be used by those who are acquainted with it. Halos, rainbows, the Aurora Borealis, the depth of the blue colour of the sky, and the colour of the clouds at sunrise and sunset, will naturally attract the notice of every observer.

To those meteorologists who have sufficient leisure, and the means of performing such experiments, we would recommend the use of kites or of balloons for ascertaining the temperature and state of the upper atmosphere. The Earl of Minto has obtained several very interesting results by the use of balloons, and by proper precautions has found them perfectly manageable.

The following is an alphabetical list of the observations on the 17th July which have already been received, and there is reason to expect as many more, as few of the foreign ones have yet arrived.

It is greatly to be desired, that those who have so well begun this interesting series of experiments, will continue them on the 15th January, and also in subsequent years.

List of the Hourly Registers of the Weather kept on the 17*th July* 1826, *that have been received.*

Scotland.

Castle Forbes, Aberdeenshire, -	George Fairholme, Esq.
Castle Kennedy, Ayrshire, -	Peter Burnet, Esq.
Dundee, Johnfield, Forfarshire, -	Rev. Mr Macvicar.
Allerly, Roxburghshire, -	Dr Brewster.
Eckford, Roxburghshire,	Rev. Mr Gray.
Edinburgh, Caltonhill, Mid-Lothian,	Mr John Foggo.
Canaan Cottage, do. - - -	Mr Adie.
Forres, Sanquhar House, Morayshire,	Mr J. Christison.
Garvock, Kincardineshire, - -	Mr Murray.

Glasgow, Lanarkshire, - -	Mr John Weir.
Glenfinart, Argyllshire, - -	James Skene, Esq.
Gordon Castle, Banffshire, -	The Duke of Gordon.
Huntly Lodge, Aberdeenshire, -	Mr Alexander Murdoch.
Inchbonny, Roxburghshire, -	Mr James Veitch.
Kelso, do. - -	Mr W. Mein.
Leith, Mid-Lothian, -	Mr Coldstream.
Minto House, Roxburghshire, -	Earl of Minto.
Shetland, Uga Sound, H. M. S. Woodlark,	Mr J. Frembly.
——— West Sandwich Yell,	Mr Mathewson.
——— Lerwick, - -	
Tweedsmuir, Peebles-shire, -	Mr Fairlie.
Wemyss Castle, Fifeshire, -	Captain Wemyss, M. P.
Whim, Peebles-shire, -	Arch. Montgomery, Esq.

England.

Kendall, Westmoreland, -	Mr S. Marshall.
Newcastle, Northumberland, -	Rev. Mr Turner.
Pitmaston, Worcestershire, - -	J. Williams, Esq.
Plymouth, Devonshire, - -	W. Snow Harris, Esq.
Sfwaffam Balbeck, Cambridgeshire, -	
Wallington, Northumberland, -	W. C. Trevelyan, Esq.

Ireland.

Castlebar, Mayo County, - -	W. Bald, Esq.
Edgeworthstown, Longford, - -	Mr and Miss Edgeworth.

Germany.

Gotha Observatory, -	M. Hoff.
Halle Royal Observatory,	MM. Gartz, Weber, and Hugel.
Leipzig Observatory, -	Moebius.
Seeberg Observatory,	C. A. Hansen.
Zehmen, near Leipzig, -	MM. Smiedeh and Brandes.

The following register, which we give as a specimen of those received, was kept at Tweedsmuir in Peebles-shire, by Mr William Fairlie, schoolmaster there, who has, at the request of the Royal Society, kept very regular, and highly interesting registers of the weather at that place for six years. The great elevation of Tweedsmuir above the level of the sea, (about 1200 feet,) gives great value to these observations.

JULY 17th 1826. { Latitude 55°30′ N. / Longitude 3°25′ W. } TWEEDSMUIR SCHOOL. { Distance from the Sea, between 30 and 40 Miles. / Height above the Sea, supposed to be about 1200 feet.

Hour.	Temp. in Shade.	Temp of a Spring	Barom.	Force of Radiation.	Hygrom.	Wind. Velocity	Wind. Direction by Vane.	Wind. By carry of Clouds.	Nature of Clouds.	Weather	Appearance of the Sky.
	Fahr.		Inch.								
1 A.M.	49°.5	46°.5 without variation during the day.	29.06				W.	W.N.W.	Cirro-strati, with detached Cumuli	Fair, with Clouds, and a fine breeze throughout.	Between 1 and 2 A.M. A mass of remarkably luminous Cirro-strati, extending from N. to N. E. and reaching to about 18° above the horizon.
2	49 .5		29.06						Do.		Sky clear, with the exception of a few Cirro-strati, &c.
3	49 .0		29.06		3°.0	7.5			Do.		Cirro-strati E. white, W. dusky, Cumuli brown.
4	51 .0		29.07		3 .5	8.0			Do.		
5	51 .5		29.09		4 .0	11.0			Do.		Sky partially clouded.
6	53 .2		29.09	70°.0	4 .7	6.0			Do.		Do.
7	54 .0		29.10		5 .0	7.5			Do.		Do.
8	56 .0		26.10		6 .0	7.0			Do.		Do.
9	57 .5		29.12		6 .0	8.6			Do.		Do.
10	59 .0		29.14		6 .0	12.5			Cumulo-strati.		Sky nearly overclouded.
11	60 .0		29.13		6 .5	9.0			Do.		Do.
12	62 .3		29.14		8 .5	8.0		W.	Do.		Do.
1 P.M.	64 .0		29.16		10 .5	6.6			Do.		Do.
2	65 .0		29.14	89°.0	10 .0	10.0			Cirri and detached Cumuli.		Sky partially clouded.
3	62 .5		29.14		8 .0	8.2			Do.		Do.
4	62 .0		29.14		7 .3	9.7			Do.		Do.
5	59 .7		29.13		5 .7	8.0			Do.		Sky overclouded.
6	61 .0		29.14		4 .0	9.5			Do.		Sky partially clouded.
7	59 .0		29.13		3 .7	6.0			Cirro-strati.		Do.
8	55 .0		29.12		3 .0	4.7			Do.		Do.
9	52 .5		29.12		0 .5	5.0			Strati.		Sky overclouded. Clouds tinged red N. W.
10	53 .5		29.14						Do.		Sky completely overclouded.
11	53 .5		29.14						Do.		Do.
12	54 .5		29.14						Do.		Do.
Averages.	56°.44	46°.5	29.116		5°.57	8.4					

We cannot conclude this notice, without expressing a wish, that those gentlemen who have not sufficient experience in making meteorological observations, or who may not feel it convenient to devote a whole day to science, will at least encourage and assist those in their neighbourhood who have the inclination and ability to make them, but who want only the requisite instruments. Those who have not yet sent in their schedules of the 17th July, are requested to transmit them as speedily as possible to Dr Brewster, Secretary to the Royal Society, 10, Coates Crescent, Edinburgh.

ART. XXI.—*On the Deviation of the Magnetic Needle produced by a common Electrical Machine* *. By M. D. COLLADON of Geneva.

ALL attempts having hitherto failed to produce a deviation of the magnetic needle by the electrical machine, M. Colladon supposed that this was owing to the employment of too small a charge of electricity, or to imperfectly insulated galvanometers. He therefore repeated this experiment with a galvanometer of 100 turns with two needles, such as that contrived by M. Nobili. The wire of it, says he, is doubly covered with silk, and in order to have a considerable quantity of electricity, I employed a battery of thirty jars, and having a square surface of 4000 square inches. The galvanometer was placed in a separate chamber, and communicated with the battery by two copper wires covered with silk, and suspended by insulating cords. At the end of each wire was soldered a very fine point for drawing off electricity. These two points are the *extremities of the galvanometer*.

After having charged the battery till its electroscope began to diverge, I put one of the extremities of the galvanometer in contact with the exterior armour of the battery, and holding the *other* extremity by a glass-handle, I approached the point of it to the bottom of one of the jars. When this was done at four or five centimetres distance, the needle of the

* This is a brief abstract of the original memoir which was read at the Academy of Sciences on the 21st August, and which is printed in the *Ann. de Chim.* Tom. xxxiii. p. 62.

galvanometer began to deviate. At a distance of one or two centimetres, the deviation became 23°. It then grew weaker, and vanished after a duration of five seconds. The direction of the deviation was in the direction of the current, and the direction was changed by presenting to the battery the *same* extremity of the galvanometer. Opposite directions were also obtained, by charging the battery alternately with positive and negative electricity.

In dry weather, M. Colladon obtained deviations of three or four degrees, by using the simple electrical machine, and also Nairne's machine for two electricities, or a plate machine of five feet.

M. Colladon next soldered to the extremities of his galvanometer a platina wire, and when one of the soldered pieces was kept at the temperature of 32°, while the other was heated in a mercurial bath to the temperature of 313° Fahr. a deviation of 45° took place. Hence it follows, that the electricity which may be accumulated in a given time in a battery, or even in a conductor, is a finite portion of that which circulates during the same time in a closed electromotive circle.

M. Colladon then proposes to use the galvanometer in place of an electrometer, for measuring small quantities of electricity accumulated in batteries, or drawn off by points. With this view he prepared a galvanometer with 500 turns, having its wire not only doubly covered with silk, but each series of turns covered with gummed taffetas. With the plate glass machine with which he obtained a deviation of 3° or 4°, he now obtained

At 1 decimetre of distance a deviation of	18°
2	10
4	5½
8	3
1 metre,	2
5 centimetres,	19
2½ cent.	20
1 cent.	20

A single Leyden phial, with two square feet of surface made the needle deviate 32° when it was fully charged.

In another section of his paper, M. Colladon treats of atmospheric electricity, and he shows that the galvanometer is a precise means of measuring the quantity of electricity which passes along conductors.

"On the 4th of August," says he, "about mid-day, when the electrical clouds announced a storm, I raised a metallic point on the observatory of the College of France. A pole of nine metres was placed near the highest paratonnerre, which it surpassed by about a metre. It carried a conducting wire terminated by two needles, very fine and slightly divergent. This conducting wire, covered with silk, traversed a glass tube, and descended into the chamber where the galvanometer was placed. It was fixed to one of the extremities of the galvanometer, whilst the other extremity communicated with the rod of the paratonnerre, and consequently with the ground. When it began to thunder, the needle of the galvanometer deviated between 34° and 32°, and the electricity was negative."

Art. XXII.—*Description of the Volcano of Kirauea, in Hawaii, one of the Sandwich Islands.* By the Reverend William Ellis. With a Plate.*

In our last Number, p. 303, we had occasion to lay before our readers Mr Ellis's interesting account of the burning chasms of Ponohohoa, and we propose at present to give an account of the active volcano of Kirauea, as described by the same author.

The plain through which it is necessary to pass to the mountain was an extensive waste of ancient lava, which resembled an inland sea bounded by different mountains. It seems to have been once in a fluid state, but has now the appearance of having been suddenly petrified while its waves had been in a state of tumultuous agitation. Not only were the large swells and hollows distinctly marked, but the surface was covered by a smaller ripple like that which precedes the springing up of a breeze. Before the crater suddenly burst upon our view, we expected to have seen a mountain with a broad base, and rough indented sides, composed of loose slags;

* See last Number, Plate III.

or indurated streams of lava, and whose summit might have resembled the rim of a huge cauldron formed by a rugged wall of scoria. Instead of this, however, we found ourselves on the edge of a steep precipice, with a vast plain before us fifteen or sixteen miles in circumference, and sunk from 200 to 400 feet below its original level. The surface of this plain was uneven, and strewed over with huge stones and volcanic rocks, and in the centre of it was the great crater at the distance of one mile and a half from the spot where we stood. Walking on to the north end of the ridge, a place was found where the descent to the plain seemed practicable, but it was difficult and dangerous. After walking some distance over the sunken plain, which often sounded hollow beneath our feet, we at last came to the edge of the great crater, where a most sublime and appalling spectacle presented itself. Before us yawned an immense gulf like a crescent about two miles in length from N. E. to S. W., and the northern parts of it were one vast flood of burning matter boiling with tremendous agitation. Fifty-one conical islands, varying in form and size, and with each a crater, rose either round the edge, or from the surface of the burning lake. Twenty-two emitted columns of grey smoke, or pyramids of brilliant flame, and several of those, at the same time, vomited streams of lava, which rolled in blazing torrents down their black indented sides into the boiling mass below. These conical craters led us to infer that the cauldron of lava before us did not form the focus of the volcano;—that the mass of melted lava was comparatively shallow, and that the basin in which it was contained was separated by a stratum of solid matter from the great volcanic abyss, which discharged its contents through these craters into the upper reservoir. The sides of the gulf before us, though composed of ancient lava, were perpendicular for about 400 feet, and rose from a wide horizontal ledge of solid black lava of irregular breadth, but extending completely round. Beneath this ledge the sides sloped gradually towards the burning lake, which was, as nearly as we could judge, 300 or 400 feet lower. It was evident that the large crater had been recently filled with liquid lava up to this black ledge, and had by some subterraneous canal emptied itself into the sea, or under the low land on the shore. The grey, and in some places apparently calcined sides of the great crater before us, the fissures which intersected the surface of the plain on which we stood,—the long banks of sulphur on the opposite side of the abyss;—the vigorous action of the numerous small craters on its borders; the dense columns of vapours and smoke that rose at the north and south ends of the plain, together with the ridge of steep rocks by which it was surrounded, rising perpendicularly in some places 300 or 400 feet, presented an immense volcanic panorama, the effect of which was greatly increased by the constant roaring of the vast furnaces below.

Beside the volcano now described, there are several extinct ones in Owhyhee. * Captain King makes one of these, viz. Mouna Roa 16,020 feet high, while he makes Mouna Kaa, whose peaks are constantly covered with snow, 18,400 feet. Mr Ellis reckons the height of this at between 15,000 or 16,000 feet.

Mr Ellis regards the whole Island of Owhyhee, (of about 4000 square miles,) as one complete mass of lava. "Perforated," says he, "with innumerable apertures in the shape of craters, the island forms a hollow cone over one vast furnace, situated in the heart of a stupendous marine mountain rising from the bottom of the sea; or possibly the fires may rage with augmented force beneath the bed of the ocean, rearing through the superincumbent weight of water the base of Hawaii, and at the same time forming a pyramidal funnel from the furnace to the atmosphere."

Art. XXIII.—*On the Subterranean Sounds heard at Nakous, on the Red Sea.*

Baron Humboldt informs us, on the authority of most credible witnesses, that subterranean sounds like those of an organ are heard towards sunrise, by those who sleep upon the granite rocks on the banks of the Orinoco. Messrs Jomard, Jollois, and Devilliers, three of the naturalists who accompanied Bonaparte

* See the Scientific Intelligence under General Science in this Number.

to Egypt, heard at sunrise a noise like that of a string breaking in a granite monument placed at the centre of the spot on which the palace of Carnac stands.

Sounds of a nature analogous to these have been heard by Mr Gray of University College, Oxford, at a place called Nakous, (which signifies a bell,) at three leagues from Tor, on the Red Sea. This place, which is covered with sand, and surrounded with low rocks in the form of an amphitheatre, presents a steep declivity towards the sea, from which it is half a mile distant. It has a height of about 300 feet upon 80 feet of width. It has received the name of a bell, because it emits sounds, not as the statue of Memnon formerly did at sunrise, but at every hour of the day and night, and at all seasons. The first time that Mr Gray visited this place, he heard at the end of a quarter of an hour a low continuous murmuring sound beneath his feet, which gradually changed into pulsations as it became louder, so as to resemble the striking of a clock. In five minutes it became so strong as to resemble the striking of a clock, and even to detach the sand. *

Anxious to discover the cause of this phenomenon, which no preceding traveller had mentioned, Mr Gray returned to the spot next day, and remained an hour to hear the sound, which was on that occasion heard much louder than before. As the sky was serene, and the air calm, he was satisfied that the sound could not be attributed to the introduction of the external air,† and in addition to this, he could not observe any crevices by which the external air could penetrate. The Arabs of the desert ascribe these sounds to a convent of monks preserved miraculously under ground, and they are of opinion that the sound is that of their bell. Others think that it arises from volcanic causes, and they found this opinion on the fact that the hot baths of Pharaoh are on the same coast.

* The people of Tor declare that the camels are frightened and rendered furious by these sounds.

† M. Humboldt ascribes the sound in the granite rocks to the difference of temperature between the external air and the air in the narrow and deep crevices of the shelves of rocks. These crevices, he informs us, are often heated to 48° or 50° during the day, and the temperature of their surface was often 39°, when that of the external air was only 28°. Humboldt's *Personal Narrative*, vol. iv.—ED.

M. Seetzen has given a similar account of Nakous, in Zach's Ephemerides for October 1812.—See Daubeny's *Description of Active and Extinct Volcanoes.* Lond. 1826. p. 437.

Art. XXIV.—*Notice respecting the existence of the New Fluid in a large cavity in a specimen of Sapphire.* By David Brewster, LL. D. F. R. S. and Sec. R. S. Edin.

In two papers which are printed in this *Journal*, I have fully described the physical properties of the two new fluids which occur in mineral bodies. These fluids having been found only in the precious stones,—in quartz, amethyst, topaz, and chrysoberyl, it became interesting to detect them in other minerals, not only with the view of establishing their general prevalence at the formation of this class of bodies, but of ascertaining if they experienced any change in their properties from the mineral in which they are found.

Mr Sanderson lately put into my hands a specimen of sapphire, containing a very large fluid cavity, which, from the expansible nature of the fluid, seemed to resemble that which occurs in topaz. The cavity itself is regularly crystallized, and is about one-third of an inch in length. The fluid occupies about *two-thirds* of its length, and fills the cavity at a temperature of 82° of Fahrenheit. It seems to be more viscid and more dense than I have usually observed it, and in consequence of this property, the capillary margin of the fluid remains distinct and well marked, even at the instant when it fills the cavity. When the temperature descends below 82°, the contraction of the fluid is not accompanied with that violent effervescence which takes place in the deep cavities in topaz.

In the specimen under consideration, the fluid seems to have exerted a high expansive force upon the sides of the cavity, which it has succeeded in opening on both sides. The surfaces of the fissures thus occasioned, are covered with specks of a gelatinous-looking matter, like portions of the second fluid, when in a state of induration. The force, however, was not sufficient to burst the specimen, and the only effect of it seems to have been to expel into the fissures the second fluid, which always occupies the angular and narrow parts of the cavity. This opinion seems to be confirmed by the fact, that none of the second fluid can be seen within the cavity, although this may arise from the difficulty of examining the angular portions of the cavity in the present state of the specimen.

There is another very interesting peculiarity in this specimen of sapphire. It contains at one extremity of the fluid cavity distinct groupes of transparent crystals, which have, no doubt, been deposited by the fluid. What these crystals are, we are not entitled to conjecture, but if the cavity were opened, it might be practicable to ascertain whether or not they are sapphire.

Art. XXV.—*Account of the Carrion Crow, or Vultur atratus.* By Mr John James Audubon, Member of the Lyceum of New York. Communicated by the Author.

Although this bird is closely connected with the Turkey-Buzzard *(Vultur aura,)* in many material points, yet the difference in their appearance and habits is sufficient to establish a difference of species.

The first view of the carrion crow is disgusting, when compared with that of the *Vultur aura;* its head and neck resembling in colour that of putrid matter. Its relative shortness, squareness, and clumsiness, together with its gait and manner of flying, are characteristic of an individual less powerful, and less deserving the high station which the carrion crow possesses in the order of birds, which naturalists place before eagles and falcons, so much its superior in every point of view.

Like the turkey-buzzard, the carrion crow does not possess the power of smelling, a fact which I have ascertained by numerous observations.

It is not common for these birds to extend their flight over the Alleghany Mountains. I have seldom seen them as far as Cincinnati on the Ohio, though the *Vultur aura* is by no means a scarce bird in the country around, and far above that place, yet at particular times I have met with flocks of twenty, or more in the neighbourhood of Louisville, Kentucky, not, however, with the true habits which they display in the south, but so remarkably wary, that no person can approach within gunshot of them without great difficulty.

On the Mississippi, Missouri, and adjacent countries, the carrion crow abounds, even sometimes during winter. The cold is less troublesome to them than the turkey-buzzard, and I have often seen them near St Genevieve, and also on the upper parts of the Wabash river during severe frosts, and when much snow lay on the ground. In all these places they are quite shy, a fact which I can only ascribe to the scarcity of food in colder countries, and to the little regard which is paid to them on account of their utility. In the states where they are suffered to remain without molestation, and have become accustomed to the society of man, they will suffer one to walk within a few feet of them; but yet they keep an eye on every passenger, and know so well their intentions from their movements, that if a boy has an Indian bow, a gun, a bow and arrow, or a pebble in his hand, the crow will instantaneously take wing, or hop off sideways at a quick rate, uttering a hissing noise much coarser than that of the turkey-buzzard.

In the cities where they are protected they enter the very kitchen, and feed on whatever is thrown to them, even on vegetables. If unmolested, they will remain in the same premises for months, flying to the roof at dusk to spend the night. Six or seven are often seen standing in cold weather round the funnel of a chimney, apparently enjoying the heat from the smoke.

Notwithstanding the penalties imposed by law, a number of those birds are destroyed on account of their audacious pilfering. They seize young pigs as great dainties. They watch the cackling hen in order to get the fresh egg from her nest, and they will not hesitate to swallow a brood of young ducks. In order to keep them from the roofs of houses where their dung is detrimental, the inhabitants guard the top with broken pieces of glass fastened in mortar, and they often kill them by throwing boiling water upon them. No fewer than 200 of these birds are daily fed by the city of Natchez.

In following the carrion crow to its haunts in the woods, I discovered that they remained nearer the plantations than the buzzards, and were more addicted to wait there for the entrails of slaughtered animals, dead dogs, rotten eggs, &c. than to hunt in the fields like the *Vultur aura.*

Early in February they make choice of a companion in the air, and this is the only season when they exhibit any thing like activity. The males chase each other furiously for great distances, going through the air with a rumbling noise. The conqueror rejoins the female, flies a considerable length by her side, and alighting on a tall dead tree, they ratify the contract of annual union by many caresses.

Unlike the buzzards, the carrion crows do not seek to deposit their eggs in low damp retired swamps. They search for situations on high ridges; and the neighbourhood of a village or a plantation is by no means rejected. In this state (Louisiana,) you can easily find their eggs by examining the standing hollowed trees, and in some of them, on the bare earth, their two large eggs are deposited, and are hatched after twenty-eight days incubation. I found a nest of these birds where the hole of entrance was near four feet from the earth, and just large enough to admit the owner. Out of that dark abode the young did not make their escape until fully fledged, and they had been so seldom fed by their fatigued parents, that they were scarcely able to fly, though they were nearly full grown.

In different instances I have found bits of earthen-ware with the eggs, and I might have become superstitious on this head, had I not been told by a planter that they had probably been left by runaway negroes, who had rested and hid themselves in these hollow trees.

The moment the carrion crow hears any person approaching their nest they fly off, and if the tree has a double entrance, they sneak off on the opposite side, and hopping away twenty or thirty steps, they watch the movements of the intruder. If this happens during incubation they and some other species void themselves on such occasions. They are not the least discomposed on touching the eggs. I once, indeed, carried two eggs home, drew one of them and blew out the contents of the other to keep the shell, and having replaced one, and substituted for the other that of a tame turkey, I found both the birds hatched, though at different times. In another instance, I made a female lay five eggs successively, by removing every other day the one last laid; but upon putting back the whole number, the bird left her nest and never returned.

The male and female take by turns the labours of incubation, and they also feed each other. It is not unusual to see young carrion crows, when yet all over down, leave the site of their nativity to meet the parent coming with food many yards from the spot; but if they are surprised in the act by a hunter, they squat immediately close to the ground as a setting spaniel, and lie there till all danger is over. The young accompany their parents (who have only one brood each season) till October. This is perceived when a flock is disturbed, on which occasion the old and young pair single off by themselves, and they alight nearer to each other than those of a different family.

While the turkey-buzzard rises from the ground with great ease, and with four or five flaps of their large wings, the carrion crows are seen labouring hard to assist their slower ascent. They give a few flaps that are so powerful as to occasion a rustling through the air, and having failed after they have got on a very few yards, they are again forced to flap to enable them to keep at least on the same horizontal line. Their wings are squared with the body, the neck extending to its full length before, whilst the legs and feet are stretched under the tail behind. In ascending, the inclination of their body upwards is very apparent, and their labour is extreme till they are sufficiently high to form large circles, and force themselves towards the sky by imitating the easier movements of the buzzard.

Like the buzzards they rise very high, and they at last disappear, following each other in a straight line. When so high they seldom launch themselves obliquely for pleasure, for to re-ascend is too irksome, but when they are observed to incline to the earth, or to alight on a tree, they suffer their legs and thighs to hang perpendicularly under them, even although they are at a great distance from the place, as if they were afraid to come in contact with it unprepared.

Hawks of different species are frequently found sailing among them, and also buzzards, more particularly the great ibis, which the carrion crow follows to the lakes in autumn, to feed on the fish killed and abandoned by these extraordinary birds. The fish thus killed are often so numerous, that hundreds of carrion crows may be supported by them for weeks. I have often looked with wonder upon the great number of vultures that had alighted on very large cypress-trees, bordering on lakes of some extent covered with thousands of floating dead fishes of different kinds, waiting till the water retreated to allow the crows to feast upon them.

The manner of flight of both these birds is precisely the same, and on the discharge of a gun, they will both rise from a lake with a violent quick heavy motion, and ascend until out of sight in such astonishing numbers, as to render it impossible to follow the course of any single individual intersecting so often their circling lines.

I may again remark, that the buzzards and carrion crows cannot be suspected of smelling the fish alive under water, and only to be killed by the Ibises, who, with the assistance of their long legs, chase them through the lakes, the water being generally from one to two feet deep. The vultures have to wait with extreme patience till nearly all of it is dry, before they can alight to seize their prey, which they swallow with avidity.

When hawks are sailing among the carrion crows, the former will sometimes, as if for amusement, charge upon them, and produce such dismay, that every crow will launch to the earth in angular lines, not unlike those of forked lightning, while the exulting hawks announce their victory with reiterated cries, as they rise again to a high station in the air to recommence their circles.

Like all other cowards these birds only fight violently when urged on by hunger or imminent danger, gradually augmented to a high pitch ; but then they make amends by beating their conquered adversary to death if in their power. When busily engaged with a dead carcase, they often jump against one another with bill and legs striking like a common fowl, and if in the attack one overthrows the other, the victor will, without scruple, and in the most unmerciful manner, pick his naked head till it becomes clotted with blood. When any crow gains such an advantage, the victor is assisted by several others, who appear to engage in the conflict solely because there seems to be no danger.

These birds are subject to a particular disease that I never remarked in the *Vultur aura.* It consists of a kind of itching wart, which often covers the whole of the skin of their head and back of the neck, having a reddish appearance, and suppurating with a very fetid greenish humour. The bird thus afflicted, scratches these warts almost constantly, and the more irritated the larger they grow. In every one of these warts I have found fastened, as a common leech to the real skin, a small worm very like some of those which torment certain quadrupeds, particularly, in this country, the common grey squirrel. I never could ascertain if these parasites killed the birds, but I am certain that many die during winter, or through some means to me unknown. These worms are killed by the bird, as I have found many of the warts dried, although large, but without any tenant, after a continuance of cold weather. It is not improbable that the continued filth attached to the head of these birds, after being immersed in the decayed flesh of the animals they feed on, occasions their birth. I have observed this to take place generally with the younger carrion crows, who, from the tenderness of their skin, are probably more liable to these vermin, and the older ones probably clear themselves of them more easily, as their skulls and skins become tougher. Besides these troublesome settlers, the carrion crows are troubled with lice and tick-flies of a large size, that never leave them unless they are killed, or the bird dies.

The unexpected sight of a powerful enemy always makes these birds instantly disgorge a part of the contents of their stomachs. The object of this is supposed to be to disgust the stranger and make him desist from advancing nearer, but in my opinion it is done to lighten the bird of an extra load, with which it is difficult for it to fly off quickly. This is more probable, as immediately after this discharge the bird takes to its wings.

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

1. *Account of a New Method of Drawing upon Stone.* By M. Laurent, Painter, Paris.

The ingenious process which we propose at present to describe, is taken from the report laid before the Institute by Messrs Thenard and De Blainville.

Having taken the outline of the original design upon transparent paper, by tracing all the lines of the original with a dry point, more or less fine, the outline is then glued by its edges upon a board, and there is spread over it with a piece of fine linen, a sufficiently hard paste, formed with lithographic ink dissolved in essence of turpentine, which may be made in a spoon, exposed to the heat of a candle. The outline is then rubbed hard with a piece of clean linen, till the linen ceases to have a black tint. The outline is then transferred to the stone by means of a press. For this purpose M. Laurent places in a vertical paper press the stone and the outline in contact, taking care to place above the latter from twenty to twenty-five sheets of paper wetted in water, and adding in solution some calcined muriate of lime. Upon these last sheets is put a stone, and to prevent any injury, two large plates of paper about an inch thick are interposed. The pressure is then applied for an hour, and upon separating the stones it will be found that the transparent outline adheres more or less to the stone. The paper is then removed by hot water, and the design is left upon the stone, which is now washed with cold water till no trace of the transparent paper remains. There is no fear of the outline dissolving, as the base of the muriate of lime forms with the oil of the soap an insoluble soap, while the soda is combined with the hydrochloric acid, and composes a soluble salt, which has been carried away by the washing.

MM. Thenard and Blainville, who commend highly this process, propose the following lithographic ink as superior to any other, viz. soap one-fourth, mutton suet one-half, yellow wax one part, mastic in tears one-half, and as much lamp black as is necessary. The whole being melted on a gentle fire, and well mixed, is reduced to the consistency of a thick cream, by mixing with it equal parts of turpentine and lavender. The commissioners also recommend a thick and strait plank in place of the second stone, and they regard the process as a very valuable one in the arts. —*Abstract* from the *Ann. de Chim.* September 1826, tom. xxxiii. p. 89-93.

2. *Experiments on the Discharge of Air by different Orifices.*

M. D'Aubuisson was recently led to make some interesting experiments on the discharge of air by orifices of different forms, on the occasion of his establishing a ventilator at the mines of Rancie (Arriege.)

The gasometer which he used was 0.65 metres in diameter, and 0.80 high. It carried a water manometer. At an aperture in the upper he put on nineteen different orifices. By means of weights by which the gasometer was loaded, he caused it to descend more or less quickly. These weights brought the manometer from 0.028 to 0.144 above zero, and consequently they impressed on the current of air, which issued from the orifices, velocities of from twenty-one to forty-eight metres.

The section of the gasometer, 0.331 square metres, multiplied by the height which this instrument descended in unity of time, gave the real discharge. The theoretical discharge is obtained by the following formula:

$$310\ d^2 \sqrt{\frac{1+0.004\ t}{13.6\ b+h}}$$

where d represents the diameter of the orifice, h the height of the manometer, b that of the barometer, and t that of the thermometer.

From the experiments of M. D'Aubuisson which it is unnecessary to repeat more particularly, it follows,—

That the conical has little advantage over the cylindrical form of the aperture, which is not the case with incompressible fluids.

That when air issues from a reservoir under any pressure, the ratio between the real and the theoretic discharge will be 0.65 if the discharge is made by an orifice pierced in a thin plate; 0.93 if we employ a short cylindrical ajutage; 0.95 if a short conical ajutage is used; and, referring to the case which is most interesting in practice, M. D'Aubuisson adds, that, by employing ajutages or bases slightly conical, the real will be six per cent. less than the theoretical discharge.—*Ann. de Chim.* tom. xxxii. p. 327.

3. *Method of restoring Wine that has been turned.*

A method has been in practice for some years to restore wine that has been turned. The process consists in adding from half an ounce to two ounces of tartaric acid of the shops, to a hectolitre of wine, according to its state of decomposition. The tartaric acid reproduces the tartar, disengages the carbonic acid, and consequently destroys the alkaline character given to the wine by the sub-carbonates.

The Agricultural Society of Bourges has frequently repeated this experiment; but it has not always succeeded. They, however, ascribe this uncertainty to the impossibility of determining the exact quantity for every case.—*Bull. des Sc. Technol.* Sept. 1826. p. 145.

4. *Method of preventing, by means of Galvanism, the formation of calcareous deposits in Leaden Pipes.* By M. Dumas.

Most of the springs which rise in the hills in the neighbourhood of the Seine are charged with carbonate of lime dissolved in carbonic acid. By considering this product as a solution of the bi-carbonate of lime, M. Dumas conceived the idea that it might be decomposed into carbonate, and into acid by a weak galvanic pile. He found that the calcareous deposits in leaden pipes were formed principally at the soldered joints, upon the bars of iron and the copper cock which met at these places. He therefore placed a galvanic pair in a vessel filled with water from a spring which supplied the manufactory at Sèvres, and at the end of two days the surface of the copper only was covered with a flocculent deposit. A plate of silver, soldered to a bar of lead, was placed in a reservoir of the same water, and at the end of six months the silver was found covered with a thick stratum of deposit, whilst the lead was perfectly clean. M. Dumas therefore proposes to prevent these calcareous deposits, by placing at different distances along a leaden pipe, other small pipes, perpendicular to the first, and communicating with it, and into which might be introduced at pleasure bars of iron, for the iron being more electro-negative than the lead, will have the calcareous deposit formed upon it.—*Bull. des Sc. Technol.* Sept. 1826. p. 155.

5. *An Improved method of working Water Wheels.* By Mr WILLIAM MOULT.

This method, which is secured by patent, consists in immersing a bucket-wheel in water, and in throwing a current of air under the buckets at the lower part of the wheel, for the purpose of displacing the water and filling them with air. One side of the wheel being thus rendered specifically lighter than the other, it revolves.—See *Newton's Journal of Arts*, Sept. 1826, p. 76, where this contrivance is more fully explained.

ART. XXVII.—ANALYSIS OF SCIENTIFIC BOOKS AND MEMOIRS.

I.—*Journal of a Third Voyage for the Discovery of a North-west Passage from the Atlantic to the Pacific, performed in the years* 1824-5, *in his Majesty's Ships Hecla and Fury, under the orders of* Captain WILLIAM EDWARD PARRY, R. N. F. R. S. 1826. 4to.

IN a preceding article of this work we have already made our readers acquainted with the leading particulars of the narrative of this expedition. We shall therefore not touch again upon this part of Captain Parry's work, but shall proceed to the more appropriate object of this article, viz. to give an analysis of the scientific results obtained by the expedition.

1. *Magnetical Observations.*

After the ships were secured, and the observatory erected on shore, Captain Parry directed his attention in an especial manner to magnetical inquiries. The first observations on the magnetic needle on the arrival at Port Bowen, discovered to them the interesting fact of an increase in the variation since 1819, amounting to about 9°, viz. from 114° to 123°. To the northward Lieutenant Sherer found the increase to be only 5°.43, and Lieutenant Ross to be southward only 1°15. By using needles delicately suspended, he discovered a very remarkable diurnal variation. The maximum westerly variation was observed to occur between 10^h A. M. and 1^h P. M., and the minimum betwen 8^h P. M. and 2^h A. M. The exact time of the maximum, as deduced from a mean of 120 days, was 11^h 49′ A. M. and that of the minimum 10^h 1′ P. M. The amount of the diurnal variation was seldom less than 1½° or 2°, and it sometimes amounted to 5°, 6°, and even to 7°.

Captain Parry likewise discovered a diurnal change in the magnetic intensity, which, excepting occasional anomalies, exhibited an increase of intensity from the morning to the afternoon, and a decrease from the afternoon to the morning. "It also appeared that the sun, and, as we had reason to believe, the relative position of the sun and moon with reference to the magnetic sphere, had a considerable influence both on the intensity and diurnal variation."

In repeating the experiments of Messrs Barlow and Christie on a needle

Edinburgh Journal of Science Vol. VI

W. Miller Sculp.

having its position modified, and its directive power reduced by the application of artificial magnets, Lieutenant Foster found, that the true bearing upon which a needle exhibits its minimum variations is the same at Port Bowen as at Woolwich, or about S. 38° E, (or S. 85 W. at Port Bowen, magnetic,) which would almost lead to a conclusion that this is a constant line over all the world. A similar coincidence seemed to obtain with respect to the magnetic bearing of the line of maximum variation, which appeared to be at Port Bowen N. 66 E., agreeing very nearly with that determined in England by Mr Barlow.

The effect of Mr Barlow's Plate, for correcting the effect of local attraction on board ship, occupied the particular attention of Captain Parry, and it is with much satisfaction that we quote the following high and well merited eulogium on this great invention.

"The plate thus placed was now to undergo a severe trial on the ship's arrival in Barrow's Straits and Prince Regent's Inlet, where, from the extraordinary increase of dip, and the consequently augmented effect of the ship's iron upon the magnetic needle, the compass had before been rendered wholly useless on board ship. Never had an invention a more complete and satisfactory triumph; for, to the last moment of our operations at sea, did the compass indicate the true magnetic direction, requiring of course at times a considerable degree of tapping with the hand merely to relieve the needle from friction. And even at Port Bowen, where the dip is eighty-eight degrees, and the magnetic intensity acting on a horizontal needle extremely weak in consequence, the azimuth compass on board actually gave the same variation as that observed on shore, within the fair and reasonable limits of error of observation under such circumstances. Such an invention as this, so sound in principle, so easy of application, and so universally beneficial in practice, needs no testimony of mine to establish its merits; but when I consider the many anxious days and sleepless nights which the uselessness of the compass in these seas had formerly occasioned me, I really should esteem it a kind of personal ingratitude to Mr Barlow, as well as great injustice to so memorable a discovery, not to have stated my opinion of its merits, under circumstances so well calculated to put them to a satisfactory trial."

The following Table contains some of the principal results respecting the variation and dip of the needle:—

Table of Variations and Dips of the Needle in 1824-5.

VARIATION.

N. Lat.	West Long.	Variation W.
68°59	53°13	70°24′
71 2	60 36	77 42
72 34	62 8	83 26
74 28	81 51	104 49
73 9	89 1	118 48
72 45	89 27	122 27
73 23	90 53	125 35
72 46	91 50	129 25
Mean at Port Bowen in 73°14	88°55	123 22

DIP.

N. Lat.	West Long.	Dip N.	Intensity.
Woolwich Common.		70°9′	1.00
68°59′	53°13′	82 54	1.148
70 56	60 52	84 9	
Mean at Port Bowen in 73°14	88 55	88 1	1.297
73 6	91 20	88 2	
73 9	89 1	88 8	
Woolwich Common when brought back,		70 0	

It is obvious from the preceding observations, compared with those formerly made by Captain Parry, that the magnetic pole is somewhere about 70° west latitude, and 90° west longitude; but what is of more importance, it is obvious, that, since 1819, *the magnetic pole has moved considerably towards the east,* according to the ingenious theory of Professor Hansteen, which supposes a motion of 11′ eastward every year, which would give a motion of 1°6 in six years.—See this *Journal*, No. ix. p. 67.

2. *Meteorological Observations.*

The determination of the mean temperature of the arctic regions in a meridian nearly at right angles to that which passes through the coast of Europe, has, in our apprehension, been one of the most important results of the voyages under Captain Parry, and, in a scientific point of view, well worthy of all the labour and expence which the expedition has cost.

The year 1824 was considered by Captain Parry as more severe than former years, in proportion to the latitude of the station. The following are the mean temperatures of the months in 1824 and 1825:

		Mean Temp.			Mean Temp.
1824.	September,	+ 25°.883	1825.	April,	— 6°.496
	October,	+ 10 .85		May,	+ 17 .65
	November,	— 4 .996		June,	+ 36 .12
	December,	— 19 .05		July,	+ 37 .29
1825.	January,	— 28 .914		August,	+ 35 .77
	February,	— 27 .32			
	March,	— 28 .375			
		Mean Temp. of year at Port Bowen.			+ 4°.034

By comparing this with the results formerly obtained by Captain Parry and Dr Richardson, we have

	Lat.	Mean Temp.		Lat.	Mean Temp.
Melville Island,	75°45	— 1°.7	Igloolik,	66	+ 6°.5
Port Bowen,	73 15	+ 4 .04	Fort Enterprise,	64	+ 14 .21
Winter Island,	69 19	+ 2 .6			

At Port Bowen the coldest month was January, and the difference in the mean temperature of January, February, and March, was little more than a degree. The thermometer did not rise above zero till the 11th of April, having remained below that point of the scale for 131 successive days, the only instance of this kind which Captain Parry ever knew. This severity of weather, however, was compensated by the unusual mildness of the early part of the winter.

The Aurora Borealis, one of the principal meteors which enliven an arctic winter, occurred frequently at Port Bowen, viz.

Twice in	October	1824.	Fifteen times in	January	1825.
Five times	November		Thirteen do.	February	
Six do.	December		Five do.	March	

in all 47 times. They assumed one general character, and occupied nearly the same position. The Aurora usually consisted of an arch sometimes tolerably continuous, but more frequently broken into detached irregular masses, or nebulæ of light stretching generally from about W. to S. E. but sometimes a few points beyond these bearings. Its termination to the S. E. was never exactly visible from the height of the land, but the arch was more frequently bisected by the plane of the magnetic than by that of the true meridian. The height of the upper margin of a permanent arch seldom exceeded 10° or 15° and coruscations generally shot from this towards the zenith. Sometimes the arch itself passed as high as the zenith, and on one occasion, 28th January, its direction was N. and S. The lower edge of the arch was generally well defined and unbroken, and the sky beneath it appeared by contrast so exactly like a dark cloud, that nothing but the stars shining in it removed the deception.

There were few brilliant displays of the Aurora during the winter. A fine Aurora appeared on the 21st December 1824, but a very remarkable and instructive one showed itself on the 27th January 1825. It broke out at midnight in a single compact mass of brilliant yellow light, situated in about a south east bearing, and appearing only a short distance above the land. Though generally continuous, it sometimes seemed composed of numerous pencils of rays compressed as it were laterally into one, being well defined on both sides, and nearly vertical. Though at times bright, its intensity unceasingly varied, and it seemed produced by one volume of light overlaying another as in clouds of smoke. While Captain Parry and Lieutenants Sherer and Ross were admiring the phenomenon, they simultaneously uttered an exclamation of surprise *at seeing a bright ray of the Aurora shoot suddenly downward from the general mass of light,* AND BETWEEN THEM AND THE LAND, *which was then distant only three thousand yards.* This we conceive to be one of the most important facts respecting the Aurora Borealis which has ever been published, and extinguishes at once many of the absurd explanations of it, which have been given to the world.

Captain Parry frequently listened for any sound proceeding from this phenomenon, but never heard any. He likewise endeavoured in vain to observe any influence upon the electrometer.

One of the most important observations of Captain Parry, however, relates to the circumstance which he seems to have completely established, *that the Aurora Borealis exercises no action whatever on the magnetic needle.* " Our variation needles," says Captain Parry, " which were extremely light, suspended in the most delicate manner, and from the weak directive energy, susceptible of being acted upon by a very slight disturbing force, were *never in a single instance visibly affected by the Aurora,* which could scarcely fail to have been observed at sometime or other, had any such disturbance taken place, the needles being visited every hour for several months, and oftener when anything occurred to make it desirable."

The scientific reader will feel considerable surprise when he compares the preceding distinct statement, with the statements published in the *Annales de Chimie* by M. Arago, who not only finds that his magnetic needle *in Paris* is affected by the Auroræ which are seen to the north of

Leith in Scotland, but who even ventures to predict the occurrence of Auroræ at Leith, from the indications of his magnetic needles in Paris. As the extraordinary Aurora of the 27th January 1825, whose distance from Captain Parry's needle could not exceed *one mile and a half*, did not in the least degree affect his delicately suspended needles, we must ascribe the influence of the Leith Auroræ to some ethereal delicacy in the Parisian needles, one of which we hope Captain Parry will take out with him in his approaching journey to the Pole. If the English needles shall be found as delicate as the French ones, which, with our nationality, we may suppose to be the case, we must then conclude, that the Leith Auroræ possess physical properties totally different from those which enliven our arctic winters!

In Davis's Straits on the 15th September 1825, Captain Parry encountered, in latitude 69½°, a very brilliant Aurora in the S. E., and on the 20th there was a bright arch across the zenith from S. E. to N. E., *which seemed to be very close to the ship*, and which threw the shadow of objects on the deck.

The most brilliant display, however, of the Aurora, and which surpassed all that he had seen at Port Bowen, occurred on the 24th September in latitude 58½°, and longitude 44½°. "It first appeared," says he, "in a (true) east direction, in detached masses like luminous clouds of yellow or sulphur-coloured light, about 3° above the horizon. When the appearance had continued for about an hour, it began at 9 P. M. to spread upwards, and gradually extended into a narrow band of light passing through the zenith, and again downwards to the westward horizon. Soon after this the stream seemed no longer to emanate from the eastward, but from a fixed point one degree above the horizon on a true west bearing. From this point, as from the narrow point of a pencil, streams of light resembling brightly illuminated vapour or smoke appeared to be incessantly issuing, increasing in breadth as they proceeded, and darting with inconceivable velocity, such as the eye could scarcely keep pace with, upwards towards the zenith, and in the same easterly direction which the former arch had taken. The sky immediately under the spot from which the light issued, appeared, by a deception very common in this phenomenon, to be covered with a dark cloud, whose outline the imagination might at times convert into that of the summit of a mountain, from which the light proceeded like the flame of a volcano. The streams of light, as they were projected upwards, did not consist of continuous vertical columns or streamers, but almost entirely of separate, though constantly renewed masses, which seemed to roll themselves laterally onward with a sort of undulatory motion, constituting what I have understood to be meant by that modification of the Aurora called the "merry dancers," which is seen in beautiful perfection at the Shetland Islands. The general column of the light was yellow, but an orange and a greenish tinge rose at times very distinctly perceptible, the intensity of the light and colours being always the greatest when occupying the smallest space. Thus the lateral margins of the band or arch seemed at times to roll themselves inwards so as to approach each other, and in this case the light just at the edges became much more vivid than the rest. The intensity of light during the brightest parts of the phenomenon, which continued three quarters of an hour, could scarcely be inferior to that of the moon when full.

We once more remarked, in crossing the Atlantic, that the Aurora often gave a great deal of light at night, even when the sky was entirely overcast, and it was on that account impossible to say from what part of the heavens the light proceeded, though it was often fully equal to that afforded by the moon in her quarter. This was rendered particularly striking on the night of the 5th October, in consequence of the frequent and almost instantaneous danger which took place in this way, the weather being rather dark and gloomy, but the sky at times so brightly illuminated, almost in an instant, as to give quite as much light as the full moon similarly clouded, and enabling one distinctly to recognize persons from one end of the ship to the other. We did not on one occasion perceive the compass to be affected by the Aurora Borealis.

II.—*On the Mathematical Theory of Suspension Bridges, with Tables for Facilitating their Construction.* By Davies Gilbert, Esq. V. P. R. S. &c. &c. From the *Philosophical Transactions* for 1826. Part iii.

The learned Vice-President of the Royal Society has furnished us in the present paper with a most interesting investigation of all the essential formulæ connected with the theory of suspension bridges, and by expanding those formulæ into suitable and convenient tables, has conferred a great benefit on civil engineers, and, through that useful and honourable class of men, the public at large.

Mr Gilbert informs us, that his attention was first directed to the consideration of suspension bridges, when the plan for making such a communication across the Menai Straits * was submitted to the Commissioners appointed by Parliament to improve the communication by roads and bridges through Wales. It appeared to Mr G. that the depth of curva-

* We have now before us a beautiful engraving of this truly magnificent structure,—a structure which, as a work of art, stands unrivalled, and which reflects the highest credit on Mr Telford, the distinguished engineer. The main pillars from centre to centre are distant from each other 579 feet, and the span of the immense catenary formed by the massy chains 570 feet. The height from low water of spring tides to the road-way is 121 feet, and from high water spring tides 100 feet, thus affording free and uninterrupted scope to all the purposes of navigation. The height of the main supporting pillars above the road-way is 50 feet, and the total breadth of the road-way is 28 feet, divided into a foot-way of 4 feet in the centre, and a carriage-way of 12 feet on each side, thus separating the entire road-way into three distinct parts. The number of suspending chains amounts to 16, each composed of 5 bars, and each bar having a section of 3¼ inches of iron. The total sectional area of iron is therefore 260 inches. From the division of the road into the foot-way and the two carriage-ways, there are consequently four sets of suspending chains. The road-ways, from the main pillars to the land, are supported by a series of magnificent arches.

ture * proposed was not sufficient for insuring such a degree of strength and permanence, as would be consistent with the due execution of a great national work. Wishing, however, to take upon himself the full responsibility for the increased expence which such an alteration must necessarily involve, Mr Gilbert printed, in the *Quarterly Journal of Science*, some approximate investigations, and which confirmed him in the opinion he had originally advanced as a member of the Commission. The result was, that the interval between the points of support and the road-way was augmented to fifty feet; and the bridge now possesses, to adopt the language of the distinguished author of the paper, "that full measure of strength which experience has established as requisite and sufficient for works of iron not perfectly at rest."

Mr Gilbert has not only in the paper before us most fully investigated all the necessary formulæ for the ordinary catenary, and adapted tables to them, but also added formulæ and tables for the catenary of equal strength, "a curve not merely of speculative curiosity," as he judiciously remarks, "but of practical use, where a wide horizontal extent may chance to be combined with natural facilities for obtaining a corresponding height for the attachments."

By assuming the following elements; viz.

$a =$ the tension at the apex, estimated in measures of the chain;
$x =$ the absciss, the versed sine, or depth of curvature;
$y =$ the ordinate, or semi-transverse length; and
$z =$ the length of the curve;

and considering that the tension a acts *horizontally* at the apex A, the weight of the chain z *perpendicularly*, and the force of suspension in *the direction of the tangent* to the curve; these forces may be represented in direction and magnitude by the elementary triangle Prp; and hence we have

$$\dot{x} : \dot{y} :: z : a, \text{ or } \dot{x}^2 : \dot{y}^2 :: z^2 : a^2,$$
$$\text{or } \dot{x}^2 + \dot{y}^2 : \dot{x}^2 :: a^2 + z^2 : z^2,$$

or since from the nature of the elementary triangle $\dot{x}^2 + \dot{y}^2 = \dot{z}^2$, we have $\dot{z}^2 : \dot{x}^2 :: a^2 + z^2 : z^2$,

whence $\dot{x} = \frac{z\dot{z}}{\sqrt{(a^2+z^2)}}$,

and taking the fluent $x = \sqrt{(a^2 + z^2)} - a$, which is the first equation of condition.

Again, since $\dot{x} : \dot{y} :: z : a$, we have $\dot{y} = \frac{a\dot{x}}{z}$. Substituting in this last

* The depth of curvature here alluded to cannot be too particularly attended to by engineers. In some plans of suspension bridges that have been proposed for erection, the strength which a proper versed sine for the catenary affords, in proportion to the horizontal interval between the points of suspension, appears to have been entirely lost sight of. To diminish the expence as much as possible, the towers above the road-way have been proposed much too low, thus sacrificing strength in no inconsiderable degree. We beg earnestly to call the attention of engineers to this important subject.

found equation, the value of $\dot{x}$ before deduced,

we have $\dot{y} = \frac{a\dot{z}}{\sqrt{(a^2+z^2)}}$,

and taking the fluent $y = a \times$ nat. log. $\frac{\sqrt{(a^2+z^2)}+z}{a}$, which is the second equation of condition.

By assuming also N for the number of which $\frac{y}{a}$ is the natural logarithm, supposing a and y to be given, and afterwards adopting M as the representative of $a\,\mathrm{N} - a$, Mr Gilbert deduces the equation

$$x = \frac{\mathrm{M}^2}{2\mathrm{M}+2a},$$

which determines the value of the abscissa of the catenary. And from the first equation of condition he obtains

$$z = \sqrt{(2ax+x^2)},$$

which determines the length, and consequently the weight of the chain.

The tension also at the point of suspension P being equal to $\sqrt{(a^2+z^2)}$, becomes in the present case equivalent to $a+x$, and which furnishes, since the value of x is known, the absolute value of the tension at P.

From the analogy also which exists between the parts of the elementary triangle, and of the forces corresponding with it, the angle of suspension becomes known.

To render the subject accessible to practical men, Mr Gilbert has, as before mentioned, constructed, from the preceding theorems, his first and second tables, and the application of which he has explained by the following example.

Suppose the span of a suspension bridge to be 800 feet, and the adjunct weight of suspension rods, road-way, &c. one-half the weight of the chains. Then if the full tenacity of iron be represented by the modulus of 14,800 feet, the virtual modulus for the whole weight must be reduced in the proportion of 3 to 2, or to 9867. Let it also be determined to load the chains at the point of their greatest strain, which is at the point of suspension, with one sixth-part of the weight they are theoretically capable of sustaining.

Then since the semi-span is by the hypothesis 400 feet, and that y in the first of Mr Gilbert's tables is taken at 100 measures, each of these measures must in the present instance be 4 feet, and the weight expressed in the same measures to be sustained at the points of suspension; or, in other words, the value of T, must be $9867 \div 6 \times 4$, or 411.125. Entering, therefore, with this value of T in the proper column of the table, we obtain, with the greatest ease, the following values; viz.

a = 400 measures or 1600 feet.
x = 12.565 measures or 50.26 feet.
z = 101.045 measures or 404.18 feet.

and the angle of suspension 75° 49′.

This example is sufficient to explain the great practical utility of the table.

In the catenary of equal strength, Mr Gilbert introduces the symbol ζ as the representative of the mass of the chain. Then, since the forces operating on this peculiar catenary, may be represented as in the ordinary curve, by the same incremental triangle as before, we shall have

$$\dot{x} : \dot{y} :: \zeta : a,$$

and which will produce by a repetition of the former steps, the fluxional equation $\dot{x} = \frac{\zeta \dot{z}}{\sqrt{(a^2+\zeta^2)}}$.

But on the principle of equal strength,

$$a : \sqrt{(a^2+\zeta^2)} :: \dot{z} : \dot{\zeta};$$

Consequently $\dot{z} = \frac{a \dot{\zeta}}{\sqrt{(a^2+\zeta^2)}}$,

and which by taking the fluents, produces

$$z = a \times \text{nat. log.} \frac{\sqrt{(a^2+\zeta^2)}+\zeta}{a}.$$

By substituting also the value of z just determined, in the equation

$$\dot{x} = \frac{\zeta \dot{z}}{\sqrt{(a^2+\zeta^2)}}, \text{ we shall have } \dot{x} = \frac{a \zeta \dot{\zeta}}{a^2+\zeta^2},$$

and which taking the fluents, produces

$$x = \frac{a}{2} \times \text{nat. log.} \frac{a^2+\zeta^2}{a^2}.$$

From the first analogy also, we derive $\dot{y} = \frac{a \dot{x}}{\zeta}$,

and which by substituting for x its value before derived, produces the equation $\dot{y} = \frac{a^2 \dot{\zeta}}{a^2+\zeta^2}$,

or by taking the fluents

$y =$ Circ. arc of which ζ is the tangent to the radius a.

From these theorems Mr Gilbert constructs his third and fourth tables, the application of which he also illustrates by an example.

Assuming in the ordinary catenary, that $x = 65.85$ measures, is the height of the attachment to give a maximum extent of span, with any virtual tenacity of material, a will be 85 measures, and $a + x = 85 + 65.85$, or 150.85 measures, equal the given virtual tenacity. This taken as before at $\frac{2}{3}$ of $\frac{1}{6}$ of 14800 feet, will give 10875 feet for each measure, and the whole span at $2y = 2175$ feet. Chains merely supporting themselves, and at the utmost of their tenacity, will extend nine times further, or to 19575 feet.

In the catenary of equal strength, the semispan being equal to the circular arc, of which ζ is the tangent, to radius a, it is obvious that $a \times$ semicircular arc, must be the limit of the span. Therefore, if $a = \frac{2}{3}$ of $\frac{1}{6}$ of 14,800 feet, or 1644.44, we shall have $a \times \frac{c}{2} = 5154$ feet.

And if the chains merely sustain themselves at their utmost tenacity, 5154×9 will give 46,385 feet, or somewhat more than eight miles and three quarters.

But this case, Mr Gilbert remarks, is purely hypothetical, for the purpose of ascertaining a limit, since ζ, the mass or weight of the chain, must be infinite, and consequently its length: the figure approaching indefinitely near to that of a chain sustaining itself from an infinite height, which figure is identical with that of a building, capable, so far as pressure and the strength of materials are alone concerned, of being carried to any elevation whatever. This figure may be determined as follows:

Let $a =$ the section of such a building at its base,
$y =$ the section at any height,
and $x =$ that height.

Then, since the section and the superincumbent pressure must always be in the same proportion to each other, $\dot{x}$ and $\frac{\dot{y}}{y}$ are in a constant ratio. Let then $\frac{\dot{x}}{m} = -\frac{\dot{y}}{y}$, where m is the modulus of pressure in the given material. But when $x = o$, $y = a$, and therefore $\frac{x}{m} =$ nat. log. $\frac{a}{y}$; or $\frac{x}{A.m}$ $=$ tab. log. $\frac{a}{y}$, A being 2.3025851. If, however, ϵ and γ be the homologous sides or diameters of these sections, then will $\frac{x}{2\,A.m} =$ tab. log. $\frac{\epsilon}{\gamma}$.

Mr Gilbert in conclusion observes, that in the event of suspension bridges wanting stability to counteract and restrain undulatory motion, the ballustrades may be carried to any required height, and rendered inflexible by diagonal braces; and if further means were required for imparting stability, such braces might be adjusted with screws to the suspension rods themselves, after these rods had acquired their exact positions, on the completion of the work.

We recommend the entire paper to the particular attention of the engineer.

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

November 27.—At a General Meeting of the Society held this day, the following Office-Bearers were elected:

President.—Sir Walter Scott, Baronet.

Vice-Presidents.—Right Hon. Lord Chief-Baron. Lord Glenlee.
Dr T. C. Hope. Professor Russell.

Secretary.—Dr Brewster.

Treasurer.—Thomas Allan, Esq.

Curator of the Museum.—James Skene, Esq.

Physical Class.—Lord Newton, *President*
John Robison, Esq. *Secretary.*

COUNSELLORS.—	Sir William Forbes, Bart.	Dr Turner.
	Dr Home.	Sir Thomas M. Brisbane.
	Professor Wallace.	Dr Graham.

LITERARY CLASS.—Henry Mackenzie, Esq. *President.*
P. F. Tytler, Esq, *Secretary.*

COUNSELLORS.—	Right Hon. the Lord Advocate.	Dr Hibbert.
	Sir Henry Jardine.	Lord Meadowbank.
	Sir John Hay, Bart.	Thomas Kinnear, Esq.

The following gentlemen were elected Ordinary Members:—
George Moir, Esq. Advocate.
John Stark, Esq.

December 4.—A Notice by Dr BREWSTER was read respecting the existence of one of the New Fluids in a specimen of Sapphire. See this number, p. 155.

A Paper communicated by Sir THOMAS MAKDOUGALL BRISBANE, K. C. B. was read, entitled "Observations on the Comet of 1825," made at Paramatta. By Mr JAMES DUNLOP. This paper is printed in this Number.

CAPTAIN BASIL HALL exhibited and described a Pocket Azimuth and Altitude Circle, recently devised by CAPTAIN KATER.

A Paper on Sternbergite, a New Mineral, by Mr HAIDINGER, was also read.

ART. XXIX—SCIENTIFIC INTELLIGENCE.

I. NATURAL PHILOSOPHY.

ASTRONOMY.

1. *Struve's Observations on the Ring and Satellites of Saturn.*—The fine telescope at the observatory of Dorpat, which we have described in a preceding number, has been applied by Professor Struve to the measurement of the ring of Saturn. The following results are suited to the mean distance of the planet. The power was 54.

External diameter of external ring, - -	40″.215
Internal diameter of external ring, - -	35 .395
External do of internal ring, - -	34 .579
Internal do of do, - - - -	26 .748
Equatorial diameter of Saturn, - - -	18 .045
Breadth of the external ring, - - -	2 .410
Breadth of chasm between rings, - -	0 .408
Breadth of internal ring, - - -	3 .915
Distance of ring from Saturn, - - -	4 .352
Equatorial radius of Saturn, - - -	9 .022

The mean inclination of the ring to the ecliptic is 28° 5′.9, the error of which probably does not exceed 6′9. Professor Struve was unable to discover any marks of a division of the ring into many parts. He remarked, however, that the outer ring is much less brilliant than the inner.

Professor Struve has never seen the seventh satellite. The fourth has a diameter of 0.75, and resembles a small disc. The five old satellites are easily seen, and the sixth has been observed several times by M. Struve. Professor Struve's paper was read at the Astronomical Society of London on the 9th June 1826.

2. *Struve's Observations on Jupiter and his Satellites.*—Professor Struve has also applied Fraunhofer's telescope to Jupiter, with a power from 540 to 600. The mean results suited to the planet's mean distance are,

Jupiter's major axis, - - -	38″.442
——— minor axis, - -	35 .645
Compression at the Poles, - -	0 .0728 or $\frac{1}{13.71}$
Mean Diameter of 1st Sat. - -	1 .018
——————— 2d - -	0 .914
——————— 3d - -	1 .492
——————— 4th - -	1 .277

It had been supposed by preceding astronomers, and even by M. Struve himself, that the figure of Jupiter deviated from the elliptical form. On March 7 1826, he believed that the diameter passing through 61° 4′ lat. preceding south, and 61° 4′ lat. preceding north, was smaller than the ellipse allowed; but upon measuring it with great care he found this to be an illusion, the length of this diameter being 42″.34 by measurement, and 42″.38 by calculation.

3. *Royal Observatory of Edinburgh.*—The friends of astronomy will be gratified to hear that his Majesty has granted the sum of L. 2000 for the purchase of instruments, &c. for the Royal Observatory of Edinburgh.

This observatory, which some foreigners suppose to be attached to the Royal Society of Edinburgh, and others to the University of Edinburgh, belongs to an Association of 183 individuals, who, by subscriptions of twenty-five Guineas each, have raised about L. 4800 for the promotion of astronomy. A plan, elevation, and description of the very handsome building which they have erected on the Calton Hill, will be found in the article OBSERVATORY, in the *Edinburgh Encyclopædia*, vol. xv. p. 443.

4. *New Observatory at Brussels.*—The King of the Netherlands has given directions for the erection of an Observatory at Brussels. The site of it will probably be between the gates of Louvaine and Schaerbeck, in the vicinity of one of the promenades of the city.

5. *Mr Dunlop's Observations on Encke's Comet in* 1825.—The observations on Encke's comet are scarce worth transmitting, this latitude having been very unfavourable for seeing it.

I find, on the 14th of August, I discovered it near star τ Gemini, but was prevented by haze from making observations on it.

On the 16th, 2_h 50′ sidereal time, it is north, following τ Gemini about 12′ 30″ in AR in time, and about 6′ 40″ north of the star. This observation was made by the equatorial instrument, and is not to be depended on to great accuracy.

On the 17th August, at 3^h 9′ 55″, the comet followed τ Gemini = 19′ 26″ in time, and south of the star, = 8′ 27″ 36, bar. 30.300, ther. 35°. This observation was made within two degrees of the horizon. I observed τ Gemini, and waited till the comet passed through the field. *Comet very faint.*

I searched diligently for it coming out from the sun, but could not find it.—*Letter from Mr Dunlop to Sir Thomas Brisbane.*

OPTICS.

6. *Nature of the light emitted by lime, in a high state of incandescence.* Mr Herschel upon examining the light from lime obtained by Lieutenant Drummond, and described in No. x. p. 319, found that it contains all the usual rays, and three of those remarkable in quantity and quality, viz. the *red*, the *yellow*, and the *green*. The red is intermediate between the red and orange of the solar spectrum, but is nearer to the latter. It is remarkable, as Mr Herschel mentions, that a red of the above character is yielded by lime itself, whilst the colour given to burning bodies by the combinations of that earth is a brick red.

7. *On the light developed at the separation of Boracic Acid into fragments.*—M. Dumas has observed that the boracic acid, when melted, presents a particular phenomenon at the moment of its cooling. When it is cooled in a platina dish, at the instant when the contractions of the two substances becomes unequal, the boracic acid splits and discharges a bright light, which follows the direction of the cracks. This light, which is probably owing to the cause which developes the opposite electricities in plates of mica quickly separated, is sufficiently strong to be seen in the day-time. The experiment is a remarkable one in the dark.—*Ann. de Chim.* p. 324, 335.

HYDRODYNAMICS.

8. *On the Periodical Fountain of the Jura, called the Round Fountain.*—On the 26th June 1826, M. Dutrochet read a memoir on this fountain to the Academy of Sciences. This fountain is periodical, and not intermitting. The quantity of water which it discharges increases every three minutes, so that the entire period is six minutes. The general explanation given of these fountains is, that they are supplied by subterranean reservoirs communicating with one another by channels which perform the office of syphons. This explanation, however, M. Dutrochet conceives to be inapplicable to the round fountain. Here, indeed, the time of the period is not constant, as the period is sometimes four minutes in place of six, viz. two minutes of intermittence, and two of increase. On the hypothesis of a syphon, the time of intermittence ought to have no influence.

M. Dutrochet is of opinion that the periodicity, and all the phenomena of this fountain may be explained by the periodical admission of a current of gas directed obliquely towards the current of water which supplies the fountain, and traversing its course during regular intervals. It is, he conceives, a confirmation of this opinion, that there is a very sensible disengagement of carbonic acid gas during the period of intermittence. M. Dutrochet does not inquire into the cause of this disengagement of gas, but he considers it sufficient for his purpose, that carbonic acid gas is disengaged in all the springs of Jura.—*Le Globe*, tom. iii. No. 82, July 1st 1826.

METEOROLOGY.

9. *Meteoric Stone containing many substances*—There was laid before the Academy of Sciences a meteoric stone which fell in the principality of Ferrara on the 19th January 1824. This fragment is remarkable from the diversity of substances which the eye can discern in it. It will be examined microscopically by M. Cordier, and chemically by M. Laugier.

10. *Great Variation of the Barometer in* 1822.—On the 3d July 1836, M. Arago communicated to the Academy of Sciences some of the details which he obtained respecting this phenomenon. It took place over a very considerable extent; but, contrary to the general opinion, it did not show itself simultaneously in every direction. There was no sensible interval, it is true, over an immense line extending from east south east, to west north west, but, in the direction perpendicular to this, the phenomenon was transmitted at intervals very appreciable, and even of such length, that *a day and a half* elapsed between the time when it took place at Paris, and the time when it happened at Moscow and St Petersburgh.—*Le Globe*, tom. iii. No. 84, July 6th 1826.

II. CHEMISTRY.

11. *Brome, a new substance, supposed to be simple, contained in sea water.* (Extract from the *Annales de Chimie et de Physique*, for August 1826.) —As M. Balard has published his memoir on the new substance *Brome*, (from βρωμος a bad odour) of which we gave a short notice in the last number of the Journal under the name of *Muride*, we lose no time in laying before our readers a more complete account of this interesting body.

At common temperatures brome is a liquid, the colour of which is blackish-red when viewed in mass and by reflected light, but appears hyacinth-red when a thin stratum is interposed between the light and the observer. Its odour, which somewhat resembles that of chlorine, is very disagreeable, and its taste powerful. It acts with energy on organic matters, such as wood or cork, and corrodes the animal texture; but if applied to the skin for a short time only, it communicates a yellow stain, which is less intense than that produced by iodine, and soon disappears. It is highly destructive to animals, one drop of it placed on the beak of a bird having proved fatal. Its specific gravity is about 3. Its volatility is very considerable, for at common temperatures it emits red coloured vapours, which are very similar in appearance to those of nitrous acid, and at 116.5° F. it enters into ebullition. It retains its liquid form at the temperature of zero of Fahrenheit's thermometer.

Brome is a non-conductor of electricity, and undergoes no chemical change from the agency of the imponderables. It was transmitted through a red-hot glass tube, and exposed to the action of a voltaic pile, sufficiently powerful for disuniting the elements of water, without evincing the least trace of decomposition. It supports combustion in a very feeble manner:—a lighted taper immersed in the vapour of brome is soon extinguished; but before going out, it burns a few seconds with a flame which is green at its base and red at its upper part, as in an atmosphere of chlorine.

Brome is soluble in water, in alcohol, and particularly in ether. It does not redden litmus paper, but bleaches it rapidly like chlorine; and it likewise discharges the blue colour from a solution of indigo.

From these points of close resemblance between brome and chlorine, M. Balard was led to examine its relations with hydrogen. No chemical action takes place between the vapour of brome and hydrogen gas at common temperatures, not even by the agency of the direct solar rays; but on introducing a lighted candle or a piece of red-hot iron into the mixture, combination ensues in the vicinity of the heated body, though without extending to the whole mixture, and without explosion. The union is readily effected by the action of brome on some of the gaseous compounds of hydrogen. Thus on mixing the vapour of brome with hydriodic acid, sulphuretted hydrogen, or phosphuretted hydrogen gases, decomposition follows, and a colourless gas, possessed of acid properties, is generated. The hydro-bromic acid gas may be conveniently procured for experimental purposes by a process similar to that for forming hydriodic acid. A mixture of brome and phosphorus, slightly moistened, yields a large quantity of pure hydro-bromic acid gas, which may be collected over mercury.

The hydro-bromic acid gas is colourless, has an acid taste, and a pungent odour. It irritates the glottis powerfully, so as to excite cough, and when mixed with moist air, yields white vapours, which are denser than those occasioned under the same circumstances by muriatic acid gas. It undergoes no decomposition when transmitted through a red-hot tube, either alone, or mixed with oxygen. It is not affected by iodine; but chlorine decomposes it instantly, with production of muriatic acid gas, and deposition of brome. It may be preserved without change over mercury; but potassium and tin decompose it with facility, the first at common temperatures, and the last by the aid of heat.

The hydro-bromic acid is very soluble in water. The aqueous solution may be made by treating brome with sulphuretted hydrogen dissolved in water, or still better, by transmitting a current of hydro-bromic acid gas through pure water. The liquid becomes hot during the condensation, acquires a great density, increases in volume, and emits white fumes when exposed to the air. This acid solution is colourless when pure, but possesses the property of dissolving a large quantity of brome, and then receives the tint of that substance.

Chlorine decomposes the solution of hydro-bromic acid in an instant. Nitric acid likewise acts upon it, though less suddenly, occasioning the disengagement of brome, and probably the formation of water and nitrous acid. The nitro-hydro-bromic acid is analogous to *aqua regia,* and possesses the property of dissolving gold.

The elements of sulphuric and hydro-bromic acids react on each other in a slight degree; and hence on decomposing the hydro-bromate of potassa by sulphuric acid, the hydro-bromic is generally mixed with a little sulphurous acid gas.

The metallic oxides, as might be expected, do not act in an uniform manner on the hydro-bromic acid. The alkalies, earths, the oxides of iron, and the peroxides of copper and mercury, form compounds which may be regarded as hydro-bromates; whereas the oxide of silver, and the protoxide of lead, give rise to double decomposition, in consequence of which water and a metallic bromuret result.

The composition of hydro-bromic acid gas is easily inferred from the two following facts. 1. On decomposing hydro-bromic acid by potassium, a quantity of hydrogen remains precisely equal to half the volume of the gas employed; and 2. when hydriodic acid gas is decomposed by brome, the resulting hydro-bromic acid occupies the very same space as the gas which is decomposed. It is hence apparent that the hydro-bromic is analogous to hydriodic and muriatic acid gases; or, in other words, that 100 measures of hydro-bromic acid gas contains fifty measures of the vapour of brome, and fifty of hydrogen.

Since brome decomposes the hydriodic, and chlorine the hydro-bromic acid, it is obvious that brome, in relation to hydrogen, is intermediate between chlorine and iodine, its affinity for that substance being weaker than the first, and stronger than the second. The affinity of brome and oxygen for hydrogen appears nearly similar, for while oxygen cannot detach hydrogen from brome, brome does not decompose watery vapour.

The action of brome on the metals presents the closest resemblance to that which chlorine exerts on the same substances. Antimony and tin take fire by contact with brome; and its union with potassium is attended with such intense disengagement of heat as to cause a vivid flash of light, and to burst the vessel in which the experiment is performed. M. Balard is of opinion, that the soluble metallic bromurets are converted, like the similar compounds of chlorine and iodine, into neutral hydro-bromates, and reciprocally, that the hydro-bromates are frequently converted into bromurets in passing into the solid state. All the bromurets are decomposed by chlorine with evolution of brome; and the hydro-bromates are not only attacked by chlorine, but by all substances, such as the chloric or nitric acids, which have a strong tendency to deprive other bodies of hydrogen.

The bromuret of potassium, which may be obtained in cubic crystals from the hydro-bromate of potassa by evaporation, was found by M. Balard to consist of

Brome	-	-	65.56
Potassium	-	-	34.44

And hence, supposing it to contain one atom of each element, the weight of an atom of brome will be represented by 9.326, that of oxygen being regarded as unity.

Ammoniacal gas unites with its own volume of hydro-bromic acid gas, forming a white, solid, volatile salt, which is soluble in water, and crystallizes in long prisms by evaporation.

The hydro-bromate of baryta is very soluble in water, and is also dissolved by alcohol. It forms opaque mamillated crystals, which have no resemblance to the transparent scales of the muriate of barytes.

The hydro-bromate of magnesia is deliquescent and uncrystallizable, and, like the muriate of that base, is decomposed by an elevated temperature.

On mixing a soluble hydro-bromate with the nitrate of lead, silver, and the protoxide of mercury, white precipitates are obtained, which are very similar to the chlorides of those metals, and which appear to be metallic bromurets. By the action of brome on metallic mercury, a compound results which yields the peroxide of mercury when decomposed by alkalies, and must therefore be a bi-bromuret. It may be sublimed by heat, is soluble in water, alcohol, and ether, particularly in the last, and presents a close analogy to corrosive sublimate. It is distinguished from that substance, however, by yielding the red vapours of brome when treated by the nitric, and still better by the sulphuric acid.

The bromuret of silver has the same curdy appearance as the chloride, blackens by exposure to light, is soluble in ammonia, and insoluble in nitric acid, which does not decompose it even at a boiling temperature. Boiling sulphuric acid, on the contrary, detaches some vapours of brome. The bromuret of silver is decomposed by hydrogen in a nascent state, and was found by M. Balard to consist of

Silver, - -	589
Brome, - -	411
	1000

The atomic weight of brome, estimated from these data, is 9.429.

Brome acts upon metallic oxides much in the same manner as chlorine. On passing the vapour of brome over potassa, soda, baryta, or lime, a vivid incandescence ensues, oxygen is disengaged, and a metallic bromuret results. Magnesia and zirconia are not decomposed by this treatment.

When brome acts on the solution of an alkali or alkaline earth, considerably diluted with water, the bromuret of an oxide is produced, which possesses bleaching properties, and from which acetic acid causes the disengagement of brome. But when this substance acts upon a concentrated solution of potassa, or when solid potassa is agitated with the ethereal solution of brome, two salts are generated, the hydro-bromate and bromate of potassa; and on evaporating the solution, the former is obtained in cubic, and the latter in acicular crystals. The bromate of potassa is separated from the hydro-bromate by being very sparingly soluble in cold water. The alkaline earths likewise cause the formation of the two acids, but magnesia does not appear to possess that property.

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The bromates are analogous to the chlorates and iodates. Thus the bromate of potassa is converted by heat into the bromuret of potassium, with disengagement of pure oxygen, deflagrates when thrown on burning charcoal, and forms with sulphur a mixture which detonates by percussion. The acid of the bromates is decomposed by deoxidizing agents, such as the sulphurous acid and sulphuretted hydrogen, in the same manner as the acid of the iodates. The bromates likewise suffer decomposition from the action of hydro-bromic and muriatic acids.

The bromate of potassa does not precipitate the salts of lead; but occasions a white precipitate with the nitrate of silver, and a yellowish-white with the proto-nitrate of mercury;—characters which, if correctly observed, distinguish the bromate from the iodate and chlorate of potassa in a very satisfactory manner.

The bromic acid may be procured in a separate state by decomposing a dilute solution of the bromate of baryta with sulphuric acid. From the analysis of the bromate of potassa, it appears to consist of one atom of brome and five atoms of oxygen, and is consequently similar in constitution to the iodic, chloric, and nitric acids.

Brome unites with chlorine at common temperatures, forming a very volatile liquid of a reddish-yellow colour, penetrating odour, and exceedingly disagreeable taste. It is soluble in water, and dissolves in that liquid apparently without decomposition; for the solution bleaches litmus paper without previously reddening it, and has the characteristic odour and colour of the compound. By the action of alkalies it is resolved into muriatic and bromic acids. M. Balard has also described compounds of brome with iodine, phosphorus, and sulphur. With olefiant gas it produces an oily fluid, denser than water, and of a mild ethereal odour. This substance, when transmitted through a red hot tube, suffers decomposition, charcoal being deposited, and hydro-bromic acid gas evolved. It is therefore very analogous to the hydro-carburet of chlorine.

Brome exists in sea water in the form of hydro-bromic acid, combined, in the opinion of M. Balard, with magnesia. It is present, however, in very small quantity; and even the uncrystallizable residue called *bittern*, left after the muriate of soda has been separated from sea water by evaporation, contains but little of it. On adding chlorine to this liquid, an orange-yellow tint appears; and on heating the solution to the boiling point, the red vapours of brome are expelled, which may be condensed by a freezing mixture. A better process for preparing brome is to transmit a current of chlorine gas through the bittern, and then to agitate a portion of ether with the liquid. The ether dissolves the whole of the brome, from which it receives a beautiful hyacinth red tint, and, on standing, rises to the surface. When the ethereal solution is agitated with caustic potash, its colour entirely disappears, and, on evaporation, cubic crystals of the hydro-bromate of potash are deposited.

M. Balard has ascertained that brome exists in marine plants which grow on the shores of the Mediterranean Sea, and has procured it in appreciable quantity from the ashes of the sea-weeds that furnish iodine.

He has likewise detected its presence in the ashes of some animals, especially in those of the *Janthina violacea*, one of the testaceous mollusca.

From the circumstance of brome being intermediate between chlorine and iodine in some of its more important chemical relations, M. Balard at first suspected it to be some unknown compound of these bodies; but as, on further examination, he failed in obtaining the least trace of decomposition, he was induced to adopt the opinion that it is an elementary substance. The facts which have been related are greatly in favour of this view. They have not, however, as yet, been confirmed by other chemists, and therefore it would be premature to form a decided opinion on the subject. We may observe, however, that MM. Vauquelin, Thenard, and Gay-Lussac, in their report to the Parisian Academy of Sciences, speak in the most flattering terms of the memoir of M. Balard, and regard his opinion as highly probable, though they express themselves in a very guarded manner.

III. NATURAL HISTORY.

MINERALOGY.

12. *Thenardite, a new mineral species.*—The mineralogical characters of this substance were ascertained by M. Cordier, from specimens sent to him for the purpose by Professor J. L. Casaseca of Madrid, a pupil of M. Thenard, in compliment to whom it is denominated. According to M. Cordier, it possesses the following characters. Form, a scalene four-sided pyramid, whose base is a rhomb of nearly 125° and 55°, the ratio between the axis and a side of this rhomb being = 7.3 nearly. Crystals frequently have the apex of the pyramid taken off by a plane. It cleaves readily in a direction perpendicular to the axis of this pyramid, and likewise parallel to planes replacing its lateral edges. It is not transparent, and its specific gravity approaches to that of glauberite, which is 2.73.

From the details given by M. Casaseca, it appears that *Thenardite* is one of those substances, whose formation and decomposition is continually going on in the grand chemical laboratory of nature, and which hence forms one of those links by which *minerals*, commonly so called, are connected with the substances produced by nature with the assistance of chemical art, and arbitrarily excluded in the usual definitions from the *mineral* kingdom. It was dicovered nearly nine years ago by M. Rodas five leagues from Madrid, and two and a half from Aranjuez, in a place called the salt-mines of Espartines, and considered by him as a sulphate of soda, mixed with a small quantity of subcarbonate of soda. During the winter season water impregnated with particles of the salt exudes from the sides and the bottom of a hollow, and when sufficiently concentrated, it deposits part of its contents in more or less regularly formed crystals. Mr Casaseca states, that, when exposed to the action of the atmosphere, it is changed into powder, the change beginning from the surface, upon which the powder forms a coating. This is not however owing to the same cause upon which depends the decomposition of common glauber-salt, which loses water, whereas Thenardite attracts a portion of it, and forms a hydrous salt, which is again immediately decomposed. In a dry atmosphere they preserve their original appearance. No matter is disengaged from it by the application of heat. It is perfectly soluble in water. When reduced to powder, and brought in contact with a small portion of water, it immediately combines with it and crystallizes, during which some heat is disengaged. It consists of

Sulphate of soda	99.78
Subcarbonate of soda	0.22

The analysis was conducted in the following manner. The sulphuric and carbonic acids were precipitated by nitrate of baryta, the precipitate ignited, and then digested in nitro-muriatic acid, to reduce entirely to the state of sulphate whatever might have been changed into sulphuret by the contact with the filter at an elevated temperature, and to dissolve the caustic baryta arising from the decomposition of the carbonate. This portion of baryta was afterwards precipitated by sulphuric acid. Thenardite has been employed by M. Rodas in manufacturing soap, but it is worked likewise and sold in its natural state—(*Annales de Chimie et de Physique*, tom. xxxii. p. 308.)

This substance was for the first time mentioned as a new species in Professor Mohs mineralogy, * and described likewise by Mr Haidinger, † though these descriptions were drawn up not from specimens occurring in nature, but from crystals obtained from solutions. The natural crystals are frequently much larger than the artificial ones. Those in M. Cordier's possession, and some that were presented to the school of mines in Paris by M. Casaseca, are about half an inch in diameter. They will therefore allow of a much more accurate determination of the specific gravity than the crystalline coats whose weight is given in Mohs = 2.462. Their colour is a yellowish-white; that of the artificial crystal is a pure white, but their transparency is always inconsiderable. Their hardness is = 2.5 of the scale of Mohs, between gypsum and calcareous spar.

M. Gay-Lussac has observed that the capacity of water for dissolving sulphate of soda is greatest at 33° Centigr. (106¼° Fahr.) Above this temperature crystals of *Thenardite* are deposited, and this is perhaps the condition upon which its formation at Espartines depends.

13. *Halloysite, a new mineral species.*—Occurs in more or less regular globular masses, sometimes larger than the fist, in those aggregated masses of ores of iron, zinc, and lead, which frequently are found filling the cavities in the neighbourhood of Liege and Namur. It was first observed by M. Omalius d'Halloy, in compliment to whom it has been named by M. Berthier. It is always compact, with a conchoidal fracture somewhat resembling wax; it yields to the nail, and is polished by it; its colour is white, generally with a slight bluish-grey tint; it is translucent on the edges; it adheres to the tongue. It imbibes water like the hydrophane. If exposed to an elevated temperature, it loses in weight, but acquires much hardness, and its colour turns milk-white.

* *Grundriss.* vol. i. Translation, vol. ii. p. 33.
† *Edin. Phil. Journ.* vol. x. p. 314.

Sulphuric acid decomposes it readily, even at the ordinary temperature of our atmosphere; it dissolves the alumina, and leaves the silica in a gelatinous state, which is then soluble in alkalies. It was thus found by M. Berthier to contain

Silica,	0.395
Alumina,	0.340
Water,	0.265

It does not contain either phosphoric or fluoric acid, lime, magnesia, glucina, or oxide of copper; but it contains a small quantity of iron, which, together with the bluish-colour of the *mineral*, makes M. Berthier suppose a little phosphate of iron to be the cause of this colour. Dried in a stove and then analyzed, it gave only 16 *per cent.* of water. It is difficult to say how much water should be considered as being chemically combined, and how much only adherent by capillary attraction.—(*Annales de Chimie et de Physique*, tom. xxxii. p. 332.)

14. *Artificial cold produced by mixing metals.*—M. Dobereiner dissolved 207 gr. of lead, 118 gr. of tin, and 284 gr. of bismuth in 1617 gr. of mercury, at a temperature of 64.5 degrees of Fahrenheit. The mixture immediately fell to 14° Fahr.—(*Annales de Chimie et de Physique*, tom. xxxii. p. 334.)

ZOOLOGY.

15. *Mr Audubon's Ornithology of the United States of America.*—The Ornithology of the United States of America, from drawings by Mr John James Audubon, made during a residence of twenty-five years in those countries, and now on view at the Rooms of the Royal Institution here, is, we understand, about to be published. These drawings exceed 400 in number, amongst which upwards of eighty are undescribed birds; and as the projected work will appear in parts, at moderate intervals, he has promised to give one *nondescript* specimen in each fasciculus. The book will consist of three volumes, double-elephant folio, coloured like the author's beautiful drawings, and in every instance the engravings will be the natural size of the birds, or, in other words, of the same dimensions as the drawings themselves. We have seen two of the engravings at the Royal Institution, which, for execution, give the greatest promise.

Both as works of art and as drawings elucidatory of natural history, we highly applaud Mr Audubon's system of representing his figures in all attitudes, because by doing so he has not only made most pleasing pictures, but has exhibited all the important varieties in the plumage, and other characterestic points in the species represented. His fine taste in the arrangement of the groups of flowers, plants, and water, where the feathered tribes are represented employing themselves in their varied natural habits and pursuits, marks a new era in the delineation of objects of natural history.

Mr Audubon's graphic illustrations will be described afterwards, in a series of letters, in a separate work.

BOTANY.

16. *Icones Filicum.*—The tribe of ferns, universally celebrated as amongst

the most elegant and graceful of vegetable productions, and which an eminent French author has lately elevated to the rank of a distinct Class among plants, does not appear hitherto to have been illustrated in the degree that it deserves. Besides that beauty of external appearance in the Ferns, which must strike even the most casual observer; the power and wisdom of the Creator are nowhere more evident, than in the curious and varied forms of their fructification. They seem to hold a middle rank between the Cotyledonous and Acotyledonous plants, with somewhat the habit of the former, though possessing the simpler organization for the production of their seeds which characterizes the latter. The largest of them emulate the *Palms* in their stature and mode of growth, while the smallest are hardly discernible at first view from some of the *Hepaticæ*, especially from the genera *Marchantia* and *Jungermannia*.

The ferns are not without their obvious use in the arts, and in domestic economy. In the East Indies and New Zealand several species are employed as food by the natives. In our own country, and in the north of Europe, potash is procured from them after combustion, and this substance is so combined in the *Pteris aquilina*, or common brake, with resinous extractive matter, as to allow of its being used as a substitute for soap. Tannin, again, is another product of Ferns, and gallic acid of the *Scolopendrium officinale*, and *Polypodium vulgare*. Many of our most abundant species are employed medicinally, and one already mentioned, the *Pteris aquilina*, affords, in its stalk, an excellent covering for the roofs of houses, and as such is very commonly used in the countries where it grows.

For a long time, the exotic kinds of fern were almost wholly excluded from our stoves and greenhouses, in consequence of an erroneous opinion that their culture was attended with so much difficulty as to be nearly impracticable. The reverse is now found to be the case, and the Messrs Shepherd of the Liverpool Botanic Garden were the first to prove that these plants might be raised from seed, even after that seed had, for many years, been attached to specimens in the herbarium. It was thus that Willdenow enriched the Berlin Garden with numerous species that existed in the Hortus Siccus of the German botanist; and to confine ourselves to instances in our own country, we need only mention the Liverpool Garden, the Royal Garden at Kew, that of Messrs Loddiges at Hackney, and those of Edinburgh and Glasgow, and of the late Mr Hasell at Ipswich, to prove the facility with which the ferns may now be cultivated, and what a valuable addition they make to our collections. In the herbarium, too, no plants retain their form and colour so well.

Few, indeed, are the works which have, by means of faithful representation, aided the study of this tribe of plants. Professor Raddi of Florence, has lately published a book with numerous plates, entirely confined to the ferns of Brazil, and Schkuhr's Filices contains sufficiently accurate representations of many, and especially the more common kinds.

To compensate, in some measure, for what is wanting in these and other similar publications of less note, Dr Hooker and Dr Greville have undertaken the editing of a work on the new, or rare and little known species of the family, under the title of "*Icones Filicum, ad eas potissimum species illustrandas destinatæ, quæ hactenus, vel in Herbariis delituerunt prorsus incognitæ, vel saltem nondum per icones botanicis innotuerunt*; Auctoribus Gulielmo Jackson Hooker, LL.D. Botanices in Academia Glasguensi Professore Regio, et Regiæ, Antiquariæ, et Linnæanæ Societatum Londini Sodali, et Roberto Kaye Greville, LL.D. Regiæ Societatis et Antiquariæ Edinæ Sodali."

The herbaria of the authors are enriched by the contributions of their correspondents in various parts of the world, and they have received the promise of still farther assistance from their friends, both at home and abroad.

The work will be concluded in twelve parts, each consisting of twenty plates, accompanied with as many leaves of description, to appear quarterly. The descriptions will be written entirely in Latin, and a few remarks added in English; and the plates will be executed with the greatest attention to accuracy, and in the best style of the art, especially in the dissections of the fructification, from drawings made by the authors. The engravings which adorn Humboldt and Bonpland's *Nova Genera*, and De Lessert's *Icones*, may be considered as the models for those which will illustrate the present work.

The price of the work will be twenty-five shillings each part. A few copies will be coloured in a superior style, price two guineas each.

The work will be published in London by Messrs Truttel and Wurtz, 30, Soho Square; and Rue de Bourbon, Paris; and Rue des Saruriers, Strasburg.

17. *Hooker and Taylor's Muscologia Britannica.*—The second edition of this work is just ready for publication, and will contain, besides many new mosses and six supplementary tables and many additions and corrections, generic and specific characters of all the British *Hepaticæ*, with references to the figures in *English Botany*, and in the Monograph of the *British Jungermanniæ* of Dr Hooker.

18. *Exotic Flora and Botanical Magazine.*—The *Exotic Flora*, we are informed, will be terminated with the two next numbers, which, with the title-pages and indexes, will complete the third volume. The author, however, Dr Hooker, has but relinquished one botanical work to undertake another of a similar nature. The advanced age and indifferent state of health of Dr Sims, has compelled him to discontinue the direction of the *Botanical Magazine*, and Dr Hooker has already succeeded to the superintending the continuation; the drawings, as well as the descriptions, being entirely executed by himself. Of this extensive work, which has now reached to 53 volumes, including above 2700 plates, a New Series will be commenced on the 1st of January 1827, with improved paper, plates, &c. New subscribers can therefore commence with it as with a new work, and those subscribers, who already possess the old series, will be secure in not having a recurrence of figures of the same plants as appeared in the former numbers.

IV. GENERAL SCIENCE.

19. *Large Extinct Volcano in Hawaii.*—The varied and strongly marked volcanic surface of the higher parts of the mountain called *Mouna Huararaî*, in the immediate vicinity of Kairua; the traditional accounts given by the natives of the eruptions which, from craters on its summit, had, in different ages, deluged the low land along the coast, rendered it an interesting object. About 8 o'clock in the morning Messrs Hurston and Gardner left Kairua, accompanied by three men whom they had engaged to conduct them to the summit. Having rested all night in a tent, they next morning ascended the hardened surface of an ancient stream of lava. Between nine and ten in the forenoon they arrived at a large extinguished crater about a mile in circumference, and apparently 400 feet deep, the sides sloped regularly, and at the bottom was a small mound, with an aperture in its centre. By the side of this large crater, divided from it by a narrow ridge of volcanic rocks, was another fifty-six feet in circumference, from which volumes of sulphureous smoke and vapour continually ascended. The bottom could be seen, and on throwing stones into it, they were heard to strike against its sides after eight seconds, but not to reach its bottom. There were two other apertures near this, nine feet in diameter, and apparently about 200 feet deep. As the party walked along the giddy verge of the large crater, they could distinguish the course of two principal streams that had issued from it in the great eruption about the year 1810. One had taken a direction nearly N. E., the other had flowed to the N. W. in broad irresistible torrents, for a distance of twelve or fifteen miles to the sea, where, driving back the water, it had extended the boundaries of the island. They attempted to descend this crater, but the steepness of its sides prevented their examining it so fully as they desired.

After spending some time there, they walked along the ridge between three and four miles, and examined sixteen different craters, similar in construction to the first they had met with, though generally of smaller dimensions. The whole ridge upon which they walked seemed little else than a continued line of craters, which, in different ages, had deluged the valleys below with floods of lava, or showers of burning cinders. Some of these craters appeared to have reposed for ages, as trees of considerable size were growing upon their sides, and many of them were covered with earth and clothed with verdure. They continued ascending till 3 P. M., when, having suffered much from thirst, and finding they should not be able to reach the highest part before dark, they judged it best to return to Kairua without having reached the summit of Mouna Huararai.—Ellis's *Missionary Tour through Hawaii.*

ART. XXX.—LIST OF PATENTS GRANTED IN SCOTLAND SINCE SEPTEMBER 9, 1826.

37. Oct. 10. For certain Improvements in Steam-Engine Boilers, or Steam Generators. To JOHN POOLE of Sheffield, in the County of York.

38. Nov. 2. For a New process in Painting for producing the appearance of Damask. To David Ramsay Hay, Edinburgh.

39. Nov. 8. For an Improvement or Improvements on Wheels for Carriages. To Theodore Jones of Coleman Street, London.

Art. XXXI.—CELESTIAL PHENOMENA,

From January 1st to April 1st 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.

JANUARY.

D.	H.	M.	S.	
1	17			☌ ☿ ϱ Oph.
4	12	42		☽ First Quarter.
4				☿ Greatest Elong.
4	0	15		♃ in Quad. with ☉
5	13	4	11	Em. III. Sat. ♃
7	14	12	25	Im. I. Sat. ♃
8	15	21	15	Im. II. Sat. ♃
8	23			☌ ♂ λ ♒
9	14	29	0	☌ ☽ ι ♉ ☽ 43′ S.
10	6	44	30	☌ ☽ ζ ♉ ☽ 21′ S.
11	6	48	20	☌ ☽ ν ♊ ☽ 21′ S.
12	14	12	21	Im. } III. Sat. ♃
12	17	0	59	Em. }
12	18	2		○ Full Moon.
13				☿ Stationary.
13	17			☌ ♄ η ♊ a near App.
14	4	55	43	☌ ☽ 1 α ♋ ☽ 31½′ N.
14	6	9	38	☌ ☽ 2 α ♋ ☽ 7′ N.
14	12	15		☌ ♅ and ☉
14	16	5	49	Im. I. Sat. ♃
15	12	23	26	☌ ☽ π ♌ ☽ 67′ S.
15	17	54	18	Im. II. Sat. ♃
16	16			☌ ♂ φ ♒
19	14	19	55	☌ ☽ α ♍ ☽ 27½′ S.
*19	14	59	30	☌ ☽ i ♍ ☽ 54½′ N.
19	18	10	33	Im. III. Sat. ♃
19	22			☌ ☿ 1 ν ♐
20	4	48		☾ Last Quarter.
20	6	9		☉ enters ♒
21	3	13	25	☌ ☽ 2 α ♎ ☽ 65′ S.
21	14			☌ ☿ ο ♐
21	17	59	12	Im. I. Sat. ♃
22	4	26	18	☌ ☽ λ ♎ ☽ 31½′ N.
22	9	12	38	☌ ☽ 1 β ♏ ☽ 9′ N.
22	9	14	1	☌ ☽ 2 β ♏ ☽ 9½′ S.
22	11	48	55	☌ ☽ ν ♏ ☽ 39′ S.
23	12	27	30	Im. I. Sat. ♃
23	14	27	19	☌ ☽ ρ Oph. ☽ 18′ N.
24	10	42	37	☌ ☽ 1 μ ♐ ☽ 53′ N.
24	11	16	48	☌ ☽ 2 μ ♐ ☽ 35′ N.
25	11	37	5	☌ ☽ d ♐ ☽ 52′ N.
26	21	46		● New Moon.
28				♃ Stationary.
29	21			☌ ☿ and ♅

FEBRUARY.

D.	H.	M.	S.	
2	12	17	27	Im. II. Sat. ♃
3	9	6		☽ First Quarter.
5	5	35	29	☌ ☽ ε ♉ ☽ 68′ N.
5	21	54	19	☌ ☽ ι ♉ ☽ 54½′ S.
6	14	14	15	☌ ☽ ζ ♉ ☽ 31½′ S.
6	16	14	20	Im. I. Sat. ♃ ☽
7	14	23	31	☌ ☽ ν ♊ ☽ 29′ S.
8	10	42	44	Im. I. Sat. ♃
9	14	51	1	Im. II. Sat. ♃
*10	12	11	38	☌ ☽ 1 α ♋ ☽ 32′ N.
*10	13	24	37	☌ ☽ 2 α ♋ ☽ 8′ N.
11	10	23		○ Full Moon.
11	19	9	14	☌ ☽ π ♌ ☽ 62′ S.
13	17	36	3	☌ ☽ υ ♌ ☽ 65′ S.
13	18	7	48	Im. I. Sat. ♃
13	22			☌ ☿ γ ♑
14	22			☌ ☿ δ ♑
15	12	36	12	Im. I. Sat. ♃
15	19	28	58	☌ ☽ α ♏ ☽ 12′ S.
15	20	9	11	☌ ☽ i ♏ ☽ 70′ N.
16	17	24	47	Im. II. Sat. ♃
17	8	29	0	☌ ☽ 2 α ♎ ☽ 48½′ S.
17	12	44	57	Em. III. Sat. ♃
18	5	29	46	☌ ☽ κ ♋ ☽ 39′ N.
18	10	6	21	☌ ☽ λ ♎ ☽ 47′ N.
18	13	10		☾ Last Quarter.
18	14	58	57	☌ ☽ 1 β ♏ ☽ 6′ N.
18	15	0	21	☌ ☽ 2 β ♏ ☽ 6′ N.
18	17	38	56	☌ ☽ ν ♏ ☽ 24′ S.
18	20	52		☉ enters ♓
*19	21	2	9	☌ ☽ ϱ Oph. ☽ 31′ N.
*20	17	57	2	☌ ☽ 1 μ ♐ ☽ 65′ N.
*20	18	32	22	☌ ☽ 2 μ ♐ ☽ 47′ N.
20	21			☿ Sup. ☌ ☉
20	23			☌ ♀ d ♐
*21	19	40	37	☌ ☽ d ♐ ☽ 60′ N.
21	21			☌ ☽ and ♀ occult.
22	14	29	44	Im. I. Sat. ♃
22	22	6	16	☌ ☽ β ♑ ☽ 14′ N.
24	9			☌ ☿ λ ♒
24	13	58	26	Im. } III. Sat. ♃
24	16	42	10	Em. }
25	9			☌ ♂ ε ♓
25	10	14		● New Moon.

D.	H.	M.	S.	
27	14	36	13	Im. } IV. Sat. ♃
27	15	18	48	Em. } IV. Sat. ♃
27	15			☌ ☿ φ ♒
				MARCH.
1				♄ Stationary.
1	6			☌ ♂ ζ ♓
1	16	23	20	Im. I. Sat. ♃
3	10	51	43	Im. I. Sat. ♃
4	13	28	55	☌ ☽ ε ♉ ☽ 52′ N.
5	6	27		☽ First Quarter.
5	22	25	20	☌ ☽ ζ ♉ ☽ 47′ S.
5				♀ Greatest Elong.
6	11	50	2	Im. II. Sat. ♃
6	22	46	39	☌ ☽ ν ♊ ☽ 43′ S.
9	21	4	38	☌ ☽ 1 α ♋ ☽ 26′ N.
9	22	17	42	☌ ☽ 2 α ♋ ☽ 1½′ N.
10	12	45	24	Im. I. Sat. ♃
11	3	56	17	☌ ☽ π ♌ ☽ 65′ S.
13	0	9		○ Full Moon.
13	1	41	34	☌ ☽ υ ♌ ☽ 62′ S.
13	14	24	37	Im. II. Sat. ♃
15	2	20	34	☌ ☽ α ♍ ☽ 3′ S.
16	14	28	8	☌ ☽ 2 α ♎ ☽ 36′ S.
17	11	7	39	☌ ☽ κ ♎ ☽ 53′ N.
17	14	39	11	Im. I. Sat. ♃
*17	15	40	40	☌ ☽ λ ♎ ☽ 61′ N.
17	20	30	11	☌ ☽ 1 β ♏ ☽ 20′ N.
17	20	31	34	☌ ☽ 2 β ♏ ☽ 20′ N.
17	23	8	39	☌ ☽ ν ♏ ☽ 10′ S.
18	4			☌ ☿ ε ♓
18				☿ Greatest Elong.
19	2	26	20	☌ ☽ ρ Oph. ☽ 46′ N.
19	9	7	40	Im. I. Sat. ♃
19	20	22		☾ Last Quarter.
20	0	5	13	☌ ☽ 2 μ ♐ ☽ 60½′ N.
20	9	30		♄ in Quad. with ☉
20	16	59	27	Im. II. Sat. ♃
20	21	3		☉ enters Aries.
21	1	36	4	☌ ☽ d ♐ ☽ 72½′ N.
22	4	35	59	☌ ☽ β ♑ ☽ 24′ N.
24	16	33	3	Im. I. Sat. ♃
26				☿ Stationary.
26	11	1	39	Im. I. Sat. ♃
27	0	2		● New Moon.
28	1			☌ ☽ and ☿
29	14			☌ ☽ and ♂
30	12	15		♃ ☍ ☉
31	11	32	51	Em. II. Sat. ♃
*31	21	44	8	☌ ☽ ε ♉ ☽ 41′ N.

Times of the Planets passing the Meridian.

JANUARY.

D.	Mercury. h.	′	Venus. h	′	Mars. h	′	Jupiter. h	′	Saturn. h	′	Georgian. h	′
1	22	22	22	57	3	35	18	2	11	21	0	56
7	22	21	22	23	3	26	17	38	10	53	0	36
13	22	27	21	55	3	17	17	13	10	25	23	59
19	22	37	21	33	3	8	16	48	9	58	23	38
25	22	50	21	17	3	0	16	24	9	31	22	58
							FEBRUARY.					
1	23	7	21	4	2	50	15	55	9	0	22	48
7	23	24	20	57	2	42	15	31	8	35	22	26
13	23	42	20	53	2	35	15	6	8	10	22	3
19	0	0	20	51	2	28	14	42	7	47	21	41
25	0	16	20	52	2	21	14	17	7	24	21	20
							MARCH.					
1	0	29	20	53	2	17	14	1	7	8	21	5
7	0	47	20	56	2	11	13	36	6	46	20	44
13	1	0	21	0	2	6	13	12	6	25	20	23
19	1	4	21	4	2	0	12	48	6	4	20	2
25	0	53	21	9	1	55	12	23	5	43	19	40

Declination of the Planets.

JANUARY.

D.	Mercury. °	′	Venus. °	′	Mars. °	′	Jupiter. °	′	Saturn. °	′	Georgian. °	′
1	20	34 S.	18	57 S.	11	24 S.	4	11 S.	22	31 S.	21	55 S.
7	21	50	18	3	9	38	4	10	22	32	21	51
13	22	53	17	33	7	49	4	16	22	34	21	47
19	23	25	17	27	5	58	4	21	22	35	21	43
25	23	16	17	37	4	6	4	22	22	36	21	39

FEBRUARY.

1	22 6 S.	18 0 S.	1 54 S.	4 21 S.	22 37N.	21 36 S.
7	20 13	18 21	0 2 S	4 17	22 38	21 32
13	17 28	18 36	1 50 N	4 10	22 39	21 28
19	13 51	18 43	3 41	4 1	22 40	21 24
25	9 24	18 36	5 30	3 49	22 41	21 20

MARCH.

1	6 1 S.	18 24 S.	6 41N.	3 41 S.	22 42N.	21 20S.
7	0 36 S.	17 51	8 26	3 26	22 43	21 16
13	4 37N.	17 2	10 7	3 10	22 44	21 14
19	8 42	15 55	11 45	2 52	22 45	21 11
25	10 46	14 31	13 18	2 34	22 46	21 8

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.

Art. XXXII.—*Summary of Meteorological Observations made at Kendal, in September, October, and November* 1826. By Mr Samuel Marshall. Communicated by the Author in a Letter to the Editor.

Previous to the summary of Meteorological Observations which I send for insertion in the *Journal of Science,* it appears needful to make a few remarks on the situation of Kendal, as they may serve to throw some light on the results of these observations.

This place has long been a point of considerable interest in meteorological observations, from the accounts which have been regularly kept for a series of years, and published in many of the literary periodical works which this country produces. Its locality suggests important considerations, which may perhaps tend to elicit conclusions, and throw some light on the science of meteorology.

The height of the town from the sea is little more than forty-two yards, calculating from the canal which is cut between the town and Lancaster. Kendal is situated on the W. side of a valley, bounded on each side by a chain of hills, running from N. E. to S. W. and is at the southern extremity of the mountainous district of Westmorland and Cumberland. It is subject to an uncommon quantity of rain. The average annual quantity taken for twenty years may be stated at 51.8 inches, an average equalled by few places in England. The prevalent winds in this district are S. W. and W. The vapours carried in these directions from the Atlantic Ocean, and the Irish Sea will be interrupted in their progress by the hills which bound the N. of the town and neighbourhood; hence the deposit of aqueous vapour will be greater than in places further S. which is the fact. In Manchester, for instance, the annual average quantity of rain is but thirty-four inches. The lowness of the situation of Kendal may also contribute to this circumstance, as it is a fact proved by experiment, that on the top of a hill a less quantity of rain falls than in its surrounding valleys. But little dependence can be placed on observations on the winds in this valley; and this remark will probably apply to most places situated in mountainous districts, as the eminences will most likely give a direction differing from its original one, to any current of the atmosphere.

The chain of hills which has received the appellation of the Back Bone of England, and the English Apennines, and which runs in a S. W. direction from Cross Fell, through Yorkshire to Derbyshire, appears very materially to influence the weather on the N. Western shores of England. It has been frequently remarked that on the W. side of this chain, torrents of rain have deluged the countries adjacent, whilst on the eastern, the neighbourhood, within a few miles, has been nearly free from them. This circumstance may be accounted for on the supposition that S. W. winds, which are here the most prevalent, being loaded with vapours from the Atlantic and the Irish Sea, are arrested in their progress before they pass this natural boundary, and occasion an extraordinary deposit of rain. On the E. side of this ridge, falls of snow are much more numerous and deeper than on the W. side, snow showers here being generally accompanied with an E. or S. E. wind, and for the same reason are principally deposited before they reach the western parts.

The fear of prolixity prevents my making other remarks respecting the peculiarities of this interesting district.—I am, very respectfully, &c.

SAM. MARSHALL.

Abstract of Meteorological Observations made at Kendal.

September 1826.

	Inches.
Maximum of the barometer on the 15th, - -	30.03
Minimum of do on the 7th, - - -	29.16
Mean height of do - - - -	29.68
Maximum of the thermometer on the 3d, - -	68°
Minimum of do on the 15th, - -	33°
Mean height of do - . - -	53.68°

Quantity of rain, 3.452 inches.
Number of rainy days, 13.
Prevalent wind West.

October 1826.

	Inches.
Maximum of the barometer on the 14th, - - -	29.99
Minimum of do on the 25th, - - -	29. 02
Mean height of do - - - - -	29.63
Maximum of the thermometer on the 1st, - - -	65°
Minimum of do on the 6th, - - -	29°
Mean height of do - - - -	48.69°

Quantity of rain, 4.362 inches.
Number of rainy days, 19.
Prevalent wind, S. W.

November 1826.

	Inches.
Maximum of the barometer on the 21st, - - -	30.31
Minimum of do on the 25th, - - -	28.69
Mean height of do - - - - -	29.61
Maximum of the thermometer on the 12th, - -	50°
Minimum of do on the 28th, - -	21°
Mean height of do - - . - -	37.15°

Quantity of rain, 4.296 inches.
Number of rainy days, 11.
Prevalent wind, N. W.

ART. XXXIII.—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 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.

SEPTEMBER 1826.

D. of Week.	Day of Month.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
F.	1	60	55	57.5	44	64	54	29.63	29.76	.03
S.	2	60	51	55.5	50	64	57	29.79	29.77	
S.	3	62	57	59.5	42	70	56	29.76	29.71	
M.	4	59	50	54.5	51	67	59	29.71	29.77	
T.	5	57	51	54	41	64	52.5	29.75	29.70	
W.	6	57	53	55	39	63	51	29.37	29.27	.07
T.	7	58	48	53	49	62	55.5	29.37	29.56	.20
F.	8	54	48	51	43	63	53	29.17	29.56	
S.	9	54	48	51	45	62	53.5	29.38	29.38	
S.	10	57	50	53.5	47	63	55	29.46	29.72	
M.	11	60	51	55.5	46	64	55	29.83	29.82	
T.	12	51	55	53	48	62	55	29.75	29.66	
W.	13	59	60	59.5	50	67	58.5	29.60	29.38	.05
T.	14	55	45	50	47	63	55	29.66	29.93	
F.	15	52	47	49.5	35	61	48	30.06	30.05	
S.	16	59	57	58	43	66	54.5	29.96	29.73	
S.	17	66	53	59.5	55	70	62.5	29.74	29.88	
M.	18	50	50	50	50	54	52	29.98	29.98	.27
T.	19	56	54	55	49	64	56.5	39.96	29.97	
W.	20	54	49	51.5	46	58	52	29.97	30.00	.06
T.	21	53	48	50.5	44	57	50.5	30.01	30.04	
F.	22	50	45	47.5	39	59	49	30.00	29.94	
S.	23	53	47	50	38	61	49.5	29.90	29.76	
S.	24	53	48	50.5	39	63	51	29.65	29.65	
M.	25	55	56	55.5	40	59	49.5	29.59	29.53	
T.	26	64	59	61.5	53	71	62	29.48	29.42	.19
W.	27	62	54	58	54	66	60	29.52	29.67	.16
T.	28	60	46	53	47	65	56	29.83	29.93	
F.	29	58	61	59.5	40	68	54	29.80	29.58	
S.	30	68	54	61	54	70	62	29.50	29.51	
	Sum,	1716	1550	1633	1368	1910	1639	891.18	891.19	1.01
	Mean.	57.2	51.67	54.43	45.6	63.67	54.63	29.706	29.706	

OCTOBER 1826.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
S.	1	60	52	56	48	63	55.5	29.64	29.65	
M.	2	51	51	51	41	61	51	29.69	29.68	
T.	3	54	48	51	42	59	50.5	29.57	29.42	
W.	4	46	44	45	36	55	45.5	29.47	29.48	
T.	5	42	41	41.5	33	55	44	29.58	29.76	
F.	6	44	52	48	30	56	43	29.82	29.65	.09
S.	7	59	43	51	46	63	54.5	29.43	29.57	
S.	8	53	44	48.5	38	54	46	29.49	29.28	.07
M.	9	43	44	43.5	38	52	45	29.28	29.28	.20
T.	10	46	51	48.5	45	62	53.5	29.23	29.40	.05
W.	11	53	46	49.5	45	57	51	29.61	29.61	
T.	12	53	55	53	38	55	46.5	29.59	29.35	.10
F.	13	50	43	46.5	47	55	51	29.48	29.97	
S.	14	50	51	50.5	37	55	46	29.88	29.63	.06
S.	15	57	56	56.5	45	60	52.5	29.58	29.40	
M.	16	59	45	52	52	64	58	29.11	29.38	.16
T.	17	53	49	51	44	59	51.5	29.53	29.78	
W.	18	46	45	45.5	36	55	45.5	29.88	29.98	
T.	19	54	48	51	34	59	46.5	30.00	29.96	
F.	20	52	54	53	47	70	58.5	29.91	29.78	
S.	21	60	56	58	52	65	58.5	29.72	29.71	
S.	22	57	56	56.5	48	64	56	29.67	29.56	.04
M.	23	58	55	56.5	52	70	61	29.57	29.49	
T.	24	55	55	55	52	65	58.5	29.47	29.06	
W.	25	52	45	48.5	48	54	51	28.84	28.87	.14
T.	26	46	43	44.5	39	49	44	29.07	29.23	
F.	27	44	42	43	40	50	45	29.28	29.48	
S.	28	40	47	43.5	35	47	41	29.56	29.68	.10
S.	29	49	36	42.5	46	56	51	29.76	29.82	
M.	30	50	40	45	29	57	43	29.75	29.85	.30
T.	31	45	42	43.5	29	57	43	29.72	29.51	.07
		1581	1477	1529	1292	1803	1547.5	916.18	916.30	1.38
		51.	47.64	49.32	41.68	58.16	49.90	29.554	29.558	

NOVEMBER 1826.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
W.	1	42	41	41.5	38	59	48.5	29.56	29.66	
T.	2	45	40	42.5	34	46	40	29.85	29.93	
F.	3	43	36	39.5	37	48	42.5	29.95	29.97	
S.	4	45	43	44	33	48	40.5	29.96	29.96	
S.	5	47	46	46.5	38	52	45	29.65	29.66	
M.	6	37	31	34	34	40	37	29.71	29.73	
T.	7	35	34	34.5	27	42	34.5	29.79	29.88	
W.	8	34	38	36	29	42	35.5	29.95	30.00	
T.	9	38	39	38.5	35	44	39.5	30.08	29.88	
F.	10	45	50	47.5	30	48	39	29.71	29.46	
S.	11	53	43	48	44	55	49.5	29.15	29.18	.06
S.	12	44	41	42.5	36	44	40	29.07	29.03	
M.	13	40	33	36.5	32	45	38.5	28.93	28.83	.25
T.	14	36	35	35.5	30	42	36	28.98	29.22	
W.	15	36	35	35.5	31	43	37	29.49	29.63	
T.	16	33	36	34.5	25	38	31.5	29.65	29.71	
F.	17	40	36	38	31	44	37.5	29.91	30.08	
S.	18	38	39	38.5	30	40	35	30.19	30.18	
S.	19	42	38	40	38	46	42	30.26	30.32	.03
M.	20	40	35	37.5	35	42	38.5	30.40	30.35	
T.	21	40	44	42.5	30	46	38	30.31	30.23	
W.	22	43	43	43	35	49	42	30.19	30.00	
T.	23	44	44	44	40	49	44.5	29.70	29.30	
F.	24	38	35	36.5	35	42	38.5	28.99	28.48	.12
S.	25	36	32	43	31	36	33.5	28.73	28.88	
S.	26	35	28	31.5	28	35	31.5	29.04	29.28	
M.	27	28	33	30.5	21	34	27.5	29.40	29.40	.25
T.	28	40	43	41.5	28	43	35.5	29.21	29.00	
W.	29	40	43	41.5	37	45	41	28.80	28.85	.05
T.	30	43	36	39.5	40	46	43	29.08	29.21	
		1200	1150	11.75	992	1333	1162.5	887.69	887.29	.76
		40	38.33	39.16	33.07	44.43	38.75	29.590	29.576	

THE

EDINBURGH

JOURNAL OF SCIENCE.

Art. I.—*Memoir of the Life and Writings of M. Piazzi, Director General of the Observatories of Naples and Palermo.*

M. Joseph Piazzi, President of the Academy of Sciences of Naples, Member of the Royal Society of London, Associate of the Institute of France, and the Societies of Turin, Gottingen, Berlin, and Milan, was born at Ponte, in the Valteline, on the 16th July 1746. Having taken the habit of the Theatins at Milan, he finished his noviciate in the convent of St Anthony. His classical and mathematical studies were carried on successively at Milan, Turin, and Rome, and among his instructors he had the honour of ranking the celebrated PP. Tiraboschi, Beccaria, and Lesueur and Jacquier. After being initiated into the literature and science of the times, he went to teach philosophy at Genoa; but the freedom with which he expressed his opinions alarmed the zeal of the Dominicans, and he would have been exposed to all the troubles of a religious persecution, had not the Grand Master Pinto rescued him from its power, by appointing him professor of mathematics in the new university of Malta.

After the suppression of the order of the Knights of Malta, he repaired to Rome, and afterwards to Ravenna, where he was appointed to the chair of Philosophy and Mathematics in the college of the nobles. Here he was exposed to the same illiberal zeal, in consequence of having published some philosophical theses, which appeared too bold for a young religious. From Cremona, to which he now retired, he was called to Rome, where he was nominated reader of Dogmatic Theology of St André de la Vallé, where he had for a colleague Father Chiaramonte, (Pius VII.) who retained for him, after his elevation to the Papal throne, the same regard which he had acquired for him in the cloister.

By the advice of Father Jacquier, Piazzi accepted, in 1780, the chair of the higher mathematics in the Academy of Palermo. In this situation he effected a great change in the methods of instruction. He replaced the works of Wolff by more modern systems, and the productions of Locke and Condillac, hitherto almost unknown, soon became familiar to the students. By these, and other changes, he contributed, in a high degree, to dispel the darkness which the united influence of the Inquisition and the Jesuits had shed over the classical soil of Sicily. His ardour for fame was here equally conspicuous, and he obtained from the Prince of Caramanica, Viceroy of that island, permission to found an observatory at Palermo, in the palace of the Viceroy.

In order to procure instruments for this new establishment, he put himself in communication with the most distinguished astronomers of the day, and he formed in Paris, in April 1787, a personal acquaintance with Lalande, Jeurat, Bailly, Delambre, and Pingré. Cassini, Mechain, and Legendre, were about to set out to determine the difference of meridians between Paris and Greenwich. Piazzi accompanied them on that mission, and availed himself of the opportunity of visiting England, where he became intimately acquainted with Maskelyne, Herschel, and Vince. He studied with attention the methods of observing as practised at Greenwich, and he observed there the solar eclipse of 1788, an account of which he published in the *Philosophical Transactions*, under the title of *Results of Calculations of the Observations made at various places of the Eclipse of the Sun on June* 3, 1788.

Piazzi engaged our countryman Ramsden to construct for him the instruments for his observatory. Strongly impressed with the imperfections of the quadrants then in use, he ordered a five feet astronomical circle, with an altitude and azimuth circle, and divided with all the precision for which Ramsden was so celebrated. In order to expedite its completion, he attended every day the workshop of that artist; but finding that the work advanced very slowly, he conceived the idea of stimulating Ramsden, through the medium of his love of reputation. He therefore addressed a letter to Lalande, in which he gave an account of the life and works of the English optician. The scheme happily succeeded; Ramsden wrought with unwearied zeal, and our author had the satisfaction of witnessing the completion of his principal instrument. He obtained also a transit instrument, a sextant, and some other instruments of secondary importance. The excise-office is said to have claimed a duty on the exportation of the circle, on the ground that it was an English invention, but the claim was speedily abandoned, as Ramsden maintained, that whatever novelty there was in the instrument, was due to the Italian astronomer, whose instructions he had implicitly followed. Piazzi accompanied his instruments to Sicily, where he arrived with them in safety, at the end of 1789.

After the destruction of the observatory of Malta by fire, in 1789, the observatory of Palermo was the most southerly in Europe. The observations made in it, therefore, possessed a peculiar interest, which was in no small degree heightened by the excellence of its instruments, and the activity and skill of their possessor.

An account of the observatory of Palermo was published by our author in 1798, under the title of *Della specola astronomica de regi studi di Palermo.*

When he was thus established in the midst of his instruments, Piazzi devoted himself to the construction of a new catalogue of the fixed stars, which he justly considered as the true basis of astronomy. François Lalande, Cagnoli, Zach, and others, had undertaken works of the same kind, but they were of too limited a nature, and were founded on the positions of the thirty-six stars which Maskelyne had pointed out to astronomers, as sure points of comparison. Piazzi, on the contrary, resolved not to trust to the results of single observations, which might be affected by any inaccuracy on the part of the observer, and any imperfection in his instruments. He felt, also, that if Flamstead, Mayer, and Lemonnier, had repeated their observations more frequently, they might have anticipated Herschel in his great discovery of the Georgian planet.

Under the influence of these views, Piazzi frequently resumed his observations on the same star, before he considered its position as fixed, and after having practised for ten years, this laborious method of observation, he published in 1803, his first great catalogue of 6748 stars, under the title of *Stellarum inerrantium positiones.* This work was crowned by the Academy of Sciences of France, and gained for its author the admiration and esteem of all the astronomers of Europe.

Among the results of that catalogue, we may mention one, which formed a new era in astronomy, viz. the discovery of a new planet.

While Piazzi was examining, on the 1st January 1801, the 87th star of the zodiacal catalogue of Lacaille, between the tail of the Ram and the Bull, he occasionally observed a star of the eighth magnitude. His practice of verifying the observations of the preceding day, led him to observe a difference in the position of this small star, which he at first took for a comet. He communicated his observations to Oriani, who, observing that this luminous point had none of the nebulosity of comets, and that it continued stationary and retrograde within a very small space like the planets, calculated its elements on the hypothesis of a circular orbit. This result was confirmed by other astronomers, and Piazzi was invested with the honour of adding a new planet to the system. Piazzi continued to observe it till the 12th of February, when a dangerous illness compelled him to discontinue his observations.

In compliment to his Royal patron, and in imitation of Sir W. Herschel, Piazzi gave to the new planet the name of *Ceres Ferdinandea.* The King of Naples resolved to consecrate this illustrious discovery by striking a gold medal, containing the head of the astronomer, but Piazzi requested that the value of this present should rather be employed in purchasing an equatorial instrument for his observatory.

The illness, which we have already mentioned, continued for nearly four years to interrupt the observations of our author, but he still wrought with the same zeal; and having conceived the plan of re-examining the thirty-six stars of Maskelyne, he engaged his assistant, M. Cacciatore, to undertake this difficult task.

These observations were made upon 120 stars, which formed the basis of a new catalogue, which contained no fewer than 7646, and was published in 1814.

At the urgent request of his friends and his pupils, Piazzi now devoted his time to the composition of several memoirs, destined for the different academies of which he was a member. The Neapolitan Government had entrusted him with the renovation of the system of weights and measures in Sicily, and after completing this task he published, in 1808, an essay on the subject, intended to instruct the clergy in the new system.

During the Constitutional Government of 1812, Piazzi was consulted on the subject of a new territorial division of Sicily, which, decreed by parliament, according to a report of our author, was preserved even after the destruction of the representative government.

The great comet of 1811, which excited such general notice throughout Europe, gave our author an opportunity to publish his opinions on the nature of these bodies. He supposed that they were not formed contemporaneously with the planets, but that they were produced from time to time in the immensity of space, where they afterwards dissipated themselves like those globes of fire and luminous meteors which have their origin and disappear in our own atmosphere.

In the year 1817 Murat, King of Naples, founded a new observatory on the heights of Capo di Monte, and M. Piazzi was invited to Naples to examine it. He introduced many changes into the plan which had been adopted, of which he published an account before his return to Palermo. M. Cacciatore, his own assistant and pupil, was, upon his recommendation, appointed director of the new observatory.

Piazzi took an active part in the labours of the commission charged with the public instruction of Sicily. To this country he had formed the deepest attachment, and though Napoleon had held out to him the most brilliant offers to bring him to the university of Bologna, he declined them all.

Beside the astronomical observations which we have mentioned, Piazzi had collected an uninterrupted series of solstitial observations, from 1791 to 1816, for the purpose of determining the obliquity of the ecliptic. By comparing these with those made in 1750 by Bradley, Mayer, and La Caille, it appears that the obliquity diminished 44″ in a century.

Piazzi had now reached the advanced age of eighty-four years, and he expired at Naples on the 22d July 1826.

To the observatory of Palermo, of which he was the founder and the ornament, he bequeathed his library and his instruments, and he left an annual sum for the support of an observer.*

The following is a list of the writings of M. Piazzi:—

1. *Result of the Calculations of the Observations made at Various Places of the Eclipse on June* 3, 1778. In the *Phil. Trans.* vol. lxxix. 1789, p. 55.

2. *Discourse on Astronomy.* Palermo, 1790.

3. *Description of the Royal Observatory of Palermo.* Four books in 1792, and other five books in 1794.

4. *On the Discovery of the New Planet Ceres Ferdinandea.* Palermo, 1802.

5. *Stellarum Inerrantium Positiones.* 1803.

6. *Observations on the Obliquity of the Ecliptic. Mem. Soc. Italiana,* tom. xi. 1804.

7. *On the Precession of the Equinoxes. Ephem.* de *Milan,* 1804.

8. *On the Parallax of some of the Fixed Stars. Mem. Soc. Italiana,* tom. xii.

9. *On the Measure of the Tropical Year. Id.* tom. xiii.

10. *Researches on the Proper Motions of the Fixed Stars. Mem. de l'Inst. Nat. Ital.* tom. i.

11. *The Metrical System for Sicily.* 1812.

12. *Catalogue of the Principal Fixed Stars.* 1814.

13. *Leçons d'Astronomie.* 1817.

* This sketch of Piazzi's life has been composed chiefly from an abstract of a Memoir by De Angelis, in the *Bull. des Sciences,* Nov. 1826, p. 339.

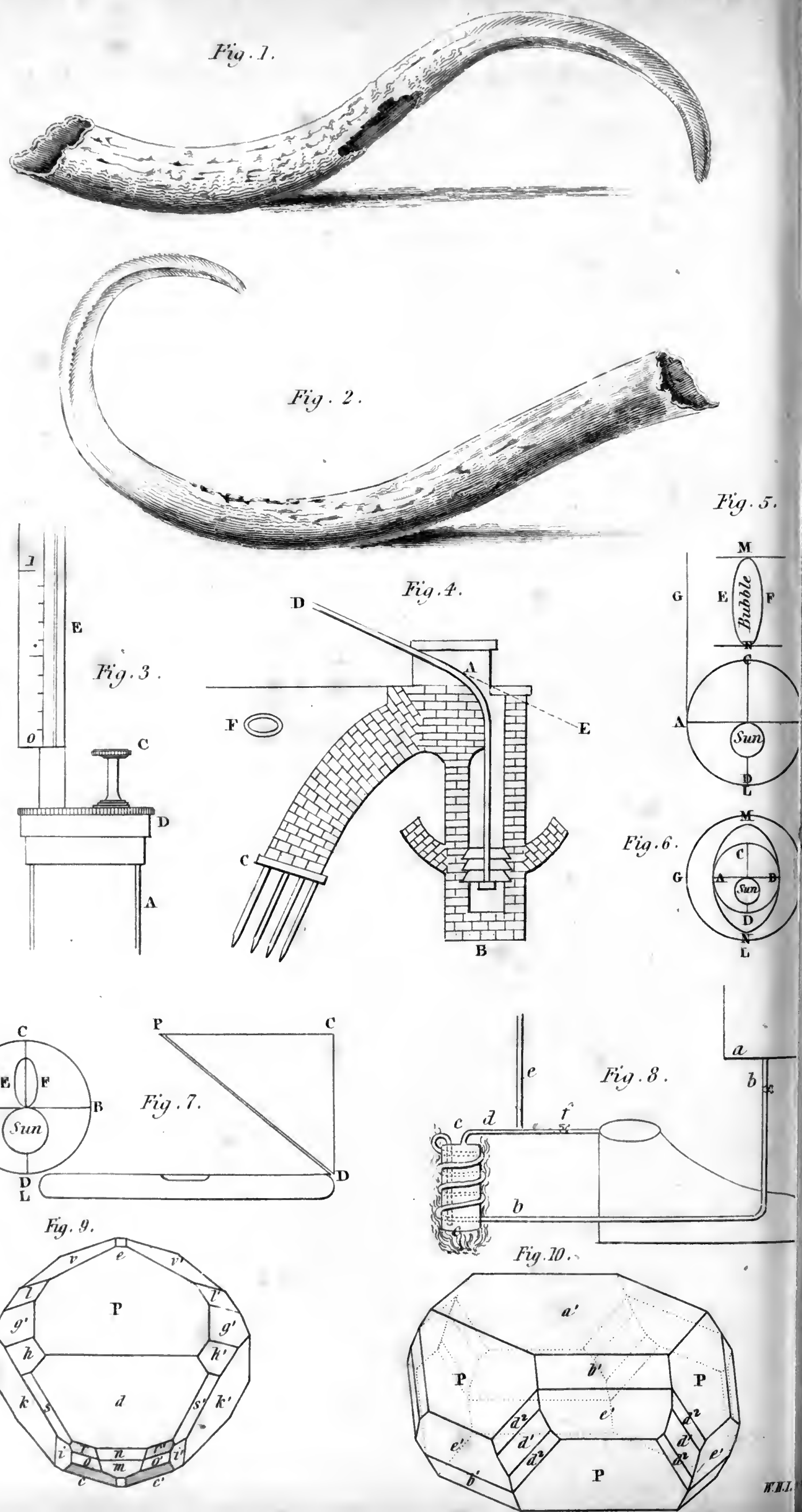
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Bubble
Sun
Fig. 6.
Sun
Fig. 7.
Sun
Fig. 8.
Fig. 9.
Fig. 10.

14. *On the Observed and calculated Solstices. Mem. de l'Inst. de Milan*, tom. ii. p. 229, 250.

15. *On the Italian* and *European Clock. Giorn. de Scienze, par la Sicilia.* Aug. 1824. p. 137.

16. *Discourse on the progress of Astronomy. Giorn. de Sc. Lett. et Arti par la Sicilia.* April 1824, p. 30.

17. *Description of the Meridian of the Cathedral of Palermo, established by Piazzi in* 1798. By M. Cacciatore, *Id.* Aug. p. 172.

Art. II.—*Account of the Fossil Remains in the neighbourhood of Harborough.* By the Reverend James Layton, in a Letter to Dawson Turner, Esq. Yarmouth. Communicated by Mr Turner. With Figures.

My Dear Sir,

Your wish that I would give you what account I can, respecting the fossils of my neighbourhood, shall be fulfilled to the letter. All my knowledge upon the subject I readily communicate; but as that knowledge is recently and casually picked up by observation only, it consequently is slight, and any inference I may venture likely to be erroneous.

The cliff at Harborough is composed of a rich light-brown clay, having occasional strata of sandy gravel, containing shells corresponding with the Suffolk crag, and beneath, of a very strong blue clay. In this, and in some gravel which may perhaps lie below, are numerous remains of antediluvian quadrupeds, as also belemnites, ammonites, gryphites, terebratulæ, and other shells, and large nodules of blue limestone enclosing wood. A thin stratum of this wood, with its bark even and leaves, appears in various places upon the beach. These fossils have been noticed from time to time. Parkin, in *Hist. of Norf.* under Harborough, mentions a letter, dated Norwich, Nov. 17, 1659, telling of "the head and bones of a very great fish exposed by the fall of the cliff;" these probably belonged to an elephant. Mr Arderon, F. R. S. procured many fossils from Harborough and Walcot, almost sixty years ago, as appears by the series of his letters in your collection, addressed to Mr Baker, author of "The Microscope made easy." From that time, till very lately, they have been almost unnoticed. However, four years since, a bed of oysters was discovered a mile from the shore, and the dredgers took up stag and ox horns, and fragments of various large bones. These they describe as having been found in great quantities during the first year, and as thrown away into the deeper water, though they recognized the bones as belonging to the "giants which once inhabited the forest where Harborough sand is now." The origin of this tradition is now clear enough. They have now learned to preserve what they find, and the Norwich Museum and different individuals are in possession of many specimens, brought up from that mine of antediluvian remains. Among them are the jaw and humerus of one of the Saurian tribe; horns and bones of three kinds of deer, and of the ox, teeth of the horse, a tusk of the hippopotamus; but especially, numerous are the grinders of the elephant, many of them very large, up to twenty laminæ, and weighing as many pounds, and in beautiful preservation. Fragments of their tusks also have been found, few, and generally small, owing probably to the dredges having so contracted a mouth.

There can be no doubt that the land formerly extended over the sea considerably beyond this bed, and I would say beyond the Harborough sand, and the waves washing away the cliff and dissolving the clay, the softer particles have been carried into the deep, while the denser parts remained. A hard mass of gravel resting on chalk has here resisted the action of the tide, and some fossils rest on its surface, while the others are buried in the sand and silth. How far the land extended it is impossible to judge; perhaps the twelve miles to the sand are quite enough for the sea to have swept away during the longest time allowed since the deluge of Noah. That the fossils extended much farther, has been lately proved by a tusk found by some men dredging for soles on a bank called the Knole, about twenty miles from the present shore. The accompanying sketch, Plate IV. Fig. 1, 2, gives an idea of its form. Following the outside of the spiral it is nine feet and a half in length. Its greatest circumference is one foot nine inches, and the depth of the hollow two feet. Two laminæ have been lost from the greater part of its surface, which is little changed, but a wound in one spot discovers that internally the ivory is decomposed into a brittle substance, dry and adhering when applied to the tongue, purely white, but exhibiting the decussating circles peculiar to ivory. Its weight is ninety-seven pounds. The whole coast presents fossil remains. At Cromer, Trimingham, Barton, Walcot, Harborough, Waxham and Winterton, teeth and bones of one animal or other have been dug from the clay exposed at low water. A fragment of a jaw with its tooth was in 1820 dug from the bottom of the cliff at Kessingland in Suffolk, and at the mouth of the Harwich river considerable quantities of bones have been found. In 1820 at Horehead by Norwich the entire skeleton of the great mastodon was discoverd in the gravel close above the chalk, and by it the remains of an elephant. That it was a mastodon, is proved by the grinder now in your possession, and thus it makes a valuable addition to the list of Mammalia whose fossil remains enrich this neighbourhood. I am, my Dear Sir, Yours very faithfully,

James Layton.

To Dawson Turner, Esq. Gr. Yarmouth.

Catfield 28th December 1826.

Art. III.—*On the Relative Compressibilities of different Fluids at High Temperatures.* By H. C. Oersted, Professor of Natural Philosophy in the University of Copenhagen, F. R. S. Lond. and Edin. and Correspondent of the Institute of France. Communicated in a Letter to Dr Brewster.

Having in the course of last summer performed a very great number of experiments on the compressibility of different fluids, and particularly on the compressibility of water at high pressures, I am now about to calculate the corrections which must be introduced for the variations of atmospherical pressure, temperature, &c. As soon as the paper is finished I will send you a translation of it. The following results, however, will not be much affected by these corrections.

1. As far as the strength of my apparatus has permitted me to push the compression of water, (viz. seventy times that of

the atmosphere) the compressibility is in proportion to the compressing powers.

The compression produced by one atmosphere, as already stated by Canton, is about *forty-five millionth* parts of the volume. Mr Perkins has obtained by a pressure of one hundred atmospheres, a compression equal to 0.01 (one hundreth of the volume) which is much more than could be expected from my experiments. From calculations founded on the results of experiments made with pressures beneath seventy atmospheres, I have obtained only 0.0045 for 100 atmospheres.

In consequence of this great discrepancy between my results, and those of that highly distinguished inventor, I have repeated them with great care, and, from their simplicity, I believe there is not much room to doubt of their accuracy.

2. In so far as I have tried the temperature of compressed water (to forty-eight atmospheres) *no heat is liberated by its compression.*

3. The compressibility of *mercury* is not much greater than *one-millionth* of its volume by one atmosphere.

4. The compressibility of *sulphuric ether* is nearly *thrice* that of *alcohol*; nearly *twice* that of *sulphuret of carbon*, but only *one and a third* that of *water*.

5. The compressibility of *water* containing *salts, alkalies*, or *acids*, is less than that of *pure water*.

6 The compressibility of glass is exceedingly small, and very greatly beneath that of *mercury*.

COPENHAGEN,
December 30*th* 1826.

ART. IV.—*On the Communication of Magnetism to Steel, by the direct white light of the Sun.** By M. A. BAUMGARTNER, Professor of Natural Philosophy at Vienna.

IN repeating last summer the experiments of Mrs Somerville, on magnetising wires by the influence of the coloured light of the sun, I have discovered a process, which has succeeded with more quickness and certainty than that of M. Morichini

* Translated from the *Ann. de Chim.* November 1826, p. 333.

and Mrs Somerville. It has conducted me to this result, that if a piece of steel, of the size of an ordinary sewing-needle, of which one or more parts are polished, and the others without lustre, is exposed to the influence of the direct white light of the sun, it takes a *north* pole at each *polished* part, and a *south* pole at each unpolished part. The following is the process employed.

I took a wire of English steel, of the size of an ordinary sewing-needle, and I heated it, so as to cover it entirely with a black oxide. I then removed the oxide from one or more places, by means of a hone, and I completed the polish with chalk and a piece of lime tree, so as to form brilliant zones, about two or three lines long. The steel thus prepared being laid in a place perfectly exposed to the sun, was found at the end of some time strongly magnetic, and in the manner already mentioned. The time, every thing else being equal, appeared to depend on the intensity of the solar light, for when I concentrated the rays of the sun upon the polished zones by means of a lens, I produced in a few minutes a magnetism, which would have required several hours with the natural intensity of the solar rays.

A piece of steel polished only at one of its extremities acquires a north pole at that extremity, and a south pole at the other. If the polished part occupies the middle, the two extremities acquire a south pole, and the middle a north pole. If the wire, on the contrary, is polished at its two extremities, these acquire a north pole, and the middle a south pole: In short, if the wire has several *polished* zones, each of them takes *north polar magnetism*, and the *obscured* zones *south polar magnetism*. We may in this way develope any number of magnetic poles, provided that the steel wire has a length proportional to the number of poles required.

I have thus been able to obtain easily eight poles upon a wire eight inches long, but certainly of unequal intensity. I have constantly found that the extreme poles were stronger than the others, and that they preserve their magnetism longer.

I have not been able to succeed in magnetizing, by the same means, steel needles entirely covered with oxide, or perfectly polished, nor other needles which had polished lines in the direction of their length. All the results which I have mentioned are equally produced in whatever way the needles are placed. Each experiment was repeated several times with the same result. It is scarcely necessary to add, that, before exposing any needle to the solar action, I carefully examined whether or not it was magnetic, and the experiments were made only with needles which had no magnetism.

Art. V.—*On the Modes of Division of Vibrating Bodies.** By M. Felix Savart. *With a* Plate.

It has been hitherto supposed that all sounding bodies are capable of dividing themselves into vibrating parts, the number of which goes on increasing according to a certain law, so that each body can only produce a determinate series of sounds, which become more acute in proportion to the vibrating parts. On the other hand, I have established it as a fact, that when two or more bodies are in contact, and the one set into vibration by the other, they will arrange themselves so as to execute the same number of vibrations; from which it follows, that it is not true that bodies are susceptible only of a determinate number of modes of division, between which there are no intermediate ones, but that, on the contrary, they may produce such vibrations, which gradually transform themselves into others, so that they are fit to execute any number of vibrations.

This opinion is easily proved in the case of membranes stretched and agitated through the air by means of a vibrating body. As square membranes present modes of division simple and easily perceived, and as they divide themselves nearly like rigid plates of the same shape,† I shall explain the phenomena presented by membranes of that form. For the sake of simplicity I shall always suppose that we have first obtained a figure composed of nodal rectilineal lines, which cut one an-

* Translated and abridged from the *Ann. de Chim.* Tom. xxxii. p. 384.

† The only difference is, that in the rigid plates the vibrating parts near the free margin are always smaller than the others, while in membranes, all the divisions are equal.

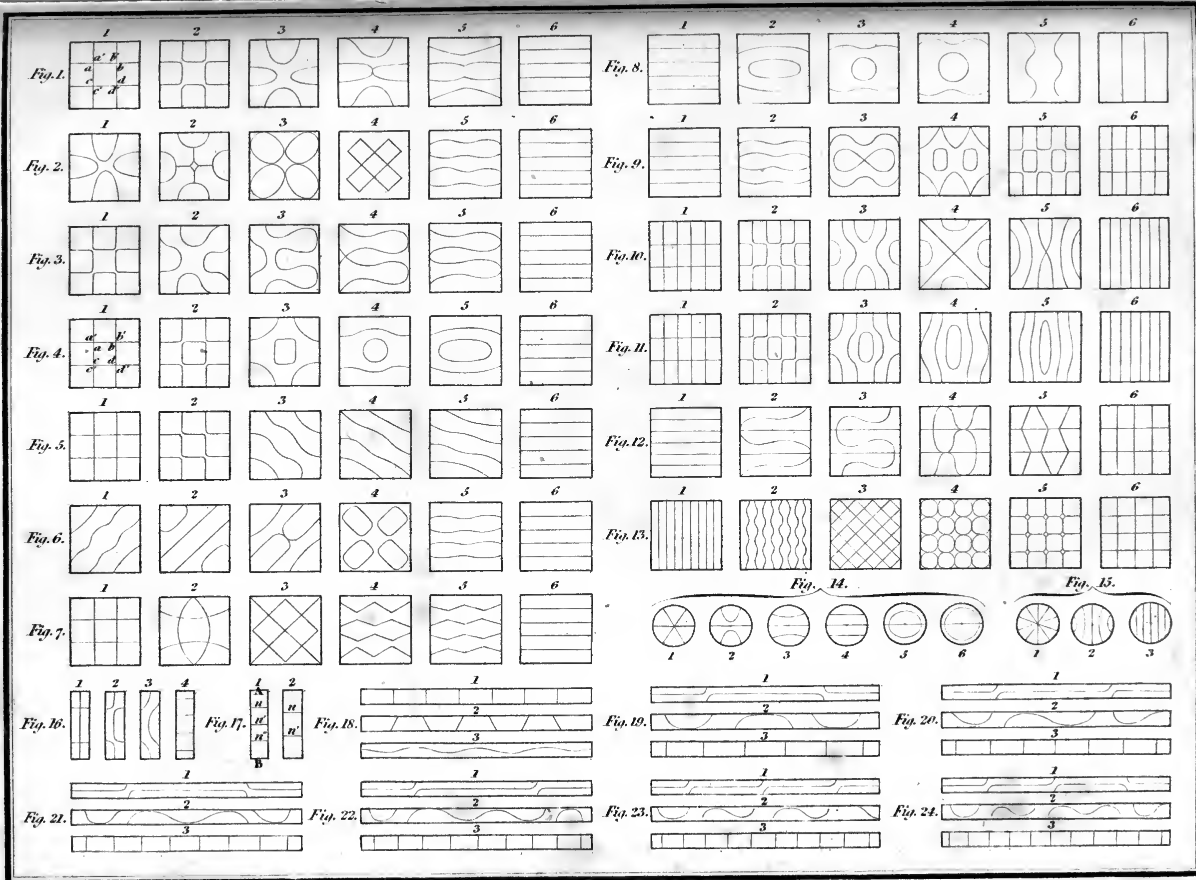

Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.
Fig. 20.
Fig. 21.
Fig. 22.
Fig. 23.
Fig. 24.

W. H. Lizars sc.

other rectangularly, and I shall examine in what way this figure may pass to another composed simply of parallel lines.

For example, I suppose that we have produced the mode of division represented in No. 1. Fig. 1, of Plate V. then if the tension of the membrane is constant, its sound becomes a little more acute. It may happen that the angles opposite to the summit in *a a′*, *b b′*, *c c′*, *d d′*, may disunite, as in No. 2, which will gradually assume the aspect of Nos. 3, 4, and 5, (if the sound always ascends,) and afterwards that of No. 6, composed of only four parallel lines. The same transformation may take place as in Fig. 2 and 3. It may also happen, as in Fig. 4, that the opposite angles in *a a′*, *b b′*, *c c′*, *d d′*, are those which divide themselves first, and that the figure formed by the sand assumes successively the aspects of Nos. 2, 3, 4, 5 and 6; or this division may take place, as in the Nos. 2 of Fig. 5 and 6, which will produce still new modifications in the successive figures, which terminate in four parallel lines. In short, it may even happen that the opposite angles do not divide themselves as in No. 1. of Fig. 7, which passes to that of No. 6, by the simple inflections of right lines in opposite directions.

A number of parallel lines may pass into another number of lines, either parallel or directed rectangularly. Fig. 8. shows a transformation of this mode of division to two nodal parallel lines, and Fig. 9. a passage from the same mode of division to four lines also parallel, but cut rectangularly by two other straight lines.

In general, when we set out from a figure composed of rectangular lines, the character of the successive modifications depends on the manner in which the angles opposite to the summit divide themselves. This may be observed in a very distinct manner in Figs. 10 and 11, which are the passages of four parallel lines, cut by two other right lines, to six parallel lines. On the other hand, if we set out from parallel lines, we may say in general that the character of the modifications depends on the different inflexions which those lines may affect. It is thus that in Figs. 10 and 11, the Nos. 5, considered as the first modifications of the right lines, ought to produce quite different phenomena, dependent on this, that one of the lines bends itself outwards, whilst in the other they bend themselves inwards. But of all the modifications which the straight lines may produce, there are none which present phenomena more singular than those which result from the alternate inflexions which these lines may at first take, according as they present two curvatures in one direction and one in another, or three in one direction and two in another. Remarkable examples are shown in Fig. 12 and 13.

It follows, therefore, from these observations, not only that square membranes are susceptible of producing all possible numbers of vibrations, and that from each of these numbers they divide themselves in a particular manner, but also that the same number of vibrations may be given by several modes of division. With regard to those membranes whose contours are different, circular, triangular, &c. they present analogous, though more complicated, phenomena. It is thus, for example, that in a circular membrane three diametral lines may pass gradually to three parallel lines, and afterwards to a single diametral line, accompanied with a circular line, Fig. 14;—that five diametral lines may pass to five parallel lines, Fig. 15, and from this to other modes of division; for example, to two circular lines divided by a single diametral line.

The successive transformations of nodal lines are much more difficult to observe on rigid plates than upon membranes, because, as we can only produce given modes of division by rendering immoveable several parts of the surface of these bodies, it happens almost always that these parts belong to one or several other systems of nodal lines, so that one often falls from a sound very grave to a sound very acute, and reciprocally, without being able to pass through intermediate ones. Nevertheless it is possible to produce general phenomena of this kind; and it is easy to see, from what we have said of the modes of division of membranes, that the figures which M. Chladni has designed under the name of *distortions*, are only modes of division intermediate between different systems of rectilineal nodal lines. As this natural philosopher has only observed the nearest distortions of the figures, which he regards as primitive types, and as the ear is a bad judge of the number of vibrations, he has maintained that the sound of distortions is the same as that of the principal figure. In the tables of his *Traité* *d'Acoustique*, we see distortions which are given by sounds more acute by a semitone, and by a tone, and even a tierce minor than their primitive type. Besides, in the case of modes of division of rectangular plates, whose sides are in different proportions, M. Chladni observes, that it is possible, in a great number of cases, to pass from one mode of division to another, which gives a sound a little different by successive transformations of the nodal lines, occasioned by slight changes in the position of the parts, which are rendered immoveable; facts which confirm perfectly what I have here advanced, and of which M. Chladni relates several remarkable examples.

Not only are the transformations possible, when two sounds differ very little, but they are so in certain cases, when they differ by a tone and even more. A rectangular plate of glass, for example, 10 inches long, $2\frac{1}{2}$ wide, and half a line thick, may pass gradually from the mode of division of No. I. Fig. 16, which gives the sound *ut* 4, to No. 4 of the same figure which gives the sound *ré* 4. We might adduce several other facts of the same kind, so that it cannot be doubted, that in rigid plates, we cannot produce gradual transformations between two modes of division which give sounds sufficiently remote from one another. It is not that these transformations do not exist; but it is from the method of agitation which we employ that they become impossible in the greater number of cases. But we cannot produce any of these transformations in rigid plates, of which we are led by analogy to admit the existence. As the modes of division of square membranes differ very little from those of plates of the same form, we may remark, in comparing them, that all the distortions observed by Chladni in square plates, have analogies in the intermediate modes of division presented by membranes, while they pass insensibly from a figure composed of right lines, to another figure of the same kind. We may then maintain, without the risk of error, that rigid plates are in the same predicament as membranes, and that they are capable of producing an infinity of modes of motion connected with one another, and transform themselves gradually, a result which, as I have shown in my *Mémoire sur les Instrumens à Cordes*, ought to take place.

It cannot be doubted, that bodies, when their dimensions either are equal, or approach to equality, ought to give similar results. It is even to be presumed, that the variety of ways of passing from one mode of motion is still greater than in these bodies; but do filiform bodies, which, like strings, are reduced to a single dimension, present also transformations from one mode of division to another? This is very probable, at least we may conclude so by analogy, from what passes in plates and rectangular membranes very narrow and very long. Suppose, for example, that a membrane of this kind presents the mode of division in Fig. 17, No. 1, even if the sound becomes gradually more grave, the nodes will all assume a progressive motion towards B, which will increase the interval A*n*, and at the same time, the intervals *nn'*, *n'n"*, will increase also, and consequently *n"* B will be much diminished. It would appear that this part then vibrates either not at all, or very little, and that *n* becomes, as it were, the extremity of the membrane; at last the sound always descending, *n"* coincides with B, and the membrane is found divided only by two nodal lines, as in No. 2, Fig. 17. This way, however, of passing from one mode of division to another, seems very imperfect, and nature employs many others which accompany it with great regularity, and in which the continuity is constantly observed. For example, I suppose that the membrane has six nodal lines, as Fig. 18, No. 1. if the sound becomes more acute, these lines will incline alternately and oppositely, as in No. 2, and at last their nearest extremities will join in an angle, which will by degrees round itself, so as to form the sinuous lines in No. 3; then they will become straighter, and again sinuous, but in presenting an inflexion, or a semi-inflexion more. In the last case, there will be produced seven nodal lines parallel to the small sides of the rectangle, and in the last case eight. We may conceive, that this mode of transformation is applicable to every case whatever in the primitive number of parallel lines.

Rigid rods which are long, and very narrow, present phenomena of the same kind, which are still more easily examined. All the transformations which they present, are gradual passages from lines perpendicular to the length of the rod to other systems of lines, some of which are perpendicular, and others parallel to that dimension. Several examples of this are shown in Fig. 19, 20, 21, 22, 23, and 24. We may here remark, that the character of the successive modifications depends here, as in membranes, on the manner in which the disunion is effected at the intersection of the lines which at first cut one another.

It would appear then, that thin and narrow bodies, and even strings, may, like plates and membranes, affect an infinity of modes of division, which transform themselves into one another by insensible gradations,—for strings are also susceptible of these modes of motion, where there is a longitudinal nodal line cut at right angles by one or more lines of rest; and we do not see why this mode of division should not pass gradually to that where there are only nodal lines perpendicular to the length.

From these results we may deduce this general conclusion, that the modes of motion of sounding bodies are much more varied than has hitherto been believed, and that we ought not to admit the existence of determinate series of sounds for each body of a given form, unless with this important restriction, that the proper character of the modes of subdivision ought to remain the same.

Art. VI.—*Contributions to Physical Geography.*

Among the various subjects of popular science, there are few so instructive as those which relate to the physical condition of the globe. The scientific acquirements, and the habits of correct observation which distinguish modern travellers, has enabled them to enrich their works with accurate descriptions of this class of natural phenomena; but, however interesting they may be, they often escape the notice of scientific readers, and remain buried among the ordinary details of general scenery, or national peculiarities. A collection of such descriptions cannot fail to interest and amuse the general reader, while it furnishes topics of speculation to the physical geographer. Under this impression we shall present our readers with a series of papers on this class of subjects.

1. *Account of the Conflagration in the Quicksilver Mines of Idria in* 1803.*

In 1803, on the night between the 15th and 16th of March, the workmen observed a thick smoke issuing from some of the lower galleries. It ascended and spread itself through the higher. No fire was seen, no sound of flames was heard; but it was too evident that the mine was on fire below. Some of the workmen, with great intrepidity, endeavoured to reach the scene of the conflagration. It was in vain; they were forced to retreat from one gallery to another, flying before an enemy whom they could not discover, for the smoke, which continued to make its way upwards to the open air, was not merely so dense and suffocating, but so loaded with noxious fumes, and particles let loose from the fossils among which the flames were raging in the bowels of the earth, that no living creature could safely meet it, much less penetrate it. They were fortunate enough to save themselves above ground, and the idea was adopted of extinguishing the fire by excluding the air. All the passages were closed as near to the supposed scene of the conflagration as they could be reached. The two shafts which lead immediately above ground were stopped up outside, and plastered over with clay. Five weeks the mine remained thus sealed up, but without effect. Twice, during this period, the coverings above were removed; each time the enemy was found more furious than before. The flames were heard raging below with a sound at which the miner still trembles when he relates it; the smoke, burdened with mercurial and sulphurous exhalations, rolled forth from the mouth of the pit, like streams from the jaws of Acheron, striking down every one that came within its reach. It was apprehended that the fire had attacked the upper works, and was thus threatening the final destruction of the mine. As a last resource, the director resolved to hazard the experiment of laying the mine under water. A stream was turned into the perpendicular shaft, and allowed to flow two days and three nights. During the first

* A very complete account of the Quicksilver Mines of Idria will be found in the EDINBURGH ENCYCLOPÆDIA, Art. IDRIA, vol. xi. p. 720. The following account of the conflagration, which is not given in that work, is taken from Russell's *Tour in Germany*, vol. ii.

day it produced no effect. In the course of the second day, whether it was that steam, generated by the meeting of the fire and water, was struggling for escape, or that an inflammable air had been produced and kindled by the glowing fossils, of a sudden a subterraneous explosion shook the mountain with the noise and violence of an earthquake. The huts of the miners situated near the entrance were rent; houses farther off, but standing on the slope or near the skirts of the hill, started from their foundations; and the panic-struck inhabitants were flying in dismay from the ruin that seemed to threaten their valley. The whole thing must have been splendid; accidental as it was, art could go no farther in imitating nature. In the mine itself, as was afterwards found, the explosion had rent the galleries, thrown down the arched roofs, and torn up the stairs. But the victory was gained; the vapours began to diminish, and at the end of some weeks it was possible to venture into the mine. It cost two years to prepare an apparatus and pump out the water. It was carried off into the Idria, and was found to contain only a small quantity of mercury, but a large proportion of vitriolic acid, and so much iron, that the bed and banks of the river were encrusted with iron ochre throughout its whole course, from Idria to where it falls into the Lisonzo. At the same time, every fish disappeared from the stream except the eel, which seems to bid defiance to every thing except actual broiling or roasting.

Even when the galleries had been cleared of the water, it was impossible to work in them, partly from the heat which they still retained, but still more from the fumes of sublimated mercury, which produced in the miners a violent salivation, accompanied with convulsions and trembling of the limbs. To produce an almost inhuman zeal, high wages were offered to such as would venture into places reckoned the most dangerous, to explore the consequences of the disaster, and collect the quicksilver which had been deposited in large quantities in the galleries. Many purchased this additional pittance with their lives; and altogether the atmosphere, which continued for months to infect the mine, was so baneful, that it was difficult to muster a sufficient number of healthy men for ordinary operations.

2. *Account of the Journey of the American Missionaries to the Volcano of Kirauea.**

In our last Number, we gave a very interesting description of the crater of Kirauea, in order to illustrate the drawing of it which accompanied the preceding number. The journey of Mr Ellis, and the American Missionaries, to examine the volcano, is too interesting to be withheld from our readers.

After examining the crater, as described in our last Number, our travellers walked along the western side of it in search of water, which they had been informed was to be found in the neighbourhood, and succeeded in finding three pools, where the water was perfectly fresh and sweet. These pools appeared great natural curiosities. The surface of the ground in the vicinity was perceptibly warm, and rent by several deep, irregular chasms, from which steam and thick vapours continually arose. In some places these chasms were two feet wide. From thence a dense volume of steam ascended, which was immediately condensed into small drops of water by the cool mountain air, and driven like drizzling rain into hollows in the lava, at the leeward side of the chasms. The pools, which were six or eight feet from the chasms, were surrounded and covered by flags, rushes, and tall grass. Nourished by the moisture of the vapours, these plants flourished luxuriantly, and, in their turn, sheltered the pools from the heat of the sun, and prevented evaporation. We expected to find the water warm; but in this respect we were also agreeably disappointed. When we had quenched our thirst with water thus distilled by nature, we directed the natives to build a hut for us to pass the night in, in such a situation as to command a view of the burning lava; and while they were thus employed, we prepared to examine the many interesting objects around us. Mr Thurston visited the eastern side of the great crater; and Messrs Ellis and Goodrich went to examine

* From the Journal of Professor Silliman, who received some particulars from Mr Goodrich, which are not given in Mr Ellis's Work.

some extensive beds of sulphur at the north-east end. After walking about three quarters of a mile over a tract of decomposed lava, covered with ohelo bushes, they came to a bank about 150 yards long, and in some places upwards of 30 feet high, formed of volcanic sulphur, with a small proportion of red clay. The ground was hot, its surface rent by fissures; and they were sometimes completely enveloped in the thick vapours that continually ascended. A number of apertures were visible along the whole extent of the bank of sulphur; smoke and vapours arose from these fissures; and the heat around them was more intense than in any other part. They climbed about half way up the bank, and endeavoured to detach some parts of the crust, but soon found it too hot to be handled. However, by means of their walking sticks, they broke off some curious specimens. Those procured near the surface were crystallized in beautiful circular prisms of a light yellow colour, while those found three or four inches deep in the bank, were of an orange yellow, generally in single or double tetrahedral pyramids, and full an inch in length.

A singular hissing and cracking noise was heard among the crystals, whenever the outside crust of sulphur was broken, and the atmospheric air admitted. The same noise was produced among the fragments broken off, until they were quite cold. The adjacent stones and pieces of clay were frequently encrusted, either with sulphate of ammonia, or volcanic sal ammoniac. A considerable quantity was also found in the crevices of some of the neighbouring rocks, which was much more pungent than that exposed to the air. Along the bottom of the sulphur bank, they found a number of pieces of tufa, extremely cellular and light. A thick fog now came on, which being followed by a shower of rain, obliged them to leave this interesting laboratory of nature, and return to their companions.

They saw flocks of wild geese, which came down from the mountains, and settled among the ohelo bushes: they were informed that they were numerous in the interior, but were never seen on the coast.

At sun-setting, although the thermometer was as 69°, expecting a cold night upon the mountain, they collected fuel, and removed from a dangerous place, which the natives had superstitiously chosen for them, upon the very edge of the crater. The ground sounded hollow in every direction, frequently cracked, and in two instances, actually gave way as they were passing over it, and exposed the persons, whose limbs sunk through the lava, to great danger, and to some injury.

Mr Thurston, who had been benighted at some distance, found his way back, directed by the fire, but not without experiencing great difficulty from the " unevenness of the path, and the numerous wide fissures in the lava." They now partook with cheerfulness of their evening repast, and afterwards, amidst the whistling of the winds around, and the roaring of the furnace beneath, offered up their evening sacrifice of praise. " Between nine and ten, the dark clouds and heavy fog, that, since the setting of the sun, had hung over the volcano, gradually cleared away, and the fires of Kirauea, darting their fierce light across the midnight gloom, unfolded a sight terrible and sublime beyond all they had yet seen."

" The agitated mass of liquid lava, like a flood of melted metal, raged with tumultuous whirl. The lively flame that danced over its undulating surface, tinged with sulphureous blue, or glowing with mineral red, cast a broad glare of dazzling light on the indented sides of the insulated craters, whose bellowing mouths, amidst rising flames and eddying streams of fire, shot up at frequent intervals, with loudest detonations, spherical masses of fusing lava, of bright ignited stones. The dark, bold outline of the perpendicular and jutting rocks around, formed a striking contrast with the luminous lake below, whose vivid rays, thrown on the rugged promontories, and reflected by the overhanging clouds, combined to complete the awful grandeur of the imposing scene."

They sat " gazing at the magnificent phenomenon for several hours, when they laid themselves down on mats, to observe more leisurely its varying aspect; for, although they had travelled upwards of twenty miles since the morning, and were both weary and cold, they felt little inclination to sleep. The natives, who probably viewed the scene with thoughts and feelings somewhat different from theirs, seemed however equally interested. They sat most of the night, talking of the achievements of Pele, and regarding with a superstitious fear, (at which we were not surprised,) the brilliant exhibition. They considered it the primeval abode of their volcanic deities. The conical craters, they said, were their houses, where they frequently amused themselves by playing at *konane*. The waving of the furnaces and the crackling of the flames, were the *kaui* of their *hura*, (music of their dance,) and the red flaming surge was the surf wherein they played, sportively swimming on the rolling wave."

The natives said, that, according to tradition, the volcano had been burning from chaos, or night, till now—for they refer the origin of the world, and even of their gods, to chaos, or night; and the creation was, in their view, a transition from darkness to light. They stated that, in earlier ages, the volcano "used to boil up, to overflow its banks, and inundate the adjacent country; but that, for many kings' reigns past, it had kept below the level of the surrounding plain, continually extending its surface, and increasing its depth, and occasionally throwing up, with violent explosion, huge rocks, or red hot stones. These eruptions, they said, were always accompanied by dreadful earthquakes, loud claps of thunder, and vivid and quick succeeding lightning. No great explosion, they added, had taken place since the days of Keona, but many places near the sea-shore had been overflowed, on which occasions, they supposed that Pele went, by a road under ground, from her house in the crater to the shore.

The mythology of Hawaii is much interwoven with the phenomena of their volcanoes and earthquakes, and with the thunder and lightning by which they are accompanied. It is easy to trace in their absurd and extravagant fables respecting the contests of Pele, the goddess of volcanoes, with opposing powers, the physical conflict of fire and water, and of the various elemental agents, and certainly these fables are recommended to a poetical imagination, by much that is splendid and grand.

Whenever the natives spoke of those gods of fire, it was as "dreadful beings." They reside in all the volcanoes, but chiefly in that of Kirauea. They never travelled on journies of mercy, but always on those of wrath. Earthquakes, thunder, and lightning, announced their approach: sacrifices were made to appease their anger. Hundreds of hogs, both cooked and living, were thrown into the craters, when they threatened an eruption; and during an inundation, multitudes were thrown into the rolling torrent of lava, to stay its progress.

When these infernal gods were enraged, "they filled Kirauea with lava, and spouted it out; or taking a subterraneous passage, marched to some one of their houses (craters) in the neighbourhood, and thence came down upon the delinquents, with all their dreadful scourges."

On the 2d of August, the provisions of the party being exhausted, they prepared for an immediate return; but they endeavoured previously to ascertain, in the best manner they could, the size of the crater. They estimated it at five miles, or five and a half in circumference, but the more accurate measurement of Mr Goodrich, mentioned in his letter, makes it seven and a half. The depth of the crater, they estimated at 700 or 800 feet; but Mr Goodrich fixes it at more than 1000.

The travellers "threw down several large stones, which, after several seconds, struck on the sides, and then bounded to the bottom, where they were lost in the lava. Some of them were as large as they could lift; yet, when they reached the bottom, they appeared like pebbles, and they were obliged to watch their course very steadily to perceive them at all."

The party separated into two divisions; one pursued the path along the edge of the crater, towards the sea-shore. The path was in many places dangerous, lying along narrow ridges, with fearful precipices on each side; or across deep chasms and hollows, that required the utmost care to avoid falling into them, and where a fall would have been certain death, as several of the chasms seemed narrowest at the surface. In one place they passed along for a considerable distance under a high precipice, where the impending rocks towered some hundred feet above them on their left, and the appalling flood of lava rolled almost beneath on the right. On this side they descended to small craters on the declivity, and also to the black ledge, where they collected a number of beautiful specimens of lava, generally of a black or red colour, light, cellular, brittle, and shining. They also found a quantity of volcanic glass, drawn out into filaments as fine as human hair, and called by the natives *rouoho o Pele*, (hair of Pele.) It was of a dark olive colour, semi-transparent, and brittle, though some of the filaments were several inches long. Probably it was produced by the bursting of igneous masses of lava, thrown out from the craters, or separated in fine spun thread, from the boiling fluid, when in a state of perfect fusion, borne by the smoke above the edges of the crater, and thence wafted by the winds over the adjacent plain, for they also found quantities of it at least seven miles distant from the crater. They "entered several small craters that had been in vigorous action but a short period before, marks of very recent fusion presenting themselves on every side. Their size and height were various, and many, which, from the top, had appeared insignificant as mole-hills, they now found twelve or twenty feet high. The outsides were composed of bright shining lava, heaped up in piles of most singular form. The lava on the inside was of a light or dark red colour, with a glazed surface, and in several places, where the heat had evidently been intense, they saw a deposit of small and beautifully white crystals. They also entered several covered channels, down which the lava had flowed into the large abyss. They were formed by the cooling of the lava, on the sides and surface of the stream, while it continued to flow on underneath. As the size of the current diminished, it had left a hard crust of lava of various thicknesses over the top, supported by walls of the same materials on each side. The interior was beautiful beyond description. In many places they were ten or twelve feet high, and as many wide at the bottom. The roofs formed a regular arch, hung with red and brown stalactitic lava, in every imaginable shape; while the bottom presented one continued glassy stream. The winding of its current, and the ripple of its surface were so entire, that it seemed as if, while in rapid motion, the stream had suddenly stopped and petrified, even before its undulated surface could subside. They travelled along one of these volcanic chambers to the edge of the precipice, that bounds the great crater, and looked over the fearful steep down which the fiery cascade had rushed. In the space where it had fallen, the lava had formed a spacious basin, which, hardening as it cooled, had retained all those forms, which a torrent of lava, falling several hundred feet, might be expected to produce on the viscid mass below."

Large rocks were scattered around, of four or five tons weight, which appeared to have been thrown out in the volcanic eruptions.

Within one hundred yards of the great crater, is another of about half the size, called little Kirauea. "Its sides were covered with trees and shrubs, but the bottom was filled with lava, either fluid or scarcely cold, and probably supplied by the great crater, as the trees, &c. on its sides, showed that it had remained many years in a state of quiescence." It was stated that there were many others in the neighbourhood.

So hot are the ground and the air and vapours issuing from it, that the natives formerly cooked, by these means, (and it would have been considered as impious to do it by any other,) the various sacrifices offered to Pele; and even food for ordinary purposes is always cooked here, simply by burying it in the ground. This is done by the wood-cutters and by the bird-catchers.

3. *Account of the Effects of the Earthquake of the* 19*th November* 1822, *in the Gold Mine of El Bronce.*

I visited the gold mines of El Bronce de Petorca, accompanied by a very intelligent Chilian miner, who, with several of his comrades, was in a mine on this lode a hundred fathoms deep, when the great earthquake of the 19th of November 1822, which almost destroyed Valparaiso, took place. He told me, that several of his comrades were killed, and that nothing could equal the horror of their situation.

He said, that the mountain shook so, that he could scarcely ascend; large pieces of the lode were falling down, and every instant they expected the walls of the lode would come together, and either crush them, or shut them up in a prison from which no human power could liberate them. He added, that when he got to the mouth of the mine, the scene was very little better; there was such a dust, that he could not see his hand before him; large masses of rock were rolling down the side of the mountain on which he stood, and he heard them coming, and rushing past him, without being able to see how to avoid them, and he therefore stood his ground, afraid to move. In almost all the mines which we visited in Chili, we witnessed the awful effects of these earthquakes, and it was astonishing to observe how severely the mountains had been shaken.—Captain Head's *Rough Notes on the Pampas.* London, 1826.

4. *Account of the Lake of Ybera, formed by infiltration from the River Parana.* By M. Azara.

On the river Parana, there is a chain of rocks situated in 27° 27′ 10″ of north lat. and 59° of west long.; but the passage is always free for small boats, when the river is large, so that the Parana is navigable from the confluence of the Ygazu to the sea. Near this is the Lake Ybera. It is *thirty leagues* wide to the north, parallel to the Parana, to which it closely approaches, without having any visible communication with this river. It extends thirty leagues to the south, where it forms what is called the gorge of Yuquicua, and afterwards, widening in proportion as it advances to the south, it terminates by forming the river Miriuay, which is a considerable one, and which throws itself into the Uruquay. From Yuquicua the banks of the Ybera have a westerly direction for thirty leagues, and there issue from it three rivers, viz. that of St Lucie, the Corrientes, and the Bateles, which one can never pass, and which throws itself into the Parana. The lake of Ybera *receives neither river, nor brook, nor spring.* It subsists the whole year without almost any variation; and it is in a great measure filled with aquatic plants, and even with some trees. It is kept up, however, by the simple filtration of the waters of the Parana, which is without example in any other part of the world. This filtration furnishes not only the water of four large rivers, but also that which is carried off by evaporation from a surface of at least 4000 square sea miles, and which cannot be estimated below 70,000 tons a-day, according to Halley.

I have read in some manuscript historians of the Jesuits, that in the interior of the lake Ybera, there lived an Indian nation of pigmies, and a very detailed description of it is given. But all this is false, and has no more reality than that empire which is supposed to exist in the middle of the lake of Jarages. The Ybera is a great extent of water, which in some places forms a true lake; but the larger portion of it is filled with plants, so that it is impossible to explore the interior of it either on foot or on horseback, or in a boat. Its situation, and the general disposition of the country, indicate, that the river Parana formerly traversed this lake, and that it afterwards divided itself into the four rivers which now flow out of it.—*Voyages dans L'Amerique Meridionale*, par Don Felix de Azara, tom. i. p. 80—82.

3. *Account of the Cavern of Planina, in Carniola.*

For about a quarter of a mile we followed the course of the stream upwards through the narrow dell, bounded on both sides by bold rocks, and tufted with luxuriant underwood. A long array of corn and saw-mills succeeded. Above the last of them, the dell is terminated by a semicircle of bold and lofty precipices, in the middle of which an enormous archway, almost as regularly formed as if hewn out by the hand of art, opens a way into the entrails of the mountains. Through this majestic portal, the river Laybach pours itself forth at once from the bosom of the earth, and spreads out its waters to the day in an ample basin, which extends on both sides to the walls of rocks that bound the dell. The stem of a huge fir, hollowed out like a canoe, furnishes the only means of reaching the entrance, for the waters of the basin not only wash the precipices, but, as was evident from the hollow sound of the waves, have undermined them. A miller's man guided this frail bark with a wooden shovel. The whole passage to the opening does not exceed a hundred feet, and if one sits quietly, danger is out of the question.

This natural gateway is about twenty feet wide, and twice as high. It is regularly curved. A few steps forward, and it enlarges itself into a cavern of magnificent dimensions and wonderful regularity of form. There are not many traces of stalactitic ornament. The gigantic walls and vaulted roof stand in their natural grandeur, unadorned and overpowering. Nothing seems to support the enormous weight of mountain above; it rises from the earth gradually and regularly, bending itself into a majestic natural cupola. The effect is aided by the circumstance, that, owing to the spaciousness of the entrance, no part of the dome remains in darkness; the eye takes in the whole at once.

Except during inundations, the river does not occupy the whole of the floor of the cavern. The bottom is irregular, sloping down from the one side to the other. The upper part was now dry, in consequence of the long continuance of dry weather, and consisted entirely of sand, a deposition from the overflowings of the stream, which, when inundated, occupies the whole width of the portal. The course of the river cannot be followed far into the bowels of the mountain. At the extremity of the cavern it suddenly turns round to the left. The cavern itself is no longer a vault, but a narrow passage; the roof sinks down; light disappears; and the sound of the water announces that it is flowing over an uneven and interrupted channel. From the moment it enters the cavern its course is slow and tranquil, and it pours itself without noise into the deep sunk mountain basin, which, imbedded among precipices, varies in depth from 12 to 25 feet.

But its troubles are not yet past. Flowing from the basin over the artificial embankment erected to raise its waters to the necessary elevation for the mills, it continues its course northwards through the valley. Scarcely, however, has it reached the northern extremity, when the earth again gapes for it, and swallows it up, not through a bold aperture like that which it has quitted, but through numerous small insidious rents and crevices. It is lost for nearly nine miles, pursuing its course under ground. It finally bursts forth again at Upper Laybach, where the hilly country sinks down into the wide plain which surrounds Laybach itself; and in the neighbourhood of the latter, it takes refuge from all its subterranean foes, by joining its waters to those of the more formidable Save.

The origin of this subterraneous river, which during the thaws in the beginning of summer, and the rains of autumn, pours forth from the jaws of the cavern at Planina a mass of water so much superior to the capacity of the apertures which drink it up at the northern extremity, that the whole valley, bounded as it is on both sides by rocky eminences, is converted into a romantic lake, has not yet been satisfactorily ascertained. The more general opinion holds it to be the Poick, a river which throws itself into the mountain at Adelsberg, about nine miles south of Planina, and at a considerably higher elevation. This is likewise the more probable hypothesis. The body of water in both, at the time I saw them, was alike, and its somewhat muddy colour was the same. The course of the Poick, where it disappears in the mountain at Adelsberg, is to the north; Planina lies in the same direction, and much lower. According to the other hypothesis, which has been started of late years, the Poick, instead of reappearing through the portal of Planina, and sending its waters by the Save and the Danube to the Black Sea, turns to the westward beneath ground; reappears, after a subterraneous course of twenty miles, in the sources of the Wippach, on the western confines of Carniola; pours itself under this name into the Lisonzo, and is thus finally lost in the Adriatic. The Poick being thus disposed of, the river of Planina is declared to be a subterraneous outlet of the neighbouring lake of Zirknitz. The hypothesis is entirely gratuitous. The Wippach, it is true, has a similar origin; but we have the Idria, the Jersen, and various other streams in every corner of these calcareous hills. It is said, that pieces of wood and other light bodies, which have been thrown into the Poick at Adelsberg, have reappeared in the Wippach, but such *on dits* are always of doubtful credibility. It is said, for instance, that a travelling cooper, who had suffered shipwreck in the *Strudel*, or whirlpool of the Danube, above Vienna, afterwards found part of his equipage floating on the lake of Neusiedel in Hungary, and the people of the country still believe that a subterraneous communication exists between the river and the lake. If the cavern of Planina be an outlet of the lake of Zirknitz, its waters ought to disappear when the lake is dry; but the waters of the Laybach never fail entirely.—*Russell's Tour in Germany*, vol. ii.

6. *Account of the Lake of Zirknitz supplied by Subterranean Streams.*

The lake of Zirknitz lies in a higher ridge of eminences, about eight miles to the eastward of Planina. It is not remarkable either for its size or beauty. When full, it is just like any other large piece of water; and the rocks which surround it are too bare and uniform to be picturesque. Its celebrity is due solely to the periodical flux and reflux of its waters from and into the breach of the mountain. It is scarcely worth visiting except when the departure of its waters has left uncovered the orifices of the conduits from which they issue, and through which they disappear; for it is only then that any idea can be formed of the natural machinery by which its phenomena are produced. It is about six English miles long, and three broad. It is imbedded among ridges of limestone, the predominating fossil in the mountains of this part of Carniola. On the approach of midsummer, in ordinarily dry seasons, when the snow has disappeared from the neighbouring mountains, its waters begin to decrease. If the weather continues dry, the diminution proceeds rapidly, and in a few weeks the whole mass is drained off. A rank vegetation springs up from the mud which remains behind. The peasants, if the summer promises well, sow grass, or perhaps rye, on the exterior part of the abandoned bed. In a couple of months they are mowing grass where the dark waters of the lake were formerly spread out; and the sportsman shoots game where, but a short time before, he was fishing pike. When the lake is entirely gone, the caverns through which it has fled become visible, sinking into the mountains, some on the side, and others in the bottom of its bed. They all lie towards the northern bank; they vary in size. Though some of them can be entered, they are not practicable to any extent. Water, or the narrowness and lowness of the passage, uniformly arrests your progress. So far as they have been traced, they all descend.

On the southern side, the bottom and bank of the lake yawn into a similar set of apertures, through which, as the rains set in towards the end of autumn, water begins to rise. It continues increasing in quantity, and gradually fills the deeper hollows of the deserted bed. Even some of the openings on the northern side, which had assisted to drain the lake, now send forth their stores from beneath to fill it. As the rains continue, the waters issue from these apertures with such impetuosity, that pike are said to have been frequently taken, wounded and disfigured in a manner which could only be explained on the supposition, that the violence of the subterranean streams had dashed them to and fro against the rocks of the hidden passage, through which it hurries them up from deeper reservoirs, before they emerge into the lake. So soon as the waters begin to appear, the birds which had nestled in the long grass seek another refuge; the peasant removes in haste what of his hazardous crop may still remain within the margin of the basin; and within as short a time as that in which it had retired, the lake is again there in all its former extent, and stocked with its former inhabitants.

The length of the time in which it remains dry, depends entirely on the comparative dryness of the season. The waters ran off in the summer of 1821, returned toward the end of November, and ran off a second time in the end of February 1822, not, indeed, an ordinary occurrence, but perfectly natural; because no rain had fallen from the beginning of January, and the snow on the higher mountains still continued to be frozen. Sometimes, again, when the summer is decidedly what may be called a wet one, the lake does not retire at all; all proofs that the sources of its waters are not subterranean, although the channels which conduct them into this basin are subterranean.

The phenomena of this lake, therefore, do not seem either to be of very difficult explanation, or to deserve the astonishment with which many travellers, and some naturalists have regarded them. The whole ridge of mountains consists of a very porous calcareous rock, through which the rains and melted snow easily penetrate. It is traversed, likewise, internally by innumerable suites of galleries and caverns, in which the waters unite themselves into streams, and pursue their subterraneous course, till they issue from the mountain into some lower open hollow, as in the valley of Planina, or here in the lake of Zirknitz. The quantity and size of the fish, which retire with the lake into the caverns beneath, and return with the returning stream, prove that there must be capacious reservoirs within the bosom of the mountain, in which they can exist and prosper.

Where the outlets of the lake finally discharge their waters cannot, of course, be easily traced, because their subterraneous channels cannot be followed; but the whole country, from the northern limits of Carniola to the shores of the Adriatic, from the caverns of Planina to the sources of the Timavus, is so full of streams, whose first appearance above ground implies a previous subterranean course, that there is no difficulty in accounting for the disappearance of the lake. The Jersero issuing from the cave of St Cantian, the Idria bursting from the mountains not far from the mines, the Wippach rising in the same manner farther to the westward, are, in all likelihood, outlets of the Zirknitz. And what is there improbable in the supposition, that even the Timavus itself draws part of its stores from this alternating reservoir?—*Russel's Tour in Germany.*

Art. VII.—*Description of an Instrument for Measuring the Comparative Expansibility of Metals and other Solid Bodies.* By Mr James Nasmyth. Communicated by the Author.

This instrument consists of a glass tube, about one inch in diameter, and about four inches long, sealed at one end. To this tube is cemented a brass cap, the top of which is made to screw off. To this top or cover is cemented a glass tube, about three feet long, (such as that used for thermometers,) open at each end. A scale of inches and tenths is attached to this tube.

In order to operate with this instrument, equal bulks of each of the metals to be operated upon is to be procured, of such dimensions as just to fill the glass tube A, Plate IV. Fig. 3, but not tightly. The tube A is then to be filled with water at temperature 50°. One of the pieces of metal is then to be introduced (lead for instance;) the cover D, with its tube and scale, is now to be screwed on, and the water that remains in the tube A is to be made to stand at the beginning of the scale, by screwing the small screw C into it The tube A and its contents being at temperature 50°, the apparatus is then ready for an experiment. The tube A and its contents is then to be heated to 100°, by immersing it in water at that temperature. The lead will now expand and force the water up the tube E, for example, to twelve inches. The lead is now to be removed, and the next piece to be introduced, (tin.) All things being in the same state as at the commencement of the former experiment, the apparatus is again to be heated to 100°; the tin and water will now expand to six inches. From this we may infer, that lead is twice as expansible as tin. The same operation is to be repeated with each of the other metals or solid bodies under trial.

By knowing, also, the contents of each inch of the bore of the tube E, by deducting from the expansion of both the water and metal, that of the water alone, which must be previously ascertained, we may be able to tell the total expansion of each of the substances in parts of cubic inches.

Art. VIII.—*Observations on the Mean Temperature of the Earth at Sydney, made in the year* 1824 *and* 1825. Communicated to the Editor by Sir Thomas Makdougall Brisbane, K. C. B. F. R. S. London and Edinburgh.

Among the numerous and important scientific inquiries instituted by Sir Thomas Brisbane in New South Wales, those relative to the mean temperature of the earth hold an important place. The following annual series of observations on the temperature of deep wells, is doubtless the most complete that has ever been made, and affords interesting data for various scientific speculations.

The mean temperature of the earth at Sydney, as obtained from the last column, is 63°.8, differing only the fraction of a degree from 63°, the temperature deduced from Dr Brewster's formula.

By another set of observations, Sir Thomas had found that the mean temperature of the earth at Paramatta was only 61°9, though almost in the same latitude; and though the depth of the thermometer in the bores was at an average not above 14 feet. The observations at Sydney are on the other hand made at depths of *eighty-four* feet, and hence there is reason to believe, that this excess of the *temperature of the earth* at Sydney over that at Paramatta, viz. 2° nearly, is owing to the depth at which the observation was made, and consequently to the same cause which occasions a rise of temperature as we descend into deep mines.

We are aware, that there is a great difference between the mean temperature of the atmosphere at Paramatta, and at Sydney, but this cannot explain the increase of heat at Sydney, at a depth of 84 feet.

Register of the Temperature of the Well at the Prisoners' Barrack, Sydney, from March 12, 1824, *to March* 14, 1825.

Date. 1824.		Number of feet to the Water.	Depth of Water.	Thermometer. Before immersion.	Temperature of Water at the Surface.	Temperature of Water at the Bottom.	Remarks.
March	12.	32.	52	66°.	64.	64°	7 A. M.
	13.	34.	50.	67.	64.	64.	6
	15.	34.	50.	70.	64.	64.	7
	22.	33.	51.	61.	64.	64.	6
	24.	33.	51.	60.	63.8	64.	7
	25.	33.	51.	56.	63.5	64.	7
	28.	33.	51.	56.	63.5	64.	6
	29.	33.	51.	56.	63.5	64.	7
April	4.	59.	25.	60.	63.5	64.	7
	12.	56.	28.	60.	63.6	64.	7
	15.	51.	33.	59.	63.7	64.	7
	19.	47.	37.	55.	63.6	64.	7
	26.	45.	39.	65.	4.	64.	7
May	3.	40.6	43.6	57.	63.6	64.	7
	8.	38.6	45.6	49.	63.2	64.	7
	13.	36.6	47.6	56.	63.6	64.	7
June	22.	22.6	61.6	54.	63.2	64.	10
	25.	22.	62.	47.	62.9	64.	8
	29.	22.	62.	50.	62.9	64.	7
July	9.	17.6	66.6	46.	62.8	64.	8
	14.	17.6	66.6	52.	63.	64.	7½

Date. 1824.		Number of feet to the Water.	Depth of Water.	Thermometer. Before immersion.	Temperature of Water at the Surface.	Temperature of Water at the Bottom.	Remarks.
July,	21.	18.6	65.6	53°.	63°.	63.9°	8 A. M.
	24.	18.6	65.6	8.	63.	63.8	8
	28.	19.	65.	46.	63.	63.8	7½
Aug.	7.	19.6	64.6	44.	62.8	63.7	8
	18.	20.6	63.6	56.	63.	63.6	8
	23.	21.6	62.6	54.	63.	63.6	8
	25.	22.	62.	47.	62.8	63.6	8
	28.	22.9	61.3	45.	62.6	63.6	8
	31.	23.2	60.10	51.	62.8	63.6	7½
Sept.	7.	23.6	60.6	48.	62.6	63.6	8
	16.	22.	52.	58.	63.	63.5	8
	18.	22.8	61.4	59.	63.	63.5	7½
	25.	22.	62.	51.	63.	63.5	7
Oct.	1.	22.	62.	50.	62.8	63.5	7
	7.	22.	62.	62.	63.6	63.6	7
	19.	21.8	62.4	65.	63.8	63.8	7
	29.	21.	63.	70.	63.9	63.8	7
Nov.	7.	20.4	63.8	62.	64.	63.9	7
	12.	20.4	63.8	68.	64.	63.9	7
	24.	20.	64.	69.	64.	63.9	7
Dec.	7.	19.8	64.4	67.	64.	63.9	7
	22.	20.	64.	66.	64.	63.9	7
1825.							
Jan.	17.	19.11	64.1	71.	64.2	64.	7
	22.	20.5	63.7	66.	64.	64.	6
	27.	20.8	63.4	70.	64.3	64.	7
Feb.	2.	22.5	61.7	62.	64.	64.	7
	16.	25.5	58.7	68.	64.5	64.	7
March	14.	24.7	59.5	65.	65.	64.4	7

Art. IX.—*Account of a Voyage to Madeira, Brazil, Juan Fernandez, and the Gallipagos Islands, performed in* 1824 *and* 1825, *with a view of examining their Natural History.* By Mr Scouler. Communicated by the Author. (Continued from Number xi. p. 73.)

On the 6th August we left Nootka, and directed our course for the Straits of Juan de Fuca, concerning whose existence there has been so much discussion. On the southern side of the straits, we saw the village of Tatoach, and many canoes came off to the vessel. Some of these people had been at Fort George, and seen some of the people we had on board, so that friendship was soon established between us. They were, however, very uneasy, as they did not wish to venture far from their own coast, on account of the Clayoquats and Nithnats of the opposite coast, with whom they were at war, for the purpose of obtaining slaves. One remarkable circumstance, with regard to these Nichases, is, that many of them were clothed in blankets of their own manufacture. The wool they employed was obtained from their dogs, but we could not learn by what method they succeeded in weaving them. They seemed sufficiently comfortable in their dog's-wool blankets, and had dyed them of various colours. They said they kept all their white dogs in a small island about two miles from the main land, and fed them regularly every morning; and by this means they preserved their breed of dogs producing white wool. Their dogs differed much in their appearance from those of the other Indian tribes; the ears were more pendulous, and they had more the appearance of spaniels than of the native dogs of America.

9th.—The country, on both sides of the straits, had the most beautiful appearance of any part of the coast we had ever seen. It abounded in beautiful towns, interspersed with trees, and in some of the finest shrubs of American growth; and the numerous villages we saw, showed that the country abounded in the necessaries of life. In the afternoon, we anchored in Port Discovery, where we were visited by many canoes from the Indian village. This tribe was named the Klallums, and were superintended by an old chief called Squastin; and because some of his people had been kindly received at Fort George, he behaved in the most friendly manner. During the five days we remained here, the old chief visited us every morning, bringing with him a present of berries of the *Gualtheria shallon*, salmon, and shell-fish. In return for his hospitality, he was very anxious we should assist him in making war on the tribes farther up the straits, and was at great pains to persuade us, that we would meet with a people who would prove extremely hostile, and would poison all the provisions they sold us. To these representations of the chief we paid little attention. In the neighbourhood of their village, we saw many of those poles, so well described by Captain Vancouver. They were about eighteen or twenty feet in height, and were supported by three shorter ones. We were at a loss to conjecture the use of these sticks, and our inquiries among the Indians produced but little information on this subject. The most probable opinion is, that they expose the heads of their vanquished enemies on them. This opinion is supported by Captain Vancouver, who saw human heads affixed to them near Port Townshend; and I think it is probable, that these people, notwithstanding their peaceable and friendly conduct towards us, are extremely revengeful. In most of the canoes, we saw spears about ten feet long, furnished with iron points, and ornamented with the hairs of their enemies. If these poles be the monuments of savage vengeance, it is at least pleasant to know, that the practice is confined to a very limited district, and that a motive of avarice will generally prevent these tribes from using their prisoners cruelly, as slaves constitute their principal source of wealth. The Klallums of Port Discovery were much less covetous than the people of Nootka, and the numerous presents of provisions they gave us, supported the ship's crew, and they were grateful for every thing we chose to give them in return. When we consider the abundance of provisions this beautiful country affords, we shall not be surprised at the great population it maintains; and, probably, no Indians in North America have less difficulty in procuring their food than the tribes from the Gulf of Georgia to the Columbia River. The sea yields an abundant supply of fishes of the most delicious kinds, as various species of mullet, turbot, and cod; every rivulet teems with myriads of salmon; and the meadows and forests produce an endless variety of berries and esculent roots. The collection of the latter forms the occupation of the women and children, while the men are occupied in procuring the former, and both are carefully dried for winter stores. About the end of September, they quit their summer residence on the coast, and retreat into the interior of the country, where, in addition to their winter stock, they kill abundance of otters, beavers, and elks, whose skins afford them clothing, or the means of obtaining European articles. They return to the coast again in the beginning of April.

14th.—We left the friendly Klallums of Port Discovery, and coasted along this fine country. As we approached the Nootka side, two canoes came off to us belonging to a famous chief named Wascalatchy, who, from his propensity to travelling, was well known over a great extent of country. He often travelled from his residence on De Fucas Straits to visit the fort, as he did not wish to sell his skins through any of his countrymen, in whose honesty he placed little confidence. His journeys did not always terminate when his buisness was concluded; but he had ascended the Columbia as far as the falls, and visited tribes whose language and manners differed entirely from those of his own people. Probably no Indian inhabiting De Fucas Straits, had ever been nearer the Rocky Mountains.

15th.—We anchored in Strawberry cove of Vancouver, and, as the country here was uninhabited, employed the time in wandering through the woods and collecting plants. Next day we proceeded down the Gulf of Georgia, and remained two days near an Indian village. As the people were on terms of friendship with the natives of Port Discovery, we were kindly received, and they presented us with two newly killed beavers, which afforded us an agreable repast after living so long on salmon. These poor people received our presents so thankfully, and a good understanding was so well established, that we resolved to venture ashore among them. On landing, some children which had been amusing themselves scampered away on our approach. I hastened to a saline marsh near the village which afforded some interesting plants; and in dry situations we found plenty of the yellow-flowered *myosotis* which grows so sparingly on the Columbia. During the time we were ashore the Indians examined our conduct with the most eager curiosity; but the astronomical instruments surprised them most, and they inquired if we gained information in the sun of the friendly or hostile dispositions of the tribes we were next to visit, or performed these enchantments to cure some sick person.

On leaving this peaceable tribe, (the Summus) we proceeded to Point Roberts. In this situation the coast is low and marshy, and covered with rushes and willows, but we had been informed that there was a very numerous clan in this place. Before we saw any of them a canoe arrived from Squastin and his allies to warn us against the insidious Indians we would soon see. This only convinced us of the inveterate enmity that subsisted between the different tribes, and of course the advice was little regarded, and the plausible story they invented, that these Indians were preparing to attack the vessel, was equally unsuccessful.

20th.—These Indians arrived to day, and we were on friendly terms with them, notwithstanding the tales which had been told us to their disadvantage. They belonged to the allied tribes of the Cowitchen and Yucualtah. The name last mentioned bears a strong affinity to the Indian name of Nootka. The chief Chassia came on board; he behaved in a very friendly manner, and informed us that he had once seen white men in the interior, and in the canoe of this chief we saw a man deeply marked with the small pox, the only Indian we had seen on the north-west coast with marks of this disease. The rarity of such an occurrence proves how fatal this disease must have been among them. This disorder broke out among the tribes in the vicinity of Hudson's Bay, and spread in every direction among the Indians, depopulating the country in its progress. Even the Indians behind the rocky mountains were not secure from its entrance; and its ravages were only arrested at the shores of the Pacific. The natives of the Columbia remember it with terror; and the name of the disease has been sufficient to deter hostile tribes from plundering the traders. The disease must have been extremely fatal among the Indians; and it accounts for the depopulated state of the coast, which did not escape the acuteness of Captain Vancouver. He found in several places great quantities of bones, and many canoes containing five or six skeletons, which were no doubt interred at that unfortunate period.

26th.—While near Point Roberts, I made several excursions, and as we were under no apprehension from the Indians, we did not hesitate to venture among them, and to employ one of them in carrying my box, an office which they were eager to do, as they always expected some little present to reward their diligence. As our business in the Gulf of Georgia was now completed, we left the Yucualthas and anchored in the afternoon near the village of our old friends the Summus. We then landed at their village but found the chief was absent; his people however received us with much kindness. The village is finely situated on a small dry plain, surrounded on the north and east by a forest of pine and cedar trees, and exposed to the genial influence of the westerly breezes. The number of houses amounted to twenty, but they were very large. The village might contain about 250 inhabitants. The houses had sloping roofs of fir and cedar planks, and thatched with mats of *Typha latifolia.* Nearer the shore there were several large shades for drying fish, and from the immense quantities of dried salmon we saw, there was little probability they would have to encounter the horrors of famine the ensuing winter. The method of preparing the salmon was very simple. The vertebræ and intestines are taken out, and the fish is split into four thin slices, which are dried in the sun. To preserve the salmon roe they make bags of the fish's skin, and then fill it with roe and preserve it for winter use. When opened the smell is most disgusting, but this species of caviar is keenly relished by the Indians. After satisfying our curiosity, I wandered through the woods, attended by the little children. It was with satisfaction we reflected, that through mild treatment we had gained the good-will of every tribe we had visited. On embarking we found the Indians busy in removing the planks of their houses to their winter abode. While continuing our voyage through the straits, canoes came off from every quarter, bringing plenty of salmon and holibut, and eager to obtain in return, needles, fish-hooks, and small knives.

The different tribes who inhabit De Fucas Straits, and the Gulf of Georgia differ very little in their habits from the Columbian aborigines. The practice of flattening the heads of their children is universal. They are much addicted to painting themselves, and the paints they use are red ochre, charcoal, and pulverized mica. They make regular lines on their faces with these articles, which gives them a most disagreeable appearance. They apply great quantities of grease to their hair. Their dresses are very various. Some had blankets of dog's-wool, others had robes made of raccoons and elk skins, and very few had English blankets. The women, as in all other places, wore petticoats of straw, or of the prepared bark of the cedar.

As iron is very scarce among them, their arrows are generally pointed with bone or with pieces of muscle shells.

On the 3d September we crossed the bar of the Columbia, and again anchored in Baker's Bay. Next morning I set out for Fort Vancouver to join my old associate Mr Douglas. As we passed Cheenook Point we saw the burying ground of Comcomly, where, within two years, this unfortunate old chief has deposited the bodies of eight individuals of his once numerous family.

The canoes in which the bodies were deposited were covered with the laced coats, silks, blankets, and other articles the deceased possessed, and had a remarkably melancholy appearance. The Indians, like the ancient inhabitants of Britain, deposited the arms of the dead along with their body. Each of Comcomly's sons had a fowling piece by his side, and a loaded pistol in each hand. The bodies are annually uncovered by the old chief, and if necessary, wrapped in new blankets. Formerly the Cheenooks used to live in this place, but since it became a burying-place, it has been abandoned by the Indians. As it was sunset before we left the ship, we had to travel all night, and in the morning we breakfasted on a small alluvial island, about twenty miles from the ship. At this place I had a few minutes to botanize, and, although the season was far advanced, we found some curious plants. The wapito or Indian potato grew in abundance. *Valisneria* grew in the mud of the river, and I also found a beautiful *Sisyrinchium* with yellow flowers. On arriving at Fort Vancouver we were kindly received by all the gentlemen. Mr Douglas was just returned from a short excursion he had made to the interior. While I had botanized along the coast, from the Columbia in lat. 45. N. to Queen Charlotte's island in 52, Mr Douglas had taken a most extensive range in a different direction, and through a very different country, so that our respective herbariums contained entirely different sets of plants. His first excursion had been up the Multuoma or Wilhamut river, which takes a southerly course from the Columbia. He followed this river for about fifty miles in a country abounding in salt springs, and where the Indians cultivate the *Nicotiana rustica.* His next journey was to the falls of the Columbia, where he found a rich country for the botanist, and saw a race of Indians who differ entirely in language and habits from the Indians of this coast. They inhabit the immense plains of the interior, and their principal wealth consists in their numerous herds of horses, so that, in some respects, they may be called a pastoral people, analogous to the inhabitants of the plains of northern Asia, though inferior in civilization.

During my stay at the fort, our time past pleasantly away in making excursions, arranging our collections, and procuring specimens of the animals of the country. While thus employed, one of the most respectable of the Indian chiefs requested our medical aid to his brother who was sick. The sick chief was named Tutilliham, and had the reputation of being the greatest warrior on the Columbia; he was unfortunately in the last stage of an enteritic affection, and, after explaining this to his friends, we gave such medicines as might palliate his complaint; but he died in a few days. One of the symptoms he had, was a small tumour situated on the right side, below the liver. This circumstance afterwards led to serious consequences, for it was recollected that three months ago he had eaten at the house of a neighbouring chief, who pretended to great knowledge of medicine, a quantity of chamass roots,* which they now blamed as the cause of his death. In consequence of this opinion, the unfortunate chief was assassinated by the friends of the deceased chief.

20th September.—I left Fort Vancouver to return to the ship, which was soon to sail, and on this occasion I cannot but mention the kind reception I had ever experienced there from Mr M'Loughlin, and the other gentlemen of the establishment. I saw with pleasure that the canoe I was to sail in was manned by Sandwich Islanders in the Company's service, and as they were less superstitious than the Canadians, I could examine Mount Coffin with more freedom. Our arrival at this famous Indian cemetery, called by the Canadians *Rocher des Morts*, was under favourable circumstances; the day was stormy, so that there was less risk of being interrupted by canoes. This hill is about 150 feet above the level of the river, and only covered by a few shrubs in some places. On its steep

* Bulbs of *Phalangium esculentum.*

and naked summit no canoes were deposited, but they were all placed on the side towards the river, and in such a manner, that I suspect it was intended they should fall into the water when they became decayed. Near some canoes there were large boards painted with various figures, but generally that of the human face ; to the boards were affixed little bunches of feathers, and in some cases narrow slips of red cloth. On the top of many of the canoes they had placed wooden dishes such as they use in cooking their fish, and other domestic utensils. The bodies with their ornaments were enveloped in mats of *Typha latifolia*, and the canoes covered with boards, and secured by having stones placed on them. On opening one of these canoes of the dead, a large snake issued out as if to repel all intruders on these melancholy abodes, and many of these reptiles were seen around the other canoes. The occurrence of serpents around the abodes of the dead is known in all countries, and sometimes attracted the attention of the poets. This method of depositing the dead is peculiarly affecting. Every exertion of Indian ingenuity is exerted to show their respect to deceased friends. Their most valuable property is deposited along with them, and the solitude and wildness of the places they select, add much to these impressions. When once the body is placed in the place of the dead, the name of the deceased is never mentioned on any occasion, but they allude to him as the relation of some surviving friend. The feeling that makes them refuse to pronounce the name of their dead friends, prevents them from visiting their cemeteries unless on some very important occasion. The stormy weather that favoured my purpose of examining this curious spot continued without interruption till we left the Columbia, where we exchanged its dense fogs and constant showers for a brighter sky and a more pleasing climate.

Art. X.—*On the separation of Epistilbite from Heulandite, as demonstrated by optical characters.* By David Brewster, LL. D. F. R. S. Lond. and Sec. R. S. Edin.

In the eighth Number of this *Journal* we had the satisfaction of printing a communication from Dr Gustavus Rose of Berlin, "on *Epistilbite, a new mineral species of the Zeolite family.*" This distinguished chemist, whose crystallographic and chemical knowledge is well known, had separated the *Epistilbite* from *Heulandite* on the authority of certain differences in their chemical composition, their hardness and specific gravity, and their crystallographic form. Professor Weiss too, in whose practised eye and theoretic skill every confidence may be placed, had previously regarded the Epistilbite as a new variety of foliated Zeolite; and Count Bournon, one of the fathers of mineralogical science, had likewise considered it as something new.

With all this evidence in favour of the separation of these two species, we were not a little surprised at an ingenious and elaborate memoir, published by Mr Levy in the *Philosophical Magazine* for January 1827, in which he considers the identity of the two minerals as almost demonstrated. In order that the nature of his arguments may be understood, we shall give the following comparative tables of the properties of the two minerals.

		Heulandite.	Epistilbite.
Specific gravity,		2.211	2.249
Hardness,			a little greater than Heulandite.
Blowpipe,			the same as Heulandite.
Analysis, *	Silex,	59.95	58.59
	Alumine,	16.87	17.52
	Lime,	7.19	7.56
	Water,	15.10	14.48
	Soda,	-	1.78

In order to compare the crystallographic structure of the two minerals, Mr Levy assumes that the crystals of Epistilbite may be derived from the primitive form of Heulandite; and he then shows that this primitive form may be so modified as to give a secondary form very like that of Epistilbite. In this way he obtains the following angles :

* In this comparison, taken from Dr Rose's paper, the soda is wanting in the *Heulandite*. Dr Rose's second analysis of Epistilbite contains, however, no soda; but we think it has been omitted in the manuscript by mistake.

Calculated angles of the modification of Heulandite.	Angles of Epistilbite, according to Dr G. Rose.
147°40′ 40′	147°40′
135 52	135 10
122 15 } 123 19 }	122 9
108 29	109 46
154 31 } 154 11 }	154 51

It is not our intention to examine this ingenious result of Mr Levy's. We leave this task to Dr Rose, who will no doubt remove some of the objections at least, which have been brought against the separation of Epistilbite from Heulandite. Our object is to take advantage of the perplexity into which the crystallographer and the chemist are respectively thrown;—to direct the attention of the philosophical mineralogist to the dilemma in which his science is thus placed, and to point out the influence of *optical characters*, and the singular facility of their application, in extricating a doubtful species from the arena of contending opinions, and establishing it upon the basis of unquestionable physical principles.

I have long ago shown that *Heulandite* has two axes of double refraction; that the principal axis is perpendicular to the planes of most eminent cleavage, and that the two systems of polarized rings are easily seen through a plate bounded by the cleavage planes.

If we now take a plate of *Epistilbite* comprehended between its planes of most eminent cleavage, and examine its structure by polarized light, we shall look in vain for the two systems of coloured rings. If the two plates are of equal thickness, it will be seen that the double refraction of the Epistilbite, in directions perpendicular to the cleavage planes, is enormously greater than that of Heulandite, the latter at a certain thickness giving the colours of the third order, while the former gives the white light of fixed polarization, and exhibits at its edges many orders of colours.

This experiment, which can be made by the merest tyro in science, establishes between Heulandite and Epistilbite a difference of structure of such a decided character, as to settle for ever the question at issue. Had we merely shown that the two minerals were separated by certain constant differences in their refractive power, or in their double refraction, or in the inclination of their resultant axes, we might have expected that some mineralogists would not appreciate the value of such physical distinctions; but when we have shown that the physical structure of the two bodies has entirely different relations to the single cleavage which so strikingly characterizes both, we anticipate the ready acquiescence of all classes of mineralogists.

From this result, we may now return to consider the influence of Mr Levy's process on the union of mineral species. It is obvious that the secondary form of one species may be derived by calculation from the primary form of another species which never exhibits the same modifications, and yet the two species may be perfectly distinct; and, consequently, the assimilation of a real to a calculated secondary form can never be held as a proof of identity of species. To this it may be replied, that, in the case of Epistilbite and Heulandite, the assimilation is not perfect, and that the principle may still be sound, though its failure may, in the present case, be admitted. This argument is plausible; and we should certainly attach some value to the principle, if all the other characters of the two species put in comparison concurred in establishing their identity; but "the difference in the general appearance of Epistilbite from the ordinary crystals of Heulandite," admitted by Mr Levy,—the existence of soda in the former, and its superior hardness and specific gravity,—are points of dissimilarity which cannot be overlooked in estimating the present application of the principle.

Before concluding this notice, I cannot avoid directing the attention of mineralogists to the singular perplexity into which the crystallographer is thrown, by the discovery of Haytorite, a substance found in Devonshire, possessing a distinct crystalline form, and exhibiting bright planes capable of having their inclination measured by the reflecting goniometer. These forms are considered by Mr W. Phillips and Mr Levy, two of our ablest mineralogists, to be *pseudomorphous*, and the latter regards it as probable that they have had these forms impressed upon them in moulds, made either by crystals of Humboldtite, a mineral not even found in England, or by some unknown species.*

If we admit this probability, which is inferred from the absence of cleavage in Haytorite, then we are entitled to suspect that many of the old species, particularly those which have only one locality, and which are destitute of cleavage, such as Wagnerite and others, may also be pseudomorphous crystals, deriving their form from that of an unknown species. When the forms of cleavage correspond with the external forms of the mineral, all perplexity is removed; but if there should be no such correspondence, or no cleavage, the crystallographer is left in utter darkness. That which is merely external, and which, therefore, may be impressed by external causes, can never of itself be regarded as a secure ground for discriminating mineral species. Those properties which are internal, which have their origin in the nature of the molecules of the body itself, or in their mode of aggregation, and which are, therefore, incommunicable, and independent of all external circumstances, form the only secure basis of mineralogical classification.

Art. XI.—*Account of the Failure of the Suspension Bridge at Paris.* By John Robison, Esq. F. R. S. Edin. In a Letter to the Editor.

Dear Sir,

I regret that I am unable to give more than a very superficial reply to your inquiries relative to the failure of the Suspension Bridge at Paris, as I did not visit it after that event. On viewing it a few days before the accident happened, I saw enough to make me fear that it could not stand long; the greatest resistance which the supports could oppose to the pull of the chains having already begun to yield to the load of the unfinished roadway. To explain this it is necessary to describe the mode of attachment adopted in this bridge, as it differs essentially from any other which I have seen or heard of.

The supporting chains in this case, instead of proceeding in the direction DE, Plate IV. Fig 4. to be inserted in a mass of

* This curious subject will be treated in a subsequent article in this Number.

masonry, or other immoveable fixture, were deflected perpendicularly downward at A, through hollow masses of building, at the bottoms of which they were made fast. In order to prevent these masses from being pulled inward, their sides next the bridge were supported by buttresses of masonry, which in their turn were sustained by platforms (as at C) resting on piles.

If this construction had been executed in strict consonance with the theory which indicated it, the platform C would have been at right angles, and the piles parallel to a line bisecting the angle DAB formed by the chain, but the difficulty of driving piles when they deviate much from the perpendicular, probably prevented this from being done, and the masses as executed had a tendency to a movement of rotation round the point C. It could hardly be expected, under such circumstances, that this point should have remained fixed, even in dry weather; and, accordingly, it appears to have been from this part of the structure yielding inwards, that the whole gave way; fortunately the scaffolding on which the roadway had been formed, was still standing a few inches below it, and immediately relieved the chains of a great portion of their load, so that little damage was done to any part of the materials.

The indication of approaching failure which struck me during my short visit to the works of the bridge, was a vertical fissure which had taken place in the masses AB, the sides on which the chains pressed having receded about an inch from the opposite ones. This showed, that though the bridge had not been fully loaded, the pull of the chains had overcome both the resistance of the mass AC, and the adhesion of the masonry in AB. This had happened although the season had been remarkably dry, and it occurred to me that wet weather, by softening the ground, would cause a complete subversion. I understood afterwards (from report) that the great water main from Chaillot, which passed between the masses and the bridge about F, (and had perhaps contributed materially to their support) had been broken across by their pressure, and that the escape of its water hastened the work of destruction.

I may add, that considerable inconvenience seemed to have been experienced from the triple ranks of chains having been conducted so close to each other. The uppermost rank being most exposed to the direct influence of the sun, acted as a shade to the lower ones; it therefore expanded more than them, and subsided so as to lay both its own weight, and its share of that of the roadway, on the second rank.

The workmanship of the chains and the whole detail of the bridge seemed excellent, and it appears certain that, if the usual methods of securing the ends of the chains had not been departed from, this bridge would have continued to ornament its beautiful site, and to be an honourable monument to the learned engineer who planned it.

Length of the bridge from pillar to pillar,	170 metres	=	557 ft.	nearly.
The width - - - - - -	9½ -	=	31 ft.	———
Height of pillars above the roadway -	14 -	=	46 ft.	———

I am, Dear Sir,

Your very obedient servant,

John Robison

9 Athol Crescent, *Feb.* 1827.

P. S.—A detailed account of this bridge, and much valuable information, will be found in the interesting "*Mémoire sur lès Ponts suspendus, par M. Navier, Ingenieur en chef au Corps Royal des Ponts et Chaussées.*"—Paris, 1823.

Art. XII.—*Observations on the Bones of Hyenas and other Animals in the Cavern of Lunel, near Montpellier, and in the adjacent Strata of Marine formation.** By the Rev. W. Buckland, D. D. Professor of Mineralogy and Geology, Oxford.

The cave of Lunel is situated in compact *calcaire grossier*, with subordinate beds of globular calcareous concretions, and the whole of the rock having something of an oolitic structure. In working a freestone quarry of this *calcaire grossier*, the

* Having already (No. viii. p. 378) published a short description of this interesting cavern, as examined by M. Marcel de Serres, we are glad to be able to give an abstract of Professor Buckland's account of it, which was read at the Geological Society on the 17th November last. This abstract is taken from the *Phil. Mag.* No. i. p. 66, Jan. 1827. Professor Buckland visited the cave in March 1826, and has established nearly a perfect identity between the cavern of Lunel and those of England.

side of the present cavern was accidentally laid open, and considerable excavations have since been made in it, at the expence of the present government, for the purpose of extracting its animal remains, which lie buried in mud and gravel, and of searching for the aperture through which all these extraneous substances have been introduced. These operations have exposed a long rectilinear vault of nearly 100 yards in length, and of from ten to twelve feet in width and height. The floor is covered with a thick bed of diluvial mud and pebbles, occasionally reaching almost to the roof, and composed at one extremity chiefly of mud, whilst at the other end pebbles predominate.

Some vertical fissures in another quarry of *calcaire grossier* a few miles distant, are filled with similar materials to those within the cavern, and containing occasionally a few bones, sometimes cemented by calcareous infiltrations to a breccia like that of Gibraltar, Cette, and Nice. These materials are similar in substance to, and are uninterruptedly connected with, a superficial bed of diluvium that covers the surface of these quarries, and are identical with the general mass of diluvial detritus of the neighbourhood. Stalactite and stalagmite are of rare occurrence in the cavern of Lunel; hence neither its bones nor earthy contents are cemented with a breccia.

On examining the bones collected in the cavern by M. Marcel de Serres and his associate M. Cristol, Dr Buckland found many of them to bear the marks of gnawing by the teeth of ossivorous animals; he also discovered in the cave an extraordinary abundance of balls of *album græcum* in a high state of preservation. Both these circumstances, so important to establish the fact of the cave of Lunel having been inhabited, like that of Kirkdale, as a den of hyenas, had been overlooked by the French geologists. The more scanty occurrence of stalactite, and the greater supply of *album græcum* in that cavern than in those of England, are referred to one and the same cause, viz. the introduction of less rain water into the cave by infiltration than into that of Kirkdale; in the latter cave a large proportion of the fecal balls of the hyenas appears to have been trod upon and crushed at the bottom of a wet and narrow cave, whilst at Lunel they have been preserved by the greater size and dryness of the chamber in which they lay.

M. Marcel de Serres has published a list of the animal remains contained in this cavern, which differ but little from those of Kirkdale. The most remarkable addition is that of the beaver and the badger, together with the smaller shaped or Abyssinian hyenas. For these discoveries we are indebted to the exertions of M. Cristol, a young naturalist of Montpellier.

With respect to the bones of camels said to have been found in the cavern, Dr Buckland proved that the bone referred to does not belong to the camel. In some few parts of the diluvial mud there occur the bones of rabbits and rats; and M. Cristol also discovered the leg of a domestic cock. All these were found by Dr Buckland to be of recent origin, not adhering to the tongue when dry like the antediluvian bones. The rats and rabbits are supposed to have entered the cave spontaneously, and died in the holes which they had burrowed in the soft diluvial mud, and the cock's bone to have been introduced by a fox through a small hole in the side of the cavern, which had been long known as a retreat of foxes, in the bottom of an ancient quarry.

Some shells, similar to those which hybernate in the soil or fissures of the neighbouring rocks, are also found in the mud that filled the cave. The author considers that this may either be the shells of animals that in modern times have entered some small crevices in the side of the cavern to hybernate there, and have buried themselves in the mud; or that they entered in more ancient times, and died while the cave was inhabited by hyenas, and lay mixed by the bones before the introduction of the mud and pebbles; or that they were washed in by the same diluvial water which imported there the alluvial detritus in which they are now imbedded.

Dr Buckland draws a strong line of distinction between the mud and gravel of the caves and fissures, which he considers to be part of the general diluvium so widely spread over the adjacent country, and the local fresh water formations occurring also in the same neighbourhood of Montpellier; and which differ as decidedly from them, and bear to them the same relation, that the gravel on the summit of the Headen Hill in the Isle of Wight bears to the strata of fresh water limestone that lie beneath it.

The author next proceeds to consider the epoch of the deposition of the remains of quadrupeds that have been found in some extensive quarries of stone and sand in the Fauxbourg St Dominique at Montpellier, imbedded in a very recent marine formation, which has been described by M. Marcel de Serres in the fourth volume of the *Linn. Trans.* of Paris.

In the central beds of this deposit the remains of the elephant, rhinoceros, hippopotamus, mastodon, ox, and stag, are found intermingled with those of cetacea, dugong, or lamantins; they are more or less rolled, and are occasionally covered with marine shells. Beds of oysters also, (*ostrea crassissima* of Lamarck,) and barnacles, occur in horizontal and nearly parallel strata, amid the marine sand, and show that this deposition has taken place gradually, and at successive though short intervals, rather than to have resulted from a sudden marine eruption. The period of the deposition is supposed to have been that which immediately preceded, and was terminated by, the last grand aqueous revolution which formed the diluvium.

To a similar and contemporaneous period with this upper marine formation of Montpellier, he refers the bones of the elephant, rhinoceros, &c. with marine shells, (oysters and adhering barnacles,) that have been found in certain parts of the Sub-Apennine Hills, and also the bones of similar quadrupeds and shells that occur in the crags of Norfolk and Suffolk.

To the same period also he assigns the bones of the osseous breccia of Gibraltar, Cette, and other fissures in caves along the north coast of the Mediterranean; and the accumulation of the remains of bears, hyenas, &c. in the caves of Germany, England, and France. He also attributes the same date to the bones of similar animals found bedded in the sediments of the antediluvian fresh water lake of the upper Val D'Arno.

Observations on another Cavern at Lunel and one at Cadillac.

We have been indebted to John Robison, Esq. for the following recent information respecting another cavern at Lunel, and a new one discovered at Cadillac.

A wine proprietor in Lunel, while enlarging his cellar, has broken into a cavern containing many bones, and I believe entire skeletons, some of lions I hear. A box of them will be here soon, which my friend Mr Exshaw has procured for me. I have a letter from him, dated the 30th January, in which he says, "A discovery somewhat similar has been made at Cadillac, fifteen miles above Bordeaux. It differs from the Lunel cavern," (that of the proprietaire,) "by the size being much smaller, and by the species of bones found in it. With the exception of those of the hyena, (which are in great quantity,) the others are of the herbivorous species, all bearing the evident marks of being partly devoured by the hyena."

Art. XIII.—*Observations made at Port Macquarie, Van Dieman's Land, for the purpose of determining the Decrease of Heat in Ascending in the Atmosphere.* Communicated to the Editor by Sir Thomas Brisbane, K. C. B. F. R. S. Lond. & Edin. and Corresponding Member of the Academy of Sciences of Paris.

There is no department of meteorology less understood, and at the same time more important, than that which relates to the law of variation in the temperature of the atmosphere at different heights. It is closely connected with the difficult subject of astronomical refractions, and without its aid we cannot reduce to the level of the sea the annual mean temperatures of different points upon the earth's surface.

It is generally assumed that the temperature decreases 1° of Fahrenheit for every 300 feet that we ascend in the atmosphere; but this must vary not only with the mean temperature of the place, but with various circumstances in the relative situation of the two heights at which the observations are made. If the lowest point is on a level plain, and the highest in the free air, the decrease must be very different from what it will be if the lowest point is the bottom, and the highest the top of a mountain; or if the observations are made at the lowest and highest points of a great city; or at the sea side, and on the summit of a hill in the interior. In these different cases a different law must prevail, and this law can only be deduced from numerous and accurate sets of observations.

Even in the first case, where the highest point is in the free air, no decrease of heat was observed in the arctic regions. This curious experiment was made by Captain Parry and the Reverend George Fisher. "This was done by means of a paper kite, to which was attached an excellent register thermometer, in a horizontal position. Its height above the level of the frozen sea, upon which the experiment was made, was determined by two observers, in the same vertical plane, taking its altitude, at the same time, above the distant horizon; and from thence its height was computed. The greatest height observed was 379 feet, at which height it was nearly stationary for about a quarter of an hour. It probably, however, had been more than 400 feet above the sea. After an unsuccessful attempt, the experiment was made under very favourable circumstances, the kite being sent up, and caught in coming down, without the slightest shake. *The indices had not altered their position in the slightest degree*, and they would have indicated any variation of temperature, had it existed to less than a quarter of a degree of Fahrenheit. The temperature at the time was — 24° Fahrenheit." Upon this experiment Dr Young * remarks, "The theory is greatly illustrated by Mr Fisher's very valuable experiment with the kite, which shows that the law of decrease of temperature must be supposed to be very different in the arctic regions from that which prevails in more moderate latitudes; but it serves fully to prove the impossibility of forming any hypothesis respecting the constitution of the atmosphere which shall be universally correct."

The observations contained in the following table possess great interest, especially as they were made *five* times a day. The following are the means for an altitude of 65 — 13 = 52 feet.

		Fahr.
Mean Difference of temperature at Sunrise,		— 6.°
	at 9h A. M.	— 9. 01
	Noon,	— 7. 55
	3h P. M.	— 5. 5
	Sunset,	— 3. 5
General Mean,		— 6.° 31

* *Quarterly Journal*, No. xlii. p 364.

			Fahr.
Maximum Difference	at Sunrise,		— 13°.
	9h A. M.		— 25
	Noon,		— 18
	3h P. M.		— 11
	Sunset,		— 9½
Minimum Difference	at Sunrise,		0
	9h A. M.		+ 1½
	Noon,		+ ½
	3h P. M.		0
	Sunset,		+ 3

Out of the 108 observations recorded, there were only four in which the temperature at the highest station exceeded that of the lowest station, and the excess in these cases was ½°, 1°, 1½°, and 3°.

Diary of a Thermometer kept at Port Macquarie, 13 *Feet above the level of the Sea, and at the Barrack Hill, at an elevation of* 65 *Feet above the Sea.*

1824.	Sunrise.			9 o'Clock.			Noon.			3 o'Clock.			Sunset.		
	Thermometer.			Thermometer.			Thermometer.			Thermometer.			Thermometer.		
	13ft	62ft	Dif.	13ft	62ft	Dif.	13ft	62ft	Dif.	13ft	62ft	Dif.	13ft	62ft	Dif.
June 1.	58½°	58½°	0°	67°	60½°	6½°	74½°	70½°	4°	74°	71°	3°	70°	64½°	5½°
2.	58	52	6	73	71½	1½	80	72	8	75	71½	3½	70½	61	9½
3.	63½	50½	13	65½	58	7½	73	65	8	75	69	6	69	62½	6½
4.	57	51	6	68	52½	15½	75½	70	5½	71	67	4	69½	65	4½
5.	57	50	7	76	51	25	77	68½	8½	70	65½	4½	71	67½	3½
6.	62	51½	10½	63½	54	9½	72½	67	5½	72	69½	2½	69	65	4
7	60	52½	7½	65	58	7	73½	70	3½	70	67	3	68	67½	0½
8.	61	49½	11½	71	63	8	73	64	9	70½	65	4½	69	68	1
9.	58	47	11	71	58	3	82	67	15	72	68	4	70	67	3
10.	54	47½	6½	74	57	17	82	66½	15½	73	67½	5½	72	64½	7½
11.	59	52½	6½	66	58	8	83	65	18	73½	66	7½	64	65	+1
12.	53	48	5	71	57½	13½	70½	65½	5	75	69	6	66	61½	4½
13.	59	56	3	62	59	3	72	64	8	76	67½	8½	65	62	3
14.	62	58	4	64	52½	11½	65	64	1	67	67	0	66½	63½	3
15.	60	50½	9½	70	60	10	78½	65½	13	68	57	11	68	67	1
16.	52½	46	6½	64	55½	8½	71½	67	4½	64½	57½	7	61	55	6
17.	52	47½	4½	66	55½	10½	72	67½	4½	67	59	8	64	61½	2½
18.	54	52½	1½	72½	57¼	15¼	76	69	7	70	64½	5½	64	62½	1½
19.	56	53½	2½	64	52½	11½	67½	65	2½	71	67	4	67	61½	5½
20.	56	53	3	60	56	4	75	71½	3½	72	68½	3½	67½	63	4½
21.	54½	50	4½	51	52½	+1½	55	55½	+½	70	67	3	62	65	+3
22.	51	47	4	60½	54	5½	67	50½	16½						
			— 6°.00			— 9°.01			— 7.55			—5°.½			— 3°.5.
Means,	General Mean, = — 6°.37														

*Abstract of Calculations of the first 20 * days of a Meteorological Diary kept at Port Macquarie, for June 1824.*

	Bar. Inches.	Ther. Fahr.	Ther. † Fahr.
Maximum, -	30.40	83°	72°
Minimum, -	29.31	52	46
Mean, -	30.12	67.44	61.15

Art. XIV.—*On the Mean Temperature of Chapel Hill, North Carolina, as determined by* President Caldwell.

In determining the laws of the distribution of heat on the earth's surface, there is a particular interest attached to observations made on the American continent, and that interest increases, if the observations are made either near the arctic circle, or towards the tropics.

We were therefore, much gratified with the following observations, made at Chapel Hill, North Carolina, in lat. 35° 54′, which are published in the *American Journal of Science,* vol. x. part ii.

	1820. Mean Temp.	1821. Mean Temp.	1822. Mean Temp.
January, -	36°.86	35°.32	36°.65
February, -	56. 80	49. 17	43. 93
March, -	50. 80	47. 95	53. 71
April, -	63. 50	57. 20	61. 29
May, -	66. 36	68. 01	69. 24
June, -	78. 00	77. 00	78. 00
July, -	78. 16	76. 00	79. 88
August, -	76. 03	77. 33	75. 90
September, -	71. 20	75. 44	72. 14
October, -	56. 81	61. 86	64. 76
November, -	50. 52	45. 91	59. 56
December, -	44. 76	39. 19	43. 33
Mean,	59°.89	59°.19	61°.53

* As the original tables contain nearly 22 days' observations, we have retained them in our averages.—Ed.

† This thermometer was kept on the Barrack Hill, at an elevation of 65 feet above the level of the sea, and 52 feet above the other thermometer.

From the average of these three years, the mean annual range is 87°.5. The mean annual temperature was found to occur nearly at 10^h A. M.

President Caldwell remarks, " that the annual mean from the observations of 1820 and 1821 is 59° 54. The observations of 1822, he adds, would carry it a little higher, but the accuracy of this last is doubtful."

Assuming, therefore, with President Caldwell, that the mean temperature of Chapel Hill is - - 59°.54

We have the temperature calculated by Dr Brewster's formula, viz. - - $T=86.3 \sin. D-3\frac{1}{2}°=57°.7$

Difference between the formula and observation, 1°.84

Art. XV.—*Account of an Improvement on the Nautical Eye-Tube. By David Brewster, LL.D. F.R.S. Lond. and Sec. R. S. Ed.**

A description of Mr Adams's nautical eye-tube was communicated to this society last winter, and was accompanied by certificates of its excellent performance on board the Clio. Mr Adams was not able to illustrate by one of the instruments themselves; but I have now the satisfaction of submitting to the society a perfect instrument, through the kindness of Mr Copland and Mr Park, of his Majesty's ship the Diamond, by both of whom it has been frequently used in their voyages across the Atlantic. This instrument was ordered by Lord Napier for the purpose of submitting Mr Adams's invention to a fair trial.

The principle of Mr Adams's construction will be understood from Plate IV. Fig. 5, where ACBD is the field of view of the sextant telescope, to which the eye-piece is applied. A piece of mirror glass GH, is placed obliquely above a small level at L, so as to reflect the image of the bubble up to EF, immediately above the field of view. Two marks, M, N, are

* Read before the Society of Arts for Scotland, February 6, 1827. Mr Adams's invention is fully described in this Journal, No. vii. p. 95.

made upon the mirror, and the parts are so adjusted, that when the wire AB is in contact with the upper limb of the sun and the image of the bubble EF exactly between the marks M and N, the axis of the telescope is in a true horizontal line.

In making this observation, the eye sees by direct vision the contact of the sun with the wire AB, and by oblique vision, the contact of the bubble with one or both of the marks M, N. This double and simultaneous observation is difficult to make; but, independent of this difficulty, there is a property of vision, in virtue of which an object seen obliquely disappears as if it had been completely annihilated.

On this and other grounds Mr Adams's eye-tube has always appeared to me susceptible of improvement. The first idea of this kind which occurred to me is shown in Fig. 6, where the field of view ACBD is contracted, and consists of a perforation in the reflecting mirror. The parts are then adjusted, so that when the wire AB touches the sun, the bubble AMBN is concentric with the field of view ACBD. This approximation of the bubble to the observed limb of the sun is an obvious advantage, but as it is liable to the objection formerly stated against oblique vision, I thought of the method shown in Fig. 7. In this method I dispense entirely with a metallic reflector, and I form the image of the bubble by a plate of parallel glass PD, lying between the eye and the field CD, and inclined 45° to the axis of the tube. By this means the bubble may be brought in contact with the wire AB; and the parts are adjusted, so that the axis of the telescope is horizontal when the wire AB is in contact with the lower end of the bubble, and the upper surface of the sun. The only objection to this construction is, that the glass plate PD reflects little light; but this may be completely remedied by placing the darkening glass anterior to the field of view, or by throwing an additional light upon the bubble of the level.

Art. XVI.—*On the Temperature of the North West Coast of America.* By Mr Scouler. Communicated by the Author.

Every traveller who has visited the N. W. coast of America has remarked the uncommon mildness of its climate when compared with that of the eastern side of the continent in the same parallel of latitude. While the inhabitants of Quebec are subjected, during the winter months, to all the severity of the most intense cold, the natives of the Columbia, in nearly the same latitude, are almost strangers to the phenomena of frost and snow, and go about during the coldest season of the year in a state little different from nudity.* The most obvious cause of this remarkable difference of temperature between the two coasts of North America, arises from the N. W. winds which pass over a great extent of the Pacific Ocean, bringing a supply of heat and moisture along with them. The moisture of the country is however excessive, so that from November till March the Indians rarely travel far, on account of the almost incessant showers. The most correct idea of the climate of Columbia will be obtained from the following tables, constructed from the observations made by a gentleman who resided for several years at Fort George. These tables, however, can only be regarded as approximations to accuracy, as the observations were made at the same period of the day during every season of the year, and I am afraid sufficient attention was not paid to the situation of the thermometer. The observations were made at 6 A. M., Noon, and at 6 P. M., and the thermometer was placed in a northern situation.

In the two following tables the first and second columns give the observed extremes of temperature, and the third gives the mean of all the observations made during each month.

Table of the Temperature of Fort George, Columbia, Lat. 46° 18′ *Long.* 123° *W. from June* 1821 *to June* 1822.

1821, 1822.	Max.	Min.	Mean.
June,	72°	53°	$60\frac{2}{3}$°
July,	72	52	$61\frac{1}{3}$
August,	69	58	$62\frac{1}{3}$
September,	65	48	$59\frac{1}{3}$
October,	66	44	57

* Notwithstanding this mildness of temperature, the *Linnæa borealis*, which usually prefers a cold climate, is found in abundance on the N. W. coast so far south as lat. 46°.

1821, 1822.	Max.	Min.	Mean.
November,	56°	38°	$45\frac{2}{3}$°
December,	48	19	34
January,	53	32	$34\frac{3}{4}$
February,	55	33	$43\frac{1}{3}$
March,	63	31	$46\frac{1}{3}$
April,	61	38	50
May,	62	41	$50\frac{1}{3}$
Mean Annual Temp.			50.°5

Table of the Temperature of Fort George, from April 1823 *to April* 1824.

1823, 1824.	Max.	Min.	Mean.
April,	60°	33°	$47\frac{1}{3}$°
May,	76	46	$57\frac{1}{2}$
June,	79	47	$58\frac{1}{2}$
July,	73	53	$61\frac{1}{2}$
August,	88	52	63
September,	79	49	$59\frac{3}{4}$
October,	68	40	$55\frac{1}{4}$
November,	62	40	$49\frac{1}{2}$
December,	56	31	$45\frac{1}{3}$
January,	49	25	$37\frac{1}{2}$
February,	55	29	$41\frac{1}{2}$
March,	65	23	$43\frac{1}{4}$
Mean Annual Temp.			51.°7

The following table contains the results of observations made for two years.

	Annual Mean Temp.	Mean Temp. Winter.	Mean Temp. Spring.	Mean Temp. Summer.	Mean Temp. Autumn.	Mean Temp. hottest Month.	Mean Temp. coldest Month.
1821–2	50.°5	38.°	46°	57.°	59.°	61.°	34.°
1823–4	51. 7	46.6	44	59.6	59.3	63.1	37.5

Art. XVII.—*Magnetical Observations on the Variation and Dip of the Needle, made during the Voyage of the Coquille from Toulon to Port Jackson, in* 1822, 3, and 4. By M. Duperrey, Commander of the Expedition. Communicated by Sir Thomas Makdougall Brisbane, K. C. B. F. R. S. London and Edinburgh.

When M. Duperrey, the distinguished commander of the Coquille, which performed the last voyage of discovery fitted out by the French government, visited Port Jackson on his return home, he communicated to Sir Thomas Brisbane, Governor of New South Wales, the complete series of his magnetical observations. In order to promote the interests of science, Sir Thomas has kindly given us the use of this MS. for the purpose of publishing an abstract of its leading results.

The scientific reader will not fail to observe the great importance of these observations, in reference to the determination of the form of the magnetic curves, and of the position of the magnetic equator, and the magnetic poles of the earth.

The two dipping compasses employed by M. Duperrey were the same which were used by Captain Freycinet on board the Uranie. One of these was intended to be used only on shore, while the other, which was mounted with a double suspension, was particularly destined for being used at sea. The first of these compasses had *four* needles, and the second *two*, and wherever they were observed, either at land or at sea, their poles were changed by twenty frictions given upon each of their faces by means of strongly magnetised bars. The recorded *inclination* or *dip* of the needle is the mean of the observed inclinations taken before and after the change of poles.

In order to understand the following tables, it may be remarked that the north point of the needle is the one which is directed freely to the pole of the same denomination.

The inclinations which have no sign, indicate that the north point of the needle is below the horizontal line, so that the observation is made to the north of the magnetic equator; while those that have the sign—indicate that the north point is above the horizontal line; and, consequently, that the observation is made to the south of the magnetic equator.

The declination of the needle was observed on shore by means of a small compass, with a telescope, which had been previously employed in hydrographical voyages by M. Gautier, Captain of the Coquille.

When the azimuth of a terrestrial object had been determined by numerous observations taken with a geodetic circle, the object was observed with the compasses above mentioned, and the definitive declination was that which resulted from the readings taken at the two extremities of the needle, before and after the return of the instrument, and before and after the reversing of the needle in its case.

The magnetic power of the Coquille was measured with every possible accuracy, and presented nothing that was remarkable.

Before the expedition sailed the dip was observed at Toulon in June 1822.

Lat. 43° 7′ 9″. Long. 6° 0′ 41″. Mean Dip. 63° 57′ 9″

The following observations were made in the voyage from Toulon to St Catherine's, in Brazil, in August, September, and October 1822.

Lat.			Long.			Mean Variation.		Mean Dip.		
29°	43′	0 N.	14°	30′	9″ W.	21°	0′ N.	57°	40′	3
28	28	47	16	13	15	21	0.6	57	6	2
24	24	0	20	8	45	16	33	55	22	7
15	50	12	25	29	12	15	15	47	21	
13	44	47	25	30	37	15	15	45	6	3
6	56	39	20	38	5	12	0	33	10	5
2	49	35	21	58	52	12	51	26	36	7
1	18	19 N.	23	58	49	12	57½	23	49	5
0	13	30 S.	24	16	37	13	40	19	41	9
1	40	9 S.	23	37	15	12	45	18	35	1
2	47	37	23	49	16	11	30	18	13	6
4	34	52	24	4	36	12	30	15	15	5
6	20	19	24	17	9	11	30	11	7	
11	13	56	24	33	55	8	0	2	9	4
11	42	31	24	41	13	8	0	1	37	3
12	27	11	24	58	7	8	0	0	0	
12	55	12	25	10	14	8	0	— 0	11	
12	24	40	25	20	15	8	0	— 0	51	3
14	42	30	25	51	5	9	0	— 3	13	2

Lat.			Long.			Mean Variation.		Mean Dip.		
16°	43′	10	26°	19′	45	8°	0′	— 6°	28′	8
19	30	29	27	15	43	7	56	—11	1	2
21	11	27	30	18	15	3	20	—12	42	
25	33	12	41	23	55	5	10	—20	25	5
27	18	0	46	11	45	6	30	—23	7	2

At St Catherine's, in south lat. 27° 25′ 36″ and west long. 48° 29′ 15.4, the dip was—22° 47′ 7, and the variation 6° 26′ 14″ 7 N. E. In the expedition of M. Roussin in 1819, the variation was 7° 29′ 26″.

The following observations were made during the voyage from St Catherine's to the Malouine Islands in October 1822.

Lat.			Long.			Mean Variation.		Mean Dip.		
40°	0	0 S.	37°	39′	45 W.	11°	22 E.	— 41°	34′	1
46	44	0 S.	44	23	45	17	21	— 50	58	2

At the Malouine Isles in November 1822, in lat. 51° 31′ 42″8, and long. 58° 3′ 54″ 7, the variation was 19° 7′ 19″ 7 N. E. and the dip 54° 43′ 3.

During the voyage from the Malouines to Conception, in Chili, in lat. 57° 52′ 17′ S., and long. 76° 47′ 52″ west, the variation was 27° 6′ 22″ east, and the dip—65° 35′ 19.

At Conception, in lat. 36° 42′ 18″, 48 S. and long. 73° 11′ 45″ west, the variation was 16° 16′ 23 N.E., and the dip.—44° 42.′

The following observations were made during the voyage from Conception to Lima, in February 1823:

Lat.				Long.			Variation.			Dip.	
28°	30′	0 S.		74°	39′	45″ W.	11°	37′	13″ N.E.	—33°	38′,1
26	12	25		75	17	52	13	19		—30	5,1
23	56	59		75	46	0	13	0		—27	11,6
21	53	0		76	25	1	11	23	30	—26	17,2
19	41	0		76	37	6	9	47	24	—20	11,5
16	56	0		76	38	35	9	15	47	—14	50,2
14	5	0		76	39	45	9	33		— 9	54,6
13	0	0		76	47	35	8	2		— 8	25,6
12	3	20	Callao	77	1	45	9	30		— 8	33,3

The following observations were made in the voyage from Lima to Bayta.

Lat.	Long.	Variation.	Dip.
11° 15′ 20 S.	78° 20′ 1″ W.	8° 27′ 38″ N.E.	—7° 5′,9
10 5 21	79 12 36	8 31 48	—4 7,6
8 54 0	80 11 30	7 42 0	—2 19,3
8 24 4	80 34 41	7 42 0	—1 41,3
7 45 0	81 17 45	8 23 35	—0 11,4
6 53 0	81 10 45	8 23 35	+1 50,8

At Bayta, between the terrestrial and the magnetic equator, in March 1823, in lat. 5° 5′ 50″. 6 S. and long. 80° 58′ 5″ W. the variation was 8° 55′ 37″ N.E. and the dip. + 4° 6′.8.

(To be concluded in next Number.)

ART. XVIII.—*Notes on the Habits of the Wild Pigeon of America, Columba migratoria.* * By JOHN JAMES AUDUBON, Esq. F. R. S. Edin. M. W. S., &c. &c. and Member of the Lyceum of New York. Communicated by the Author.

THE most important facts connected with the habits of these birds relate to their extraordinary associations and migrations. No other species known to naturalists is more calculated to attract the attention of either the citizen or the stranger, as he has opportunities of viewing both of these characteristic habits while they are passing from north to south, east and west, and *vice versa* over and across the whole extent of the United States of America.

These remarkable migrations are owing entirely to the dire necessity of providing food, and not merely to escape the severity of a northern latitude, or seek a southern one for the purpose of breeding. They consequently do not take place at any fixed period or season of the year. Indeed, it happens sometimes that a continuance of a sufficient supply of food in one district will keep those birds absent from another for years. I know at least to a certainty, that in Kentucky they remained for several years constantly, and were nowhere else to be found. They all disappeared one season suddenly when the mast was exhausted, and thus did not return for a long period. The same facts have been observed in other states.

Their great power of flight enables them when in need to survey and pass over an astonishing extent of country in a

* Read before the Royal Society of Edinburgh, Feb. 19, 1827.

very short time. This is proved by facts known to the greater number of observers in America. Pigeons, for example, have been killed in the neighbourhood of New York, with their crops still filled with rice, collected by them in the fields of Georgia and Carolina, the nearest point at which this supply could possibly have been obtained; and as it is well ascertained, that, owing to their great power of digestion, they will decompose food entirely in twelve hours, they must have travelled between 300 and 400 miles in six hours, making their speed at an average about one mile in a minute, and this would enable one of these birds, if so inclined, to visit the European continent, as swallows undoubtedly are able to do, in a couple of days.*

This great power of flight is seconded by as great a power of vision, which enables them, as they travel at that swift rate, to view objects below, to discover their food with facility, and thus put an immediate end to their journey. This I have also proved to be the case, by having observed the pigeons, when passing over a destitute part of the country, keep high in air, and in such an extensive front, as to enable them to survey hundreds of acres at once. But if, on the contrary, the land is richly covered with food, or the trees with mast, they will fly low in order to discover the portion most plentifully supplied, and upon these they alight progressively.

The form of the bodies of these swift travellers is an elongated oval, steered by a long well-plumed tail, furnished with extremely well set and very muscular wings for the size of the individual. If a single bird is seen gliding through the woods and close by, it passes apparently like a thought; and on trying to see him again, the eye searches in vain—the bird is gone!

Their multitudes in our woods are astonishing; and, indeed, after having viewed them so often, and under so many circumstances, for years, and, I may add, in many different climates, I even now feel inclined to pause, and assure myself afresh that what I am going to relate is fact. That I have

* A specimen of the *Columba migratoria* was shot in Fifeshire in January 1826. See this *Journal*, vol. iv. p. 276.

seen it is most certain; and I have seen it all in the company of hundreds of other persons looking on, like myself, amazed, and wondering if what we saw was really true.

In the autumn of 1813, I left my house at Henderson, on the banks of the Ohio, on my way to Louisville. Having met the pigeons flying from north-east to south-west, in the barrens or natural wastes a few miles beyond Hardensburgh, in greater apparent numbers than I thought I had ever seen them before, I felt an inclination to enumerate the flocks that would pass within the reach of my eye in one hour. I dismounted, and, seating myself on a tolerable eminence, took my pencil to mark down what I saw going by and over me, and made a dot for every flock which passed

Finding, however, that this was next to impossible, and feeling unable to record the flocks, as they multiplied constantly, I rose, and counting the dots then put down, discovered that 163 had been made in twenty-one minutes. I travelled on, and still met more the farther I went. The air was literally filled with pigeons; the light of noon-day became dim, as during an eclipse; the pigeons' dung fell in spots, not unlike melting flakes of snow; and the continued buz of their wings over me, had a tendency to incline my senses to repose.

Whilst waiting for my dinner at Young's Inn, at the confluence of Salt River with the Ohio, I saw, at my leisure, immense legions still going by, with a front reaching far beyond the Ohio on the west, and the beech wood forests directly on the east of me. Yet not a single bird would alight; for not a nut or acorn was that year to be seen in the neighbourhood. They consequently flew so high, that different trials to reach them with a capital rifle proved ineffectual, and not even the report disturbed them in the least. But I cannot describe how beautiful their aërial evolutions were, if a black hawk appeared in their rear. At once, like a torrent, and with a thunder-like noise, they formed themselves into almost a solid compact mass, pressing each on each towards the centre; and when in such solid bodies, they zig-zagged to escape the murderous falcon, now down close over the earth sweeping with inconceivable velocity, then ascending perpendicularly, like a vast monument; and when high were seen wheeling and twisting within their continued lines, resembling the coils of a gigantic serpent.

Before sunset I reached Louisville, distant from Hardensburgh fifty-five miles, where the pigeons were still passing, and this continued for three days in succession.

The people were indeed all up in arms, and shooting on all sides at the passing flocks. The banks of the river were crowded with men and children, for here the pigeons flew rather low as they passed the Ohio. This gave a fair opportunity to destroy them in great numbers. For a week or more the population spoke of nothing but pigeons, and fed on no other flesh but that of pigeons. The whole atmosphere during this time was strongly impregnated with the smell appertaining to their species.

It is extremely curious to see flocks after flocks follow exactly the very evolutions performed by a preceding one, when they arrived at the place where these manœuvres were displayed. If a hawk, for instance, has chanced to charge on a portion at a certain spot, no matter what the zigzags, curved lines, or undulations of lines might have been during the affray, all the following birds always keep the same track; so that if the traveller happens to see one of those attacks, and feels a wish to have it repeated, he may do so by waiting for a short time.

It may not, perhaps, be out of place to attempt an estimate of the number of pigeons contained in one of those mighty flocks, and the quantity of food daily consumed by its members. The inquiry will show the astonishing bounty of the Creator in his works, and how universally this bounty has been granted to every living thing on that vast continent of America.

We shall take, for example, a column of one mile in breadth, which is far below the average size, and suppose it passing over us without interruption for three hours, at the rate mentioned above, of one mile per minute. This will give us a parallelogram of 180 miles by 1, covering 180 square miles, and allowing two pigeons to the square yard, we have one billion one hundred and fifteen millions one hundred and thirty-six thousand pigeons in one flock; and as every pigeon consumes fully half a pint of food per day, the quantity must be eight millions seven hundred and twelve thousand bushels per day which is required to feed such a flock.

As soon as these birds discover a sufficiency of food to entice them to alight, they fly round in circles, reviewing the country below, and at this time exhibit their phalanx in all the beauties of their plumage; now displaying a large glistening sheet of bright azure, by exposing their backs to view, and suddenly veering, exhibit a mass of rich deep purple. They then pass lower, over the woods, and are lost among the foliage for a moment, but they reappear as suddenly above; after which they alight, and, as if affrighted, the whole again take to wing with a roar equal to loud thunder, and wander swiftly through the forest to see if danger is near. Impelling hunger, however, soon brings them all to the ground, and then they are seen industriously throwing up the fallen leaves to seek for the last beech-nut or acorn; the rear ranks continually rising, passing over, and alighting in front in such quick succession, that the whole still bears the appearance of being on the wing. The quantity of ground thus swept up, or, to use a French expression, *moissonée,* is astonishing, and so clean is this work, that gleaners never find it worth their while to follow where the pigeons have been. On such occasions, when the woods are thus filled with them, they are killed in immense numbers, yet without any apparent diminution. During the middle of the day, after their repast is finished, the whole settle on the trees to enjoy rest, and digest their food; but as the sun sinks in the horizon, they depart *en masse* for the roosting-place, not unfrequently hundreds of miles off, as has been ascertained by persons keeping account of their arrival and of their departure from their curious roosting-places, to which I must now conduct the reader.

To one of those general nightly rendezvous, not far from the banks of Green River in Kentucky, I paid repeated visits. It was, as is almost always the case, pitched in a portion of the forest where the trees were of great magnitude of growth, but with little underwood. I rode through it lengthwise upwards of forty miles, and crossed it in different parts, ascertaining its average width to be rather more than three miles. My first view of it was about a fortnight subsequent to the period when they had chosen this spot, and I arrived there nearly two hours before the setting of the sun. Few pigeons were then to be seen, but a great number of persons with horses and waggons, guns, and ammunition, had already established different camps on the borders. Two farmers from the vicinity of Russelsville, distant more than 100 miles, had driven upwards of 300 hogs to be fattened on pigeon-meat; and here and there the people, employed in picking and salting what had already been procured, were seen sitting in the centre of large piles of those birds, all proving to me that the number resorting there at night must be immense, and probably consisting of all those then feeding in Indiana, some distance beyond Jeffersonville, not less than 150 miles off. The dung of the birds was several inches deep, covering the whole extent of the roosting-place like a bed of snow. Many trees, two feet in diameter, I observed, were broken at no great distance from the ground, and the branches of many of the largest and tallest so much so, that the desolation already exhibited equalled that performed by a furious tornado. As the time elapsed, I saw each of the anxious persons about to prepare for action; some with sulphur in iron pots, others with torches of pine knots, many with poles, and the rest with guns double and treble charged. The sun was lost to our view, yet not a pigeon had yet arrived,—but all of a sudden I heard a general cry of "*Here they come!*" The noise which they made, though distant, reminded me of a hard gale at sea, passing through the rigging of a close reefed vessel. As the birds arrived, and passed over me, I felt a current of air that surprised me. Thousands were soon knocked down by the polemen. The current of birds, however, kept still increasing. The fires were lighted, and a most magnificent, as well as wonderful and terrifying, sight was before me. The pigeons, coming in by millions, alighted everywhere, one on the top of another, until masses of them resembling hanging swarms of bees as large as hogsheads, were formed on every tree in all directions. These heavy clusters were seen to give way, as the supporting branches, breaking down with a crash, came to the ground, killing hundreds of those which obstructed their fall, forcing down other equally large and heavy groupes, and rendering the whole a scene of uproar and of distressing confusion. I found it quite useless to speak, or even to shout to those persons nearest me. The reports even of the different guns were seldom heard, and I knew only of their going off by seeing the owners re-load them.

No person dared venture within the line of devastation, and the hogs had been penned up in due time, the picking up of the dead and wounded sufferers being left for the next morning's operation. Still the pigeons were constantly coming, and it was past midnight before I perceived a decrease in the number of those that arrived. The uproar continued, however, the whole night; and as I was anxious to know to what distance the sound reached, I sent off a man, who, by his habits in the woods, was able to tell me, two hours afterwards, that at three miles he heard it distinctly. Towards the approach of day the noise rather subsided; but long ere objects were at all distinguishable, the pigeons began to move off in a direction quite different from that in which they had arrived the day before, and at sunrise none that were able to fly remained. The howlings of the wolves now reached our ears, and the foxes, the lynx, the cougars, bears, rackoons, opossums, and pole-cats, were seen sneaking off the spot, whilst the eagles and hawks of different species, supported by a horde of buzzards and carrion-crows, came to supplant them, and reap the benefits of this night of destruction.

It was then that I, and all those present, began our entry amongst the dead and wounded sufferers. They were picked up in great numbers, until each had as many as could possibly be disposed of; and afterwards the hogs and dogs were let loose to feed on the remainder.

Persons unacquainted with these birds must naturally conclude, that such dreadful havoc must soon put an end to the species; but this is very far from being the case, for, by long observation, I have satisfied myself, that, as they not unfrequently quadruple their numbers yearly, and always at least double it, nothing but the gradual diminution of our forests can accomplish their decrease. In 1805 I have seen schooners loaded in bulk with pigeons caught up the Hudson river, coming in to the wharf at New York, and those birds sold for a cent a-piece. I knew a man in Pennsylvania, who caught and killed upwards of 500 dozens in a clap-net in a day, sweeping sometimes twenty dozens or more at one haul.

I have also seen the negroes at the United States Salines, or salt-works of Shawanee Town, wearied with killing pigeons, as they alighted to drink the water issuing from the leading pipes, for weeks at times; and yet in 1826, in Louisiana, I saw congregated flocks of those birds as numerous as ever I had seen them before, during a residence of nearly thirty years in the United States.

The greater portion of the time alluded to has been employed in studying, with the greatest care, the particular habits of each feathered individual in North America, with a view to publish at last its complete Ornithology;—but to return to our more immediate subject.

The breeding of the wild pigeons, and the places chosen for that purpose, are points of great interest. As I have said before, the time set apart for this is not influenced by climate or season, but generally takes place where and when food is most plentiful and most attainable, and always at a convenient distance from the water, and in high timbered forests. The spot generally chosen is not, like that above described, a scene of confusion and death, but one where, it is no exaggeration to say, the tenderest affection seems to prevail. To this place these countless myriads of pigeons fly, and settle to coo, and, with parental care, begin their nests in general peace and harmony. On the same tree, from 50 to 100 nests may be seen, formed of slight materials, being only composed of a few dried twigs, crossed in different ways, supported by suitable forks in the branches, from the lowest to the highest, and each mate partakes in the task of incubation. The females lay two white eggs each, proportioned to the size of the bird, and as they sit the greater portion of this precious time, the males feed them from bill to bill, with amorous tenderness and care.

The young are hatched, and would grow and leave the nest in course of time, did not man discover the place, and commence his work of devastation. Armed with axes, their enemies reach the spot, to seize and destroy all they can. The trees are felled, and are made to fall in such a way, that the cutting of one causes the fall of one or two more, or shakes others in such a manner, that the squabs or young pigeons are violently hurried to the ground. Their tender juicy flesh is no great trial, it may be supposed, to man's compassion, and the poor birds are eaten up under the eye of their fluttering parents, without any pangs of remorse.

ART. XIX.—*On the Developement of Magnetism by Rotation, in reply to Mr Christie.* By P. BARLOW, Esq. F. R. S. Mem. Imp. Ac. Petrop. &c. Communicated by the Author.

DEAR SIR,

As I am equally anxious with Mr Christie to put a stop to the correspondence so unnecessarily begun in your *Journal*, I shall content myself by replying principally to his remark respecting the authorship of the historical sketch. On this head I beg to state that, with the exception pointed out in my former letter, I wish him to consider me responsible for the accuracy of the several points to which he has thought proper to object; but, at the same time, it is right that I should say I am not the author of the entire paper in the form in which it appears in your *Journal*. I think it necessary to state this, because I feel, that, however unintentionally, too much credit is given in that article to the English experiments, as contrasted with those of the French. I have certainly always considered M. Arago's experiments as an entire and distinct series; developing a beautiful and independent system of forces, neither suggested by, nor derivable from, any experiments made in England; that the results obtained by the rapid rotation of the iron shell form an important link in this chain of phenomena I am willing to believe; but it was altogether accidental that both facts should have been observed so nearly at the same time.

Having said thus much, I am quite content to leave whatever may be in dispute between Mr Christie and myself to be judged of from what has been already stated. Mr Christie conceives that the experiments he undertook in 1821, and which led to those that form the subject of his paper, were so totally unlike my experiments, begun in 1819, and continued in the construction of my correcting-plate to the present time, that "no latitude of language" will admit of the former being considered as a repetition or extension of the latter.

He also considers his experiments on the attraction of the iron shell, published in the *Camb. Trans.* to be "quite unconnected" with my experiments just before completed on the same apparatus; and lastly, that his idea of referring the positions of a ball, by means of an imaginary sphere circumscribing the needle, is quite original and independent of my idea of referring the position of the needle by means of a sphere circumscribing the ball; and so completely independent, that he not only omits all reference in these cases himself, but objects to such reference being made by others.

On the other hand, he maintains that the connection between the phenomena due to rapid rotation, and those which he had observed, was so obvious, (although it had never occurred to him during the four years he had the subject on hand,) that notwithstanding I have, in the first page of my paper, stated my knowledge of his experiments, and that his results had encouraged me to proceed with the idea I had in view; and notwithstanding I waited five months for him to complete his paper before I sent my own, yet after all this I have, in his opinion, so very inadequately made my acknowledgments that he felt himself, in consequence, justified in adding a chapter on this new class of phenomena to the very paper for which the delay had taken place, without noticing, in any manner whatever, either my experiments or the accommodation.

On all these points it is clear Mr Christie and I entertain very different opinions, and both of us probably very conscientiously. It will therefore, I conceive, be best to leave the subject with the explanations which have been offered on both sides to be decided by less interested judges; and, in order to prevent the necessity of any farther discussion, I have avoided offering any comments upon Mr Christie's last letter; but there are one or two points of minute criticism, by which some parts of my former letter are represented as erroneous, which

I cannot pass without notice. Mr Christie says I have inaccurately represented him to have *included* his chapter on rapid rotations in his original communication, it having been *added* afterwards. This may be; but it is all printed under one title, without mark or distinction, and it was impossible for me to know when it was sent. Still, however, if he did not *intend* it to be so printed, the explanation is so far good, although it does not account for the omission of my name. Again, he says it is not quite accurate to say that his hypothesis is founded on a comparison of my results, it having been suggested by one only of my leading facts. As Mr Christie knows best, let this also be granted. I only supposed that he would have compared my results to ascertain that the fact was correctly deduced.

I have no objection, of course, to these verbal corrections being made in my former letter, if Mr Christie imagines that his argument can derive support from such minute distinctions.

I remain, Dear Sir, Yours very truly,

Peter Barlow.

Art. XX.—*On the Progressive Compression of Water with High Degrees of Force, with some Trials of its effects on other Fluids.* By J. Perkins, Esq.

The instrument with which Mr Perkins made the experiments of which we propose to give an account, was constructed with much care and attention, and is described with great minuteness in the *Philosophical Transactions* for 1826, p. 541. The water was placed in a glass piezometer, consisting of an elongated bulb nearly four inches long, and about three-fourths of an inch in diameter, and terminating in a tube of regular bore nine inches long, and about one-eighth of an inch of internal diameter. By weighing the quantity of quicksilver contained in this instrument when full, and ascertaining the weight contained in a given length of the tube above, it was found that the whole content was equal to a tube of 190 inches long, having the diameter of the contracted part of the piezometer. In the bottom of the piezometer is a small disk of steel, and above it a delicate hair spring of sufficient strength to retain its position, after being pressed upwards on the tube, so as to serve as a register of the degree of compression that has been effected. The piezometer is now filled with water, and with its register and disk it is placed in a phial containing a small quantity of quicksilver. It is next placed in the receiver of the compressing press, and after the proper pressure has been applied the piezometer is removed, and the indicating spring is found raised in the tube more or less, according to the power employed.

The greatest amount of which this apparatus admitted was 1000 atmospheres, being equal to 14,000 pounds to the square inch. With this apparatus Mr Perkins obtained the following results, which are the means that we have calculated from his tabular numbers. The column of water is 190 inches, and the numbers in the tables are the compression produced by the number of atmospheres around.

Atmospheres.	Compression. Inch.	Atmospheres.	Compression. Inch.	Atmospheres.	Compression. Inch.
10	0.189	80	1.187	500	5.087
20	0.372	90	1.288	600	5.907
30	0.543	100	1.422	700	6.715
40	0.691	150	1.914	800	7.402
50	0.812	200	2.440	900	8.243
60	0.956	300	3.339	1000	9.002
70	1.056	400	4.193	2000	15.833

If we make the number of atmospheres the abscissa of a curve, and the compressions its ordinates, it will be found that the curve approximates to a hyperbolic one.

In order to estimate higher degrees of compression, Mr Perkins constructed another piezometer eight inches long, ground internally perfectly cylindrical, and stopped at its upper extremity with a flat disk of glass cemented into it. This tube he filled with water, and subjected it to a pressure of 2000 atmospheres. After repeating this experiment a great number of times, the average result was, that *the column of water* EIGHT *inches long was compressed two-thirds of an inch, or one-twelfth of its length.* If we reduce this result to the scale of the preceding table, we shall find it to be 15.833, as there inserted.

With the same apparatus Mr Perkins made experiments on the compression of other fluids. The most remarkable result he obtained was with *concentrated acetic acid*, which, after compression with a force of 1100 atmospheres, *was found to be beautifully crystallized*, with the exception of about one-tenth part of fluid, which, when poured out, was only slightly acid.

He next applied his apparatus to the compression of aeriform fluids. For this purpose a gasometer was filled half full of water. It was then inverted and placed in a receiving tube, and it was found, under a pressure of 500 atmospheres, *that the whole of the air was taken up by the water, but none of it was given out* when the pressure was removed.

As it might be supposed that even glass was pervious to water by such a force, a small phial was made air-tight by fitting into its neck a well ground glass stopper. It *sustained a pressure of* 500 *atmospheres without change, and was perfectly dry within*, although it remained fifteen minutes under that pressure. When subjected to a pressure of 800 atmospheres it was crushed to atoms.

During these experiments Mr Perkins observed the curious fact, *that the air began to disappear* at a pressure of 500 atmospheres, a circumstance which he attributes to its *partial liquefaction*. At an increased pressure of 600 atmospheres, the quicksilver was suspended about one-eighth of the volume up the tube or gasometer; at 800 atmospheres, it remained about one-third up the tube; at 1000 atmospheres, two-thirds up the tube, and small globules of liquids began to form about the top of it; at 1200 atmospheres the quicksilver remained three-fourths up the tube, *and a beautiful transparent liquid was seen on the surface of the quicksilver, in quantity about* $\frac{1}{2000}$ *part of the column of air.*

The gasometer was now charged with carburetted hydrogen, and placed in a mercury bulb with its mouth immersed in quicksilver. It was subjected to different pressures, and *it began to liquefy at about* 40 *atmospheres, and at* 1200 *atmospheres the whole was liquefied.*

Mr Perkins is now occupied with the construction of a suitable apparatus for ascertaining the law of condensation of gaseous fluids at high degrees of pressure.

Art. XXI.—*On Burrowing and Boring Marine Animals* By Edward Osler, Esq.*

The object of Mr Osler is to explain the mechanism by which the boring and burrowing shell-fish form their habitations. With regard to the Pholades, about whose mode of boring the softer rocks and wood much difference of opinion has prevailed among naturalists, Mr Osler coincides entirely with Mr Stark † in thinking that they perforate their habitations by mechanical action alone. From the anatomical structure of the animal of the *Pholas candida*, and the actual observation of its young by this gentleman, this fact seems now placed beyond the possibility of doubt.

The Pholas, says he, has two methods of boring. In the first it fixes itself by the foot, and raises itself almost perpendicularly, thus pressing the operative part of the shell upon the substance to which it adheres; it now proceeds to execute a succession of partial rotatory motions, effected by the alternate contraction of the lateral muscles, employing one valve only by turning on its side, and immediately regaining the erect position. This method is almost exclusively employed by the young ones. When above two or three lines in length, the altered figure of the shell, and the increased weight of that part of the animal behind the hinge prevents it from raising itself perpendicularly, independent of the narrow space it now occupies. Attached by the foot, the lateral muscles contract, and, raising the posterior extremity of the shell, press its operative part against the bottom of the hole; and the moment after, the action of the posterior adductor brings the dorsal margins of the valves into contact, so that the strong rasp-like portions are suddenly separated, and scrape rapidly and forcibly over the substance on which they press.

Every peculiarity of structure upon which the boring powers of the Pholas depends, exists in an equally marked degree in the *Teredo navalis*, which, happily for the shipping of this country, Mr Osler states to be nearly and probably quite ex-

* Mr Osler's paper is printed in the *Philosophical Transactions* for 1826, part iii. p. 342.

† See this *Journal*, vol. v. p. 98, and *Edinburgh Transactions*, vol. x. part ii.

tinct. Being an imported animal, and from a warmer climate, the change of temperature, Mr Osler thinks, has effected this, in conjunction with the very prevalent use of copper for sheathing vessels.

But while Mr Osler proves that the Pholas and Teredo perforate their dwellings by mechanical action alone, he is of a different opinion with regard to other species of Lithophagi. " If all the boring shell-fish (he says) penetrate mechanically, it would be reasonable to expect, that their powers should evidently be in proportion to the hardness of the bodies which they inhabit: this is found to be the case in the different species of Pholas; but the Lithophagi, which would have the greatest mechanical resistance to overcome, appear to be destitute even of the smallest mechanical force. They have nothing which in the slightest degree resembles the boring apparatus of the Pholas. On the contrary, their shell, as in the bimusculous conchiferæ, is expanded by a powerful elastic ligament, and closed by two large round internal adductors. The valves in most of the species shut close, and the foot is not an instrument adapted for firm adhesion."

Mr Osler goes on to state, that, in the neighbourhood of Swansea, where his observations were made, four species of Lithophagi are found; and that, from particular attention to the habits of one of these, the *Saxicava rugosa* (Mytilus rugosus of Lin.) he has come to form the opinion, that they must form their burrows in the rocks which they inhabit by means of some solvent secreted by the animal.

In the first place, he says, it is evident that this animal does not bore like the Pholas, for its hole is not quite round, and the animal of course cannot turn itself in the burrow. 2. That, being attached by a short byssus, its free motions are in part prevented. 3. That the foot of the animal is not an instrument sufficiently powerful to effect this purpose. 4. That the texture of the shell is so soft, that it could make no impression on the stone without being itself acted on; and the effect of this would be permanent, because superficial injuries of the shell are never repaired. 5. The absence of any arrangement of muscles which might employ the shell with effect, even were it strong enough to act on hard stone. And he supports the presumptions to be collected from these data by the fact, that many naked animals of the softest texture form their habitations in limestone. The boring Annelides, he remarks, are innumerable in calcareous rocks, and are found to attack every marine shell, almost as soon as it has acquired sufficient thickness to afford them a nidus; and he illustrates this observation by reference to the oyster-shells, so often found on the coasts, completely perforated, and occupied by "a kind of sponge"—"a fibrous yellow pulp, filling a number of irregular cells." * "The penetration of these naked animals (says Mr Osler) leads irresistibly to the conclusion, that a shell is not essential to the boring process; and it would be inconsistent with the simplicity observable in every part of nature, to suppose that she has provided such different means for accomplishing the same end."

But the theory of a solvent, Mr Osler states, does not rest on mere negative proof. It appears impossible to explain on any other grounds the animal's exclusive choice of calcareous matter; a choice evidently depending on its inability to penetrate stones of a different nature. In specimens where portions of silex have projected into their holes, their progress has been found to be stopped from this cause. Where the Saxicavæ are abundant, and their holes communicating, the shells of some are found to be acted on when exposed to the foot of others; and when the shell is penetrated the breach becomes filled, not with new shelly matter, but with a firm yellow substance, insoluble in a strong mineral acid. A peculiar provision is thus given to the animal to preserve it from destruction by an injury to which it is particularly exposed; and it would be difficult, Mr Osler thinks, to conceive a fact short of absolute

* Dr R. E. Grant of Edinburgh, in a paper in the *Edin. New Philosophical Journal*, October 1826, has ascertained that this "fibrous yellow pulp" is a distinct and well-marked zoophyte, of which he gives an interesting description, and arranges as a distinct genus, forming the connecting link between the *Alcyonium* and the *Sponge*, under the name of *Cliona celata*. The projecting tubular papillæ of this animal, contrary to what Mr Osler supposes, are distinctly irritable; and Dr Grant even questions "whether the sharp siliceous spicula, and the constant currents of its papillæ, do not exert some influence in forming or enlarging the habitation of this zoophyte."

demonstration which could give a more decisive support to the theory of a solvent.

On the other hand, it must be stated, that Mr Osler has completely failed in his endeavours to detect this solvent. Litmus paper applied to every part of the Saxicavæ just taken from their holes, shells stained, and sea water tinged with the same test, in which animals of every size were kept till they died, gave no indication of the presence of an acid. Even the water in which a mass of rock containing above an hundred Saxicavæ had been kept for a week, afforded a precipitate, when treated with oxalic acid, only equal to that obtained from the same quantity of sea water. "Had the question been previously balanced," concludes Mr Osler, "our inability to detect a solvent would justify strong doubts of its existence; but while all the facts connected with the natural history of the Lithophagi afford a strong and consistent support to the theory of a solvent, and are opposed as decidedly to the supposition of penetration by a mechanical force, the failure of the experiments cannot be considered to militate very strongly against the only inference to be drawn from the facts."

Here then the matter must for the present rest; for though Mr Osler has given strong reasons for supposing these animals to possess the power of secreting a solvent capable of softening the rocks in which they burrow, yet other naturalists, and among them Poli, whose anatomical celebrity and talents for observation are second to none, entertain a different opinion. And as many of these Lithophagi burrow in wood as well as in stone, and, as was remarked by Mr Stark, the same solvent which was able to decompose calcareous stones might be very ineffectual when acting on submerged wood, there still seem doubts upon the subject, which future observation only can resolve.

Mr Osler's paper contains, besides, observations of much interest on the *Arenicola piscatorum* of Lamarck, (Lumbricus marinus, Lin.) the *Terebella conchilega*, and some other animals which perforate the sand, the whole detail of which is highly curious. The Arenicola piscatorum exudes a viscid fluid from its anterior portion to which the sand adheres, and forms a kind of tube; and the *Terebella conchilega* forms a more complete one by a secretion from glands below its head; the *Spatangus* buries itself in the sand by the action of its spines; and bivalves, such as the *Mya truncata*, effect their purpose by the action of their muscular foot.

Art. XXII.—*Summary for the year* 1826, *of the state of the Barometer, Thermometer, &c. in Kendal.* By Mr Samuel Marshall. Communicated by the Author.

The following summary of the meteorological phenomena for 1826, presents, in most respects, unusual results for this part of the country. The barometer throughout the year has maintained an altitude not very common for the height of Kendal above the level of the sea. This will appear from the mean altitude for the three preceding years; that of 1823 being 29.56; for 1824, 29.66; and for 1825, 29,64. The greatest height of the barometer, 30.78, was on the 19th April, and the least 28.62, on the 2d December. The mean temperature (47.°81) is also greater than in these years. This is a circumstance which has been generally experienced in every part of the island. In 1823, the mean temperature was 45.00 degrees; in 1824, 46.88 degrees; and in 1825, 47.49 degrees. It is generally admitted that no parallel to the late summer can be found, for intense heat and dryness, for the last *sixty-three years.* In this instance, as in the year 1763, the drought of the summer has been succeeded by an unusually mild and open autumn and winter, so far as the latter season has advanced. To the last day of the year, vegetation has maintained much of its verdant appearance; and cattle in this part have been enabled to derive the greater part of their sustenance from the fields. The dryness of the year is sufficiently proved from the circumstance, that only 43.060 inches of rain have fallen in that period; and within sixteen miles of this town, (Yealand,) but 29½ inches have fallen. In 1825, 59.973 inches of rain were taken at Kendal; and in the three preceding years of 1822, 1823, and 1824, nearly 63 inches fell in each year.

In this town, the winds from the S. W. may be said to prevail during nine months in the year; but in 1826, only five months show this wind to be the most prevalent. As it is from this quarter that the greatest quantity of rain accompanies the currents of the atmosphere, this circumstance appears to be an additional proof (if any were wanted,) that the greatest quantity of moisture is conveyed by this wind. In 1823, we had 198 rainy days; in 1824, 187; and in 1825, 169; but, in 1826, we have had only 147 days in which rain has fallen; and had it not been for the remarkably wet month of February, the number would have been much smaller.

We have had very little snow, and that with the wind at E. and S. E. The rain has fallen, excepting in two instances, in very small quantities at a time.

1826.	Barometer.			Thermometer.			Quantity of rain in inches.	Number of rainy days.	Prevalent Winds.
	Max.	Min.	Mean	Max.	Min.	Mean			
Jan.	30.16	29.23	29.81	44.°5	9°	30.°50	1.821	5	N.W.
Feb.	30.00	28.89	29.53	51	29	41. 37	10.775	20	S.W.
March,	30.27	29.25	29.74	66. 5	26	41. 13	2.255	10	N.E.
April,	30.78	28.85	29.76	60	26	45. 85	2.749	13	S.W.
May,	30.10	29.63	29.87	76	28	51. 87	0.369	5	N.
June,	30.25	29.70	30.02	85	38	61. 74	0.753	4	S.W.
July,	30.15	29.34	29.76	81	40	61. 62	3.550	14	W.
Aug.	30.03	29.37	29.73	75. 5	44	59. 97	4.600	16	S.
Sept.	30.03	29.16	29.68	68	33	53. 68	3.452	13	W.
Oct.	29.99	29.02	29.63	65	29	48. 69	4.362	19	S.W.
Nov.	30.31	28.69	29.61	50	21	37. 15	4.296	11	N.W.
Dec.	30.29	28.62	29.61	50	26	40. 24	4.078	17	S.W.
			29.73			47. 81	43.060	147	

Art. XXIII.—*On the production and formation of Pearls.** By Sir Everard Home, Bart. V. P. R. S. With observations by the Editor on the peculiar lustre of Pearls.

In examining the organs of generation of the large fresh water muscle, I very frequently met with what are called seed-pearls, and these were always found in the ovarium, or connected with the shell in which the ovarium lay. I at the same time accidentally discovered that all oriental pearls that are split into two halves have a brilliant cell in the centre. This, however, where the pearl has been bored is destroyed, and

* Abridged from the *Phil. Trans.* 1826, part iii. page 338.

upon comparing the size of the central cell with that of one of the ova, it is exactly large enough to contain it. The ova themselves are formed upon pedicles in the same manner as the yelks of the pullet's eggs, and must, when completely formed, have a similar mode of being discharged.

From these facts, I have been led to conclude, that a pearl is formed upon the external surface of an ovum, which, having been blighted, does not pass with the others into the oviduct, but remains attached to its pedicle in the ovarium, and in the following season receives a coat of nacre at the same time that its internal surface receives its annual supply.

This conclusion is verified by some pearls being spherical, others having a pyramidal form, from the pedicle having received a coat of nacre as well as the ovum.

It is the nacral shining lining of the central cell that produces the lustre peculiar to the pearl, which cannot be given to artificial ones.

Pearls being composed of concentric layers of nacre, which are annual, must be of slow growth, and those of large size can only be found in full grown oysters.

After making these observations, Sir Everard candidly quotes from the *Philosophical Transactions* 1674, No. 101, p. 11, a similar explanation of the origin of pearls, as given by Christ. Sandius, who had it from a Dane, Henry Arnoldi, who had observed the facts himself, at Christiania in Norway. The following is the passage alluded to.

"The pearl shells in Norway, and elsewhere, breed in fresh water. Their shells resemble those commonly called muscles, but they are larger. The fish in them looks like an oyster, and it produces a great cluster of eggs like those of craw-fish, some white, some black, which latter become white, the outer black coat being taken off. These eggs are cast out when ripe, and then grow, becoming like those that cast them. But sometimes it happens, that one or two of those eggs stick fast to the sides of the matrix, and are not voided with the rest. These are fed by the oyster against its will, and they grow, according to the length of time, into pearls of different sizes, and imprint a mark both in the fish and the shell."

This quotation we have made from Hutton Shaw and Pear-son's abridgment of the *Transactions*, and we must add the strange annotation which they have made upon it.

"This Mr Arnoldi had a very erroneous notion concerning the formation of pearls, which are certainly not the eggs of certain muscles and other bivalves in which they are found."

OBSERVATIONS BY THE EDITOR.

In the preceding very interesting paper, the origin of the seed pearl is, we think, well established. We are disposed to think, however, that Sir Everard is mistaken in ascribing *the lustre peculiar to the pearl, and which cannot be given to artificial ones, to the nacral shining lining of the central cell.*

What Sir Everard means by the *nacral shining lining of the central cell* can be nothing more than the inner surface of the pearl when the nucleus is removed; but that this has nothing whatever to do with the peculiar lustre of the pearl, may be demonstrated by grinding down the flat side of a bisected pearl till the surface of the central shell is entirely removed. It will then be found that the pearl still retains its peculiar lustre. We are persuaded, indeed, that if each successive annual growth could be separated from the rest, each concentric sphere would possess the pearly lustre, and become a perfect pearl. In proof of this opinion I have succeeded in detaching one of the annual films, and the surface of it is just as pearly and beautiful as the whole pearl from which it was detached.

It is not easy to give a precise scientific explanation of the peculiar lustre of pearls. A pearly reflexion may be produced by several very thin transparent films being put together, as takes place in a piece of mica that has been strongly heated. A similar effect takes place without heat in some minerals, such as apophyllite and stilbite where there is one eminent cleavage, and where the plates are partially separated. It is still more strikingly seen in the oxidation upon very ancient glass, where the effect is remarkably beautiful. In pearls, however, the light thrown back to the eye is not reflected, as in the cases now mentioned, merely from the surfaces of the combined films, but also at the points of junction of the carbonate of lime and the animal membrane of which the pearl is composed, the substance of the pearl not being homogeneous like transparent films. The pink and green tints which appear in the finest pearls are analogous to the pink and green masses which I have particularly examined in mother of pearl, and have described in the *Phil. Trans.* for 1815. The unequal mottled surface of the pearl, which resembles that of very fine ground glass, presents a distinct reflexion from the outer surface, and contributes to disperse and mix the various reflexions which come from the interior of the pearl.

Art. XXIV.—*On the Regular Composition of Crystallized Bodies.* By W. Haidinger, Esq. F. R. S. E. Communicated by the Author. Illustrated by Plate VI.—(Continued from Vol. iii. p. 69.)

pl. 6 at p. 120

IV.—*Prismatic System.*

The individuals of those species which belong to the prismatic system, very frequently present themselves in groupes, where two or more of them are joined parallel to one of their faces of crystallization. Generally this is a face of a rhombic prism, whose axis is either parallel or perpendicular to the axis of the fundamental form. There are a very few cases, however, in which two individuals are joined in a face parallel to one of the diagonals of the base of the fundamental pyramid, and this is possible only upon the supposition, that the secondary faces possess a peculiar hemi-prismatic character; or in which the junction takes place parallel to a face of some scalene four-sided pyramid of finite dimensions. These will be considered more at large hereafter.

Among the former there is a class of regular compositions, where the junction of two individuals takes place parallel to the faces of prisms whose angles are near 120°. The result of it, particularly when three individuals are united, has sometimes the appearance of a form belonging to the rhombohedral system, in as much as there is a kind of symmetry established in reference to six faces supposed to meet at angles of exactly 120°. Such are the compound crystals of arragonite, of the di-prismatic lead-baryte, of strontianite, of witherite, of chrysoberyl, of prismatic copper-glance, of sulphate of potash, and others. Most of them, in the infancy of crystallographic inquiry, were considered as modifications of the regular six-sided prism; a few are yet enumerated as such by very able mineralogists. The correct determinations introduced by modern authors afforded them the means of more accurately circumscribing the species themselves,—a result which has so frequently rewarded the labours of those who study the geometrical properties of substances. The general appearance of the compound groupes is so much alike in all these species, that from having more circumstantially explained one of them, the rest will be perfectly intelligible, at least if we add those observations which are rendered necessary by any occurring peculiarities of the crystallization.

To this end we select the di-prismatic lead-baryte, or the carbonate of lead, and among the forms of the individuals which occur in the composition, that of Fig. 1. Plate VI. Fig. 2. being the projection of it on a plane perpendicular to the faces *M* and *l*. The crystallographic signs, after the method of Mohs, are $\mathring{\mathrm{P}}\mathrm{r}$ (*M*), $(\bar{\mathrm{P}}\mathrm{r}+\infty)^3$ (*s*) and $\mathring{\mathrm{P}}\mathrm{r}+\infty$ (*l*). To the projection, Fig. 2, everything here shall be referred which relates to the explanation of the regular compositions. The faces of composition in this species are parallel to the faces of $\mathring{\mathrm{P}}\mathrm{r}$ (*M*), a horizontal prism of 117° 13′. The result of a regular composition of two individuals is represented in Fig. 3. The faces, ,*M* and ,*M′* are parallel, *M* is inclined on *M′* at an angle of 125° 34′, and *l* on *l′* at 117° 13′. This last angle is equal to the angle of the prism itself, and follows of necessity, the angle *a* being = *b*, and *c* = *d*, *b* and *d* being each of them equal to one-half the angle of the prism, which is a general result, whatever may be the value of it in degrees.

As in other systems, the composition is often repeated in parallel layers, particularly near the plane of junction, as in Fig. 4. If the substance of the individuals does not terminate at this face, but is continued beyond it, the groupe assumes in its transverse section a cruciform appearance, similar to Fig. 5. Beside the face of composition *no*, which is parallel to the faces *M*, *M*, another face *pq* is formed perpendicularly upon it, which, therefore, is also perpendicular upon *M* and *M*, and when the re-entering angles at *p* and *q* are filled up by the increase of the individuals, it is often difficult to ascertain their junction, since portions of the faces marked *M* will then coincide in one continuous plane. When the re-entering angles at *n* and *o* are likewise filled up, a six-sided prism is produced, having four angles of 117° 13′, and two of 125° 34′.

But it occurs often, that in the same manner in which one individual is joined to the original one, in a plane of *M*, contiguous to *n*, Fig. 6, in the same manner also one individual is joined to the same parallel to the other face of *M*, contiguous to the point *r*. The inclination of *M* on *M′* of the two individuals added, is $= 720 - (3 \times 117° 13' + 2 \times 125° 34')$, or $= 117° 13'$. If all the individuals be continued beyond their respective faces of composition, a figure will ensue like a star with six radii, similar to Fig. 7. The angles formed at the points *w*, produced by the faces *M* and *M′*, or *M″* and *M‴*, if they should happen to meet, are $= 180° + \frac{6(120° - 117° 13')}{2} =$ 188° 21′, the supplement of which to 360° is 171° 39′.

In order to show the application of these rules to nature, a few examples may now be given, selected from the varieties actually met with; although even the figures employed in the explanation of the theory are found more or less distinctly, and usually with various additional faces, as Fig. 6, at Johann-georgenstadt in Saxony, and Wanlockhead in Scotland; Fig. 3, and Fig. 5 at Leadhills, &c. Fig. 8 is a twin-crystal, of the di-prismatic lead-baryte, from Nertschinsk in Siberia. It is one of those which give the idea of a six-sided prism acuminated by six planes, set on the lateral planes of the prism. The two individuals are joined parallel to a face of M, as appears more distinctly in the projection Fig. 9, where the line *r z* represents that plane. The face *l* and *l* meet at *z*, and produce an angle of 117°13′, while the angle at *r* is $= 720° - 3 \times 117°13' - 2 \times 121°23\frac{1}{2}' = 125°34$. No re-entering angles appear, if the face of composition passes exactly through the edges of combination between $\breve{P}r$ and $\breve{P}r + \infty$. But if this be not the case, such angles will become apparent, as in the figure 10. The difference of the angle *z′* from 120° is $= 121°23\frac{1}{2}' - 117°13 = 4°10\frac{1}{2}'$, that of the angle $r' = 125°34' - 121°23\frac{1}{2}' = 4°10\frac{1}{2}'$; the angles themselves are equal to $184°10\frac{1}{2}'$, and $175°49\frac{1}{2}'$. Usually these re-entering angles are easily observable; they afford an excellent character in ascertaining the forms of the di-prismatic lead-baryte, and in distinguishing them in particular from the forms of the prismatic lead-baryte, or the sulphate of lead, when these minerals are found accompanying each other, which is often the case, as at Leadhills. Fig. 11 represents a very beautiful groupe of three individuals, joined in the manner of Fig. 7, in Mr Allan's cabinet, from that locality. The crystals are very much compressed between the faces *l* and *l*.

Hauy has given a good explanation of a composition similar to Fig. 8, without the faces *l* and *m*, but he has not been so fortunate in the illustration of what he calls the *plomb carbonaté triple*, a composition nearly similar to the one described above, and represented in Fig. 6; for he supposes here, that three crystals already formed and complete, are joined, and require exactly 360 degrees of angles to fill up the space in the centre *m*, and thus he actually places the crystals in a perfectly parallel position, in which they would form but one individual; whereas in fact, it is only necessary to trace the position of the individuals, and leave to the power of crystallization to fill up any vacuities, that may originate in the joining round a centre of several edges, that form a sum short of, or exceeding 360°. He is of opinion, also, that, besides the one mentioned in the composition of *plomb carbonaté hemitrope*, there are several other ways in which the crystals are grouped. An accurate observer will always be able to trace the law which requires any two individuals to be joined in such a position, that the axis of revolution is perpendicular upon one of the faces of *M*.

The usual crystals of arragonite might be explained from drawings executed for the preceding species, were it not for the difference in the forms which its simple crystals affect. Fig. 12 represents one of those discovered a few years ago in the Czinczow mountain, near Bilin, in Bohemia. They are generally modified by various additional facets, at the place of the solid angles *n* and *n'*. The plane of composition is parallel to one of the faces *M*, the same as in Fig. 13, where, moreover, the substance of the individuals is continued beyond the face of composition. The last is a Spanish variety. The 14th figure shows the transverse section of another regularly compound groupe from the same country. The individual B is joined to the individual A, in the plane y, according to the general law; the portion M'' of the face nr will therefore be parallel to M, and coincide in one single plane with the portion M', which itself belongs to the individual A. In a perfectly similar manner, the individual C is attached to A, in the plane z. The result is an irregular six-sided prism, having three of its edges m, n, and o equal to 116° 16′, since they are the original edges of the prism M, which has the same angle, two edges p and $q = 127°28'$, and the remaining edge r equal again to 116°16′. It is immaterial, whether this edge be formed by the substance of the individual A, or by the meeting of the two individuals B and C, the resultant angle will be always the same. This species presents a great variety of compositions of the latter kind, many of which have been described and figured by Hauy, to whom we are likewise indebted for the discovery of its forms belonging to the prismatic system, as it had been formerly considered to assume such as may be derived from the regular six-sided prism. His method of considering the compositions is however unnecessarily complicated, since he assigns particular laws of decrement to the planes in which two individuals like B and C in Fig. 14 will meet, which must even vary in such species as have different angles, whereas they are in fact a mere necessary consequence of being attached agreeably to the general law to one individual A.

Both strontianite and witherite are usually found in regularly compound groupes of crystals; the former often in six-sided prisms, produced by the junction of two individuals crossing each other, like Fig. 5, but having the lateral angles filled up; the latter more commonly in forms like Fig. 15, the composition of which is shown in its projection upon a plane perpendicular to the faces c, in Fig. 16. The angle of the prism of witherite, according to Phillips, is $= 118°\ 30'$; the four edges at $r\ s\ t$ and z will be each $= 118°\ 30'$, and the other two, v and w, each $= 123°\ 0'$. Every one of the faces visible in this groupe, those marked c, as well as those marked g and n, are parallel to the axis of the fundamental pyramid. This yields a remarkable difference between compositions like Fig. 16, and such as are formed from Fig. 7, by the filling up of the re-entering angles, in the last of which the whole is bounded by the faces of the original horizontal prisms, which are all inclined upon the same axis. The faces of composition in the first case pass through the edges, in the second through the centres of the faces of the compound groupe. The regular forms of both these substances are considered as belonging to the rhombohedral system, in the last edition of Hauy's *Traité*. Professor Fuchs first ascertained the actual forms of the strontianite of Leogang.

The four species, described above, not only agree in their mode of being joined in regular compositions, but they likewise show nearly the same secondary faces. In every general crystallographic consideration these four species are inseparable. Even their history coincides in this important point, that—with the exception of the first only—they have all been taken for rhombohedral. They form a curious instance likewise of the isomorphism of lead, calcium, baryum, and strontium.

One of the most curious substances, particularly for its near resemblance to certain rhombohedral species, is the prismatic copper-glance, the grey copper of Cornish miners. By far the greater number even of first rate mineralogists to this day consider its form as connected with the regular six-sided prism, or belonging to the rhombohedral system of Mohs; and yet these forms are derived from a rhombic prism of 119° 35′, which is usually found in regular compositions of three individuals, crossing each other at angles of nearly 60° and 120°. The 17th Figure, the projection of a crystal in the cabinet of Mr Allan, would be scarcely recognizable for what in fact it is, were we not led to it by the re-entering angles or evasures along some of its edges, and by the striæ, which, as in chrysoberyl and other species, are parallel to the intersection of the face *s* with the faces of the vertical prisms. Such striæ are usually met with, and though the entire groupes are not always so well defined as in the case represented, yet this peculiarity will be sufficient to mark out the extent of each individual, and to ascertain the law by which it is joined to another. This substance, however, occurs also in several other kinds of regular composition, which, though they render it more complicated, greatly enhance the interest attached to the consideration of the crystalline forms of the species.

Dr Gustavus Rose assigns a regular composition also to the crystals of zinkenite, a species which he first described. (See this *Journal*, p. 17.) One of them is represented in Fig. 18. The planes of junction here, as in the preceding case, pass through the centres, or nearly so, of the faces, which limit the prism whose angles approach to 120°. This is therefore, properly speaking, the complementary law to the original one; the axis of revolution is perpendicular to a face of $\mathring{P}r$, the plane of composition also perpendicular to it, and, at the same time, to an acute edge of P. The faces *P* and *M* bounding the crystal, are remnants of those of the horizontal prisms.

The reverse, that is to say, the original law, takes place in prismatic melane-glance, Fig. 19. The planes of junction pass through the edges, and are parallel to the faces of $\mathring{P}r$. The crystallographic sign, therefore, will be ... $\mathring{P}r+\infty$. $(\mathring{P}r+\infty)^3$ $\bar{P}r+\infty$, $2\{\mathring{P}r\}$. Four of the angles are $=115°\ 39'$, equal to the angle of the horizontal prism, and two $=128°\ 42'$. Notwithstanding this great difference of the angles from 120°, the crystals of the substance were long taken for rhombohedral; nay, the substance itself was confounded with red silver, with which it agrees almost in none of its properties, except that it likewise contains silver.

The antimonial silver of the Hartz sometimes occurs in acute six-sided pyramids, Fig. 20, imbedded in, or rather enveloped by, coats of native arsenic. These are compound groupes, formed exactly in the manner described of the preceding species. There is a distinct, though not very bright cleavage perpendicular to the axis of the supposed pyramid; but there are also two directions of cleavage, which produce a prism, parallel to the one, whose faces are *d* and *d*, with an angle of about $95\frac{1}{2}°$, contiguous to the apex of that pyramid. The want of continuity of these faces of cleavage immediately betrays the compound state of the mineral. I have seen at Clausthal, in the Hartz, a groupe nearly similar to Fig. 21, of two crystals, leaving between them re-entering angles, the axes of the prisms forming an angle of about 60°. I could not obtain an exact measurement of any of the forms, and more particularly not of that prism, parallel to the faces of which the composition takes place, to decide whether the obtuse edge of it is greater or less than 120°. But so much is indubitable, that the crystals neither are modifications of the cube, as is supposed by Count Bournon, nor can be comprehended in the rhombohedral system, as is taken for granted by others.

I shall not enlarge here on the regular compositions met with in Sternbergite, a new species, an account of which I have laid before the Royal Society of Edinburgh. They nearly resemble Fig. 3. in their projection. No very remarkable observations can be attached to them, and, besides, it would require more particulars than I should properly indulge myself in, in the present place.

Among the saline substances, occurring in compound crystals after this law, the sulphate of potash deserves our notice. The angle of the original prism being 120° 29′, and regular composition of three individuals very frequent, the forms were long taken for rhombohedral ones, till Messrs Mohs, Brooke, and Levy gave a more accurate description of them. Mr Brooke, in particular, describes a composition resembling Fig. 6 in its transverse section, which he obtained from a solution of the salt in distilled water. This is not, however, the manner in which the usual apparently isosceles six-sided pyramids are formed. This mode of junction is namely that of Figs. 15 and 16, the planes passing through the edges of the prisms, and producing a six-sided transverse section of the compound group with four angles of 120° 29′, and two of 119° 2′, a kind of composition demonstrated likewise by the optical discovery of it by Dr Brewster. As in the prismatic melane-glance, all the faces bounding the compound crystal, are such as are parallel to the principal axis of the fundamental form.

Saltpetre presents the same phenomenon, as is evident from its action on light, as observed by Dr Brewster. The crystallographic properties have not yet been sufficiently ascertained. Dr Forchhammer, however, informed me, that he actually found a difference to exist in the angles of the six-sided prism, hitherto supposed to be a regular one.

The figure of snow is so nearly allied in its shape to some of the results of regular composition here described, that I must add a few remarks on this subject, by which it will appear, that, though one of the most common substances, we are sadly in want of an exact knowledge of the forms of crystallized water. Except in the treatise of Mohs, these forms are uniformly described as belonging to the rhombohedral system, an opinion rendered highly probable by Dr Brewster's experiments on ice, a substance which shows a regular crystalline structure, when examined in polarized light, even in plates several inches thick, and exhibits the single system of coloured rings, characteristic of the structure of rhombohedral and pyramidal forms. There is not, however, in the whole compass of rhombohedral forms one example of a similar formation as the stars with six radii of snow, while it is common enough in those species whose forms belong to the prismatic system. The low degree of temperature has prevented naturalists from examining them more closely, the observer himself being one of the chief causes of their speedy destruction by the action of heat. Their size is often much more considerable than that of the crystals of many a species exactly described in our days. On a clear frosty day, when accompanying Mr Mohs in a walk from Freiberg to Dresden, I have seen thin six-sided plates of ice nearly half an inch in diameter, which were deposited as hoar-frost on the stalks of reeds in a marshy place, in the forest of Tharand. But from the exertion of the walk, the temperature of our bodies had so much increased, that the delicate flakes would melt on being brought so near the eye as the use of the magnifying lens required. These six-sided plates were striated parallel to their sides; the reflection of the sun from the broad faces showed a difference of level, in the portions *t*, *t*, . . *u*, Fig. 9, seemingly belonging to different individuals. During the intense cold of last winter, I had an opportunity of seeing a curious example of crystals of ice, in Berlin in one of Professor Mitscherlich's rooms, which had been the whole winter without a fire. The flowery deposit, formed by a kind of sublimation, on the windows, had considerably increased in thickness, and presented all over, when attentively examined, multitudes of crystalline plates, rectangular, and in a parallel position, where longitudinal delineations appeared, whereas they were six-sided in the spaces, formed by the meeting of them, and wherever the delineation appeared executed on a smaller scale. I have attempted to express something of this kind in Fig. 22. The ice had much more accumulated, where the six-sided plates were visible, so as considerably to obstruct the passage of light. There were even crystals, like the one marked *a*, with a distinct geniculated appearance.

The explanation of these phenomena can be scarcely given but upon the supposition of prismatic crystals. There might exist two species, characterized by different forms, with the same constituents of hydrogen and oxygen, as we have analogous cases in calcareous spar and arragonite, or in the hexahedral and prismatic iron-pyrites; but so imperfect is our positive information in this respect, that we are not entitled to consider such a hypothesis as plausible. There is one hypothesis, indeed, which might suffice for explaining all the appearances hitherto observed. The forms of ice might belong to the pyramidal system. The individuals forming on the surface of stagnant water would have all their axes parallel, and consequently show the single system of rings in polarized light equally well as if they did constitute one single individual. For the six-sided prisms, or six-sided plates, as produced by regular composition, and the star-like figures of snow, we find many analogous cases in the pyramidal system, for instance in tin ore and in rutile. The latter particularly often shows compressed prisms, and reticulated aggregations disposed upon a plane. Actual observations, however, and measurements of angles, are required to show whether this opinion be borne out by fact. Romé de l'Isle,* Bosc d'Antic,† and Scoresby,‡ have each observed four-sided pyramids, which would add to the probability of the forms of ice belonging to the pyramidal system.

(To be continued.)

* *Crystallographie,* t. i. p. 4.

† *Journal de Physique,* 1788, t. xxxiii. p. 57.

‡ *Mem. Wern. Soc.* vol. ii. part 2d.

Art. XXV.—*On a Remarkable Effect of a Magnet on the Oscillations of the Pendulum of a Clock.* By George Harvey, Esq. F. R. S. Lond. and Edin. F. L. S. &c. Communicated by the Author.

In the latter end of the year 1822, my attention was drawn to an experiment mentioned by Professor Cumming, in his paper "on the connection of galvanism and magnetism," inserted in the second part of the first volume of the *Transactions of the Cambridge Philosophical Society*; viz. that the application of a horse-shoe magnet, beneath the iron pendulum of a small clock, occasioned an acceleration of the daily rate.

Desirous of repeating the experiment, I applied a powerful horse-shoe magnet as near as possible to the steel-spill or index attached to the lower part of the weight of a compensation pendulum composed of three bars of steel, and two of a mixture of zinc and silver. The magnet was applied about nine p. m., and, not anticipating any immediate effect, I left it to attend to some other pursuits. Having occasion, however, to enter the room again about midnight, I found, to my great astonishment, that the clock had stopped. The first impression on my mind was, that I had accidentally stopped it while adjusting the position of the magnet; but, on looking at the minute hand, which indicated eighteen minutes after nine, and recollecting that I had quitted the room about four or five minutes after that hour, I began to suspect, that the action of the magnet had suspended the oscillations of the pendulum.

To determine this interesting point, I communicated motion to the pendulum, and, after the lapse of a few minutes, observed a sensible diminution in the amplitude of its vibration; and, at the end of twelve minutes after the oscillations commenced, the arc of vibration was so much reduced, as to suspend the beats of the clock; and, in a short time after, the continually diminishing arcs of vibration vanished altogether, the pendulum being reduced by the action of the magnet to a perfect state of rest.

Feeling now perfectly satisfied, that the stopping of the clock was due entirely to the action of the magnet, I proceeded to communicate motion to the pendulum in smaller arcs of vibration, and found the beats of the clock to be suspended in times proportionally less; so that, in the last experiment, the beating of the clock was stopped in the short space of fifty-nine seconds.

On examining the spill or index, to the reciprocal influence of which and the horse-shoe magnet I attributed the phenomenon, I found it to display the most decided marks of polarity. A small pocket compass, placed below its extremity, had the direction of its needle completely inverted at every oscillation of the pendulum. The south pole being attracted by it when quiescent, indicated the kind of polarity it possessed, and which might have been anticipated from the necessary position of the pendulum.

PLYMOUTH,
February 17, 1827.

ART. XXVI.—*On the different Primitive Forms of the same Salt produced by a Change in the Nature of the Solvent.** By DR CHRISTIAN WOLLNER. With Observations by the EDITOR.

IN the manufactory of alum at Putchen, near Bonn, Dr Wollner had occasion to observe, that in the tubs which contained the mother waters there were formed crystals of sulphate of iron, which had exactly the same form as alum, that is, which had the form of the regular octohedron. Having analysed these crystals, he found them to be composed, like the common copperas, as follows:

	Wollner.	Berzelius.	Mitscherlich.
Protoxide of iron,	25.36	25.7	25.19
Sulphuric acid,	28.93	28.9	29.89
Water, -	45.50	45.4	43.92
Loss, - -	0.21		

He made several attempts to obtain similar crystals from a

* Kastner's *Archiv. fur die gesammte Naturlehre,* tom. vi. p. 364, or Ferrussac's *Bull. des Sc. Nat.* Dec. 1826, p. 392.

solution of ordinary copperas, and also from the octohedral sulphate, by sometimes plunging into it a crystal of alum, and sometimes a crystal of sulphate of iron, but he could not succeed.

He now directed his attention to the nature of the mother waters, in which this sulphate had crystallized, in order that he might find a method of reproducing this solvent at pleasure. The specific gravity of these waters was 1.358, and they were composed as follows:

Sulphate of magnesia, with traces of gypsum,	6.635
Sulphate of alumine, - -	6.295
Sulphate of the protoxide of iron, -	12.000
Muriate of the protoxide of iron, -	9.975
Free muriatic acid, - -	0.570
Water, - - -	64.525

From this result Dr Wollner was able to reproduce artificially a solution capable of yielding octohedral crystals of sulphate of iron, by dissolving in water the following salts.

Sulphate of magnesia, - - -	11.5
Sulphate of alumine, - - -	6.3
Sulphate of iron, - - - -	22.0
Crystallized muride of iron, - -	18.0
Muriatic acid, sp. grav. 1.167, - -	2.3

If we now concentrate this solution to a density of 1.358, and dissolve in a 1000 parts of weight of the liquid 125 parts of ordinary copperas, and leave the solution to itself for twelve hours, we shall obtain crystals of the sulphate of iron, having the octohedral form of alum.

OBSERVATIONS BY THE EDITOR.

The subject of the preceding observations is one of the most interesting in crystallography. Several facts analogous to those mentioned by Dr Wollner have been long known, but he is the first person who has investigated with care the circumstances of the experiment, and pointed out the method of reproducing the crystals at pleasure. We do not allude to the mere change of crystalline forms, which is produced by various causes, such as the influence of mechanical mixtures, the nature of the liquid in which the solution is made, and the influence of substances which combine with the solution at the instant of crystallization; but to those cases in which there is a complete change in the crystalline system, or a passage from one form to another which is entirely incompatible with it.

M. Beudant made an interesting experiment of this kind with *nitrate of potash*, which commonly crystallizes in a *right rhomboidal prism*, and *nitrate of soda*, which crystallizes in the form of an *obtuse rhombohedron*. When the two salts are dissolved together, the *nitrate of soda* will crystallize first, if it exists in sufficient quantity, and the nitrate of potash will afterwards crystallize in prismatic needles. In a short time, however, rhombohedral crystals of the nitrate of potash are deposited, and though these were found to contain only small and variable quantities of nitrate of soda, yet M. Beudant has observed them perfectly free of nitrate of soda.

On another occasion M. Beudant obtained a result the reverse of this. Having made an aqueous solution, containing more nitrate of potash than nitrate of soda, there were first formed prismatic crystals of nitrate of potash, then rhombohedral crystals of nitrate of soda, upon which were found prismatic rhomboidal needles of the same nitrate of soda, containing some traces of nitrate of potash. Hence, M. Beudant concludes, that the change of form in the first instance was owing to the presence of the nitrate of soda in the solution, and, in the second, to the presence of nitrate of potash.

Other examples of change of system in crystallized substances I have had occasion frequently to point out. In 1816, I was led to examine crystals of *nitrate of strontian* crystallized in prisms and also in regular octohedrons. But upon submitting these salts to M. Berzelius, he assured me that the one was a *hydrous* and the other an *anhydrous* salt. In like manner, I found single crystals of *sulphate of potash* in regular six-sided prisms, (not the compound bi-pyramidal crystals,) and in rhomboidal prisms; but upon transmitting them to M. Berzelius for analysis, I learned that the former was a double salt, containing one atom of sulphate of potash, and one atom of proto-sulphate of iron. I found also the *sulphate of nickel* in *rhomboidal prisms*, and in *prisms with a square base*, but these crystals turned out by Dr Fyfe's analysis to be a new triple salt, viz. a sulphate of nickel and copper.

These cases, with several others which might be mentioned, seemed to show that, in all cases where a change of crystalline system took place, there was a change in chemical composition. This opinion, however, is discountenanced by M. Wollner's result, and also by Professor Mitscherlich's experiments on *sulphur*, in which he was able to procure *prismatic* crystals by allowing masses of sulphur of fifty pounds weight to cool slowly after being melted in an earthen-ware pot, while he obtained *hemi-prismatic* crystals like those of native sulphur, by dissolving sulphur in the carburet, chloruret, and phosphuret of sulphur.

If it shall be found strictly true that the same substance can crystallize in two different forms belonging to different systems of crystallization, while under each form it consists of the same ingredients combined in the same proportion, there arises a puzzle of no ordinary kind in mineralogy. Many accordant analyses, however, obtained by the first chemists, will be necessary to establish such a result, and, after all, the mineralogist may pause and consider whether he will believe a doctrine contrary to many general principles, or suppose that some volatile ingredient may have escaped the penetration of the chemist.

Since this notice was drawn up, Mr Haidinger has informed us that he has seen in the hands of Dr Gustavus Rose of Berlin, some of the *octohedral crystals of sulphate of iron* obtained by Mr Wollner. The crystals, he assures us, are not regular octohedrons, but irregular octohedrons, which are mere modifications of the common secondary forms of that salt. There is, therefore, in this case, no change in the system of crystallization, but merely a change of secondary form.

Art. XXVII.—*A Description of some remarkable Effects of unequal Refraction observed at Bridlington Quay in the Summer of* 1826. By the Rev. W. Scoresby, F. R. SS. Lond. and Edin. M. W. S. &c.

This interesting paper, of which we propose to give a brief abstract, was read before the Royal Society of Edinburgh on the 22d of January 1827. Mr Scoresby had frequent opportunities of observing this class of phenomena during his voyages in the Greenland seas, and in one of the latest, he saw in the lower part of the atmosphere the inverted image of a ship, so distinctly and beautifully defined, that he pronounced it to be his father's ship, which was then about twenty-eight miles distant, and some leagues beyond the limit of direct vision.

In this paper Mr Scoresby describes various phenomena of unequal refraction which took place in the summer of 1826 about Bridlington Bay, and which he saw from his residence at Bridlington Quay. These phenomena he has represented in minute drawings, and therefore we must refer the reader for an account of them to the original memoir, which will be speedily published.

On the 26th June, which was distinguished by unequal refraction, Mr Scoresby made a sketch of the appearance of the Holderness coast from the window of his sitting-room, which was forty feet above the level of the sea at low water, the state of the tide at the time. It then occurred to him that there might be a difference of appearance at another level, and on ascending to the attic story, about sixty feet above the sea, he was astonished to find the phenomena altogether changed, the coast now presenting almost its ordinary appearance. Upon returning to his sitting-room he found the appearance exactly the same as when he had first drawn it.

He then descended to the cellar flat, about twenty feet above the sea, where, on a level platform by the side of the house, there was a clear view of the same coast. In this new position scarcely any remains of the refractive influence were seen, although in the middle position, viz. in the sitting-room, all the phenomena of unequal refraction remained unchanged.

The phenomena continued to preserve their character, as seen from the three different levels, for above an hour, when the phenomena seen from the middle position began to descend, so that, as the heat of the day increased, or rather became more general and uniform, the view from the sitting-room became nearly the same as that seen from the attic story; while the view from the cellar-flat became that which was seen from the sitting-room. Shortly after mid-day the phenomena of unequal refraction became so striking from the level of the street, that they attracted the attention of all the inhabitants in the neighbourhood. From two till five P. M. the phenomena were more indistinct and less interesting; but, as the heat began to abate towards six P. M. the appearances observed in the morning were in a great measure repeated.

"The occasion," says Mr Scoresby, "of the frequency of these phenomena during the last summer, and of their extraordinary character, may perhaps be accounted for from a remarkable and sudden change in the temperature of the air. The cool weather of the preceding spring had continued down to the beginning of June. The sea, even near the coast, was, in consequence, at its winter temperature, whilst the air became greatly heated by the fervent glare of an unclouded sun. When, therefore, the air near the surface of the earth became greatly warmed, the stratum immediately in contact with the sea was chilled by its coldness, whereby media of unequal density and refractive power were produced. And through these unequal media, the rays of light, both from the shipping and the Holderness coast, had to pass, to the eye of the observer, an uninterrupted surface of water, in all cases lying between the objects and myself. The passing of the rays of light at an extremely small angle through the different strata of different refractive powers would sufficiently account for most of the phenomena observed."

ART. XXVIII.—*On the Elements of the Four New Planets* VESTA, JUNO, CERES, *and* PALLAS.

THE following elements of the four new planets have been collected by Francis Baily, Esq. the learned president of the Astronomical Society of London, who has given them in his *Astronomical Tables and Formulæ*, a work which, with his usual liberality, he has printed for the use of his scientific friends. The planets are arranged in the order of their distance from the sun.

Vesta.

This planet was discovered by Dr Olbers on March 29, 1807. Its *mean distance* from the sun is 2,367,870; that of the earth being considered as unity.

It performs its *sidereal revolution* in 1325.7431 mean solar days; and its mean *synodical revolution* is 503,41 days.

The *mean longitude* at mean noon at Greenwich, on January 1, 1820, was in 278° 30′ 0″ 4.

Its *mean motion* in its orbit in a mean solar day is 16′ 17″, 9516. Its mean motion in 365 days, is consequently 99° 9′ 15″, 33.

The longitude of its *perihelion* in Jan. 1, 1820, was in 249° 33′ 24″, 4. According to M. Santini, it has an apparent annual motion of + 1′ 34″, 24.

Its *orbit is inclined* to the plane of the ecliptic, in an angle of 7° 8′ 9″, which, according to M. Santini, has an annual decrease of 0″, 12.

Its ascending node was, on January 1, 1820, in 103° 13 18″, 2, which, according to M. Santini, has an apparent annual motion of + 15″. 63.

The eccentricity of its orbit is 0.089,130; half the major axis being considered as unity: subject to an annual increase, according to M. Santini, of 0.000004009.

The *greatest equation of the centre* is 10° 13′ 22″.

Juno.

This planet was first discovered by M. Harding on September 1, 1804. Its *mean distance* from the sun is 2.669009, that of the sun being considered as unity.

It performs its *sidereal revolution* in 1592,6608 mean solar days; and its mean *synodical revolution* in 473,95 days.

Its *mean longitude* at mean noon at Greenwich, on January 1, 1820, was in 200° 16′ 19″, 1.

Its *mean motion* in its orbit, in a mean solar day, is 13′ 32″, 9304; its mean motion in 365 days is consequently 82° 25′ 19″, 60.

The longitude of its *perihelion*, on January 1, 1820, was in 53° 33′ 46″.

Its *orbit is inclined* to the plane of the ecliptic in an angle of 13° 4′ 9″, 7.

Its ascending *node* was on January 1, 1820, in 171° 7′ 40″, 4.

The *eccentricity* of its orbit is 0.257848; half the major axis being considered as unity.

The greatest equation of the centre is 29° 46′ 19″.

Ceres.

This planet was first discovered by M. Piazzi, on January 1, 1801. Its *mean distance* from the sun is 2767245, that of the earth being considered as unity.

It performs its mean sidereal revolution in 1681.3931 mean solar days, and its mean *synodical revolution* is 466.62 days.

Its *mean longitude* at mean noon at Greenwich, on January 1, 1820, was in 123° 16′ 11″, 9.

Its *mean motion* in its orbit, in a mean solar day, is 12′ 50″, 9230; its mean motion in 365 days is consequently 78° 9′ 46″, 89.

The longitude of its *perihelion*, on January 1, 1820, was in 147° 7′ 31″, 5; which, according to M. Gauss, is subject to an apparent annual motion of + 2′ 1″, 3.

Its *orbit is inclined* to the plane of the ecliptic in an angle of 10° 37′ 26″, 2; which, according to Mr Gauss, has an annual decrease of 0″, 44.

Its ascending *node* was, on January 1, 1820, in 80° 41′ 24″. According to M. Gauss, it has an apparent annual motion of + 1″ 48.

The *eccentricity* of its orbit is 0.078439, half the major axis being considered as unity; which, according to M. Gauss, is subject to an annual decrease of 0.00000583.

The *greatest equation of the centre* is 8° 59′ 42″.

Pallas.

This planet was discovered by Dr Olbers on March 28, 1802 : its *mean distance* from the sun is 2.772886 ; that of the earth being considered as unity.

It performs its *sidereal revolutions* in 1686.5388 mean solar days ; and its mean *synodical revolution* in 466.22 days.

Its *mean longitude*, at mean noon, at Greenwich, on January 1, 1820, was in 108° 24′ 57″,9.

Its *mean motion* in its orbit, in a mean solar day, is 12′ 48″, 3934 : its mean motion in 365 days is consequently 77° 54′ 25″,59.

The longitude of its *perihelion* on January 1, 1820, was in 121° 7′ 4″,3.

Its orbit is *inclined* to the plane of the ecliptic in an angle of 34° 34′ 55″.

Its ascending *node* was, on January 1, 1820, in 172° 39′ 26″,8.

The *eccentricity* of its orbit is 0.241648 ; half the major axis being considered as unity.

The *greatest equation of the centre* is 27° 49′ 19″.

This planet appears to be subject to very considerable perturbations.

ART. XXIX.—*Description of the New Mineral called Haytorite*, drawn up from the Observations of Mr TRIPE, Mr COLE, Mr PHILLIPS, and Mr LEVY.*

THIS very remarkable mineral, which has already called forth the ingenuity of some of our ablest mineralogists, was first described by Cornelius Tripe, Esq. who transmitted crystals of it to William Phillips, Esq. for measurement.

"It was found," says Mr Tripe, "in detached pieces, accompanied by small masses of chalcedony, garnet, actynolite, talc, and very splendent octohedral oxidulated iron. These substances altogether formed a single bunch of considerable size, enveloped by a ferruginous clay in a large lode of very pure oxidulated iron, in an iron mine adjacent to the Hay Tor granite quarries, Devonshire.

* The observations of these gentlemen form three successive articles in the *Philosophical Magazine*, No i. p. 38, Jan. 1827.

"The crystals, which are generally large and well defined, are of a brownish-red ferruginous yellow, and delicate white colour. Every crystal has certain planes, smooth and splendent, while the others are rough and dull, and is either semi-transparent or translucent. The substance scratches rock crystal, and in lustre, colour, fracture, and general appearance, closely resembles chalcedony."

Mr Robert Cole, who examined the mineral along with Mr Tripe, agrees with him in regarding it as crystallized chalcedony, but considering it probable that it may be a new substance, they contemplated calling it *Haytorite*, in honour of its birth-place.

Mr Phillips has made the following observations upon Haytorite:

"It has only been found in regular crystals, which in general are well defined, the edges being sharp, and the planes for the most part brilliant. In dimension they vary from the size of a pin's head to an inch in diameter; three or four minute crystals are colourless and almost perfectly transparent; but in general their colour passes from pale brownish-yellow, in which case they are translucent, to deep brown and opaque.

The crystals, however, have rarely been found isolated, being commonly grouped together in such a manner as to show only about one half of the crystal, but they are easily separable; the planes of separation are bright, and frequently somewhat iridescent on the surface.

I have in vain attempted to discover a regular cleavage which rarely is absent in crystallized minerals, and it is remarkable, that the surface produced by breaking a crystal in any direction, is almost totally devoid of lustre, having completely the aspect and fracture of chalcedony, and this takes place even in the almost perfectly transparent crystals, which lose immediately that character, assuming the same degree of translucency as is commonly possessed by chalcedony when viewed on the fractured surface. Spec. grav. of two crystals taken by Mr S. L. Kent 2.5628, 2.5862. It scratches quartz.

The characters detailed in the preceding sentence induced the suspicion that it is only a pseudomorphous mineral.

Whether such be its real character, or whether it is to be considered a new mineral, its primary form (assuming the planes P and *k*, *k′* as primary, Plate IV. Fig. 9.) is *an oblique rhombic prism*, differing less than 1° from the proportions of a right rhombic prism, and of which the lateral planes meet at the angles of 77° and 103°, the terminal plane declining from one acute angle to the other. Some of the crystals forming one large groupe in my possession are opaque; in others translucency exists; and others again seem to have suffered a partial decomposition, having the appearance of being carious internally; but to what extent soever that appearance has taken place, it is remarkable, that the portion remaining of the external plane, however small, is not deprived of its ordinary lustre, and often is even brilliant.

Now, if this apparent injury had been the real effect of decomposition, we might expect that the agent producing it would, in the first place, have acted externally, and thus have deprived the external planes of their natural brilliancy; and this consideration again tempted the farther examination, as to whether there existed in the crystals thus partially hollowed, any stalactitic appearance of chalcedonic matter. This certainly does appear, on a close examination by the help of a glass, a *circumstance amounting almost to proof, that the crystals are in reality pseudomorphous*, and that their substance is chalcedony. The smaller crystals were sometimes enveloped by it."

Mr Phillips has given the following measurements in reference to Fig. 9. of Plate IV.

P on *d*	135° 5′	*g′* on g^2	160° 38
—— *e*	134 55	*g′* — *h*	157 30
—— *g*	147 38	—— *l*	156 50
—— g^2	128 22	—— *v*	139 42
—— *h*	141 20	g^2 — *l*	150 8
—— *i*	90 3	*k* — k^1	77 0
—— *k*	90 20	*k* — *m*	128 30
—— *l*	141 25	*l* — *v*	162 25
—— *m*	90 14	*v* — *v′*	130 22
—— *n*	116 42	*m* — *o*	157 20
—— *v*	130 5	—— *i*	147 40
d on *h*	140 32		

"The forms," says Mr Levy, "and mere inspection of the ensemble of the measurements of Haytorite prove that we may assume for the primitive form an oblique rhombic prism, the lateral planes of which would correspond to the planes g', Fig. 9, and the base to the plane m, this base being inclined upon the lateral planes at an angle very little greater than a right angle."

By comparing the angles of the secondary form, calculated from the above primitive form, with those obtained by Mr Phillips, Mr Levy remarks, that the differences are so small, that it may be inferred at once, that the crystals of Haytorite are perfectly regular, and that one of the forms, which may be taken as their primitive, can differ but very little from an oblique rhombic prism, the incidence of the lateral planes of which is 115° 16′, the incidence of the base in each of them 90° 8′ 30″, and the lateral edge equal to the oblique diagonal of the base."

"When I first saw," continues Mr Levy, "the drawings and measurements of Haytorite, I thought they might be considered as pseudomorphic crystals of sphene, because some of the angles are not very far from those of that substance; but the preceding investigation proves, that an almost perfect equality must be established between the angles of Haytorite, and those of any other mineral, before it can be reasonably suspected that the crystals of the first have only borrowed the form of the other; and therefore, the above suggestion must be abandoned. The only substance between the angles of which and those of Haytorite there seems to be a great analogy, is Humboldtite. First, by inverting the drawings of Mr Phillips, the similitude of the forms of Haytorite with those of Humboldtite, represented by Mr Phillips in his Mineralogy, p. 380, becomes apparent. The planes P, g^1, d, h, k, i, n, v, of Haytorite, correspond to the planes h, m, a_3, f, e_2, e_1, a^1, g^1, of Humboldtite, and have the following inclinations, according to Mr Phillips:

	Haytorite.		Humboldtite.
P on g^1	147°38′	m on h	147°50
P — d	135 5	h — a^3	133 56
g^1 — h	157 30	m — f	156 50

	Haytorite.		Humboldtite.
$k - k$	77	$e_2 - e_2$	77 28
$k - i$	160 50	$e_1 - e_2$	161 20
$P - n$	116 42	$h - a'$	116 20
$g^1 - v$	139 42	$m - g^1$	138 5
$P - n$	141 20	$h - f$	140 50

Mr Levy concludes his observations in the following words: "There is not, therefore, sufficient evidence, perhaps, to say that the crystals of Haytorite are pseudomorphic of Humboldtite. The repositories of the two substances seem to be different; for, besides the already known localities of Humboldtite, the Seisser Alp in the Tyrol, and Salisbury Craigs, near Edinburgh, I know only of another, which is Utoe in Sweden, where, to judge by the specimen in Mr Heuland's collection, it occurs in macled crystals, and accompanied by apophyllite, carbonate of lime, sulphate of barytes, and bitumen.

"In conclusion, it may be said, that if the reasons for supposing the crystals of Haytorite appear conclusive, there is some not unreasonable ground *to think they may owe their form to Humboldtite, but have been modelled upon crystals of that substance, larger, and of a different variety than those which have been met with hitherto, or otherwise they must be considered as pseudomorphic crystals of an unknown species.*"

Art. XXX.—*Observations on the Structure and Crystalline Forms of Haytorite.* In a letter from Dr Brewster to Cornelius Tripe, Esq. Devonport.

Sir,

As you were so kind as to send me specimens of the new mineral recently found in Devonshire, to which you have given the suitable name of Haytorite, I need not make any apology for addressing to you the results of the observations which I have thus been enabled to make upon its structure and crystalline forms.

It was impossible to peruse the ingenious observations of Mr Phillips and Mr Levy without being impressed with the opinion, that there was in this case a real difficulty worthy of being solved, and I had sufficient confidence in the powers of optical analysis, to believe that it was peculiarly fitted for conducting us to the required solution. As Mr Phillips had described some of the crystals as *almost perfectly transparent*, a character which does not belong to chalcedony, I confidently expected that the determination of the axes of double refraction, and of their relation to the primary or secondary planes, would settle at once the question, whether the crystals of Haytorite were *modelled* upon those of any other substance, as Mr Levy expresses it, or derived their form from their own proper laws of crystallization.

As the crystals, however, are not *transparent*, in the proper sense of the word, but disperse all the light which passes through them like chalcedony, or ground glass, I was disappointed in this expectation; but other modes of observation presented themselves, which I have no doubt will be regarded as sufficient to remove all ambiguity from the results to which they lead.

Having long ago had occasion to examine the structure of chalcedony, and to study the way in which it passes through agate into perfectly crystallized quartz, I was somewhat prepared for this examination. If we take a thin splinter of chalcedony, and examine it with a powerful microscope and polarized light, we shall observe that it is composed of minute particles possessing double refraction, but *having their axes lying in every possible direction.* When the splinter is very thin, we perceive even the polarized colours of some of the individual particles of quartz. Hence it is manifest that chalcedony is an aggregation of particles of quartz, having the axes of the primitive rhombohedron lying in every possible direction; and as the specific gravity of chalcedony is exactly the same as that of quartz, it is obvious that the particles must be cemented by a substance of the same density, or agglutinated by the fusion of their surfaces, or held together by molecular attraction.

If the particles thus combined had been particles of glass, or of any singly refracting body, the mass would possess that homogeneous transparency, through which objects can be distinctly seen, and in which there is no dispersion of the passing light; but as they are particles possessing double refraction, and as the double refraction varies at different parts of the crystal, a ray of light emerging from one part of a particle will not enter the corresponding part of the adjacent particle; and therefore there must be that dispersion and reflection of the light which takes place in chalcedony.

Upon submitting the Haytorite to the same scrutiny, I could not discover the slightest difference between its optical structure and that of chalcedony. It consists of particles possessing double refraction, but having their axes lying in all possible directions. Hence arises the dull fracture observed by Mr Phillips, and also the want of regular cleavage, which cannot possibly take place in a mineral so constituted. The cleavage, therefore, which you mention as having been observed by Mr Cole, cannot be a regular one, but must be one of those accidental planes of separation, which are often observed in granular rocks, where the mass has no crystalline form.

This opinion of the perfect identity of Haytorite and chalcedony, in so far as their internal structure is concerned, is confirmed by the similarity of their fracture and specific gravity, as stated by Mr Phillips, but this result only adds to the difficulty of explaining the origin of the crystalline forms of Haytorite. For as chalcedony has been found in so many localities, and in such a great diversity of forms, without ever exhibiting the slightest trace of crystalline faces, we are naturally predisposed in favour of the opinion, that the crystalline forms of Haytorite are *pseudomorphous*, or derived from some other mineral.

We shall therefore proceed to discuss the question, and a most important one in mineralogy, whether the forms of Haytorite can be derived from any other mineral. It will be seen from the preceding description of this mineral, that the crystals of Haytorite are of the most perfect kind, and that the faces are derivable, by the laws of crystallization, from an oblique rhombic prism, as their primitive form. Hence it is clear, that the faces could not have been imprinted upon fluid chalcedony, by the faces of a number of other crystals surrounding it. If such a thing were within the limits of possibility, the edges of the crystal thus formed would readily betray its unnatural origin.

The only supposition, therefore, which can be for a moment admitted, is, that crystals of Humboldtite, (or some unknown mineral of the same form as Haytorite,) were imbedded in some matrix or substance capable of receiving smooth and perfect impressions from their crystalline faces; that these crystals of Humboldtite have been subsequently decomposed; that their ingredients had escaped so entirely, as to leave their moulds free of any material substance; and that fluid chalcedony, or chalcedony in a state of solution, had found its way by injection, infiltration, or otherwise, into these moulds, and filled them up. In this way there might be formed crystals of chalcedony like Haytorite, having the form of Humboldtite, or some unknown mineral. But as the chalcedony must have been introduced into the mould by some orifice of sensible magnitude, through which also the Humboldtite had escaped, it is obvious that this imperfection ought to appear at some point of the crystal. We shall not, however, avail ourselves of this objection, nor of other difficulties which very readily present themselves. We shall freely admit that the Humboldtite escaped from the small orifice, and entirely disappeared; that the chalcedony insinuated itself, without leaving any traces of its passage; that Humboldtite, or some unknown mineral of the requisite form, though now extinct in Devonshire, had once existed, and, consequently, that *isolated* crystals of Haytorite may thus have been modelled on the forms of departed minerals.

But how will this admission, ample and liberal as it is, account for the formation of the crystals of Haytorite as they actually occur in nature? In the specimens which you have sent me, the crystals of Haytorite do not exist in an insulated state, surrounded by any matrix in which the Humboldtite could have formed a mould. *They are actually aggregated closely together, and when they are detached, the faces which have been in contact are perfectly crystallized, without a trace of the interposition of any foreign matter.* Such crystals could not possibly be formed in the manner above-mentioned, nor, indeed, upon any hypothesis however extravagant; and

I cannot but express my surprise, how any person who has seen the crystals which are now before me in their combined and in their separated state, could for one moment suppose that they were pseudomorphous ones, modelled upon any other mineral.

There is yet one supposition which remains to be made, namely, that the boracic acid, the characteristic ingredient of Humboldtite, may have somehow or other been present with the chalcedony, and determined it to assume corresponding crystalline forms, in the same way as M. Beudant (see this Number, page 291,) found that the presence of nitrate of soda determined nitrate of potash to assume its crystalline form. Without asking what has become of the boracic acid, we may state that the crystalline structure which it superinduced would appear in the interior of the crystal, as well as in its exterior; and that the crystal could, in no sense of the word, be called a pseudomorphous one, because it is formed by the usual laws of crystallization. Such a crystal would also have physical properties different from those of chalcedony, in the same manner as the nitrate of potash, altered by the presence of nitrate of soda, has its physical properties changed along with its form. But as no such variation of character appears in the chalcedony, and as no circumstances whatever render such a supposition probable, we must abandon it as untenable.

Although I trust I have now established to your satisfaction, what indeed was your own idea as well as that of Mr Cole, that Haytorite has not been modelled upon any other mineral body, whether known or unknown, yet we have only increased the difficulty of accounting for its crystalline forms by the exclusion of that hypothesis.

The existence of perfect crystalline forms, without any trace of internal crystallization, nay with an internal structure, in which the axes of the elementary crystals have every possible direction, seems a paradox in mineralogy. The subject therefore deserves the minutest investigation, and will amply reward the labours of those who have time and talents for such an inquiry. It may not be unimportant, however, to mention, that I have observed in many crystallized minerals a deviation from parallelism in the axes of their elementary crystals; and it remains to be seen whether this deviation is most common in crystallized minerals, which have either no cleavage or an imperfect one, and to what extent it can go without affecting the external form of the crystal. When we consider what curious composite structures exist in apophyllite, analcime, amethyst, chabasie, mesolite, &c. &c. without any corresponding indication of it in their external crystallization, the anomalous structure of Haytorite will cease to excite our astonishment. I conceive indeed that it may belong to the same class of facts, with this difference only, that, in the case of the former, the combined individuals have a perceptible magnitude, whereas in the Haytorite they are minute particles or granular crystals.

In order to illustrate this view of the matter, which is proposed merely as an hypothesis, let us suppose a compound crystal such as the *Sulphato-tri-carbonate of lead*, which, as Mr Haidinger has proved, is composed of three individual crystals forming what appears to be a regular rhombohedron. If we expose this crystal to polarized light, we shall see that the axes of double refraction, or of crystallization, are lying in three different directions. If the size of the crystal is conceived to be reduced so that the three individual crystals become small grains, and if we also conceive that each of these grains unites with another grain according to the same law of composition, the crystallization filling up any vacuities that may be left, we shall then have a mass really granular, and which may, without any violation of probability, be supposed to possess a regular external structure. A crystal thus composed can have no regular cleavage, and would exhibit the fracture, the imperfect transparency, and the optical structure of Haytorite.

Although this is a mere supposition with respect to Haytorite, yet the smallest crystal of analcime is actually composed of twenty-four different solids; and I possess crystals of amethyst with perfect crystalline forms which are composed of many hundreds of individual crystals, one half of which have the direct, and the other the retrograde structure of plagiedral quartz. Nay, in some crystals of this extraordinary mineral, the combined individual crystals are so numerous that they require a microscope to be seen, and there are other crystals in which their existence can be determined only by the total destruction of the circular polarization, which is possessed in an opposite manner by each pair of the combined crystals.

I am, Sir,

Yours most faithfully,

D. Brewster.

Edinburgh, 10, Coates Crescent,
March 1, 1827.

Art. XXXI.—*Account of a New Animal, which occurred in such quantities as to dye Red the Lake of Morat in the Spring of* 1825.* By Professor Decandolle.

About the end of the winter of 1825, the Lake of Morat presented the remarkable phenomenon of being covered in several places with a red substance, which coloured it in a manner so extraordinary that all the inhabitants on the banks of the river were struck with astonishment. Although this phenomenon has only now attracted particular notice, yet it is said to happen every spring, and the fishermen express the fact by saying, *that the lake is in flower*. In 1825 it lasted from November till March, April, and even May,—a circumstance which is ascribed to the mildness of the winter, and to the low state of the waters, which favours the developement of the organic matter which produces the red colour.

During the first hours of the day nothing particular is observed in the lake, but soon afterwards there are seen long red lines, very regular and parallel, along the margin of the lake, and at some distance from its banks. The winds push this matter into the small bays, and heap it round the reeds, where it covers the surface of the lake with a fine reddish foam, forming strata of colour varying from a greenish black to the most beautiful red. Sometimes yellow, red, and grey colours of all kinds are seen, sometimes they are seen marbled, and sometimes they present figures like those produced by positive electricity on the electrophorus. During the day this mass exhales a

* Abridged from the *Mém. de la Soc. de Phys. et D'Hist. Nut. de Geneve*, tom. iii. part ii.

putrid smell, and during the night the whole disappears, to reappear again the next day.

When the lake is agitated by high winds the phenomenon disappears, and presents itself again when a calm returns.

Several species of fish, such as the perch and the pike, probably from having eaten of this matter, had their outline, and even their flesh, tinged red as if they had been fed upon madder, but without experiencing any inconvenience. Several small fish, however, (as Dr Engelhart and M. Treschel both mention) which came to the surface to breath and to catch flies, died with convulsions in passing through this matter, an effect which is ascribed by some to their having swallowed a portion of it, and by others to the putrid air which existed at the surface.

MM. Engelhart and Treschel, to whom we owe these interesting details, first directed the attention of naturalists to this subject, and, in consequence of this, several bottles, filled with the different substances, were forwarded to Geneva. These substances were examined by Professor Decandolle in so far as they were connected with natural history, and by MM. Colladon-Martin, and Macaire Princep, in their chemical relations.

When the bottles were opened at the end of twenty-four hours, they exhaled an extremely fetid odour. When the contents were poured out, there appeared two substances very distinct, viz. a red and very minute matter of a brownish-red colour, and another in irregular plates of a dirty green colour.

By filtering the mass there was obtained a great quantity of the reddish-brown substance. When placed in water this substance swam on its surface; but if it was obtained without filtration, and if it was mixed with water, the fluid presented three zones, an upper one which contained the substance almost pure, a middle one which was water, and an under one which was a mass of different fragments and mud which had been mixed with the brown matter.

On the first day, the water which separated these two zones was perfectly clear and colourless; but at the end of two or three days it had a rose lilac colour, and afterwards a very brilliant red lilac. This colour begins always on the upper part. It continues to descend in the liquid; and it is evident that it proceeds from the brownish matter which swims above. When the vessel is agitated, all the zones are mixed together, and the fluid appears of a dirty lilac, more or less brownish or reddish. Hence it is certain that the colour of the water depends essentially on the reddish-brown matter which forms the upper and floating zone. This matter requires to be examined with more attention.

When we examine it through a lens, there is seen only a mass of very minute cylindrical filaments, which seem to be what Haller has described as a *purple conferva swimming in water.* By using a powerful microscope, however, the filaments are seen marked with transverse stripes, which are often entire, and in rings sometimes interrupted. These rings are often very near each other, and tolerably regular. This state of the rings rendered it probable that the filaments were not confervæ, but belonged to the genus *oscillatoria* of M. Vaucher. This supposition was confirmed by their own proper motions, as they were seen to bend and twist themselves, sometimes in one direction, and sometimes in another, and with such rapidity as to leave no doubt of their being animals.

The matter which dyed the lake of Morat red, is a new species of *oscillatoria*, having its rings less near each other, and less thick than in the *oscillatoria subfusca* found in the Rhone, and described by M. Vaucher.

The rings appear to be situated in the interior of a membranous tube, at least we often see tubular portions of the filament deprived of rings, and fragments of rings more or less complete floating on the liquid. The colouring matter appears to be contained either in the rings or between the rings. It is probable that, by the fermentation or putrefaction of these substances, which takes place either at their death, or perhaps when they are in a diseased state, this colouring matter is dissolved in the water, and forms that fine lilac rose-colour which terminates by developing itself in the water upon which the *oscillatoria* swim.

The shreds of dirty yellow, which were often mixed with this reddish matter, were considered to resemble fragments of the thallus of some foliaceous lichen. They are fetid, and a little soft, having nearly the specific gravity of water, and are almost all irregular and slashed at the margin. On one side they are whitish, and on the other of a dirty green, from half an inch to three inches long, and from half an inch to an inch wide. Under the microscope they show no distinct trace of organization. It is possible that they may be the debris of large vegetables which live in the lake, such as the *Nenuphars* and *Scirpes.* It is possible that they may be substances analogous to some species of ulva or rivalia half decomposed ; or it is possible that they may be the debris of the skins of the *oscillatoria,* and be analogous to the body which Professor Vaucher has figured in his *oscillatoria vaginata,* and in all the Nostochs. If this last hypothesis is verified, it will tend to confirm the idea that the *oscillatoria* of Morat is different from the *oscillatoria subfusca.*

When the *oscillatoria* of Morat are placed in water, they arrange themselves on the margin of the vessel in long filaments, of a colour which is brown in their lower part, and green in the upper part. Does this green part form an integral part of the other? Is it the beginning of the formation of a skin? Is it a particular age of the *oscillatoria?* or is it a formation foreign to its essence? All these questions have not yet been completely answered. Analogy with the other species of the genus seems to confirm the opinion, that this green production actually makes a part of the developement of the *oscillatoria,* and is perhaps the commencement of the formation of a skin.

This new animal may be described as follows, in the language of natural history :—

Oscillatoria rubescens.

O. filis cylindricis tenuissimis ($\frac{1}{360}$ lin. diam.) fusco-rubescentibus, confertissime annulatis.

Conferva purpurea aquis innatans.—Haller, *Helv.* No. 2109?

Hab. in Lacu Morattensi ; precipue hyeme et vere ; interdum temperie favente valde multiplicata ad superficiem fluitans, et aquam rubram efficiens.

The gentlemen who undertook the chemical examination of the substances above described, found that the red matter was composed of

1. A resinous red colouring matter.

2. A green resin.
3. A great proportion of gelatine.
4. Some earthy and alkaline salts, oxide of iron, &c.

This analysis demonstrates the existence of an organized animal substance, and confirms the opinion of some naturalists respecting the origin of products of animal nature which have been lately met with by several chemists in a great number of mineral waters.

Art. XXXII.—*On a New Class of Electro-Chemical Phenomena.* * By M. Leopold Nobili.

In the very curious experiments which we are about to describe, M. Nobili makes use of a pile of twelve small elements, having a surface of an inch square. He concentrates the current which proceeds from one of the poles in a platina wire with a sharp point, which is immersed in the liquid to be decomposed. He then conveys the current of the other pole into a conductor terminating in a disc, or flat surface of metal, which is placed in the liquid within half a line of the point of the platinum wire, and perpendicular to the current. The phenomena which M. Nobili observed, showed themselves on the surface of the metallic plane. They depend on the nature of that plane, and have their origin precisely opposite the point of the platina conductor. The liquids employed were generally strong solutions of the salts mentioned.

Sulphate of Copper.—The platinum point communicating with the negative or copper end of the pile, and a *silver disc* with the *positive* end, they are both plunged in a solution of sulphate of copper in the manner already mentioned. Opposite the platinum point, there is then found on the silver *four or five concentric circles*, alternately bright and dark.

When the *silver* communicated with the *negative* end of the pile, there was commonly formed three small concentric circles, by the deposition of copper proceeding from the decomposition of the sulphate. The smallest and the largest circle were of a deep red colour, and the intermediate circle

* Abridged from the *Bibl. Universelle*, Dec. 1826. p. 302.

was of a clearer tint. These colours are those of the copper in the state of oxide, and in the metallic state. A stratum of nitric acid passed slightly over the disc, attacked these different circles. Those formed by the oxide of copper disappeared almost entirely, and that which was formed by the copper remained. *Four* or *five* circles were sometimes formed instead of three, and the tints alternated as in the preceding case.

Upon a disc of *Brass Positive,* (that is communicating with the *positive* end of the pile,) there are several different concentric figures, which, when they are wiped with linen, leave upon it traces of *five* concentric circles of a clear brass yellow colour. Some are clearer than others, and alternate with them.

Upon *Brass Negative* there is a deposit of copper, and circles of two alternating shades, as in silver.

No distinct effects were obtained either with discs of platina, tin, or bismuth.

Sulphate of Zinc.—Upon *Silver Positive* there was a spot dark at the centre; then a clear yellow circle; then a circle of light blue; and then a fine zone, approaching to yellow.

Upon *Brass Positive* there were four small circles proceeding from the copper. They have two tints, one clearer than the other, and alternating. These tints seem to be those which distinguish copper in the state of oxide from copper in the metallic state.

Sulphate of Manganese.—Upon *Silver Positive* there appear *five* concentric circles, alternately bright and dark. The fifth is more distinct than the rest, and is surrounded with an area of a pale yellow, which terminates in a violet tint.

Upon *Brass Positive* there are five small circles, alternately bright and dark.

On *Bismuth Positive* there are four circles. The smallest is white, the second darker, the third a pale yellow, and the fourth black.

Nitrate of Bismuth.—On *Gold* and *Silver Negative* there are four or five concentric circles differently coloured, but not distinct. The tints of these circles appear to be those through which the bismuth passes in its oxidation.

Acetate of Lead.—On *Gold* and *Platina Positive.* In a few seconds there are formed different concentric circles as brilliantly coloured as the Newtonian rings. These rings rise the one out of the other, propagating themselves like waves. Their vivacity and distinctness depend in a great measure upon the polish of the metallic disc, being weak and confused on imperfectly polished surfaces. They resist the action of a moderate heat, but they disappear entirely with nitric acid.

From this and other circumstances there can be doubt that these rings are thin plates deposited by the action of the electric current on the metallic surface.

This phenomenon becomes more precise and more varied when we multiply the points on the negative side, and arrange them in regular figures, as a triangle, square, &c. There are formed on the disc as many systems of concentric rings as there are points, but in place of intersecting each other as they expand, like waves, they extend outwards when they come in contact, so as to form only a single outline. This appearance reminds us of the figures formed by sand upon vibrating plates, as described by Chladni, Paradisi, and Savart.

A disc of *Silver Positive* presents also the coloured rings, but with less distinctness. No remarkable effect is produced by lead, tin, copper, bismuth, and antimony.

Acetic Acid.—On *Gold* and *Platina Positive* there is only an uncertain colour, as with acetate of lead.

Acetate of Copper.—On *Platina, Gold* and *Silver Positive* nothing remarkable is observed, but it is otherwise when they communicate with the negative pole. On *Silver* there is often formed *four* concentric circles, which, when exposed to the air, become a *deep blue* at the centre, then a *yellowish-red,* then a less deep blue, and lastly, a yellowish-red shade, forming a ring wider than the first. Nitric acid makes the exterior circle disappear, but the three interior circles remain, leaving the ordinary colour of copper in its two states of oxide and metal. In the centre is the oxide, and then the pure metal, surrounded with another circle of oxide. *Platinum* and *gold* present analogous phenomena.

Acetate of Potash, on *Silver Positive,* exhibits a dark circle in the middle of other three which are four lines in diameter, and surrounded with a very brilliant fillet of silver, which is surrounded by an area of different colours which are feeble. The dark circle does not acquire its proper tint till the instant that we interrupt the circuit. One would say that the veil which covers the exterior circle is folded back from the centre, at the moment when the action of the current ceases. As I have seen this phenomenon only with acetate of potash, it merits the attention of philosophers.

Acetate of Copper and Lead mixed together.—On *Gold* and *Platina Positive* there appears the finest coloured rings, as with acetate of lead alone. Is this salt, therefore, the only one which enjoys the property of colouring, in this manner, these two metals which are the most difficultly oxidable? But if these coloured rings proceed, as they appear to do, from some of the electro-negative substances in the solution which deposit themselves in thin films on the surface of these two metals, why does it not happen with other metals?

Upon *Silver Negative* there is formed a great number of concentric circles, which are generally arranged as follows: In the centre is a dark circle, then a yellow circle bordering upon red, then a deep black circle, then a fine ring of pure copper, then a circle less black than the third; and, lastly, a zone of a light coppery tint. A stratum of nitric acid passed over this series of circles, discovers in the centre a spot having the lustre of silver surrounded with four circles of copper in the state of oxide and metal, alternating in the ordinary manner, and becoming more distinct by a second wash of nitric acid.

Antimoniated Tartrate of Potash, or tartar emetic.—On *Silver Positive* there appears five coloured circles. The first in the centre is dark, the second is a silvery white, the third is azure bordering upon violet, the fourth is silvery white, and the fifth is violet, but light without.

Upon *Silver Negative* there are five other circles. The first is black, the second reddish-yellow, the third black, the fourth a bright blue, and the fifth slightly deep.

Chlorate of Platina.—On *Silver Positive* there is a black spot in the centre, then a circle of an ash colour, then a slight iris. On *silver negative* there is a black spot in the centre, surrounded with a bright circle, then a circle more deep, surrounded with a slight iris, and, lastly, another circle almost black. On *platina positive* there is no appearance, but on the same metal *negative* there are two small circles bordering on black round a white circle.

Nitrates of Copper and Silver mixed together.—On *Silver Positive* there is in the centre a brilliant circle of silver, then a dark circle, then a second circle of silver, and, lastly, another darkish circle.

Phosphoric Acid.—On *Silver Positive* there is in the centre a small yellow circle, then a reddish circle, then a silvery white circle; and lastly, a wide area of different colours, beginning with yellow and ending with violet.

Oxalic Acid.—On *Silver Positive* there are three distinct circles, the first yellow, the second reddish, and the third like the first, but larger.

Subcarbonate of Potash.—Upon *Silver Positive* there is an elegant arrangement of concentric circles, which dilate before the eye, and finish by exhibiting a fine degradation of tints. I covered the piece of silver with a piece of muslin, to see if the phenomenon would be altered by it, but it suffered no change. There was no appearance upon *gold* or *tin positive.*

Common Salt.—Upon *Silver Positive* there was a series of concentric circles surrounded with various irises. The phenomenon is here more vague than in the preceding cases, and it retains its lustre only during a short time. The contact of air weakens and confounds a little the tints which are in perfect harmony. *When the silver disc is suddenly heated, all the rings assume a fine red colour*, whose intensity varies in the different circles; after which the tints acquire a certain permanence. By the action of heat, some of the exterior zones disappear, and also part of the central zones. This accident does not appear difficult to explain. The arrangement in thin plates, of the electro-magnetic substances, begins at the centre of the disc of silver, and goes on diminishing to its circumference. The exterior strata are of great tenuity, * and

* This we do not understand. If the colours are those of thin plates, as the author believes, the thickness of the plates must increase from the centre to the circumference.—Ed.

are easily dissipated by the action of heat; while, towards the centre, the deposit is much more considerable, but from its very abundance there is formed a species of crust, which splits by the heat, and is easily detached from the metal.

On *Copper Positive* there is an alternation of clear and dark circles.

On *Brass Positive* there are different concentric circles, which, when cleaned with linen, exhibit three or four rings alternately red and yellow. The red ones proceed from the copper in the brass, which then loses the zinc in its composition. There was no appearance upon *tin* and *platina positive.*

Sulphate of Soda.—On *Silver Positive* there are five small concentric circles; in the centre there is a black point, then a bright blue circle, then two dark circles, separated by a bright one.

Urine.—Upon *Silver Positive* there are different orders of very brilliant coloured rings round a dark centre. When dried, they are permanent, in contact with the air.

Urea acts like the preceding, but produces colours more definite.

Urine and Common Salt.—Upon *Silver Positive* the phenomenon is the same as in the preceding case, but the coloured rings, being more numerous, are also more delicate. When exposed to heat, they take a fine red colour, without producing any confusion among their shades. On *platina positive* there is no effect, and on brass and copper *positive* there is a small number of insignificant circles.

These experiments, which have not been pushed farther, lead to two results. The first is the property, which certain electro-negative substances possess, of attaching themselves, in certain determinate circumstances, to the surface of some of the less oxidable metals, in films so thin and regular, as to produce, in a thousand varied forms, the elegant phenomenon of coloured rings. The arts will probably avail themselves of this new colouring process, and may perhaps succeed in applying it to the ornament of some objects of luxury. When the electro-negative substances are not deposited on the metals in their films, they generally attack their surface, not in a uniform manner, or, as we might at first suppose, by a continued and decreasing gradation of intensity reckoning from the centre, but at regular intervals, following, so to speak, a law analogous to that of *interference.* At the negative pole, where the electro-positive substances appear, we observe the same phenomenon, namely an alternation of circles of oxide and of pure metal. This alternation constitutes the second result which I have announced. May we suppose that the radiation of electric currents follows a law of interference? There exists, without doubt, certain alternations, but new experiments are necessary to discover their true origin.

Reggio, *November* 20, 1826.

Art. XXXIII.—*On Haidingerite, a new Mineral Species.* 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.

In an account of the analysis of two newly discovered minerals described by Mr Haidinger in the third volume of this *Journal*, it was my intention to have proposed for the second species, the Diatomous Gypsum-Haloide, the name of Haidingerite, in honour of the distinguished mineralogist who first noticed its existence. In this wish I had the pleasure to concur with Mr Ferguson of Raith, in whose cabinet the minerals were discovered; but as Mr Haidinger was not at that time in Britain, it was thought advisable to make no allusion to the subject until after his return. Having now gained his assent, I propose to employ the name of Haidingerite to designate the species above-mentioned, and have no doubt that this proposition will be favourably received by mineralogists.

In a recent scientific tour through the continent, made in company with Mr Robert Allan, Mr Haidinger hoped to meet with specimens of Haidingerite, and ascertain its locality. But in this he was unsuccessful. He could not discover it in any of the cabinets which he had an opportunity of inspecting, not even at Carlsruhe, among the numerous and superb specimens of the arseniates of lime and other products of the mines of Wittichen in the Black Forest, collected by the Bergrath Selb, and now in the possession of the Grand Duke of Baden. He ascertained, however, that the hemiprismatic gypsum-haloide agrees exactly in form with pharmacolite. He saw distinct crystals of the latter, having the shape of Figure 4 of the paper above referred to. They are four-sided and eight-sided prisms, with an inclined base, and exhibit the same disproportionate enlargement of one of the faces of the prism *f*. Like other species which consist of arsenic acid, lime, and water, their origin depends on the oxidation of arsenical pyrites, or other minerals containing arsenic, and on the reaction of the arsenic acid so formed on calcareous spar.

The crystallized specimens of pharmacolite from St Marie aux mines, in Alsace, which have been lately found in considerable number, do not possess any very distinct forms; but in some of the more regular crystals the faces peculiar to the prismatic gypsum-haloide are perceptible. The single distinct cleavage, and the slight degree of flexibility of the laminæ, two characteristic properties of the same species, may likewise be observed.

The third species was recognized by Mr Haidinger in several crystalline fragments in the Royal Museum of Berlin; but their locality is unknown.

ART. XXXIV.—*An Account of Magnetical Experiments made in China and St Helena, with a view of determining the Position of the Plane of no deviation in those places.* By Captain J. P. WILSON of the H. E. I. C. Ship Hythe. Communicated by PETER BARLOW, Esq. F. R. S. Mem. Imp. Ac. Petrop. &c.

IT is known, that, in the commencement of my experiments, I had conceived (for the purpose of generalizing and simplifying magnetic results) an ideal sphere to circumscribe the iron ball or shell on which the experiments were performed; and, according to my deductions, it seemed to follow that this sphere would occupy different positions on different parts of the globe. I also expressed a hope that the truth of this deduction might be verified by experiments. To meet my views on this point, Captain Wilson provided himself with an apparatus like that which I employed at Woolwich; and the following is his own account of these experiments, from which it appears, that, abstracting from the errors of his dipping needle, the accuracy of the deduction is ascertained; the discrepance between the observed and the inferred position of the plane differing very little more than the known error of the needle in London, although the experiments were made in places having dips of contrary denominations, viz. north and south. Besides these results, it will be seen that Captain Wilson detected in his needle in China a very curious anomaly, depending upon the unequal distribution of magnetism in its two branches; and these having been since examined on the same apparatus in England by Captain Beaufort, R. N. F. R. S. by Captain Wilson, and by myself, they have been found to possess a greater importance in the theory of magnetism than Captain Wilson supposed, and a paper is at present before the Royal Society on these experiments. It would therefore be improper to enter upon the subject in this communication, but you will probably (should they appear in the *Transactions*) make them the subject of a future article. The following is Captain Wilson's account of his experiments on the plane of no deviation.

Having provided myself with a stout deal table, the surface of which was planed perfectly true, and also with a dipping needle made by Nairne and Blount, with several light horizontal needles, and with some powerful magnets, on my arrival in Calcutta I procured a 13 inch mortar shell from the arsenal, with the intention of ascertaining the plane of no attraction, which, according to Mr Barlow, should be at right angles to the dip in all latitudes.

Some defects, however, in the apparatus, and other circumstances, prevented my obtaining any satisfactory results before the ship's departure.

On our arrival in China, my attempts to repeat Mr Barlow's experiments were again unsuccessful, till at length it occurred to me, that, if the poles of the needle were not equally distant from the pivot on which it turned, all the inconsistencies would be accounted for which had defeated my former trials; for although, when within the influence of the ball, the needle would be materially affected, it would, when left to itself, take its natural direction in the true magnetic meridian. I therefore placed the needle on the east or west point of the table, and lowered the shell, so that its centre was level with the pivot of the needle, in which position the shell, according to Mr Barlow's experiments, ought not to have any effect. In this position I found, that, by rubbing the needle in different parts with the magnet, I could cause a greater, less, or contrary deviation at pleasure, that is, if the south end of the needle was attracted by applying the north pole of the magnet to the south point, it would cause it to take its true direction; or, if it failed to do so completely, by applying the south pole of the magnet *between* the north end of the needle and the centre, it would be accomplished, and *vice versa.*

I am not aware that Mr Barlow experienced the same deviations in his needle, probably not, as the less the angle that the plane of no attraction makes with the horizon, the less the needle would be inclined to deviate. Having discovered the mode of rectifying the needle, if I may so call it, I proceeded with the experiments, confining myself to the 75th, 80th, and 85th degrees of the circle, from the north and south towards the east and west, as they were, from the difficulty of getting the shell in the exact centre of the circle, the most convenient, frequently placing the needle on the east or west points to correct it, and found the angle that the plane of no attraction makes with the horizon to be, as in the annexed table, the dip, as found by my dipping needle, being 31° 20′ north.

Distance from North or South Points.	North towards East below the Table.	North towards West below.	South towards East above.	South towards West above.	Mean.	Inclination of the Plane.
90°						
85	1.23	1.32	1.41	1.29	1.31	54°56
80	2.56	2.69	2.65	2.57	2.62	55 2
75	5.88	3.83	3.92	3.86	3.87	54 48
					Mean,	54°55

Radius of the circle, 10.55 inches. Diameter of the shell, 12.68 inches.

As the shell is *above* the table on the south side of the east and west points, the plane of no attraction dips to the south.

At St Helena, the dip of the needle being south, I determined on following the same process which had succeeded in China, but contenting myself with the 80th and 85th degrees, as on the 75th degree it became difficult to place the shell accurately in the centre of the table. I found the inclination of the plane to be as follows. The dip of the needle being 16° 32′ south,

Distance from North or South Points.	North towards East above.	North towards West above.	South towards East below.	South towards West below.	Mean.	Inclination of the Plane.
90°						
85	3.00	3.00	3.00	3.00	3.00	72.52
80	5.93	5.93	5.78	6.03	5.92	72.48

Radius of the circle 10.55 inches. Diameter of the shell 12·68 inches.

As the shell is *below* the table on the south side of the east and west points, the plane of no attraction dips to the *north*.

My various duties prevented the repetition of the experiments a second time, either at China or St Helena; and it is necessary to remark, that I cannot depend on the accuracy of my dipping needle, as in London, previous to our sailing, it showed the dip 68°54′ north, which was 1° 36′ less than the truth.

The vibrations of the needles entered in the journal, were for the purpose of calculating the dip by the method mentioned in Mr Barlow's work, but little reliance can be placed on them, from the difficulty of keeping the magnetic power always the same, although, when not in use, the needles were always attached to strong magnets.

Art. XXXV.—*Notice respecting the Zoology of the Falkland Islands.* * By M. Garnot.

In the course of the circumnavigation of the globe by the corvette *la Coquille* from 1822 to 1825, the natural history

* Translated from the *Annales des Sciences Naturelles*.

of the Falkland Islands, (the *Isles Malouines* of the French,) hitherto so little known, received very careful investigation. A short account of the Zoological department has been published by M. Garnot, surgeon and naturalist to the expedition.

The two principal islands of the group are named Soledad and Falkland. The former, indented with a vast number of bays, has two principal ones, those of *des Francais* and *de l'Huile.* It was at the extremity of a reef of rocks at the entrance of the bay *des Francais* that the Urania was unfortunately shipwrecked. Near this bay the remains of the establishment formed by Bougainville in 1765 were still visible; and, on the south of it, the shipwrecked mariners of the Urania formed their camp, of which scarcely a trace remained.

The Island of Soledad offers scenery but little attractive. Its mountains are destitute of large vegetables. The deep valleys and some plains are covered here and there with spots of verdure; but the vegetation is scarcely elevated above the surface of the ground, except where the shrub *Veronica decussata,* and the grass, *Festuca flabellata,* 4—5 feet in height occur.

It is remarkable that the horses, the cattle, and pigs, with which Soledad was stocked by the French and Spaniards, have not degenerated, though exposed to great vicissitudes of the atmosphere. The horses are the most numerous, and are met with in troops of fifteen to twenty. They are extremely shy, and can only be approached by stratagem; their flesh in the wild state is good, certainly as delicate as that of the oxen. The oxen are generally found in pairs, and are obtained with difficulty. The pigs are less diffused, having chosen for their retreat the shrubby cover in the neighbourhood of the bay *de l'Huile.*

The quadruped, however, which exists in the greatest number is the rabbit; burrowing principally on the sea shore, and in some of the valleys. They abounded so much in one spot that the sailors took them with their hands. Some of a violet-brown colour, interspersed with white hairs, and having brown ears, is considered a distinct species, and named *Lepus magellanicus.* The *Canis antarcticus* of Shaw, and mentioned by Bougainville, the expedition did not see. About the 15th of December they were visited by many *Phocæ*, and obtained an undescribed species. The *Balæna mysticetus* also made its appearance.

In birds these islands are more prolific. I. Of Birds of Prey, the expedition found the *Vultur aura*, *Falco polysoma*, Quoy et Gaim. *F. histrionicus*, do. *F. Novæ-zælandiæ. F. brasiliensis.* A singular instance is given of the boldness of this last species. Messrs Blois and Garnot having shot a pair of geese, male and female, one of their young ones was pounced upon, and carried off from before their eyes. A species of owl, with a short tuft, terminates the list of birds of prey.

II. Passereaux.—In this division were discovered seven species. Of two species of thrush, one was new, and has been named *Turdus Falklandiæ.* There are also two species of *Sylvia*, *S. macloviana*, Garn. sp. nov. and the other resembling *S. cisticola*, native of Sicily and Sardinia. A new *Emberiza. E. melanodera*, Quoy and Gaim., the *Sternus militaris*, and the new *Certhia antarctica*, Garn. conclude this division. The *Sternus* is the only bird with splendid plumage, and is called by Bougainville the *Oiseaux rouge.*

III. Echassiers.—A pretty new species of plover, *Charadrius pyrocephalus*, Garn. and *Tringa Urvillii*, Garn. sp. nov. are the first mentioned. The latter is said to be generally perched upon *Hydrocotyle gummifera*, Lam. Two species of oyster-catchers were seen, the *Hæmatopus niger* of Quoy and Gaimard, and a distinct one, the *H. leucopodus*, Garn ; remarkable for the pale colour of the feet. The heron "*Bihoreau pouacre*" was extremely rare. The *Scolopax longirostris*, and the *Charadrius calidris* did not differ from those of Europe. Of *Chionis vaginalis*, Viell. known by navigators under the name of the white pigeon, a single specimen only could be procured. A few days before, another had been shot far out at sea, about eighty leagues from land.

IV. Palmipedes.—Belonging to this extensive order, the expedition observed several very interesting species. The birds composing it were more numerous than any other, as might be anticipated. A new species of grebe has been described by Messrs Quoy and Gaimard, (*Podiceps Rollandii*); and another by M. Garnot, (*P. occipitalis.*)

The most extraordinary birds of this order, seeming to be almost intermediate between birds and fishes, are the Penguins. They cover the shores of the islands in the bay *des Francais.* It is truly amusing to see crowds of them marching quite erect, and in regular files. When approached, a signal of alarm is given by some one of the company, and they immediately throw themselves upon their bellies to escape the more speedily. If their retreat to the sea be cut off, they are taken without difficulty. Their nests, which may be rather termed deep burrows in the earth, are large enough to contain the whole family, of father, mother, and two young ones. Various navigators have remarked the peculiar dissonance of their cry, which somewhat resembles the braying of an ass. In the present expedition, the noise produced by them on calm evenings put the hearers in mind of the sound of a populace on a day of rejoicing. *Aptenodytes demersa* was the most common, but two others were noticed.

The petrels were exceedingly numerous; above all, the stormy petrel, *P. pelagica* and *P. Berardi,* Quoy and Gaim. Specimens were also procured of the *P. gigantea, P. vittata, P. cœrulea,* Gm. and a new species named *P. Lessonii* by M. Garnot, and figured in the Atlas to the *Annales des Sciences Naturelles* for 1826. Gulls abound almost as much as the petrels, exhibiting the following species:—*Larus marinus, L. niveus, L. glaucus, L. argentatus,* and *L. ridibundus.* The beautiful *Sterna hirundo* was not unfrequent; a second species was observed with a grey head, a specimen of which could not be procured.

Three distinct species of cormorant inhabit the islands. *Pelecanus fiber,* Gmel. *Carbo leucotis,* Cuv. and one with a tuft of feathers two inches in length, a white belly and neck, with the remainder of the plumage of a slate blue colour. The *Carbo graculus* of Meyer, it is supposed is a mere variety of *Pelecanus fiber.*

Only two species of goose presented themselves, *Anser leucopterus,* (of which the female is called *A. magellanica,* by

Gmelin,) and *A. antarcticus*, Garn. The former runs so fast that it is easier to procure a specimen which is flying.

Of the genus *Anas* four species are recorded; *Anas cinerea*, Gmel. (*A. brachyptera*, Lath.) has short wings, and it is easy by firing upon a group of them to drive them upon the land, when they become an easy prey, from not being able to fly. The sailors thus killed numbers of them with sticks. It is this species which was called race-horses by the sailors in the voyages of Wallis and Cook. The second species is the "Milouin des Malouines;" the third the "Canard à bec jaune et noir d'Azara;" and the fourth the *Anas superciliosa* of Latham. The flesh of the last is said to be delicious.

Art. XXXVI.—*On a Remarkable Decomposition of Carburetted Hydrogen by its Rapid Escape from a Portable Gas Lamp.* By David Gordon, Esq. Engineer to the London Portable Gas Light Company. In a Letter to the Editor.

My Dear Sir,

I think it may be interesting to you to be informed of an accidental discovery which my son Alexander and I made when starting the portable gas works at Manchester.

You are aware that the portable gas lamps are usually filled with compressed gas to the extent of thirty atmospheres. When proceeding to do so the first time at Manchester, the safety valve of the compressing machinery happened to blow at about twenty-seven atmospheres. Most of the attendants were unacquainted with the operation, and as the valve made to them an alarming noise, it was some little time before the steam-engine, which works the condensing pumps, could be stopped. When we went to examine the safety valve, we were surprised to observe that all the metallic part of the valve, upon which the gas had rushed, was covered with a black moist carbonaceous substance, and the contiguous brick wall with dry black carbon, the moisture in this latter case having been absorbed by the brick.

Since that time, my son has repeatedly exhibited the discovery, by allowing the gas to rush out with very great violence from a portable gas lamp against a piece of white paper, which becomes immediately covered with a black carbonaceous deposit.

The discovery has confirmed in my mind what I have long suspected, that in carbonated hydrogen there is little more than a mechanical union between the hydrogen and the carbon, and that during the sudden expansion of the gas the carbon is deposited.

I should like to see it ascertained if there are any and what electric phenomena developed during the operation.—I am,

My dear Sir,

33, Cornhill, London, Yours very sincerely,

28th Feb. 1827. David Gordon.

Art. XXXVII.—*Notice regarding the naturalization of the Cochineal Insect in Spain.* Communicated to the Academy of Sciences by M. Bory de Saint-Vincent.

I have received from Madrid, says M. Bory de Saint Vincent, by the hands of the excellent botanist, M. Pavon, the subsequent note, which I conceive to merit the attention of the Academy.

" Since the publication of the edict of the 29th of March 1826, by the Consulate Royal of Malaga, the environs of this city have exhibited a spectacle exciting both interest and admiration—the complete naturalization of the Cochineal insect.

" Dr Joseph Présas, known in Europe from having served as private secretary to the Queen of Portugal during her residence in Brazil, drew up minute instructions for the cultivation of the *Nopal*, as well as for the breeding of the Cochineal itself. These instructions were published in Malaga at the commencement of the year 1825. To secure a portion of one of the greatest sources of the riches of the New World became at once an important object. Plantations of *Cacti* were made, the insect was obtained, and the instructions having been scrupulously followed, the result has been favourable beyond the most sanguine expectations. Spain has secured a source of riches which no other country in Europe possesses, and probably never will possess.

" Dr Présas has not only shown an intimate knowledge of natural history, by the publication of his Memoir, but also his patriotism, by the zeal and activity with which he himself has superintended an experiment, already productive of a liberal harvest."

Having been many times at Malaga at different seasons, I have it in my power to bring forward some facts which will prove to the Academy, that it is not without reason this eminent Spanish botanist considers the acclimation of so precious an insect to be permanently secured in his own country. The temperature of Malaga is one of the most uniform in Spain. Frost is unknown. The thermometer never falls, under any circumstances, below eight degrees of Reaumur. The sugar-cane is cultivated in the open air, as well as the cotton-plant, from which large revenues have been derived during the last fifteen years. I have seen the *Schinus Molle* (the Peruvian mastic-tree) produce its fruit, and the custard apple and plantain trees ripen theirs everywhere without protection. There are few plants of the *Flora Atlantica* of Desfontaines that I have not found there, and Cactus covers naturally all the maritime rocks. The quantity of the latter plant is so considerable, that trouble was never taken to cultivate it, though the fruit under the common name of *Figues de Thunas*, was, during its season, the principal support of a large proportion of the poor population. It is the employment of women and children to gather it and convey it to the market. If we consider that it scarcely ever rains in Malaga, and never at the period when moisture would be injurious to the cochineal, it is clear that no country could be better chosen to rival Mexico in this production. Another proof of the favourable nature of climate is, that my friend M. Zea and myself planted coffee-trees in the open ground, and sowed a bed of the *Indigofera Anil*, which passed two winters without injury, and was in abundant fructification when we left the place.—*Annales des Sciences Naturelles.*

Art. XXXVIII.—ZOOLOGICAL COLLECTIONS.

1. Professor Harlan *on the Mammalia of North America.* *

Professor Harlan enumerates 147 species of Mammalia as inhabiting North America.

Of these, *several* are entirely new, and not before described: *eleven* species are fossil, and no longer exist in a living state, in this, or any other country; many were imperfectly noticed, or erroneously described; others merely indicated. In several instances *species,* and in three or four cases, *genera,* have been confounded.

With regard to the distribution of the North American mammalia, they are thus divided—119 are Quadrupeds, 28 Cetacea.

To the order Primates belong,	1 species.	Pachydermata,	2
Carnivora, -	60	Ruminantia,	13
Glires, - -	37	Cetacea, -	28
Edentata, -	6		
			147

Twenty-five species are *common* to both Continents, without including the cetaceous animals, viz:—

Of the Mole, -	1 species.	Weasel, -	2
Shrew, -	2	Beaver, -	1
Bear, -	1	Field Mouse, -	1
Glutton, -	1	Campagnol, -	1
Otter, -	1	Squirrel, -	1
Wolf, -	2	Deer, -	2
Fox, -	2	Sheep, -	1
Seal, -	2	Fossil, - -	4
		Total, -	25

2. *Account of a remarkable Extinct species of Beaver.*

Osteopera, Harlan.

CHARACTERS.

Dental formula.—Teeth 20. { superior 10. { Incisor 2. Canine 0. Molar 8. } inferior 10. { Incisor 2. Canine 0. Molar 8. }

Inferior incisors, slender, laterally compressed, nearly pointed, not approximate, convex anteriorly; molars nearly similar to those of the beaver; head very broad and flat; snout rapidly attenuated; eyes widely separated; zygomatic arches exceedingly large, descending beneath the inferior molars, scabrous and convex externally, forming within large osseous pouches communicating with the mouth, anterior to the molars; lower jaw proportionably small and slender; the condyloid extending above the coronoid process.

* From Harlan's *Fauna Americana.*

Species.

1. *Osteopera platycephala.*

Char. Essent. Head flat, ventricose at the sides; snout obtuse; eyes widely separated.

Dimensions of the cranium compared with that of the full grown Canadian beaver: (the extremity of the snout of the *Osteopera*, together with the upper incisors, have been destroyed.)

		New Genus.		Castor fiber.	
Total length of the skull, - -	Inches	6	0	5	0
Length of the frontal bone, - -		2	5	1	5
Breadth of do. - - -		1	8	1	0
Length of the parietal bone, - -		3	0	1	7
Breadth of do. - - -		2	3	1	6
Length of the zygomatic arch, - -		3	6	3	0
Breadth of do. - - -		2	0	1	2
Width across from one zygoma to the other -		4	0	4	0
Breadth of the palate bones between the molars, -		0	4	0	8
Length of the zygomatic fossa, - -		1	7	2	3
Breadth of do. - - -		1	2	1	0
Length of the lower jaw not including the incisors,		4	0	4	0
Breadth of the same including the molars, -		1	3	1	5
From the top of the coronoid process to the base of the jaw, - - -		1	2	2	4

Description. Frontal bone nearly double the length and breadth of that of the common beaver, flat and scabrous, forming on each side a semilunar ridge, projecting into the orbits; orbit of the eye small, and nearly circular, which is due, principally, to the extraordinary developement of the zygomatic processes of the temporal and jugal bones, which are produced downward and backward, so as to conceal the posterior half of the lower jaw, together with the teeth, anteriorly arched, scabrous, and ventricose; the jugal portions being developed anteriorly and inferiorly, so as to form on each side a *bony antrum,* or cavity, capable of containing in all two or three ounces of fluid, and communicating with the mouth by large oblong openings, immediately anterior to the molar teeth; the cavity projecting posteriorly into the orbit, with which it has no communication; anterior to the orbit, above the cavity, is a bony canal, capable of admitting the little finger, somewhat analogous to the infra orbitar foramen observed in the skull of the genus *Cavia.*

The structure of the inferior jaw is equally remarkable, and adapted in every respect to the peculiarities of the upper jaw; the whole of the lower jaw is more slender and narrower than that of the beaver. In order to admit a free passage from the bony cavities into the mouth, the molar teeth and alveolar processes of the lower jaw are elevated, and the latter are separated from each other anteriorly, so as to leave a capacious opening, of an oval form, from the sack into the mouth; the coronoid process very small, and not projecting so high as the condyloid; the latter also small, rounded above and compressed; angles of the lower jaw rounded; the inferior incisors slender in proportion to those of the beaver, arched on the anterior surface, not approximate, slightly divergent at their extremity, somewhat analogous to the incisors of the squirrel; the crowns of the molars are plain, though they do not appear to have been much worn, and are traversed by three, sometimes four folds of enamel, which, in several of the teeth, have no connection with the enamel which encircles them; in others they consist of re-entering folds, as in the teeth of the beaver; thus displaying, in a remarkable manner, the extent to which this portion of the structure of the teeth may differ in the same individual: in those instances, where the transverse plates of enamel are distinct from the encircling enamel, there are no grooves on the side of the tooth; in other instances, the sides are grooved, as in the teeth of the beaver, except that portion buried in the socket, which is smooth in most instances. In all other details, this skull bears the closest analogy to that of the beaver. The animal was full grown, as is evinced by the teeth, and other particulars.

Habit and Locality.—Nothing further is known concerning the history of this animal, than that its skull was found more than thirty years ago on the shore of the river Delaware, and presented to the Philadelphia Museum; when first discovered, it was nearly perfect; by rough usage it has since lost the upper incisors, and part of their alveoles. This cranium has been frequently examined by the curious, and by them regarded as a *lusus naturæ;* the characters which it presents are certainly unique of their kind; the bony cavities communicating with the mouth, which must have served as receptacles for provision, &c. distinguish this skull from that of all other animals, and particularly the beavers, to which, in other respects, it bears so near a resemblance. That it is not a monstrous production of nature, is fully demonstrated by the well-defined characters of the jaws and teeth, as well as by the harmonious adaptation of its various parts. It is further, not in the least degree fossilized, nor does it appear to have been totally buried in the ground, inasmuch as one side of the jaw has been bleached by exposure to the sun.

The first question which presents itself for solution is, from whence came the animal? are we to consider it as the type of a genus which has become extinct and yet not fossil? or does it owe its present locality to accident, having been brought from some distant and unexplored country, and heretofore escaped the eye of the naturalist?

The present existing genera to which it is most nearly allied, being known to inhabit only Europe and America, would militate against the latter opinion, and induce us to believe, that this animal did inhabit the countries near which its remains were first discovered, its residence, like that of the beaver, being on the banks of rivers.

The skull being recent, and not in the least decomposed, the animal could not have been long dead when first discovered. It is most probable, that, in the instance before us, we are presented with the remains of the type of a genus, which has become extinct since the settlement of North America; or, if it still exists, has retreated to the most inaccessible and unexplored forests, which is at least very uncertain. It is more than probable that many species have disappeared, and are entirely lost, since the present state of the surface of our globe.

Suppose an animal to inhabit the shores of the great rivers of America previous to the discovery of this continent, and not to be endowed with the instinct of emigration, to become surrounded by the habitations of civilized man—hemmed in, and cut off from all resources by the march of civilization, the natural consequences would be destruction.

It may be necessary further to remark, that all the fossil beavers hitherto discovered resemble the recent species.

3. *Account of the Rocky Mountain Sheep.*

Genus, *Capra.* Sp. *C. montana.*

Ovis montana, Ord, Jour. Philad. Acad. Nat. Sciences, vol. i. part 1, p. 8, 1816. *Rupicapra americana,* Blain. *Antilope americana,* Ejus. Nouv. Bull. Soc. Phil. 1816, p. 80. *Mazama sericea,* Rafin. Amer. Mon. Mag. 1817, p. 44. *Antilope lanigera,* C. H. Smith, Trans. Linn. Soc. p. 38. 1822, Tab. 4, vol. xiii. *Rocky Mountain Goat.*

Char. Essent. Horns short, conical, slightly curved backwards, black, and slightly annulated in the old animal; the colour of the animal entirely white, furnished with long silky hairs, and a fine wool beneath the hair; no mane.

Dimensions. In bulk it exceeds the sheep.

Description. Body elongated, but little elevated on the legs; facial line straight; ears rather long and pointed, covered on the inside with long hairs; the neck short; the tail stumpy and directed upwards; the whole structure of the animal robust; the colour is entirely white; the bulk of the animal is considerably increased by a thick coat of long straight hair, of a yellowish tinge; side of the lower jaw, and beneath the throat, furnished with a long beard; beneath the long hair, the skin is covered with a close downy wool, of a clear white colour, and in young animals feeling like unspun cotton; on the face and legs the hair is short and close, similar to that of the sheep and goat; the eye-lashes are white; the horns are about five inches long, above an inch in diameter at base, bending slightly backwards, having two or three annuli, and terminating in a point not always obtuse; the legs exceed in thickness those of a calf; the fetlocks are short and perpendicular, and the hoofs are of a jet black, high, broad, and with deep grooves in the soles.

Remarks. Like the Goat, the facial line is nearly straight in the *C. montana,* this line being more or less arched in the sheep and antelope. Like the goat, the *C. montana* is furnished with a long beard; the sheep and the antelopes being destitute of this appendage.

In the form and size of the hoofs; in the direction of the tail; in the form of the snout; in the strength and proportion of the limbs in particular and of the body in general, our animal resembles the goat, and is unlike the sheep and antelopes; the latter animals have, besides, never been known to possess a covering consisting of fine long hair, and wool of exceedingly delicate texture, whilst, in this respect, our animal bears a striking analogy to the *Cashmere Goat.* Though the horns are at best uncertain characters, varying as they do in form, in similar species, yet, even in this respect, our animal offers stronger analogy to the goat than to the nearest allied congenera.

The horns of the young male goat are very similar to those of the *Capra montana*.

Habit and Country. For the following information concerning this highly interesting animal, we are under many obligations to Major S. H. Long, being chiefly the copy of a letter addressed by him to the Philadelphia Agricultural Society.

"The information I am able to furnish, was obtained on the late expedition to the sources of St Peter's River, &c. and was procured principally from Donald M'Kinzie, Esq. (of the family of Sir Alexander M'Kinzie,) stationed at the junction of the Assiniboin and Red Rivers, in the capacity of chief factor for the Hon. H. B. Company on that station; the intelligence furnished by this gentleman was from personal observation.

"The Rocky Mountain sheep inhabit the elevated region comprised in that portion of the mountain range from which its name is derived, situate between the forty-eighth and sixtieth parallels of north latitude.* They are found in great numbers near the head waters of the north fork of Columbia River, where their flesh constitutes the principal food of the natives. The country at the sources of Muddy River, (Marais River of Lewis and Clark,) Saskatchawin and Athabaska Rivers, are also inhabited by them; but they are said to be less numerous on the eastern slope of the Rocky Mountains than upon the western; they are seldom or never seen at a distance from the mountains, the climate and productions of which appear best adapted to their nature and mode of life. In summer, they resort to the peaks and ridges in quest of pasture, but retire to the valleys in winter. The size of the animal is nearly the same as that of the common sheep; their fleece is white, interspersed with long hair, protruding beyond the wool, and standing erect on the surface of the body, which gives them a shaggy appearance; their horns are short, merely projecting beyond the wool of the head, and slightly arcuated backwards; these, together with their hoofs, are black, while the other parts of their bodies are uniformly white; their flesh has a musky flavour, and is, at best, unsavoury.

"They are of easy access to the hunter, who seldom pursues them unless compelled by hunger. Their fleece is esteemed of little value by the traders, and is used only as a covering to the feet during winter; their skin is of a remarkably thick and spongy texture. It has been asserted by good judges, that the silky fineness of the wool is not surpassed by that of the Cashmere Goat."

* Lewis and Clarke observed this animal as low as forty-five degrees of north latitude. Vid. *Exped. up the Missouri*, vol. ii. pp. 35, 49.

Art. XXXIX.—DECISIONS ON DISPUTED INVENTIONS AND DISCOVERIES.

Professor Leslie's Apparatus for Ascertaining the Specific Gravity of Powders, not invented by him in 1826 ; *but by* H. Say, Captain of Engineers, in France in 1797.

In the year 1826 there appeared in the *Annals of Philosophy*, No. 64, and in the *Journal of the Royal Institution*, No. 42, a drawing and description of an apparatus for ascertaining the specific gravity of powders said to be invented by Professor Leslie. The editor of the *Annals* considers it as a great boon to philosophers, and after its description, he adds:

"Such is the professor's process, which appears to us remarkably ingenious as well as beautifully simple, and we shall see from some of the results which it has already afforded, that it must furnish important aid to the natural philosopher in his researches."

Although we should have been disposed to welcome such an auxiliary from any part of the world, but particularly from our own good city, yet, as the invention thus highly lauded, has been known in England and France, and published in *English* and *French*, thirty years ago, without having furnished any aid to the natural philosopher, we fear that its revival, without one single improvement, or even change, is not likely to give any new impulse to scientific inquiry.

The preceding fact has been made known to the scientific world by Baron Ferrussac in his *Bulletin des Sciences Math. Phys. et Chim.* for December 1826, in the following notice.

"*On the Pretended Invention of Mr Leslie.*"—"From the *Bull. des Sc. Math.* of September 1826, No. 117, we learn that Mr Leslie has invented an instrument for measuring the density of powders. As the description of this instrument agrees perfectly with that of the *stereometer* invented *twenty-nine* years ago by a French engineer of great merit, who unfortunately fell in Egypt, M. H. Say, it is proper to announce to Mr Leslie that he has made a mistake in attributing to himself the honour of this discovery, which he will find published, with drawings, and a complete description, in vol. xxiii. p. 1 of the *Annales de Chimie* for 1797. This instrument, too, having been actually executed, was often used in measuring specific gravities, particularly that of gunpowder, and it still exists in the collection of the Polytechnic School."

After reading the preceding passage, we turned up the 23d volume of the *Annales de Chimie*, and found that the invention published by Mr Leslie is perfectly identical with that described and drawn by Captain Say, Mr Leslie's drawing is indeed an exact section of Fig. 3 of Captain Say's paper, the tripod which contains the instrument and the frame which supports the pully for raising the lid, being left out in the professor's sketch.

Captain Say remarks, that his instrument furnishes us with the means of measuring the volume of liquid bodies, soft bodies, porous bodies, and powders, as well as that of solids. His description of it occupies *twenty-*

seven pages, and contains not only the fullest practical details, but a learned mathematical investigation of the theory of the instrument.

This instrument was too ingenious not to excite attention in England, and Mr Nicholson, one of our most learned and ingenious editors, published a full account of it, with all Captain Say's figures, in the first volume of his quarto *Journal of Natural Philosophy*, a work to the third volume of which Professor Leslie was himself a contributor.

We hope that those who, without happening to know of the invention of Captain Say, have ascribed it to another person, will yet do justice to the memory and talents of that able, but unfortunate soldier.

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

1. *Mode of Heating Water for a Bath.* By Edward Deas Thomson, Esq.

By means of the following contrivance, Mr Thomson has obtained a bath, containing forty gallons of water, at a temperature of 98° Fahr., in half an hour from the time of lighting the fire, and with only 7 lbs. of coal. The whole expence was 2½d. or 3d., exclusive of the tear and wear of the apparatus.

A cylinder *cc*, Plate IV. Fig. 8, eighteen inches high, and nine inches in diameter, is surrounded by a spiral pipe at least an inch distant from it. This pipe communicates with the cistern *a* above the apparatus by the pipe *bb*, whose other end descends into the cylinder at *c*. The water consequently passes from the cistern through *bb* into the cylinder, and thence through the pipe *d* into the bath. When the cock *f* is opened, hot water will flow from the cylinder through *d* into the bath, and its place will be instantly supplied by cold water through *bb*, a constant current of water being thus kept up through the boiler *cc*, which becomes heated in its passage. The degree of heat may be regulated by partially shutting or opening the cock *f*. An open safety-pipe *e* rising above the level of the water in the cistern, allows the steam to escape in case of the water boiling when the cock *f* is shut.

If we suppose the pipe *b* to terminate in the bath, and the bath to rise a little above the level of the pipe *f*, the cistern may be dispensed with. In this case cold water must be poured into the bath till it rise above the level of the pipe *f*. The water heated in the boiler will then flow into the bath, and its place be supplied by cold water, thus forming a continued current till the whole is heated to the required temperature.—*Phil. Mag.* No. i. p. 106.

2. *Process of Separating Elaine from Oils.** By M. Pechet.

This process is founded on the property which a strong solution of soda possesses of saponifying stearine in the cold without acting upon elaine.

* See this *Journal*, No. vi. p. 350.

Shake the alkaline solution with the oil, then heat it slightly in order to separate the elaine from the soap of stearine. After it is passed through a cloth, the elaine is separated from the alkaline solution by decantation.—*Ann. de Chim.*

3. *On the Steam Navigation of India.*

In a former Number (No. vi. p. 377) we gave an account of the *Enterprize,* the first steam-vessel which sailed to India. This vessel was purchased by the Government, and seems to have given a powerful impulse to steam navigation in that part of the globe. "Besides this vessel (says a writer in the *Col. Press Gazette* of June 9,) which is employed between Calcutta and Rangoon, we have the Diana in Rangoon river, and the Comet, one of the two small vessels here of twenty-four horse power, fitted up as packets, to carry passengers up and down the river. Two other vessels of this description will be soon ready, and both of them, by their light draught of water, are admirably fitted for carrying passengers to the upper provinces during the rains, when the rivers are full. Besides these vessels, which we owe to private enterprize, two armed steam-vessels of Government will be ready in August. Singapore too will soon boast of a steam-vessel from the Cape, and there can be no doubt that each of the Residences will have one or two in the service of the Company. For these purposes deposits of coals are about to be provided at Madras, Ceylon, and Penang. There is another vessel wrought by steam (we presume a dredging-machine) which is now in progress, for clearing away the obstruction to the navigation of the small rivers which communicate with the Hoogly. By this vessel it is hoped that a water communication with the upper provinces may be kept open at all seasons of the year, and a journey to the most distant situations, which now occupies four months, may perhaps be performed in as many weeks.

4. *On the Bursting of Steam-Boilers.* By John Taylor, Esq. F. R. S.

In the last number of the *Philosophical Magazine,* this important subject has been treated with great ability by Mr Taylor, whose theoretical and practical knowledge must give great weight to his opinions.

Mr Taylor begins by stating, that the most fatal and distressing accidents have arisen from the bursting of one sort of boiler. This boiler consists of two tubes, an inner one from three to four feet in diameter, and an outer one from five feet and a half to six feet and a half or seven feet in diameter. These tubes are generally made of wrought iron or rolled plates, the inner one being half an inch thick, and the outer one three-eighths. The ends of the boiler fix the tubes together, so that the interior tube is open at both ends, at one of which is placed the fire grate, and at the other the smoke and flame escape, and are conveyed to the stack or chimney most commonly by flues passing under and along the ends of the outer tube. These boilers are usually from twenty to thirty-five feet long.

In boilers of this kind no fewer than four accidents have happened. They were mostly new, and were each furnished with a safety valve and gauge-cocks. The *first* of these was in Wheal Fortune, the boiler alone being injured. The *second,* which happened at Polgoath tin-mine, was remarkable from one of the boilers exploding a little while before the other. In this case it seemed clear after the accident, that the steam had not acquired any formidable degree of pressure, and that the water had not been so low as to endanger the tube being improperly heated. One man was killed, and the interior tubes of the boilers were much contorted and rent. The *third* explosion took place at East Crennis mine. The inner tube was compressed as if the fire had softened the part above it, though there did not appear to be any other reason to think that the water was too low. The ends were torn to pieces, *and the tube was thrown out of the outer tube and out of the boiler, while the inner tube remained in its place, and was scarcely injured.* No person was materially injured. The *last* accident happened in the Pen-y-fron Engine, at the Mold mines in Flintshire, to a boiler of a similar construction. The *outer tube remained in its seat uninjured,* and even the weight on the lever of the safety valves was not disturbed. The inner tube was not moved from its place, but was flattened for a great part of its length, the ends having been squeezed together, and not the top and bottom, as at East Crennis. It seemed certain that the pressure of the steam did not exceed 30lbs an inch, and that the water was at its proper height. When the engine-man had put down the damper in the flue, he observed a gust of flame rushing from the fire place, and almost immediately after an explosion. This made him jump from a door very considerably above the level of the ground below, as the engine stands on the side of a steep hill. He alighted on the heap of ashes which were always discharged at the door, and got out of the way before the hot water rushed out. Other two men in the boiler house were killed instantly by the boiling water, no other injury being observed on their bodies.

From this case Mr Taylor is led, very ingeniously, to ascribe the bursting of the boiler to an explosion of an explosive mixture of coal gas and atmospheric air. When the fire door was thrown open, and the current of air up the flue stopped by closing the damper, the interior of the inner tube contains a mixture of coal gas and atmospheric air. The coal gas is increased by the distillatory action of the fire, until the mixture reaches the explosive point. It then takes fire, occasions the observed rush of flame, which would be followed by a sudden vacuum in the tube, while the other side of the tube, pressed by the steam, gives way to this sudden impulse.

In support of this opinion, Mr Taylor adds, that bursts of flame are often observed from the chimneys of steam-engines illuminating the surrounding scene. These bursts of flame often rise above the summit of the stalk, and are seen to emerge, diminishing and retiring into the flue after a blaze of some minutes, and leaving all in perfect darkness.

It is generally supposed that high-pressure boilers are most liable to accidents, but this is not the case. About twelve months ago, a boiler of the old spherical construction burst at a mine in Flintshire, about seven miles from the Mold mines, and occasioned the death of *sixteen* persons.

5. *Account of a New Method of Bleaching and Preparing Flax and Tow.* By the Rev. T. B. Emmett.

This process, which is said to be simple, easy, and cheap, and to reduce the material to a beautiful degree of whiteness, is as follows:

Steep or boil the flax or tow in a weak solution of subcarbonate of potash or soda, in order to extract the colouring matter, rosin, &c. and wash it thoroughly from the alkali. In order to prepare the bleaching liquor, reduce perfectly fresh burnt charcoal of soft porous wood, as willow or fir, to a very fine powder; tie up the powder in a bag made of cloth of a close texture, immerse it in cold soft water, and wash it by pressing it with the hands, till such a quantity is diffused through the water, that, on rinsing a little flax through it for a few minutes, and then withdrawing it, it shall be lightly blackened. Put into it the flax to be bleached, taking care that each parcel shall imbibe it to its middle. When the whole is in the liquid, the water should appear clouded by the charcoal upon being well shaken. Mr Emmett always used about half an ounce of charcoal to six or seven pounds of flax. In order to bring the charcoal in contact with it, the flax should be pressed under it several times a-day, and the liquid well agitated. After about twenty or twenty-four hours, the flax, when taken from the liquid, should be well wrung, and then put into a second vessel of water containing less charcoal, agitated and pressed down as before. If this process is well conducted, two or three days will be found sufficient. It should then be spread thinly on the grass, taking care to turn it frequently for a few days. The flax must then be rinsed in river water, and washed thoroughly with soap in hot water, till it is quite clean. The soap must then be washed out with cold water, and the flax dried, exposed to the sun and air. Mr Emmett very liberally offers to supply any person with samples perfectly prepared, by addressing him (post paid) at Great Ouseburn, near Boroughbridge, Yorkshire. Abridged from the *Phil. Mag.* No. ii. p. 119.

6. *Dr Zimmerman's Safety Gun.*

Several of the German Journals contain high eulogiums upon an invention by Dr Zimmerman, by which fire-arms are prevented from the possibility of going off either by accident or carelessness, or in any way, without the positive will of the person using them; at the same time that it does not impede or delay for an instant the use of the arm when required to act. Dr Zimmerman has obtained a patent for his contrivance in some of the German States.

Although we do not know the details of this invention, we have no hesitation in informing our readers, that Dr Zimmerman has been anticipated in the accomplishment of this object, by our ingenious countryman the Reverend Mr Somerville of Currie, who, upwards of two years ago, obtained a patent for several beautiful methods of preventing the accidental discharge of fire-arms. We have no doubt that Mr Somerville has exhausted the subject, as will be seen from the description which we have given of his contrivances in this *Journal*, No. iv. p. 316. We are glad to find that these safety guns are in great demand, and that the sale of them is likely to defray the great expence at which they have been brought to their present state of perfection by the inventor. The guns thus fitted up may be seen at Mr William Maclachlan's, gunmaker, 39 Nicholson's Street, and at Messrs Robert Wheeler's and Son, gun-manufacturers, Birmingham, *7. Perkins's Steam-Engine.*

Mr Perkins has now completed an engine, which he considers as embracing the ultimatum of his present intentions, and which is designed to show the absolute realization of his anticipated hopes, or their decided failure. The possibility of the latter Mr P. has never for a moment admitted, and he now considers that he has only perfected those plans he contemplated from the first, and which required but patience and time to bring to maturity.

The very transient view of the engine which we have been enabled to take, precludes the possibility of our describing its construction; besides we should, by so doing, anticipate a more perfect account, which we hope to give hereafter. There are many parts which exhibit considerable novelty and ingenuity, and the whole is comprised in a very compact form. The power of the engine, which stands upon a base of about four feet square, is said to be capable of variation, from fifteen to thirty horses, according to circumstances, connected with the economisation of fuel. It has not yet been exhibited in operation, but that is expected to take place in a few days.—*Newton's Journal of the Arts*, Feb. 1827, p. 367.

8. *Method of producing a fine Black Colour.* By M. Peticolas of Nashville.

Having set fire to some camphor, there will arise from the flame a very dense smoke, which may be collected on a common saucer held above the flame. This black, mixed with gum-arabic, is stated to be far superior to any India ink. After giving the above process, Mr Newton adds, that miniature painters, who use colours in small quantities, sometimes obtain a most beautiful and perfect black, by using the buttons which form on the snuff of a candle when allowed to burn undisturbed. These are made to fall into a small thimble, or any other convenient vessel, which can be immediately covered with the thumb to exclude the air. This is found to be perfectly free from grease, and to possess every desirable quality.—*Newton's Journal of the Arts*, Feb. 1827, p. 371.

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

Elements of Chemistry, including the recent discoveries and doctrines of the Science. By Edward Turner, M. D. F. R. S. E. Fellow of the Royal College of Physicians, and Lecturer on Chemistry, Edinburgh. In one large volume 8vo, pp. 723. Edinburgh, 1827. With two plates.

It is impossible to survey the present state of our elementary literature, without the most painful reflections. The field of scientific instruction, which was once occupied by men of taste and genius, has been lately trodden down by herds of authors, and the discoveries of Newton, and of Black, have been expounded by men who never read their works, and who are in-capable of understanding their doctrines. The press literally teems with treatises on natural philosophy and chemistry of all varieties of pretension, some insinuating themselves by their evanescent size; others by the number of letters which they can compress into a page; others by the slight demand which they make upon our pockets; while a fourth class with a magic wand points out to us short and royal roads through all the mysteries of science. The authors of these works are as various as their pretensions: Some are ushered into the world without any acknowledging parent; others are hatched beneath the expanded wings of learned committees and associations; and others are ornamented with the fictitious names of clergymen and foreigners,—while all of them are the mere exuviæ of our own classical writers, prematurely detached by the instrumentality of a pair of scissors. When the cultivators of letters erected their community into a republic, their sole care was to exclude a throne and a sovereign, but they unfortunately forgot to provide against the irruption of the mob.*

In making these observations, we trust it will not be supposed that we are unfriendly to the extension of science among all classes of society. On the contrary, our most ardent wish is, that knowledge should be as free as the air which we breathe, for we believe it to be as salubrious: We wish to see it glowing in the cottage, as well as dazzling on the throne, because we know that it will render happier the tenant of the one, and the possessor of the other: We wish to see it wherever there is a human form to receive it, and clasping in its wide and gentle embrace our universal species, because we know that it will be the precursor of those nobler truths, to which it is but the handmaid; and that it is essential to the developement of that spiritual nature which must always be viewed as our highest and latest attainment.

The knowledge, however, which can produce such effects is very different from that with which we are now so copiously supplied. It must be elaborated by genius,—it must be refined by taste and sentiment,—it must be exalted by piety,—and it must be administered to us by men of education and experience. We have no objections to be instructed by the multitude in the useful arts—in that which they have studied and practised; but we protest against their becoming our teachers in what they do not know, and what they can never comprehend—the refinements and applications of science. We do not object to their acquiring all that they can; but we demur against their returning it again to us. Let them study political economy, since they choose it, or medicine, or even controversial theology; but God forbid that they should either legislate for us, or bleed us, or preach to us.

Under impressions like these it is most agreeable to see an elementary work on one of the most important of the sciences, from the pen of a gen-

* Opinions, analogous to these, have been given in able reviews of some of the works above referred to in the *Journal of the Royal Institution*, the *Annals of Philosophy*, and the *Dublin Philosophical Journal*; and we believe there is only one opinion on the subject among all well educated men of science.

tleman who possesses every qualification for the task. To the readers of this *Journal,* who already know Dr Turner from his original researches and able analyses, it is unnecessary to state, that to a knowledge of all the refinements of modern chemistry, he adds a thorough acquaintance with the difficult art of chemical analysis—an art which he had the good fortune to study under the celebrated Stromeyer. His experience, too, as a lecturer on chemistry, has familiarized him with the methods of communicating instruction, and completed his qualifications for composing an elementary work on chemistry.

A work like the present, embracing the whole range of chemical science, is not a proper subject of minute analysis, and therefore we shall content ourselves with giving a general outline of its contents. Works of elementary instruction should be so composed as to present the facts and doctrines of a science in as concise and condensed a form as is consistent with clearness and precision; and we must admit that almost every page of the present volume bears internal evidence that its author has never lost sight of this principle.

We cannot do better, in order to convey an exact idea of the views which have guided Dr Turner in the composition of this work, than let him speak for himself. "The following pages comprehend a condensed view of the present state of chemical science. The chief purpose of the work is to make the student intimately acquainted with the theory at the same time that he is acquiring a knowledge of the facts of chemistry; so that, by the establishment of fixed principles, the details may more easily be impressed on the memory, and excite an interest which they would not otherwise possess. Every one who is acquainted with modern chemistry, will admit that the study of the laws of combination is fitted in a peculiar manner for promoting these objects; and hence, I have treated at length of the atomic theory, and the subjects connected with it, at an early part of the volume.

"To this arrangement, I am aware, it may be objected, that many of the facts adduced as illustrations must necessarily be unknown to the beginner. I do not anticipate, however, any serious inconvenience from that source; on the contrary, some experience in teaching the theoretical and practical details of the science, gives me reason to think that the disadvantages of my plan will be very far outweighed by its advantages. I may observe, indeed, that this work is chiefly designed for persons who have either attended or are attending lectures on chemistry; and to such readers the objection to which I allude does not apply."

Dr Turner appears to us to have accomplished this part of his undertaking in a way which cannot fail to facilitate the study of chemistry in a very material degree. We are acquainted with no work, not excepting our best systems of chemistry, which communicates such a clear and complete account of the doctrine of combining proportions, and gives the atomic explanation of individual facts in so full and intelligible a form, as will be found in the volume before us.

Dr Turner has divided his work into four parts.

The *first* is on the imponderables, and comprehends an account of caloric, light, electricity, galvanism, and electro-magnetism.

In the *second* part he has treated of inorganic chemistry. The first section of this part is on affinity. In discussing this subject the author admits with Berthollet, that the result of chemical action is not always solely determined by affinity. He proves that the order in which substances decompose one another, cannot in every case be ascribed to the agency of chemical attraction. He points out the mode by which cohesion, elasticity, and the like, may act as modifying causes; but, at the same time, contends that Berthollet, in denying the existence of elective affinity, pushed his favourite doctrine further than is justified by observation.

In the following section Dr Turner treats of the proportions in which bodies unite, and on the laws of combination, of the atomic theory of Mr Dalton, of Gay Lussac's theory of volumes, and of the atomic views of Berzelius. Without entering upon a detail of this extensive department, we may give our readers an idea of the manner in which it is treated by the following quotation. In commencing an account of the atomic theory, Dr Turner observes, "The brief sketch which has been given of the laws of combination will, I trust, serve to set the importance of this department of chemical science in its true light. It is founded, as will have been seen, on experiment alone, and the laws which have been stated are the pure expression of fact. It is not necessarily connected with any speculation, and may be kept wholly free from it."

"The reason why persons, partially acquainted with the subject, have supposed it to be of a hypothetical nature, is sufficiently obvious. It was impossible to reflect on the regularity and constancy with which bodies obey the laws of proportion, without speculating about the cause of that regularity; and consequently the facts themselves were no sooner noticed than an attempt was made to explain them. Accordingly when Mr Dalton published his discovery of these laws, he at once incorporated his description of them with his notion of their physical cause; and even expressed the former in language suggested by the latter. Since that period, though several British chemists of eminence, and in particular Dr Wollaston and Sir H. Davy have recommended and practised an opposite course, both subjects have been but too commonly comprised under the name of atomic theory; and hence it has often happened that beginners have rejected the whole as hypothetical, because they could not satisfactorily distinguish between what was founded on fact, and what was conjectural. All such perplexity would have been avoided, and this department of the science far better understood, had the discussion concerning the atomic constitution of bodies been always kept distinct from what it was intended to explain. When employed in this limited sense, the atomic theory may be discussed in a few words."

The individual chemical substances are divided into the metallic and non-metallic. They are not arranged according to any particular theory, but are described in the order which the author conceives to be most convenient for the purpose of instruction. The only circumstance which we shall particularize in this department, is the mode of giving the tests. Dr Turner states, that they are such as he employs in his own practice. The directions are short, clear, and precise, and cannot fail of being highly useful to the student of chemistry.

The third part of the work contains a description of the compounds derived from the animal and vegetable kingdoms. We shall only observe, that in this, as in other departments of the work, the author has given the most recent information on the subject.

Of the fourth part, which is on Analytical Chemistry, the author observes, " To enter into a detailed account of experimental and analytical chemistry, is altogether inconsistent with the design and limits of the present work. My sole object in this department is to give a few concise directions for conducting some of the more common analytical processes; and in order to render them more generally useful, I shall give examples of the analysis of mixed gases, of minerals, and of mineral waters."

In an appendix Dr Turner has given an account of a new and curious substance called Bromine, the only discovery of importance which was made during the printing of his work. He has added also a complete table of atomic weights, and various other tables of great use to the chemist.

Having thus given a general view of the work before us, we have no hesitation in recommending it in the strongest manner to our readers. Those who are entering upon the study of chemistry will find it an invaluable auxiliary, and those who are already versed in this branch of knowledge, will find in it all the recent discoveries and refinements of modern chemistry. The work is written with much elegance and perspicuity, and its external embellishments correspond with its other qualities. As the author has published the work at his own expence, he has been enabled to make it one of the cheapest works which has for a long time been given to the public.

ART. XLII.—PROCEEDINGS OF SOCIETIES.

1. *Proceedings of the Royal Society of Edinburgh.*

December 18.—Professor DUNBAR read a Paper on the " Origin of Language, but particularly on the formation of the Greek Alphabet."

January 4, 1827.—Captain BASIL HALL read a Notice on the Trade Winds.

January 23.—A Paper by the Reverend WILLIAM SCORESBY was read, entitled " A Description of some Remarkable Effects of Unequal Refraction observed at Bridlington Quay in the Summer of 1826." An abstract of this Paper will be found in this Number, page 293.

At the same meeting there was read, a " Sketch of the Manners and Customs of the Eboe Nations," by JOHN REDDIE, Esq. LL. D.

February 5.—A Paper by P. F. TYTLER, Esq. was read, " On the Earliest Introduction of the Greek Language and Literature into England after the Dark Ages."

The following gentlemen were elected Ordinary Members:—

James Weddell, Esq. R. N. John Gardiner Kinnear, Esq.
William Burn, Esq. Architect.

There was presented to the Museum of the Society, by GEORGE SWINTON, Esq. of Calcutta, the snout of the Saw Fish. This is one of the largest and finest specimens that has been seen.

The same gentleman also presented to the Society, the skeleton of a Boa Constrictor, *sixteen feet long*, the mother of the young brood of Boa Constrictors described in this *Journal*, No. viii. p. 221, accompanied by one of the brood preserved in spirits. Mr SWINTON likewise presented various snakes from Arracan and Sumatra.

February 19.—There was read a Paper by JOHN JAMES AUDUBON, Esq. entitled Notes on the Habits of the Wild Pigeon of America, *Columba migratoria*.—This Paper is printed in the present Number, p. 257.

There was presented by Sir THOMAS MAKDOUGALL BRISBANE, K. C. B. to the Museum of the Society various interesting objects of Natural History from New South Wales, and various specimens of the Cloth, Ropes, &c. &c. of the Natives.

March 5.—There was read a Paper by THOMAS ALLAN, Esq. entitled, "Notice respecting the Tusk of a Mastodon, with some Bones and Fossils found in tirring Woodhill Quarry, near Kilmarnock."

Mr ALLAN presented this Tusk and the other Fossils to the Museum of the Society.

There was read at the same meeting, a Paper by Dr BREWSTER, entitled, "Report on the Hourly Meteorological Register kept at Leith Fort during the year 1826."

The following Gentlemen were elected Members:—

Honorary.

Jacob Berzelius, M. D. F. R. S. Stockholm.

Foreign.

John James Audubon, Esq. M. W. S. &c.

Ordinary.

Dr James Russell.
Prideaux John Selby, Esq.
Henry Witham, Esq.
John Reddie, Esq. LL. D.
Rev. Dr Robert Gordon.
James Wilson, Esq.

2. *Proceedings of the Cambridge Philosophical Society.*

November 13.—Professor Sedgwick exhibited to the Society a very large pair of fossil horns, found near Walton, in Essex, and stated the grounds on which it appeared that they had belonged to an animal of the species *Bos Taurus*.

Mr Whewell read to the Society a paper "on the classification of crystalline combinations, and the causes of deviation by which their laws may be investigated." The object of this paper was to exhibit tables of the forms of crystals, classed according to geometrical properties, which are in most cases easily recognized by the eye; and from this arrangement to obtain, without calculation or knowledge of the angles, the relation between the secondary faces which offer themselves, and the primary forms from which they are derivable.

November 27.—A memoir was read by Professor Airy "on the motion of a pendulum disturbed by any small force, and on the application of this method to the theory of escapements." It was shown, that, by the method here proposed, the variation from the law of a cycloidal pendulum might be determined with great ease and simplicity, whether produced by resistance, friction, impulse, or any other cause. By taking, as examples of the method, the different escapements of clocks and watches which have been invented, it appeared that the relative goodness of them, as resulting from the calculation, was very nearly that which they are found to possess in practice. Professor Airy also proposed a clock-escapement which would possess the advantages of the detached escapement in watches, and could never be out of beat.

Mr Whewell gave a short account of the experiments undertaken by Mr Airy and himself in Cornwall, for the purpose of discovering the earth's density. The process employed consisted in determining the relative rate of a detached pendulum of Kater's construction at the earth's surface, and at a point 1200 feet below it, in the mine of Dolcoath. The undertaking was left incomplete in consequence of the destruction of one of the pendulums employed during its conveyance from the bottom of the mine to the top.

December 11.—A paper was read by Mr Peacock "on the numerals of the South American languages." The most complete of these systems of numerals proceed according to the vicenary scale, which has, generally, the denary and quinary subordinate to it. Others of these languages are remarkable for not having more than three or four words properly expressing numbers; and one instance was given in which the name for *one* is the only independent numeral.

Professor Airy gave an account, illustrated by drawings, of the steam-engine as it is used in Cornwall, describing some artifices in its employment which are peculiar to that district, and in particular the machinery by which it is applied to the drainage of the mines.

3. *Proceedings of the Society for Promoting the Useful Arts in Scotland.*

December 1, 1825.—Dr Hibbert read a Paper "on the productiveness of the Cod Bank to the west of the Shetland Isles." At the same meeting there was read a Paper by Mr John Henderson, Brechin Don, "on the Burning of Smoke, with plans of improved furnaces for that purpose."

January 18, 1826.—The following Papers were read:—

1. Account of a *New Life Boat* by Mr John Henderson.

2. Observations on the History of *Life Boats* by Professor Wallace.

3. Description of a *Simple Punt Boat* for saving time and labour, by Andrew Waddell, Esq. See this Journal, No. viii. p. 338.

January 24.—There was read "An Account of a New *Eye-tube for a Sextant* by Mr Adams, A. M." See this Journal, No. vii. p. 95.

February 21.—The following Papers were read:—

1. A notice of an *Improved Furnace Chimney*, by Robert Bald, Esq. was read.

2. Notice of a method of producing an *Intense Heat from Gas* for various purposes in the Arts, by Dr Brewster.

3. Dr Duncan jun. exhibited the method which he had long used of obtaining great heat from coal gas.

April 4.—A Paper "*On Vertical Windmills,* by Mr JAMES BRODIE, Aberdeen, was read.

Mr WHITELAW exhibited an Apparatus for converting a *Rectilineal into a Rotatory Motion,* and the Rev. Mr Somerville exhibited one of his Patent *Safety Guns.* See this Journal, No. iv. p. 316, and this Number, p. 337.

April 18.—The following Communications were made to the Society:—

1. Practical Observations on *Percussion* by Mr JAMES BRODIE.
2. A Model of a *Railway Carriage* by Mr ALEXANDER ADIE Junior.
3. An Idea of a *Gunpowder Engine,* by Mr JOHN HENDERSON.
4. Plan of an *Improved Capillary Steam Boiler* by Mr J. HENDERSON.

March 7.—MAJOR ALSTON read a Notice on *the Construction of Chimneys.*

Dr BREWSTER exhibited a *Portable Gas Lamp* fitted up to produce *Intense Heats.*

Mr JAMES BRODIE communicated a description of an *Eccentric Combination for Obtaining Rotatory Motion from the Piston Rod of a Steam Engine.*

March 21.—G. S. MENTEITH, Esq. of Closeburn, read a notice of an *Improvement on Limekilns.*

Mr JAMES BRODIE communicated a description of a *Double Jointed Parallel Motion.*

Dec. 5.—A method of fixing the Glass in Painted Windows, by JOHN ROBISON, Esq. was read. See this *Journal,* No. xi. p. 50.

Mr JAMES NASMYTH gave a description of an *Improved Pulley.*

Dr HIBBERT read a notice respecting the *Iron Ore* found at Glengary.

Mr JAMES NASMYTH read a description of a *Safety High Pressure Boiler.*

Mr JAMES NASMYTH was admitted an associate member.

Dec. 19.—Mr JOHNSON of Hull read a description of a *New Steam Coach,* and exhibited the model of one in operation.

Mr ROBERT TAYLOR communicated a method of restoring the damaged *Canvas of Paintings.*

Dr HIBBERT read a notice respecting the *native Copper* of Shetland.

Mr JAMES NASMYTH exhibited a model of a *High Pressure Steam Engine* in action, with a method of applying the waste steam to increase the temperature of the furnace.

Mr GEORGE NASYMTH was admitted an associate member.

Jan. 9, 1827.—Mr BROWN exhibited and explained to the Society his *New Weighing Machine.*

Mr JOHNSON exhibited an *Air Gun* of a new construction.

Jan. 24.—Mr JOHNSON read an account of a machine for *navigating the air.*

Mr JAMES NASMYTH gave an account of a method of preventing the water in steam boilers from becoming too high or too low.

Feb. 6.—SIR THOMAS MAKDOUGALL BRISBANE, K. C. B. was admitted a Member of the Society.

Mr NIMMO gave a description of a *High Pressure Engine* with a valve on a new construction. The engine was exhibited in operation.

There was read an account of an Improvement on Mr Adam's Nautical

Eye-Tube by Dr BREWSTER. Mr Adams's Eye-Tube was exhibited to the Society.

Mr JAMES NASMYTH described a method of checking accelerated velocities by the Conical Pendulum.

There were exhibited to the Society various specimens of the workmanship of the Russians in leather in the possession of Dr Rogerson of Dumcrieff.

The following Gentlemen were admitted Members of the Society.

Sir Samuel Stirling, Bart. of Glorat.
Sir William Molesworth, Bart.
Dr Francis Home, Professor of the Practice of Physic.
Dr Rogerson of Dumcrieff.
Mr Henderson, Architect.

Feb. 20.—Mr JOHN ROBISON read an account of the *Failure of the Suspension Bridge at Paris.* See this *Number,* p. 240.

Mr ROBISON exhibited a cock used in the south of France for drawing off wines and acid liquors.

There was read *a Botanical survey* of part of the county of Aberdeen, by Mr ALEX. MURRAY, A. M. Surgeon, Alford.

Mr JOHNSON was admitted an associate member.

March 6.—Messrs GEORGE and JAMES NASMYTH exhibited a model of a *Locomotive Steam Carriage* in operation.

There was read a description of the *New Safety Gas Burner* by Mr WARDEN, Engineer to the Portable Gas Company.

The Burner was exhibited in operation to the Society.

The *Buccleugh Lamp* was exhibited, in which oil is burned in capillary tubes without wicks.

Captain WATSON, R. N. was admitted an ordinary member.

ART. XLIII.—SCIENTIFIC INTELLIGENCE.

I. NATURAL PHILOSOPHY.

ASTRONOMY.

1. *Fifth Comet of* 1825 *in Eridanus.*—This interesting comet, of which we have given the elliptical elements by Clausen, in No. ix. p. 178, has been observed in March and April 1826; but as Clausen's elliptic elements are no longer accordant with observation, he has computed the following parabolic ones:

Passage of Perihelion mean time at Altona,		D		
	1826, April 21.	98905		
Log. Perihelion distance,	- - -	0.3034430		
Long. Perihelion—Long. Node,	- -	279°	16′	31″.1
Long of Node, { Mean Equinox, }	-	197	38	9 3
Inclination of Orbit, { Jan. 1826, }	-	40	2	33 1
Motion		Direct.		

2. *Gambard's Elements of the Comet of* 1826, *in the Whale.*—This comet supposed to be that of 1772 and 1805, has already been noticed in No. ix. p. 179, § 6. The following are the elements given by M. Gambard:

Passage of Perihelion, time reckoned from midnight, 1826, March	18. 94
Perihelion distance,	0.9.61
Long. of Perihelion,	3.^{s} 14° 20′ 00″.
Long of ascending Node,	8 7 54 10
Inclination,	14 39 15
Motion	Direct.

3. *Return of the brilliant Comet of Taurus from the Southern Hemisphere.*—This comet, which was discovered by M. Pons, on the 15th July 1825, was rediscovered by M. Pons on the 4th April 1826, and has been observed at Florence, Nimes, and Palermo. The parabolic and elliptical elements of MM. Capocci and Hansen deviate considerably from the new observations.

4. *Comet of August* 1826.—This comet was discovered by M. Gambard at Marseilles, on the 15th August. The elements are as follows:

Passage of Perihelion, 1828, Mean time at Marseilles,	D. October 10. 025
Perihelion distance,	0.845
Long. of Perihelion,	59° 1′ 24″
Long of ascending Node,	43 24 35
Inclination of Orbit,	26 29 52
Motion	Direct.

5. *Comet of October* 1826, *and its passage across the Sun's Disc.*—This comet was discovered by M. Gambard of Marseilles, on the 28th October 1826. Its corrected elements are as follows:

Passage of Perihelion, mean time reckoned from midnight, November,	18. 8083
Perihelion distance,	0.02314
Long. of Perihelion,	314° 57′ 28″
Long. of Asc. Node,	236 9 54
Inclination of Orbit,	89 59 24
Motion,	Retrograde.

From these elements it follows, that the comet must have entered upon the disc of the sun at - - 5^h 25 A. M.

Passage of its Node, at	7^h 1
Shortest distance from Sun's centre,	2′ 40″
Emersion from Sun's disc,	8^h 38

M. Gambard is quite certain, from observations made on the 10th November, when the error of the elements was only —2″ in long. and —5″ in lat. that the comet should have passed over the sun's disc. He did not succeed, however, in observing it at Marseilles, as the sun did not appear till 8^h 35′, when there was nothing upon his disc but the spots seen the day before. The weather was not favourable either at London, Geneva, or Paris. *Bibl. Univ.* November 1826, p. 251.

6. *Observations on the Solar Eclipse of November 29th,* 1826.—This eclipse was observed at Bushey Heath, by Lieut. Beaufoy, in west long. 1′ 20″ 93 time, and north lat. 51° 37′ 44″ 3.

Beginning,	-	21^h 46′ .4″ M. time.
End,	-	23 58 19

Mr T. Squires observed it at Epping, in long. 27″ of time, east of Greenwich, and north lat. 51° 41′ 41″ 6.

End,	-	-	12^h 0′ 54 M. Solar time.

7. *Mr Herschel and Captain Sabine's determination of the difference of Meridians of London and Paris.*—These able astronomers have determined, by means of signals, that the difference of longitude of London and Paris is 9′ 21″.6 in time, or 2° 20′ 24″ in space. Mr Herschel is of opinion that this result is not *likely* to be altered a whole *tenth* of a second in time, and *very unlikely* to be altered to twice that extent by future observations. An elaborate account of these observations by Mr Herschel will be found in the *Phil. Trans.* 1826, part ii. p. 127.

OPTICS.

8. *Fraunhofer on Halos and Parhelia.*—A theory of Halos and Parhelia has been recently published in Professor Shumacher's *Astronomische Abhandlungen*, by the late distinguished M. Fraunhofer. He ascribes the small halos round the sun and moon to the inflexion of light by the particles of vapour in the atmosphere, and the halo of 45° to the refraction of the light through hexagonal prisms of ice. From the abstract of this paper, which we have seen, there does not appear to be much novelty in it. Dr Young and others seem to have anticipated the author in all his general results. —See *Edinburgh Encyclopædia*, article Halos.

ELECTRO-MAGNETISM.

9. *Effect of a moving disc on a Voltaic conductor.*—M. Ampere has communicated to the Academy of Sciences an experiment, which proves that a disc in motion exercises a certain action on a voltaic conductor. The details of the discovery are not published.

10. *On the conducting power of Metals for Electricity.*—The following results have been obtained by M. Becquerel.

Metals.		Conducting Power.	Metals.		Conducting Power.
Copper,	-	100	Platina,	-	16.40
Gold,	-	93.60	Iron,	-	15.80
Silver,	-	73.60	Lead,	-	8.30
Zinc,	-	28.50	Mercury	-	3.45
Tin,	-	15.50	Potassium,	-	1.33

Ann. Chim. Aout 1826, p. 420.

METEOROLOGY.

11. *Noise of the Aurora Borealis observed by Hearne.*—Having stated in No. ix. p. 74, various authorities for believing that a sound sometimes accompanied the Aurora Borealis, we give the following statement made by Hearne, as an additional argument in favour of that opinion.

" I do not remember to have met with any travellers into high northern latitudes who remarked their having heard the northern lights make any noise in the air as they vary their colours or position, which may probably be owing to the want of perfect silence at the time they made their observations on these meteors. I can *positively* affirm, that, in still nights, I have frequently heard them making a rustling and crackling noise, like the waving of a large flag in a fresh gale of wind." It is probable that these lights are sometimes much nearer the earth than at others, and this may have an effect on the sound.—Quoted in the *Dublin Phil. Journal,* No. v. p. 419.

GALVANISM.

12. *Galvani's First Experiment on the Frog, made in* 1700.—The following curious fact is recorded in the History of the Academy of Sciences for 1700, p. 40. " M. Verney showed, upon a frog newly dead, that, by irritating a little with the scalpel, the nerves which go to the thighs and legs, those parts make a noise, and suffer a species of convulsion. He afterwards cut the same nerves in the belly, and keeping them a little stretched with his hand, he made them produce the same effect by the same motion of the scalpel. This did not happen if the frog had been long dead." —*Zach's Corr. Astron.* vol. xiv. p. 379.

PNEUMATICS.

13. *Mr Ivory on the Heat extricated from Compressed Air.*—From an ingenious analysis, Mr Ivory has deduced the following proposition. " *The heat extricated from air, when it undergoes a given condensation, is equal to three-eighths of the diminution of temperature required to produce the same condensation, the pressure being constant.*

Air, under a constant pressure, diminishes $\frac{1}{480}$th of its volume for every degree of depression on Fahrenheit's scale; and, therefore, *one degree of heat* will be extricated from air when it undergoes a condensation equal to $\frac{1}{480} \times \frac{3}{8} = \frac{1}{480}$.

If a mass of air were suddenly reduced to half its bulk, the heat evolved would be $\frac{1}{2} \div \frac{1}{180} = 90°$.—*Phil. Mag.* No. ii. p. 74.

II. CHEMISTRY.

14. *Letter of M. Gaultier de Claubry to M. Gay-Lussac on the mode in which Alkaline Chlorides act in purifying an Infectious Atmosphere.*—The object of this letter is to prove experimentally, that the explanation given by M. Gay-Lussac in the 26th volume, page 165, of the *Annales de Chimie et de Physique,* is correct. M. Labarraque, who has paid particular attention to the subject, supposes that the putrid miasms themselves are absorbed by the solution of the chloride, and then decomposed by the chlorine which is present. M. Gay-Lussac, on the contrary, conceives that the chlorine is disengaged by the carbonic acid of the air, or by that emitted by the putrefying substances. In this way, a carbonate of the alkali is gradually generated, chlorine is set free, and then produces its effect, by being mixed with the atmosphere. M. Gaultier de

Claubry has shown, what was known previously, that a solution of the chloride of lime, or of soda, is completely decomposed by a current of carbonic acid; and his observations leave no doubt, we conceive, of the accuracy of the views of M. Gay-Lussac.—Abstract from the *Ann. de Chimie et de Physique*, vol. xxxiii.

15. *On a new mode of preparing Carbonic Oxide Gas.* By M. Dumas.—This method is founded on a fact originally noticed by Döbereiner, that oxalic acid is converted into carbonic acid and carbonic oxide gases by digestion in strong sulphuric acid, which unites with the water of crystallization. The process of M. Dumas consists in mixing the binoxalate of potash with five or six times its weight of concentrated sulphuric acid. The mixture placed in a glass vessel and heated, yields a considerable quantity of a gas composed of equal measures of carbonic acid and carbonic oxide; and by absorbing the former by means of potash, the latter is procured in a state of perfect purity. The theory of the process is obvious. The sulphuric acid unites both with the water and base of the salt; and the free oxalic acid being unable to exist in the anhydrous state, is decomposed. M. Dumas proposes this process for testing the purity of the binoxalate of potash. In fact, the bitartrate yields by similar treatment carbonic oxide, sulphurous acid, carbonic acid, and the residual liquid becomes black, from the deposition of charcoal. The pure binoxalate, on the contrary, never gives sulphurous acid, and the solution remains colourless, and perfectly limpid.—*Ann. de Chimie et de Physique*, vol. xxxiii.

16. *New Theory of Nitrification.* By M. Longchamp.—It is well known that animal matters form a constituent part of the nitre beds employed in France and other parts of the continent for the production of saltpetre; and it is commonly supposed that the nitric acid so formed, proceeds from the nitrogen of the organic bodies uniting with the oxygen of the atmosphere. This is the theory embraced by Lavoisier, and which has for many years been adopted without question. M. Longchamp, however, has succeeded in throwing a doubt on the accuracy of this doctrine. He has adduced a considerable variety of facts, which prove that nitric acid is generated under circumstances when its production cannot be attributed to the presence of organic remains; that it is formed spontaneously in substances in which neither animal or vegetable matter is present. He finds that the sole conditions necessary for the formation of nitric acid, are porous earthy substances containing carbonate of lime, moisture, and access of air. M. Longchamp maintains, as can scarcely be doubted in such instances, that both the elements of the acid are derived from the air, and that water favours the union of the gases by dissolving them, and thus presenting them to each other in a fluid state. Tufa, chalk, and porous carbonate of lime in general, favour the action in two ways, first, by absorbing air and water; and secondly, by presenting a base which solicits the formation of nitric acid. M. Longchamp believes that similar changes occur in the ordinary nitre beds.—*Ann. de Chimie et Physique*, vol. xxxiii.

An ingenious extension of this theory has been made by Mr Graham

(*Phil. Mag.* for March.) He is of opinion that the process of nitrification is promoted by the water containing carbonic acid, by the aid of which carbonate of lime is dissolved, and thus presented in a state more favourable to chemical action. He supposes putrefying organic remains to be of use by yielding an abundant supply of carbonic acid.

17. *Alcohol derived from the Fermentation of Bread.*—In the last Number of this *Journal* we gave an extract from Dr Colquhoun's Essay on the art of baking bread, and in confirmation of the views there stated, we insert the following letter addressed by Mr Thomas Graham to the editors of the *Annals of Philosophy*. " Two facts of considerable importance in determining the nature of the pannary fermentation have been made known by your very ingenious correspondent on the art of baking bread. He has shown that the fermentation depends upon the saccharine ingredient of the flour, by renewing it when exhausted by the addition of sugar; and provided for the little alteration in the proportion of sugar existing in the flour, before and after fermentation, by exhibiting the influence of the baking in converting a portion of starch into sugar. From the known laws of the decomposition of sugar, it is presumed, with considerable reason, that the fermentation is the vinous. The production of alcohol in the course of the fermentation of bread in baking, which we have found to take place, and rendered appreciable, is perhaps a most irrefragable proof of which this theory is susceptible.

" To avoid the use of yeast, which might introduce alcohol, a small quantity of flour was kneaded, and allowed to ferment in the usual way, to serve as leaven. By means of the leaven, a considerable quantity of flour was fermented; and when the fermentation had arrived at the proper point, formed into a loaf. The loaf was carefully inclosed in a distillatory apparatus, and subjected for a considerable time to the baking temperature. Upon examining the condensed liquid, the taste and smell of alcohol were quite perceptible, and by repeatedly rectifying it, a small quantity of alcohol was obtained of strength sufficient to burn, and to ignite gunpowder by its combustion.

" The experiment was frequently repeated, and in different bakings the amount of alcohol obtained, of the above strength, found to vary from 0.3 to 1 per cent. by weight of the flour employed. When the fermented flour was allowed to sour before baking, the amount of alcohol rapidly diminished; and in all cases, the disagreeable empyreuma completely disguised the peculiar smell of the alcohol, when in its first diluted state, and in vapour."

18. *On the confinement of Dry Gases over Mercury.*—The results of an experiment made by Mr Faraday, and quoted as such, having been deemed of sufficient interest to be doubted, he has been induced to repeat it and though the original experiment was not published by him, he is inclined to put the latter and more careful one upon record, because of the strong illustration it affords of the difficulty of confining dry gases over mercury alone. Two volumes of hydrogen gas were mixed with one volume

of oxygen gas, in a jar over a mercurial trough, and fused chloride of lime introduced, for the purpose of removing hygrometric water. Three glass bottles, of about three ounces capacity each, were selected for the accuracy with which their glass-stoppers had been ground into them. They were well cleaned and dried, no grease being allowed upon the stopper. The mixture of gases was transferred into these bottles over the mercurial trough, until they were about four-fifths full, the rest of the space being occupied by the mercury. The stoppers were then replaced as tightly as could be, the bottles put into glasses in an inverted position, and mercury poured round the stoppers and necks, until it rose considerably above them, though not quite so high as the level of the mercury within. Thus arranged, they were put into a cupboard, which happened to be dark, and were sealed up. This was done on June 28, 1825; and on September the 15th, 1826, after a lapse of fifteen months, they were examined. The seals were unbroken, and the bottles were found exactly as they were left, the mercury still being higher on the inside than the outside. One of them was taken to the mercurial trough, and parts of its gaseous contents transferred. Upon examination it proved to be common air, no traces of the original mixture of oxygen and hydrogen remaining in the bottle. A second was examined in the same manner; it proved to contain an explosive mixture. A portion of the gas introduced into a tube with a piece of spongy platina, caused dull ignition of the platina. No explosion took place, but a diminution to rather less than one half. The residue supported combustion a little better than common air. It would appear, therefore, that nearly a half of the mixture of oxygen and hydrogen had escaped from it, and been replaced by common air. The third bottle, examined in a similar manner, yielded also an explosive mixture, and upon trial, was found to contain nearly two-fifths of a mixture of oxygen and hydrogen, the rest being very little better in oxygen than common air.

There is no good reason for supposing that this capability of escape between glass and mercury is confined to the mixture here experimented with; probably every other gas, having no other action on the mercury or the glass, would have made its way out in the same manner. There is every reason for believing that a small quantity of grease round the stoppers would have made them perfectly tight.—*Quarterly Journal of Science.*

19. *On Sementini's Iodous Acid.* By F. Wöhler.—From a recent examination of the iodous acid of M. Sementini, prepared by distilling iodine with an equal weight of the chlorate of potassa, M. Wöhler finds that this compound does not consist of iodine and oxygen, but of iodine and chlorine; that it is a chloride of iodine similar to that described by Gay-Lussac. In order to demonstrate the presence of chlorine, M. Wöhler saturated the liquid obtained by Sementini's method with carbonate of soda, during which a quantity of iodine was separated. The solution was evaporated to dryness, the saline mass heated to redness, taken up in water, and then allowed to crystallize. A number of crystals were thus procured, which had all the characters of those of common salt. On dissolving them in water, and adding the nitrate of silver, the yellow

iodide of silver at first formed, and then the white thick flocks of the chloride subsided. The mixed precipitate was then treated with pure ammonia, which dissolved the chloride, and left the iodine as a pale yellow powder. The matter dissolved by the ammonia had all the properties of the chloride of silver, and appeared to exceed the iodide in quantity.

The saline mass remaining in the retort after the formation of the chloride of iodine consists of the chloride of potassium, and the chlorate and iodate of potassa, provided the distillation is arrested as soon as the chloride of iodine ceases to be formed. The iodine is present only in the form of iodate, and does not strike a blue with starch except by the addition of the protomuriate of tin, or some other deoxidizing agent. M. Wöhler is of opinion, that the production of the chloride of iodine in Sementini's process depends on the formation of iodic acid, a portion of chloric acid being decomposed, and its elements uniting with separate portions of iodine.—*Poggendorff's Annalen.*

20. *On Bromine,* By M. Just. Liebig, Professor of Chemistry in the University of Giessen.—On receiving the memoir of M. Balard on a new simple substance contained in the mother water of salt-works, I hastened to make some trials of similar solutions which I was able to obtain, and I have been fortunate enough to find this remarkable body in considerable quantity in the mother water of the salt-pit of Theodorshalle, near Kreutsznach. From thirty pounds of the mother water I obtained nearly twenty grammes of bromine.

Having transmitted chlorine through this mother water, the liquid acquired a yellow tint; and on agitating it strongly, red vapours appeared upon its surface. On following the process of M. Balard, which appears the most simple, I separated the bromine by means of ether, and then by caustic potash. The distillation of the bromuret of potassium with peroxide of manganese and sulphuric acid afforded a sufficient quantity of bromine for enabling me to repeat a great number of the experiments of M. Balard; but I have not observed any phenomenon which leads to a conclusion contrary to that which he has deduced from his researches.

M. Balard, in taking for his guide the essays of M. Gay-Lussac on iodine and cyanogen, has left very little to be added to his own memoir. I may add, however, a few experiments in support of the opinion, that bromine, like chlorine and iodine, is to be regarded as a simple substance.

I heated to redness in a glass tube some iron wire formed into a spiral, and the vapour of bromine well dried by chloride of calcium was transmitted through it. The iron, at the moment of contact, became red hot, and fused, without disengaging any gaseous substance. The fused mass was of a bright yellow like Naples yellow, presented a crystalline lamellar structure, and was soluble in water without colouring it. The solution was precipitated of a bright yellow by the nitrate of silver, and chlorine disengaged from it the vapours of bromine. The compound was proto-bromuret of iron.

In another experiment I substituted platinum wire for the iron; but that metal was not attacked, and the bromine retained its properties. Lamp-black, under the same circumstances, had no effect on this body.

On bringing together iron filings, water, and bromine, the mixture acquires an increase of temperature, and proto or deuto-bromuret of iron is formed according to the proportions employed.

A very pure bromuret of potassium may be procured by pouring a solution of caustic potash into the alcoholic solution of bromine until the alcohol begins to lose its colour. This salt, evaporated to dryness, and heated to redness, becomes dark.

The bromuret of silver dissolves easily in ammonia. This solution, on standing for some time, yields white brilliant crystals, which give out ammonia when heated, and leaves bromuret of silver as a residue.

2.521 grains of very pure bromuret of potassium yielded by decomposition, with nitrate of silver, 4.041 grains of the bromuret of silver. This result makes the weight of an atom of bromine 94.11, oxygen being taken as 10.

Nature of Bromine.—Though the facts stated in the preceding paper, as well as those observed by M. Balard, are favourable to the supposition of bromine being elementary, the real nature of this curious substance is as yet by no means ascertained. M. Chevreul is said to have announced to the Academy of Sciences on the 10th of October, that M. Dumas had discovered a chloride of iodine which has all the properties of bromine.—Ferussac's *Bulletin des Sciences for December* 1826.

21. *On an Analytic Process for separating Iron and Manganese.* By M. Quesneville Junior.—The process of M. Quesneville, described in the *Journal de Pharmacie* for September 1826, consists in bringing the iron, by means of a current of chlorine, to its maximum of oxidation, rendering the liquid exactly neutral, and precipitating the iron by the arseniate of potassa. The arseniate of the peroxide of iron subsides, while the whole of the manganese is held in solution. The oxide of manganese may then be precipitated by caustic potash. We agree with M. Quesneville, that the separation of the metals may be effected in this way, provided no free acid is present; but we do not believe his process is at all preferable to that in common use by succinic acid. The per-succinate of iron is indeed decomposed by hot water; but if cold water only is employed, the whole of the iron will be separated.

22. *Proto-Ferrocyanate of Iron.*—Mr Phillips states, that a solution of the protoxide of iron, without any admixture of peroxide, may be obtained by putting the metal into an aqueous solution of sulphurous acid, and suffering the mixture to remain for a short time, without the contact of atmospheric air. When a solution of the ferrocyanate of potash is added, a perfectly white precipitate is formed, which is the proto-ferrocyanate of iron. The action of sulphurous acid upon iron is also remarkable on another account, viz. that no gas is evolved during the solution of the metal, if made to take place in closely stopped bottles. It appears that a part of the sulphurous acid is decomposed by the nascent hydrogen of the water, and

the sulphuretted hydrogen which results, remains in solution.—*Phil. Magazine*, January 1827.

23. *Discovery of a substance which inflames by contact with water.*—The following details have been communicated to us, which it would be desirable to have verified. At Doulens, near Amiens, is a large manufactory for spinning cotton, which is lighted with oil gas. This gas, upon passing from the iron retort, filled with coke, where it is formed, traverses a reservoir of oil, and there deposits a white liquid matter, which may be drawn off by means of a spigot situated at the lower part of the reservoir. Some of this matter being accidentally dropped into water, inflamed spontaneously, and having run into a neighbouring rivulet, it there spread itself over the surface of the water, which appeared to be on fire. The proprietor of the factory intends to send a bottle of this singular substance to M. Gay-Lussac for analysis.—*Bull. Un.*

24. *New Acids.*—MM. Chevreul and Gay Lussac, while treating animal matters by alcalis, have obtained different acids, having the remarkable property of neutralizing bases, and into which azote enters as an element. They are occupied in studying these acids, and will soon publish the results of their labours.—*Ann. Chim.* Nov. 1826, p. 335.

III. NATURAL HISTORY.

25. *Elementary Work on Natural History.*—Mr Stark is preparing for publication *Elements of Natural History,* adapted to the present state of the science, and including the characters of all the Genera and the principal Species of the Animal Kingdom described since the publication of the *Systema Naturæ* of Linnæus.

This work, intended equally for the scientific student and the general reader, will contain a view of all the departments of Nature methodically arranged according to the most approved systems. Besides the scientific descriptions of the Classes, Orders, and Genera, sufficient to enable any one to acquire a competent knowledge of the leading arrangements and principal facts in Natural History, the more generally interesting details of the habits of the principal species, and their use in the economy of nature will be given,—lists of the best books in each department,—explanations of the scientific terms,—and the species natives of Britain will be particularly noticed.

MINERALOGY.

26. *Kersten's Cobalto-Bismuthic Ore.*—Mr Charles Kersten of Göttingen gives a description and chemical examination of this mineral, which he discovered among some specimens of ores of cobalt from Schneeberg in Saxony. Its colour is lead-grey, inclining a little to steel-grey; its lustre nearly metallic. The substance itself is of an imperfect radiated texture, and rather porous; but in other respects resembling the nickeliferous grey antimony. Its hardness could not be ascertained on account of its being intimately mixed with quartz. The specific gravity of the pure mineral, the intermixture of

quartz being duly attended to, appears to be between 6.0 and 6.7. Nitro-muriatic acid dissolves the whole, when reduced to powder, with the exception of from 27 to 32 per cent. of quartz. The following process was adopted to ascertain the relative proportions of the substances previously found to be contained in it, viz. arsenic, cobalt, iron, bismuth, nickel, copper, and sulphur, with a trace of manganese. *A.* From the solution in nitro-muriatic acid which remained clear when diluted by twelve times its volume of water, the sulphuric acid was precipitated by nitrate of baryta. The precipitate obtained was washed with hot water, and then digested in muriatic acid, and again washed. *B.* The muriatic acid used in *A* for digesting the sulphate of baryta contained a little oxide of bismuth, and was added to the remaining fluid, freed afterwards from the superfluous baryta by sulphuric acid. *C.* Liquid hydro-sulphuric acid successively added in small quantities, till no more change ensued, precipitated a blackish-brown powder, consisting of sulphurets of copper and bismuth. Nitric acid dissolved the precipitate, with the exception of sulphur, and assumed a green colour. It was evaporated, then a great quantity of water added, and the white residue collected, repeating the process as long as a precipitate was obtained. *D.* Caustic ammonia added to the fluid gave an additional minute quantity of a precipitate, which was likewise oxide of bismuth. The result was ignited and weighed. *E.* From the ammoniacal liquid, copper was precipitated by caustic potash. The blue precipitate became brown on the solution being heated long enough to expel all the ammonia. The alcaline fluid, treated with hydro-sulphuric acid, gave, after the lapse of several days, a slight quantity of sulphuret of copper. *F.* From the remaining liquid sulphuretted hydrogen gas orpiment was precipitated. The liquid was afterwards heated to the boiling point, and the small quantity of orpiment obtained was added to the former. The orpiment was washed several days with boiling water, till the liquid was left colourless by hydro-sulphuret of ammonia. Caustic ammonia left some sulphur undissolved. *G.* The liquid was concentrated, and nitric acid was added to convert the protoxide of iron into peroxide. The solution rendered neutral by evaporation was diluted, and while hot precipitated by carbonate of soda with excess of base. The precipitate obtained had a brown colour, nearly like oxide of iron. It was washed with boiling water, and at last dissolved in oxalic acid. Effervescence ensued, and a yellow fluid was formed, while a pale rose-red powder remained undissolved. The liquid, filtered off, and warmed, gave, with caustic ammonia, a precipitate of pure oxide of iron. *H.* A slight portion of cobalt dissolved in the liquid was obtained on the addition of hydro-sulphuret of potash. A method, similar to that proposed by Laugier, was employed for the determination of the relative quantities of nickel and cobalt; on the pale red powder of *G* caustic ammonia was poured, which then assumed a deep mahogany tint, leaving a slight residue undissolved, which proved to be chiefly manganese. *K.* A portion of cobalt which it contained, and which was dissolved in the carbonate of ammonia, was added to the ammoniacal liquid of *O,* and allowed to stand undisturbed for a fortnight in a flat open vessel. It assumed a paler colour, and deposited greenish-blue granular crystals. This salt was dissolved in caustic ammonia; the solution formed was of a violet-blue colour. After some time it yielded a green precipitate, the colour of the solution being at the same time changed into a peach-blossom red. The precipitate gave a pure blue solution with caustic ammonia; and, exposed to air, it deposited a verdigris-green salt. This salt was repeatedly dissolved in caustic ammonia to obtain a pure salt of nickel, which was completely precipitated, so as to leave the liquid perfectly colourless when the blue ammoniacal solution was exposed to the air. *L.* The ammoniacal solutions of cobalt were evaporated to dryness, and yielded pure oxide of cobalt.

The results of two analyses, conducted in this manner, were

Arsenic,	78.449	77.530
Cobalt,	9.860	9.876
Iron,	4.776	4.760
Bismuth.	3.865	3.851
Copper,	1.269	1.338
Nickel,	1.103	1.106
Sulphur,	1.287	0.745
Manganese,	a trace	a trace
	100·609	99.206

The chemical composition of this mineral appears to be quite peculiar, and it is likely to belong to a new species. A good description of the species itself is therefore now a desideratum, as would be also the analysis of a well-defined crystalline variety, from which it might appear which of the numerous ingredients are essential, and which of them must be considered as accidental.

27. *Selenium discovered in Cupriferous Minerals.*—Mr Charles Kersten of Göttingen observed the peculiar disagreeable odour characteristic of selenium, when exposing the capillary red copper ore from Rheinbreitbach to the action of the blowpipe. The red ring, which forms another character of it, likewise appeared when the mineral was heated in a glass tube. He afterwards subjected the capillary crystals to a chemical examination in the humid way, and succeeded in separating the selenium from the other ingredients. Two specimens of an earthy substance, from the same locality, chiefly consisting of oxide of copper, showed likewise traces of selenium, which was not the case in similar varieties from the Bannat.

28. *Silicate of Cerium.*—Dr Wollaston examined this substance in June 1825. A perfect crystal of it, in the form of a regular hexagonal prism, is contained in the cabinet of Sir Alexander Crichton, which is to be sold by auction in the ensuing months of April and May. Cleavage parallel to the axis of the prism. Colour pale yellowish-brown. Translucent. Occurs along with magnesian carbonate of lime and emerald. Locality Santa Fé de Bogota, in Peru. Fragments of this substance, associated with the Peruvian emeralds, are preserved also in the British Museum. It is not mentioned whether this be a species of its own, or whether it be the same

as the cerite from Bastnaes in Sweden.—(*Notice of Sir Alexander Crichton's Cabinet*, p. 22.)

29. *Analysis of Zinkenite and Jamesonite.*—Professor Henry Rose of Berlin gives the results of one analysis of Zinkenite, and three of Jamesonite, as follows:

	Zinkenite.	Jamesonite.		
Sulphur,	22.58	22.15	22.53	
Lead,	31.84	40.75	38.71	40.35
Lead, containing traces of zinc and iron,	——	——	0.74	——
Copper,	0.42	0.13	0.19	0.21
Iron,	——	2.30	2.65	2.96
Antimony,	44.39	34.40	34.90	33.47
	99.23	99.73	99.72	

The material of the Zinkenite was communicated to him by Professor Gustavus Rose, who described the species; with the specimens of Jamesonite, first described by Mr Mohs, he was furnished by Mr Haidinger. Professor Henry Rose considers the first to be a compound of one atom of sulphuret of lead, and two atoms of sulphuret of antimony, expressed by the formula $Pb\ S^2 + 2\ SbS^3$, while the second is a compound of three atoms of the sulphuret of lead, and four of the sulphuret of antimony, the formula being $3\ Pb\ S^2 + 4\ SbS^3$. The contents of iron, zinc, and copper, he considers accidental, there being no example of iron and lead forming ingredients of the same chemical mixture, neither as oxides nor as sulphurets. Professor Rose did not find sulphuret of lead in any of those grey copper ores which contained sulphuret of iron, even though they were imbedded in lead-glance. The analysis of the two species, mentioned above, form part of an extensive series of analytical researches on the minerals usually named Fahlerz, or Grey Copper, with which Professor Henry Rose has been occupied for several years past. An account of them is in a considerable state of forwardness for publication.—(*Poggendorf's Annalen der Physik.*)

30. *Professor Mohs.*—We feel particular gratification in announcing to our readers the appointment of Professor Mohs to a mineralogical chair at Vienna. The chair has been established for the occasion in consequence of the peculiar interest evinced by the present Emperor of Austria for promoting the useful sciences. In order to render the lectures more effectual, the professor has been entrusted with the care of arranging systematically the Imperial cabinet, and to adapt it, at the same time, to the purpose of lecturing. For many years every occasion was seized, and considerable sums expended to enrich this collection. Under the management of Professor Mohs, it now bids fair to become an ample source of mineralogical information.

31. *Pyrochlore, a New Mineral Species.*—Its forms belong to the tes-

sular system, being regular octohedrons, according to the measurements by Professor Gustavus Rose. It presents no cleavage, but a rather perfect conchoidal fracture, with a considerable degree of a kind of lustre intermediate between the resinous and vitreous. The surface of the crystals is less bright. It is of a reddish-brown colour, often very dark, and resembling brown sphene, a substance which it is very nearly allied to in respect to similarity. It is slightly translucent only on its sharp edges. Larger fragments appear entirely opaque. It affords a pale brown streak. Its hardness is intermediate between that of fluor and felspar, or = 5.0. Its specific gravity = 4.206 — 4.216, according to G. Rose.

It occurs in the zircon-syenite of Fredriksvärn and Laurvig in Norway almost always in crystals of the size of a pea and smaller, often so firmly attached to the surrounding felspar, or elaolite, that they cannot be separated from them in their faces of crystallization. It was first noticed in the rocks near Fredriksvärn as a particular substance by Mr Tank, who likewise discovered the polymignite and the phosphate of yttria, and it was found also near Laurvig by Messrs Berzelius, Brongniart, and Woehler, during a journey which they made through Norway. The name of pyrochlore was proposed by Berzelius in allusion to its property of turning yellow when exposed to the blast of the blowpipe, a property not found in polymignite, with which it often is associated.

The above description was given by Dr Woehler, who examined the chemical constitution of the substance, and therefore has the merit of having established, both as a mineralogical species and a peculiar chemical compound, a substance which had long ago been noticed by mineralogists under erroneous names, or confounded with other bodies.

It shows the following phenomena when treated with the blowpipe. Heated alone it becomes pale brownish-yellow, but retains its lustre, and melts with great difficulty into a blackish-brown scoria.

It is perfectly dissolved by borax. The globule obtained in the oxidating flame is reddish-yellow and transparent, but becomes easily opaque and yellow by flaming. The globule turns opaque and white on cooling, if a large quantity of the mineral has been employed. In the reducing flame the globule is deep red, similar to the colour produced by titanium containing iron, but by flaming it forms a pale bluish-grey enamel, often with stripes of a pure blue colour.

It effervesces with salt of phosphorus, but is likewise perfectly soluble in it. In the oxidating flame the globule is yellow while hot, but generally becomes grass-green on cooling. In the reducing flame this green colour soon disappears, and is superseded by a deep red one, inclining to violet-blue, as from titanic acid mixed with a little iron. If again exposed to the oxidating flame, the green tint returns, which is like that from uranium.*

With soda on a platinum leaf the green colour produced by manganese is visible.

* There is a mineral occurring along with pyrochlore nearly resembling it, but giving before the blowpipe only the reactions of uranium. From the want of a sufficient supply of mineral it was not analyzed.

As the kind of substances were almost the same as those in polymignite, Dr Woehler followed nearly the same plan which Berzelius had adopted in the analysis of that mineral.

In order to ascertain the quantity of volatile ingredients it was heated in a glass tube, enlarging into a ball in its centre, over the argand spirit lamp. Some only of the small fragments showed the phenomenon of incandescence like gadolinite, though they were all alike afterwards in appearance. Water and fluoric acid, to the extent of 4.2 per cent. were disengaged.

A. The mineral reduced to an impalpable powder was decomposed by dilute sulphuric acid, with which it was digested for some time. A glass plate, with which it was covered, became corroded by the disengagement of fluoric acid. The pulpy mass, obtained by evaporating most of the water, was white, only a little inclining to bluish-green. It was again mixed with much water to precipitate entirely the titanic acid, and to dissolve the gypsum.

B. The solution filtered off the white residue was precipitated by pure ammonia. It yielded a pale brownish-yellow precipitate, which became brown on being washed. The remaining fluid was precipitated with oxalate of ammonia. The oxalate of lime thus obtained was ignited, then melted with carbonate of ammonia, and again slightly heated, to reduce it to the state of carbonate.

C. The liquid from which the lime had been precipitated, left, by evaporation, a residue which contained traces of magnesia, but principally proved to consist of sulphate of manganese.

D. The residue in A chiefly consisted of titanic acid. While yet in its humid state it was digested in hydrosulphuret of ammonia, which immediately turned leek-green, but so slightly, that the quantity of iron it contained can be but very inconsiderable. The hepatic fluid evaporated, left a small quantity of a dirty yellowish powder, which allowed with great facility globules of tin to be reduced before the blowpipe. The remaining powder was pure titanic acid, assuming a fine lemon-yellow tint when heated, which it again lost on cooling. With salt of phosphorus it gave the well known amethystine colour in the reducing flame, and with soda an opaque globule, which disengaged much light on becoming solid. It did not show any traces of silica, of tantalic acid, or of zirconia.

E. The precipitate obtained in B by pure ammonia was digested in caustic potash. The liquid thus obtained was supersaturated with muriatic acid, but did not give any precipitate by ammonia. It contained, therefore, no alumina.

The residue was digested in a concentrated solution of carbonate of ammonia. Its brown tint became still darker, and the liquid assumed a yellow colour. This liquid filtered off, on being diluted with the washings of the brown residue, became turbid, and a yellowish-white precipitate appeared when it was heated to drive away the carbonate of ammonia. When dried, it had a greyish-brown colour, and gave reactions only of tin and cerium.

The remaining yellow ammoniacal solution being evaporated to dryness, left some yellow oxide of uranium. From a solution of the latter in nitric acid, which was of a fine yellow, ammonia gave a yellow precipitate, and the cyanuret of iron and potassium a fine blood-red one.

F. That part of the brown precipitate in B, which was not soluble in carbonate of ammonia, was soluble in dilute muriatic acid, with the exception of a small quantity of a dark-brown substance, which proved to be oxide of manganese. The solution was neutralized with ammonia, and then a crystalline coat of pure sulphate of potash introduced. A white pulverulent precipitate began to form one hour afterwards. At the end of twenty-four hours it was separated by filtration, washed with a saturated solution of sulphate of potash, and then digested in a solution of caustic potash. A dirty white precipitate was left, which became darker on the filter, and proved to be oxide of cerium. On being treated with concentrated muriatic acid, chlorine was disengaged in a higher temperature, and a trace of a white substance was left undissolved, which might be zirconia.

G. The liquid left after the separation of the oxide of cerium, on being mixed with caustic ammonia, gave a little iron, still containing some manganese; a trace of the latter was also discovered in the liquid remaining after separating the oxide of iron.

The result of the analysis was,

Titanic acid,	62.75
Lime,	12.85
Protoxide of uranium,	5.18
Oxide of cerium, (impure)	6.80
Protoxide of manganese,	2.75
Oxide of iron,	2.16
Oxide of tin,	0.61
Water,	4.20
	97.30

Besides a trace of magnesia, and much fluoric acid.

Dr Woehler does not give any formula to represent the chemical constitution of the species. He could not determine the quantity of fluoric acid, which he believes to be very considerable, and as two per cent. of fluoric acid will combine with seven per cent. of lime, the quantity of it must necessarily affect the computation. There might be also some zirconia in the precipitate, deposited in E from the carbonate ammonia, in which, on account of the small quantity of it, only tin and cerium were discovered.

32. *Native Gold in Vermont.*—A fine piece of native gold, of nearly ten ounces was lately picked up by a boy near a small brook in Newfort, Vermont. It was studded with quartz crystals. It strikingly resembles the N. Carolina gold. Its specific gravity is 16.5, and it is considered worth 89 cent. per pennyweight.—*Newton's Journal of the Arts*, Feb. 1827, p. 375.

33. *Dr Brewster's Treatise on Mineralogy.*—This work, in which the author has been engaged for many years, will be published early next win-

ter. It is intended to form a popular treatise, embracing all the Chemical, Physical, and Natural History properties of Mineral Bodies, with an account of the various purposes in the fine and useful arts to which they are applied. It will occupy one large volume 8vo. and will be illustrated with numerous plates, representing the internal structure, and the external form of crystallized bodies. In the introduction it is proposed to give a popular account of all the discoveries that have been made during the last ten years respecting the optical and physical structure of minerals, and a description of various new methods and instruments for examining and distinguishing the precious stones and other mineral bodies.

34. *Mohsite, a New Mineral Species.*—Form rhombohedral. One of its crystals is represented in Fig. 10 of Plate IV. The terminal edges of the fundamental rhombohedrons R, or the incidence of P on P over b' are $= 73°43'$. The other measurements are,

b on $a' = 112°30$	b' on $b' = 96°22'$
$b' - a' = 129°39$	$e' - e' = 64°0'$
$e' - a' = 101°42$	$d^2 - d^2 = 142°14$
$P - d^2 = 157°10$	$d^2 - d^1 = 99°22$

The surface is brilliant, with the exception of d' and d^2, which are less shining; cleavage apparently none; fracture conchoidal; opaque; colour iron-black; lustre bright metallic; no action on the magnetic needle; brittle; scratches glass very easily. The crystals are flattened between the faces a' and its opposite, so as to produce a tabular appearance. They are small and implanted on quartz, mixed with a little chlorite, probably from Dauphiny.

Mr Levy, to whom mineralogy is already so much indebted for the establishment of new species, has given the above description of one which he discovered among Mr Heuland's rare minerals, and called it, at his suggestion, *Mohsite*, in honour of Professor Mohs. Mr Levy observes that this new species has almost identically the same form as *Eudialyte*, as described by him in the *Edinburgh Philosophical Journal* for Jan. 1825, the fundamental form of the latter being a rhombohedron of 73°40′. He describes likewise twin-crystals, which are said to be formed by two individuals with parallel axes, but not reversed for 180°, but only for 30° or 90°. No figure being given, it would be unavailing to attempt here any explanation of the fact stated, upon the supposition that the otherwise general law also takes place in the present instance. Mohsite very much resembles Crichtonite, and axotomous iron-ore, but is distinguished immediately by its greater hardness, and want of cleavage perpendicular to the axis.

35. *Analysis of Hetepozite.* This mineral was found at Thoreaux, in Haut Vienne, in France. Part of it was tender, and part hard. The tender part gave a fine violet powder, and the hard part a greyish and sometimes a yellowish powder. The specific gravity of the violet part was 3, and in a slight portion M. Vauquelin found it to consist of—

Iron,	-	35.5
Manganese,	-	16.5
Phosphoric acid,	-	48
		10.0

Ann. de Chim. vol. xxx. p. 130.

36. *Analysis of Huraulite, a new Mineral.* This mineral was found in Haut Vienne, by M. Alluau. M. Vauquelin found it to consist of—

Iron of manganese,	-	47.2
Phosphoric acid,	-	32.8
Water,	-	20

Ann. de Chim. vol. xxx. p. 307.

37. *Analysis of the Fer Oxidé Resinite of Hauy.* This mineral, called also *Fer Piciforme,* is from the mine of Kust, near Freyberg. M. Laugier found it to consist of—

			Atoms.
Peroxide of Iron,	-	35	1
Arsenic acid,	-	20	1
Sulphuric acid,	-	14	1
Water,	-	30	9
		99	

Ann. de Chim. vol. xxx. p. 331.

38. *Analysis of a new variety of Wolfram.*—This mineral, from Haut Vienne, has been found by M. Vauquelin to be composed as follows,—

		Old variety. Berzelius.	New variety. Vauquelin.
Tungstic acid,	-	74.666	73.2
Oxide of Iron,	-	17.599	13.8
Oxide of manganese,	-	5.670	13.0
		97.930	100.0

Ann. de Chim. vol. xxx. p. 194

39. *New Crystalline form of Apophyllite in America.*—This new form of apophyllite was found in a geode imbedded in the amygdaloidof Port Marmouze, on Lake Superior, 44 miles N. W. of the straits of St Mary The geode found by Dr Bigsby was presented by him to Dr G. Troost. This apophyllite exfoliates, like the European variety, before the blowpipe and melts into a white enamel, which, by a prolonged application of heat changes into a semi-transparent glass. It does not require so much heat for its fusion as the European variety, but coincides with it in its other characters. One of the crystals of the apophyllite exceeds *half an inch* in length. It has the appearance of an elongated octohedron, with the angles of the base truncated, and its edges emarginated. Dr Troost gave it the name of *Apophyllite Mixtunitaire.* The angles are M upon M 90°; M upon the faces of the pyramid 127° 59; M upon the emarginated edges 149° 29′ 30″.—See *Journal Nat. Soc. Philadelph.* vol. v. p. 52.

40. *New Crystalline form of Laumonite.*—This mineral was found by Dr Bigsby at three different places on Lake Superior. The crystallized variety was discovered in a small vein of white calcareous spar and red feldspar. Its form is a rhomboidal prism, acuminated with a dihedral summit.—*Id.* p. 53.

41. *Farther Observations relative to Kupffner's Law in Mineralogy.*—In vol. iv. pp. 186—188 of this *Journal,* we laid before our readers an account of the remarkable law in mineralogy, announced by M. Kupffner. The following consequences of this law have been deduced by M. Vincent:

1. The cubes of the axes of primitive forms, which contain the same number of atoms, are in the inverse ratio of the squares of their specific weights.

2. In crystalline substances, of the same primitive form, the specific weights are in the inverse ratio of the weights of the atoms.

3. The squares of the weights of the atoms are proportional to the cubes of the axes of the primitive form.

4. The cubes of the respective distances of the atoms, in two substances of the same primitive form, are proportional to the squares of the weights of these atoms, or in the inverse ratio of the squares of these specific weights.—See *Ann. de Chim.* tom. xxxi. p. 104.

42. *Pholerite, or Silicate of Alumina.*—This substance frequently occurs in the coal formations of Fins, (dep. of Allier,) in fissures in the ironstone. It occurs in small convex nacreous scales: It is soft and friable, and adhesive to the tongue, and is of a pure white colour. It is composed of

Silica,	-	-	41.775
Alumina,	-	-	43.104
Water,	-	-	15.121
			100.000

Ann. des Mines, vol. xi. p. 489.

GEOLOGY.

43. *Bowlders exhibiting Scratches and Furrows on their lower surfaces.*—"I have had occasion, says Mr P. Dobson of Vernon, Connecticut, to dig up a great number of bowlders of red sandstone, and of the conglomerate kind, in erecting a cotton manufactory; and it was not uncommon to find them worn smooth on the under side, as if done by their having been dragged over rocks of gravelly earth, in one steady position. On examination, they exhibit scratches and furrows on the abraded part; and if, among the minerals composing the rock, there happen to be pebbles of feldspar or quartz, (which was not uncommon,) they usually appeared not to be worn so much as the rest of the stone, preserving their more tender parts in a ridge, extending some inches. When several of these pebbles happen to be in one block, the preserved ridges were on the same side of the pebbles, so that it is easy to determine which part of the stone moved forward, in the act of wearing." Some of these blocks weighed fifteen and even thirty tons. These curious facts confirm the ingenious speculations and

views of Sir James Hall, Bart. respecting the revolutions on the earth's surface.—See *Edin. Transactions*, vol. vii. p. 169.

44. *Mr Poulett Scrope's arrangement of Volcanic Rocks.*—As we believe there are few of the geologists of the present day who have studied the volcanic phenomena, and examined the volcanic districts with so much attention as Mr Poulett Scrope, we shall lay before our readers his new arrangement of volcanic rocks, of which he has given an account in a late Number of the *Quarterly Journal.*

GENUS I.—TRACHYTE.

Species A, *Compound trachyte*, with mica, hornblende, or augite, sometimes both, and grains of titaniferous iron.
B, *Simple trachyte*, without any visible ingredient but felspar.
C, *Quartziferous trachyte*, when containing numerous crystals of quartz.
D, *Siliceous trachyte*, when there appears to have been introduced a great deal of silex into its composition.

GENUS II.—GRAYSTONE.

Species A, *Common graystone*, consisting of felspar, augite, or hornblende and iron.
B, *Leucitic graystone*, when leucite supplants the felspar.
C, *Melilitic graystone*, when melilite is substituted for felspar, &c.

GENUS III.—BASALT.

Species A, *Common basalt*, composed of felspar, augite, and iron.
B, *Leucitic basalt*, when leucite replaces the felspar.
C, *Basalt* with *olivine*, in place of felspar.
D, *Basalt* with *Hauyne*, in place of felspar.
E, *Ferruginous basalt*, when iron is the predominant ingredient.
F, *Augite basalt*, when *pyroxene* or *hornblende* compose nearly the whole of the rock.

The colour of the rocks of the graystone genus is universally of some tint of gray, generally lead-gray, greenish iron, purplish, or slate-gray, with the exception only of the vitrified varieties, some of which have assumed a black colour, which, however, passes away under the blowpipe, and is succeeded by the usual gray tint.

In general the colour of the mass is deeper in proportion to the quantity of augite matter in its composition, the felspar being always of a light colour, the augite of a darkish green or black hue, and the iron of a dark-brown or black.

The proportion of felspar, or its substitutes in *trachyte*, may be reckoned at or above 90 per cent. the remainder being composed of augite, or the ferruginous minerals.

In *graystone*, felspar or its substitutes composes more than 75 per cent. When these minerals are in less proportion than 75 per cent. the rock should be classed as *basalt.*

Another auxiliary test is the specific gravity of the substance reduced to powder. The specific gravity of *trachyte* does not exceed 2.7, that of *graystone* 3.0; while *basalt* occasionally reaches 3.50.

A third test is the colour of the glass before the blowpipe. That from *trachyte* is light-coloured, and nearly transparent. That from *graystone* is darker, and having numerous green or black specks, often of a green colour. *Basalt* swells into a dark-green or black enamel.

Leucite has *not* been found in *trachyte*, *rarely* in *graystone*; but *oftener* in *basalt*.

Olivine has never been found but in basalt, and it appears to replace the felspar in part, or wholly, but only when the augite is in excess.

BOTANY.

45. *South African Botany, &c.*—It is well known, that Mr James Bowie, an excellent botanist and general naturalist, has been for many years employed in collecting plants for his Majesty's gardens of Kew, in the interior of Southern Africa; and that, in consequence of the late system of retrenchment in the government expenditure, he has, to the great regret of every one attached to botany, and alive to the interest of the Royal Gardens, been recalled.

Mr Bowie had already travelled to the distance of 200 miles from the Cape of Good Hope; and of the exceeding value of the collections sent to Kew, the writer of this article can bear ample testimony. He now proposes to return to the Cape, and again explore the interior at his own risk, relying for a remuneration for his great expenditure, upon the prospect of disposing of what he may collect to the naturalists of this country.

Under this impression, he offers to collect plants, and other subjects of natural history, for those who may be inclined to favour him with their commissions, upon the following terms:—

Dried Plants, well preserved specimens, at L. 2, 10s. the hundred species.

Seeds, L.5 per hundred do.

Bulbs, (Ixiæ, &c.) 10s. per hundred, *larger ones*, 1s. to 2s. 6d. each.

Living Plants, 2s. 6d. each species. N.B.—If small succulents, three or more kinds will reckon as one.

Strelitziæ, *Zamiæ*, &c. and plants of similar size, 5s. each.

New Species will be charged somewhat higher.

Birds.—For small *birds' skins*, and to the size of *doves*, one shilling each specimen. From that size, and upwards, in proportion, to that of a *vulture* or *eagle*, 7s. as the highest price. *Birds* for dissection, preserved in spirits, (cask included,) L.5 per hundred, without regard to size.

We think we are doing, a service to men of science in this country, in recommending so deserving a naturalist to their attention; and we heartily wish him success in his undertaking.

Mr Bowie's address is Kew Green, Surry.

VEGETABLE PHYSIOLOGY.

46. *Professor Decandolle on the Lenticellæ.*—Professor De Candolle of Geneva, has lately published a valuable memoir in the "*Annales des Scien-*

ces Naturelles," "*sur les Lenticelles des Arbres et le développement des racines qui en sortent.*"

It has been supposed that, from a cutting of a tree, for example, the roots appear indifferently from all points of the bark: but this assertion M. De Candolle declares to be incorrect; they are all, without exception, protruded from small reddish, oval spots, which M. Guettard has named "*glandes lenticulaires,*" but of which the functions were never known? To these spots our author has given the name of *Lenticellæ,* (or *Lenticelles.*)

The experiments were made principally, but not solely upon the Willow, in which the following facts were observed. A branch of the *Salix bicolor,* cut from the parent plant, was placed in a bottle of water, and exposed in a stove to a heat of 12 or 13 degrees of Reaumur. The water was presently visibly absorbed, and this absorption was the more rapid, in proportion as the roots were developed. The first sign of vegetation was apparent in the gemmæ, or leaf-buds, which became slightly swollen:—soon after, the little oval spots above alluded to began to swell;—the roots were protruded, and then the developement of the gemmæ became more decided. The gemmæ of the lower part of the branch, and which were consequently nearest to the water, and those at the summit, which of course were farthest from the water, were those which showed the earliest signs of vegetation. These appeared in two fixed situations. One set, and that the first to be developed, have their origin from the axils of the old leaves; they are always solitary, and are the only ones where the branch is uninjured, and when there only remains the scar of the old leaf. The other set, which vegetate more readily, appear when some small lateral branch has been cut away, or that of the original gemmæ is cut out or destroyed. Then these develope themselves regularly, two in number, one on each side of the point or scar where the injury has occurred. All the gemmæ have, in the beginning, a decidedly ascending direction, and a green colour; they originate in the woody body, but less distinctly so than the root. Their form is that of a sharp and slightly compressed cone; they divide in two, as it were the covering formed by the epidermis, and present to the eye at once the rudiments of the branch and of the leaves.

The developement of the roots takes place in the following manner. The lenticular disc, which, in a state of repose, was almost flat, swells and bursts, often into four irregular lobes, and the epidermis is carried up at the extremity of the root. Beneath this, a white, apparently amylaceous matter is seen, from beneath or from the side of which the cylindrical filiform root is protruded, spongy and soft at the extremity, itself always of a pure white, never becoming green by the action of the solar rays. From these observations upon the nature of the lenticellæ, and from tracing the more complete developement of the roots, our author has come to the following conclusions upon this interesting subject:—

1*stly,* That the *lenticellæ* (*glandes lenticulaires* of Guettard) bear the same relation to the roots which the gemmæ or leaf-buds do to the young branches,—that is to say, that they are points upon the stem, where preparation is made before-hand for the developement of the roots, and whence originate those which are developed along the branches of trees, whether in the air, in the water, or when buried in the earth.

2dly, The young root communicates with the ligneous body of the branch by its axis, which visibly proceeds from it; and its bark appears also to be a continuation of that of the branch.

3dly, It pierces the epidermis of the branch in its developement, and carries with it some portion of the cellular covering.

4thly, The root increases only at its extremity, which part alone, of the whole root, is capable of becoming green by the action of the light.

5thly, The developement of the roots is generally more rapid in the dark than in the light, although experiments produce very varied results.

6thly, Branches immersed in water do not sensibly imbibe the fluid by the bark, but by the exposed parts of the woody body, whether in consequence of a transverse section, or upon the external surface simply deprived of the bark.

7thly, Water absorbed by the woody body has a tendency naturally upwards, towards the upper parts from which it has entered; because the leaf-buds, when they are excited by heat, attract towards them the water absorbed by the roots or the exposed wood, and it is by a similar process that the trees are enabled to produce leaves in spring.

8thly, Water penetrates more slowly in branches which are inverted, than in those in a natural position.

9thly, Water absorbed by the cut base of a branch, unites with the colouring matters with which it may be charged in the branches which are developed by this action.

10th, The roots which are put forth in coloured water, imbibe from it the colouring matter, which they transmit to those roots which are above them, but which are themselves not immersed in the coloured liquid.

11th, The length and the form even of the roots may be much modified by the nature of the medium in which they grow.

47. *New plan of grafting Pear trees.*—A very interesting paper on the cultivation of an early and a late variety of the pear on the same wall-tree, by Mr D. Montgomery, gardener to the Duke of Montrose, is printed in the *Transactions of the Horticultural Society of London,* vol. vi. p. 367. He proposes to graft the half of the late pear-trees with the early sorts, and half the early trees with the late sorts; for example, every alternate branch of the crassane with the jargonelle, and of the jargonelle with one of the best late pears. In this way there are two chances of success. Should the jargonelle, which is very early in blossom, fail, from unfavourable weather, the late sort, which flowers at another time, may succeed. Another advantage arises from the crop coming at different times. The jargonelle ripens off before much effort is required from the tree to support the late sorts, so that the tree is more capable of supplying nourishment to half a crop of jargonelles, than if the crop were all of that sort; and as the early pears are all gathered before the late sort begins to swell to size, the tree is at once relieved from half its crop, and is better able to mature in

greater perfection its late produce. Mr Montgomery states, that the trees produce finer fruit in this way than if they were all of one sort. Mr Sabine, the able secretary to the society, recommends the adoption of this plan in England, on the ground that, "as few families can consume the entire produce of a full-sized, well-managed pear-tree of any one kind, much waste would be avoided, as well as more variety for the table secured, if every tree on a wall were worked with two or more kinds."

IV. GENERAL SCIENCE.

48. *Effect of Moonlight on the Eyes.*—The effect of the moonlight on the eyes in Egypt is singularly injurious; the natives tell you, as I found afterwards they also did in Arabia, to cover your eyes when you sleep in the open air. The moon in Egypt strikes and affects the sight, when you sleep exposed to it, much more than the sun; a fact of which I had a very unpleasant proof one night, and took care to guard against it afterwards; indeed, the sight of a person who should sleep with his face exposed at night would soon be utterly impaired or destroyed.—Carne's *Letters from the East.*

49. *The Royal Medals for* 1826 *adjudged to Mr Dalton and Mr Ivory.*—The Royal Society of London, on the 30th November 1826, adjudged one of the Royal Medals to Mr John Dalton "for his developement of the chemical theory of definite proportions, and for his various other labours in chemical science; and the other to James Ivory, Esq. for his papers on the figures of the planets, on astronomical refractions, and other mathematical illustrations of important parts of astronomy."

In announcing these adjudications, we cannot avoid expressing our doubts of the propriety of the principle which the Society has adopted. Of the illustrious individuals on whom that honour has been conferred, we have the most exalted opinion. They are the proudest ornaments of English science, and ought to have received from a grateful country rewards much more substantial than honorary laurels. Fame has long since consigned their names to immortality, and it seems to us to be an anticlimax in honour to place at this late period a disc of gold upon their shrine. We had imagined that the royal medals were granted as a stimulus to new discoveries, and not as a reward for old ones, and we are sure that, while the existing principle continues to be recognized, no young philosopher will, under the influence of these honours, make any great effort at discovery.

Dr Wollaston and Dr Young must receive the royal medals for 1827; the Bishop of Cloyne and Mr Pond must receive them for 1828; Mr Herschel and Mr Babbage for 1829; Mr Troughton and Captain Kater for 1830, Dr Thomson and Dr Henry for 1831; and Mr Barlow and Mr Christie for 1832. These gifted individuals, who are placed at the head of English science, merit every honour that the Royal Society can bestow; but every aspirant after scientific fame would thus be struck out of the list of competitors for the royal prize, till all the veterans of science had received that distinguished honour.

50. *The Copley Medal of 1826 adjudged to Mr South.*—The Royal Society has adjudged the Copley Medal to James South, Esq. F. R. S. London and Edinburgh, for his paper on the apparent distance and positions of 458 double and triple stars, a work which well merits this high reward.

51. *Diamond Mines of Bundelkhund.*—These mines are situated on the table-land, between the first and second ranges of hills near Panná, and extend from the Kén River, eastward as far as the Chila Nadi, and no diamonds are found beyond these limits. They are the exclusive property of the Rajah of Panná; but adventurers may dig for them, if they choose to pay the expences, and a tax of one-fourth of the produce to the rajah. The mines, however, are so much exhausted, that this privilege is rarely accepted. The diamonds are found in a red gravelly soil, at various depths below the surface, from *three* to *fifteen* feet, but generally at *three* or *four* feet; and they are separated from the soil by washing and sifting it. The diamond is of the table or flat kind, and is rarely found perfect.—Captain Franklin's *Memoir on Bundelkhund, Trans. Royal Asiatic Society*, vol. i. p. 277.

52. *Destructive Earthquake at St Jago de Cuba.*—This earthquake, the most tremendous which has been experienced for fifty years, took place on the 18th September, between three and four o'clock, and destroyed nearly one-half of the town. The second shock was more severe than the first, and each lasted one minute. The earthquake began with a noise like that of heavily laden waggons dragged over a paved archway, and ended with a tremendous explosion, like the simultaneous discharge of a great number of cannon. Men, women, and children left their beds, and fled to the cathedral, amidst the most distressing cries and shrieks, where they plunged into the water of the baths, which had been blessed by the priests, and remained there up to the neck for hours. The earthquake was felt at Kingston, Jamaica, at the same day and hour.

53. *Earthquakes at St Brieux.*—An earthquake was felt at St Brieux (*Dep. Cotes du Nord*) at 5^h P. M. The thermometer stood at 53° 6′, and the barometer at 29 inches. The shock lasted from twelve to fifteen seconds, and seemed directed from east to west. During that time a noise was heard like that of chariots moving over a pavement.—*Le Globe*, No. 84.

Another earthquake seems to have been felt at St Brieux on the 24th June, on the same day that it was felt at Inspruck.

54. *Earthquake at Arran, in Scotland.*—An earthquake was felt and heard in the island on the 26th November 1826 about 4 P. M. The furniture in the room rattled, and the chairs moved as if the floor had been in motion. This motion continued three or four seconds. A rattling noise, like that of heavy carts, or of a thrashing mill, was heard in other quarters of the island. The sky was serene and pretty clear, with scarcely any wind.

55. *Professor Gmelin's Analysis of the Water of the Dead Sea.*—Professor C. G. Gmelin of Tubingen has just communicated to us the following analysis of the water of the Dead Sea, the specific gravity of which, at a temperature of $61\frac{1}{4}°$ Fahrenheit, he had found to be = 1.21223. He obtained the following result:—

Chloride of Calcium, - -	3.2141
Chloride of Magnium, - -	11.7734
Bromide of Magnium, - -	0.4393
Chloride of Sodium, - -	7.0777
Chloride of Potassium, - -	1.6738
Chloride of Aluminium, -	0.0896
Chloride of Manganese, - -	0.2117
Muriate of Ammonia, -	0.0075
Sulphate of Lime, - -	0.0527
	24.5398
Water, - - -	75.4602
	100.0000

56. *Eruption of one of the large Craters of Mount Huararai in* 1803.—This eruption inundated several villages, destroyed a number of plantations and extensive fish-ponds, filled up a deep bay about twenty miles in length, and formed the present coast. An Englishman who resided thirty years here, told us he was astonished at the irresistible impetuosity of the torrent. Stone walls, trees, and houses, all gave way before it; even large masses of rocks of hard ancient lava, when surrounded by the fiery stream, soon split into small fragments, and falling into the burning mass, appeared to melt again as borne by it down the mountain's side. The lava continued to flow for two or three days. In several places on the coast, the sea rushes with violence twenty or thirty yards along the cavities beneath the lava, and then forcing its waters through the aperture on the surface, forms a number of beautiful *jet d'eaux*, which, falling again on the rocks, roll rapidly back to the ocean.—Ellis's *Missionary Tour through Hawaii.*

57. *Celebrated Lava Cavern of Raniakea.*—This cavern is near Kairua, on the west coast of Hawaii. After entering it by a small aperture, the missionaries passed on in a direction nearly parallel to the surface, sometimes along a spacious archway, not less than 25 feet high and 20 wide, at other times by a passage so narrow that they could with difficulty press through, till they had proceeded about 1200 feet, where their progress was arrested by a pool of water, wide, deep, and as salt as that in the bottom of the lava, a few yards from the sea. More than thirty natives, most of them carrying torches, accompanied us in the descent, and on coming to the water, simultaneously plunged in, extending the torches with the one hand, and swimming about with the other. The partially illuminated heads of the

natives splashing about in the subterranean lake; the reflection of the torch light on its gilded surface; the frowning sides and lofty arch of the black vault hung with lava that had cooled, with lava in every imaginable shape; the deep gloom of the cavern beyond the water; the hollow sound of the footsteps, and the varied reverberation of the voices, produced a singular effect. The mouth of the cave is about half a mile from the sea, and the perpendicular depth of the water probably not less than 50 or 60 feet. Its water is cool and refreshing. From its ebbing and flowing with the tide, it has probably a direct communication with the sea.—Ellis's *Missionary Tour through Hawaii.*

58. *On the Length of the Ancient Stadium.*—A very accurate map of Turkey in Europe, and of Greece, has just been published by M. Le Chevalier Lapie, from materials collected by Count Guilleminot, the French ambassador at Constantinople, and Lieutenant-General Baron Tremelin; a very important result for understanding ancient geography, and which, from the accuracy of the new map, has been obtained by its editors. The learned differed with respect to the value of the stadium which Strabo and the ancient geographers used for indicating the distances between different places. It is evident that, in order to determine its value, we ought to ascertain the real distances between different points, whose position has not changed; and to deduce from this the true length of the ancient measure.

The precision with which M. Lapie has drawn his map, has completely resolved the problem, and has demonstrated that the stadia of ancient geographers were, according to the opinion adopted by M. Gosselin, and rejected by D'Anville, 700 to a degree. Strabo, for example, reckons it 200 stadia from Corinth to Argos, and Pausanias 660 from Sparta to Olympia. These are the exact distances found on the new map on stadia of 700 to a degree, which proves at once the accuracy of the ancient geographers, and that of the modern maps—*Le Globe, 10th June* 1826, tom. iii., No. 73, p. 391.

59. *Miniature Volcanoes in America.*—The late Dr Dwight (*Travels*, vol. ii. p. 203,) in his description of Stafford in Connecticut, mentions a volcanic eruption, reported to have taken place in that town. The spot alluded to is a high rock, forming the western bank of the valley of the Willimantic, and distant nearly a mile from the Springs. Similar eruptions are said to have taken place in the Soapstone mountains of Somers county. After a long continued rain, it is said by some of the inhabitants, living near the place, that reports have been heard from the mountains in frequent succession, louder than that of musketry. On examining this rock not long since, a small hole, about $1\frac{1}{4}$ inch in diameter, was found. which extended to a considerable depth into a bed of the sulphuret of iron. The mouth of this hole was extended in the form of a funnel, and was filled with leaves, earth, and a mixture of the sulphate of iron. In Monson county also, it is said that, some years ago, a similar eruption took place in

a spot which abounds with sulphuret of iron, and there are not wanting indications of the truth of the story.

60. *Effects of the Inspiration of Hydrogen.* Signor Giamoco Cardone inhaled, at two inspirations, 30 cubical inches of hydrogen. The effects were, great difficulty of respiration, constriction at the mouth of the stomach, copious perspiration, a general tremor, an extraordinary sense of heat, slight nausea, and violent headach. Vision was impaired, and the ears rung. All these effects soon ceased, *except that of heat, which increased in an alarming manner.* M. Cardone's health was restored by the abundant use of cold drinks. *Giornale di Fisica,* viii. 295.

Art. XLIV.—LIST OF PATENTS GRANTED IN SCOTLAND SINCE NOVEMBER 8, 1826.

40. Dec. 13. For certain Improvements in Apparatus for Cooling and Heating Fluids. To James Yandell, of Broad Wall, Surrey.

41. Dec. 14. For a New Apparatus on which to Suspend Carriage Bodies. To Henry Charles Lacy, Manchester.

42. Dec. 14. For certain Improvements on Apparatus applicable to the Burning of Oil and other Inflammable Substances. To Thomas Machell, County of Middlesex.

43. Dec. 20. For an Apparatus adapted to Cool Wort or Must, and for Condensing the Steam. To Dominique Pierre Deurbroucq, Esq County of Middlesex,

44. Dec. 29. For a New Engine for communicating Power to answer the purposes of a Steam-Engine. To Count Adolphe Eugene de Rosen, County of Middlesex.

45. Dec. 29. For certain Improvements in propelling Boats and Ships and other Vessels or Floating Bodies. To William Busk, Esq. London.

1. 1827. Jan. 15. For an Improved Winding Machine. To Henry Richardson Fanshawe, London.

2. Jan. 15. For certain Improvements in the Machines used for carding, slubbing, slivering, roving, or spinning wool, cotton, waste silk, short staples, hemp, and flax, or any other fibrous materials or mixtures thereof. To Mose Poole, County of Middlesex.

3. Feb. 2. For certain Improvements in the Manufacture of Gas for the purposes of Illumination. To John Frederick Daniell, Esq. County of Middlesex.

4. Feb. 2. For certain Improvements in Machinery or Apparatus for preparing Rovings, and for spinning, twisting, and winding fibrous substances. To Maurice de Jongh.

5. Feb. 7. For a new method of constructing Steam-Boilers. To James Fraser, London.

6. Feb. 13. For certain Improvements in Air-Engines for the moving of Machinery. To the Rev. Robert Stirling, County of Ayr.

7. Feb. 16. For an Improved method of constructing Capstans and Windlasses. To James Fraser, London.

8. Feb. 24. For certain Improvements in Machinery for heckling or dressing, and for breaking, scutching, or cleaning hemp, flax, or other fibrous substances. To Robert Busk and William King Westley, County of York.

Art. XLV.—CELESTIAL PHENOMENA,

From April 1st to July 1st 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.

APRIL.

D.	H.	M.	S.	
1	12	28	33	Em. III. Sat. ♃
2	6	32	49	☌ ☽ ζ ♉ ☽ 59′ S.
2	15	5	38	Em. I. Sat. ♃
3	7	4	39	☌ ν ♊. ☽ 55′ S.
4	2	25		☽ First Quarter.
4	9	34	5	Em. I. Sat. ♃
5	6	45		☿ Inf. ☌ ☉
6	6	23	32	☌ ☽ 1 α ♋ ☽ 17′ N.
6	7	37	44	☌ ☽ 2 α ♋ ☽ 8′ S.
7	13	14	33	☌ ☽ π ♌ ☽ 72′ S.
7	14	8	18	Em. II. Sat. ♃
8	16	25	54	Em. IV. Sat. ♃
9	4			☌ ♃ π ♌
9	11	37		☌ ☽ υ ♌ ☽ 65′ S.
11	11	23		○ Full Moon.
11	11	28	4	Em. I. Sat. ♃
11	11	38	46	☌ ☽ α ♍ ☽ 1′ S.
12	5			☌ ♂ δ ♈
12	16			☌ ♀ λ ♒
12	22	50	22	☌ ☽ α ♎ ☽ 31′ S.
13	18	52	29	☌ ☽ k ♎ ☽ 59′ N.
14	3	57	50	☌ ☽ 1 β ♏ ☽ 27′ N.
14	3	59	11	☌ ☽ 2 β ♏ 27′ N.
14	6	31	33	☌ ☽ ν ♏ ☽ 3′ S.
14	9			♄ ☌ η ♊
15	9	2	51	☌ ☽ ρ Oph. ☽ 54′ N.
17	13			♀ ☌ φ ♒
18	3	19		☽ enters Last Quarter.
18	10	9	17	☌ ☽ β ♑ ☽ 32′ N.
18	11	¼		♅ in Quad. with ☉
18	13	22	9	Em. I. Sat. ♃
19				☿ Stationary.
20	7	50	42	Em. I. Sat. ♃
20	9	30		☉ enters ♉
25	8	37	41	Em. II. Sat. ♃
25	15	2	30	☉ Ecl. Invisible.
25	15	16	19	Em. I. Sat. ♃
25	15	2		● New Moon.
27	9	44	53	Em. I. Sat. ♃
28	5	8	32	☌ ☽ ε ♉ ☽ 38′ N.
29	13	56	10	☌ ☽ ζ ♉ ☽ 63′ S.
30	14	32	10	☌ ☽ ν ♊ ☽ 59′ S.
30	20			☌ ♂ A ♉

MAY.

D.	H.	M.	S.	
2	11	13	58	Em. II. Sat. ♃
3	14	46	4	☌ ☽ 1 α ♋ ☽ 12′ N.
3	16	1	46	☌ ☽ 2 α ♋ ☽ 12′ S.
3	19	25		☽ First Quarter.
3				☿ Greatest Elong.
4				♅ Stationary.
6				♄ ☌ μ ♊
6	21	41	7	☌ ☽ υ ♌ ☽ 67′ S.
7	18			☌ ♂ 2 κ ♉
8	22	13	10	☌ ☽ α ♎
9	13	50	30	Em. II. Sat. ♃
10				☽ Eclipse Invisible.
10	9	11	18	☌ ☽ 2 α ♎ ☽ 31′ S.
10	20	25		○ Full Moon.
10	21			☿ ☌ o ♓
11	4	51	35	☌ ☽ k ♎ ☽ 60′ N.
11	9	10	20	☌ ☽ λ ♎ ☽ 68′ N.
11	13	33	30	Em. I. Sat. ♃
11	13	44	9	☌ ☽ 1 β ♏ ☽ 28′ N.
11	13	45	28	☌ ☽ 2 β ♏ ☽ 28′ N.
11	16	13	56	☌ ☽ ν ♏ ☽ 2′ S.
12	17	58	49	☌ ☽ ρ Oph. ☽ 55′ N.
13	14	25	50	☌ ☽ 2 μ ♐ ☽ 70′ N.
14	9	41	19	Im. } IV. Sat. ♃
14	12	16	3	Em. }
15	16	45	50	☌ ☽ β ♑ ☽ 33′ N.
17	10	59		☾ Last Quarter.
20	9	56	30	Em. I. Sat. ♃
21	9	49		☉ enters ♊
22	2			♀ ☌ o ♓
25	6	40		● New Moon.
26	20	23	56	☌ ☽ ζ ♉ ☽ 61′ S.

D.	H.	M.	S.	
27	11	50	58	Em. II. Sat. ♃
27	20	58	48	☌ ☽ ν ♊ ☽ 57′ S.
30	21	34	6	☌ ☽ 1 α ♋ ☽ 16′ N.
30	22	50	48	☌ ☽ 2 α ♋ ☽ 8′ S.
				JUNE.
1				♃ Stationary.
2	8	53		☽ First Quarter.
3	6			☿ ☌ 2 κ ♉
3	6	15	33	☌ ☽ υ ♌ ☽ 63′ S.
3	11	0	5	Em. II. Sat. ♃
5	8	10	24	☌ ☽ α ♍ ☽ 1′ N.
5	9			♂ ☌ 132 ♉
6	19	48	38	☌ ☽ 2 α ♎ ☽ 29′ S.
7	15	38	13	☌ ☽ k ♎ ☽ 60′ N.
7	19	57	29	☌ ☽ λ ♎ ☽ 69′ N.
8	0	31	18	☌ ☽ 1 β ♏ ☽ 28′ N.
8	0	32	37	☌ ☽ 2 β ♏ ☽ 28′ N.
8	3	0	45	☌ ☽ ν ♏ ☽ 2′ S.
8	16	45		☿ Sup. ☌ ☉
9	3	50		○ Full Moon.
9	4	32	9	☌ ☽ ρ Oph. ☽ 53′ N.

D.	H.	M.	S.	
10	0	35	42	☌ ☽ 2 μ ♐ ☽ 67′ N.
12	1	25	13	☌ ☽ β ♑ ☽ 28′ N.
12	5			☿ ☌ 132 ♉
12	10	8	39	Em. I. Sat. ♃
15	5			☿ ☌ ♂
15	20	27		☾ Last Quarter.
18	1			☿ ☌ ε ♊
21	7			☌ ☽ and ♀
21	17	28	13	☌ ☽ ε ♉ ☽ 37′ N.
21	18	22		☉ enters ♋
23	2	18	58	☌ ☽ ζ ♉ ☽ 60′ S.
23	22	4		● Full Moon.
24	2			♂ ☌ ε ♊
25	10			☿ ☌ κ ♊
25	12			♀ ☌ ε ♉
25	22			♂ ☌ ♄
26	9	35	50	Im. III. Sat. ♃
27	3	14	38	☌ ☽ 1 α ♋ ☽ 25′ N.
27	4	31	20	☌ ☽ 2 α ♋ ☽ 1′ S.
27	12	45		♃ in Quad. with ☉
28	11	52	55	☌ ☽ π ♌ ☽ 62′ S.
30	12	46	35	☌ ☽ υ ♌ ☽ 52′ S.

Times of the Planets passing the Meridian.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	h.	′	h	′	h	′	h	′	h	′	h	′
						APRIL.						
1	0	22	21	14	1	49	11	54	5	19	19	17
7	23	39	21	19	1	44	11	30	4	59	18	55
13	23	7	21	23	1	39	11	5	4	39	18	37
19	22	43	21	27	1	34	10	20	4	19	18	12
25	22	30	21	30	1	29	10	15	3	58	17	46
						MAY.						
1	22	24	21	33	1	24	9	51	3	38	17	27
7	22	24	21	36	1	18	9	26	3	18	17	1
13	22	30	21	39	1	12	9	1	2	57	16	41
19	22	41	21	42	1	6	8	37	2	36	16	17
25	22	58	21	44	1	0	8	12	2	15	15	53
						JUNE.						
1	23	26	21	48	0	52	7	43	1	51	15	23
7	23	56	21	51	0	45	7	17	1	29	14	57
13	0	23	21	54	0	37	6	55	1	8	14	33
19	0	53	21	59	0	30	6	31	0	46	14	7
25	1	18	22	3	0	22	6	7	0	25	13	43

Declination of the Planets.

APRIL

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
	°	′	°	′	°	′	°	′	°	′	°	′
1	10	7 N.	12	34 S.	15	1 N.	2	13 S.	22	47 N.	21	7 S.
7	7	28	10	37	16	23	1	55	22	48	21	6
13	4	27	8	29	17	40	1	38	22	49	21	5
19	2	26	6	11	18	51	1	22	22	50	21	4
25	1	58	3	44	19	55	1	7	22	50	21	3

	° ′	° ′	° ′	° ′	° ′	° ′
				MAY.		
1	2 53 N.	1 11 S.	20 53 N.	0 55 S.	22 51 N.	21 3 S.
7	4 57	1 26 N.	21 45	0 44	22 51	2 4
13	7 53	4 4	22 29	0 36	22 50	2 5
19	11 26	6 41	23 5	0 30	22 50	
25	15 22	9 14	23 35	0 27	22 47	21 6
				JUNE.		
1	19 53 N.	12 6 N.	23 59 N.	0 27 S.	22 48 N.	21 8
7	23 3	14 24	24 12	0 30	22 47	21 11
13	24 51	16 31	24 18	0 35	22 45	21 13
19	25 0	18 23	24 16	0 43	22 43	21 15
25	23 54	20 0	24 7	0 53	22 40	21 17

The preceding numbers will enable any person to find the positions of the planets, to lay them down upon a globe, and to determine their risings and settings.

ART. XLVI.—*Summary of Meteorological Observations made at Kendal in December* 1826, *and January and February* 1827. By Mr SAMUEL MARSHALL. Communicated by the Author in a Letter to the EDITOR.

State of the Barometer, &c. at Kendal in December 1826.

Barometer.	Inches.
Maximum on the 27th and 28th, - -	30.29
Minimum on the 2d, - - -	28.62
Mean height, - - - - -	29.61
Thermometer.	
Maximum on the 11th and 31st, - - -	50°
Minimum on the 27th and 28th, - -	26°
Mean height, - - - - -	40.24°
Quantity of rain, 4.078 inches.	
Number of rainy days, 17.	
Prevalent wind, S. W.	

The barometer has been higher during the greater part of the month than is common at this season. The temperature of the air has been the most extraordinary I ever knew in this month, or perhaps in any other, the air being little different in the nights from the days; in some cases varying not more than 1°, 2°, or 3°.

We have had very little snow, and that with the wind at E. and S. E. The rain has fallen, excepting in two instances, in very small quantities at a time.

State of the Barometer &c. at Kendal in January 1827.

Barometer.	Inches.
Maximum on the 19th, - - -	30.08
Minimum on the 14th, - - - -	28.89
Mean height, - - - - - -	29.61

Thermometer.

Maximum on the 8th and 17th, - -	49°
Minimum on the 4th, - - - -	9°
Mean height, - - - -	34.59°

Quantity of rain, 8.630.
Number of rainy days, 14.
Prevalent winds, S. W.

The temperature of this month, like the last, has varied much less between the nights and days than is commonly the case, the thermometer in several instances being not more than 2° or 3° different in the night from the preceding day. At the beginning of the month the cold was intense, the thermometer varying from 9° to the freezing point, for nearly a week. In three days, the 14th, 29th, and 30th, upwards of four inches of rain fell. On the 14th, 1.140; on the 29th, 1.730; and on the 30th, 1.208. We have had several falls of snow during the month, but mostly in small quantities at a time. The districts east of this place have occasionally had much greater deposits of snow.

On the 9th the Aurora Borealis was very bright, attended with vivid streamers of light. On the 12th there was a well-defined lunar halo.

State of the Barometer, &c. in Kendal for February 1827.

Barometer.	Inches.
Maximum on the 4th, - - -	30.40
Minimum on the 27th, - - -	28.89
Mean Height, - - -	29.51

Thermometer.

Maximum on the 28th, - - -	53°
Minimum on the 20th, - - -	14°
Mean Height, - - - -	33.92

Quantity of Rain, 2.698 inches.
* Number of rainy days, 5.
Prevalent Winds, N.

During this month we have had winds from the N. and E. the barometer keeping steady, and generally high. Though the thermometer has not been so low as in some parts of last month, the cold weather has been of longer duration, and the mean is less than that of January. But one slight shower of rain fell till the 25th; and the deposit measured on that day by the rain-gage was chiefly melted snow. This, together with heavy rain on the 26th, (1.388 inches,) makes the total quantity 2.698 inches for this month. The town is seldom visited with so heavy a fall of snow as that which fell on the 17th, and which was on an average upwards of seven inches deep, the wind having been for the previous six days in the N. and E.

* Under this head are included the days on which snow and rain fell.

ART. XLVII.—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 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.

DECEMBER 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.
F.	1	38	41	39.5	30	40	35	29.02	28.57	.10
S.	2	36	39	37.5	32	41	36.5	28.56	28.84	
S.	3	36	33	34.5	32	41	36.5	28.97	29.03	
M.	4	33	31	32	33	40	36.5	29.28	29.46	
T.	5	30	29	29.5	25	32	28.5	29.47	29.33	
W.	6	31	35	33	24	35	29.5	29.37	29.18	.19
T.	7	47	46	46.5	33	54	43.5	28.99	28.76	.16
F.	8	46	44	45	41	46	43.5	28.83	29.31	
S.	9	46	44	45	38	47	42.5	29.52	29.49	.04
S.	10	49	47	48	43	50	46.5	29.46	29.37	
M.	11	50	49	49.5	47	53	50	29.25	29.57	.08
T.	12	51	48	49.5	45	51	48	29.28	29.08	
W.	13	48	41	44.5	43	48	45.5	29.14	29.16	
T.	14	42	44	43	40	46	43	29.16	29.20	
F.	15	45	43	44	41	48	44.5	29.38	29.52	
S.	16	44	43	43.5	40	46	43	29.61	29.68	.42
S.	17	43	42	42.5	41	43	42	29.73	29.73	.16
M.	18	45	38	41.5	39	45	42	29.90	29.78	
T.	19	40	38	39	31	43	37	29.78	29.70	
W.	20	41	36	38.5	33	42	37.5	29.37	29.27	
T.	21	35	40	37.5	31	39	35	29.60	29.86	
F.	22	48	47	47.5	29	48	38.5	29.75	29.86	
S.	23	48	46	4	45	48	46.5	29.95	29.97	.11
S.	24	48	46		45	50	47.5	30.01	30.17	
M.	25	46	40	4	42	49	45.5	30.14	30 18	
T.	26	36	29	32.5	34	43	38.5	30.31	30.51	
W.	27	40	41	40.5	27	42	34.5	30,31	30.29	
T.	28	44	40	42	38	46	42	30.18	30.16	
F.	29	44	45	44.5	47	35	41	29.94	29.92	
S.	30	48	47	47.5	44	50	47	29.84	29.91	
S.	31	46	48	47	44	48	46	29.80	29.58	
	Sum,	1324	1280	1302	1157	1389	1273	915.88	916.04	1.26
	Mean.	42.71	41.29	42	37.32	44.81	41.06	29.542	29.55	

JANUARY 1827.

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.
M.	1	49	34	41.5	42	50	46	29.06	29.05	.07
T.	2	26	79	22.5	24	29	26.5	29.28	29.29	
W.	3	18	18	18	14	24	19	29.26	29.31	
T.	4	29	24	26.5	15	31	23	29.50	29.86	
F.	5	25	31	28	16	30	23	30.00	29.85	
S.	6	45	41	43	28	52	40	29.71	29.58	
S.	7	45	52	48.5	41	50	45.5	29.71	29.46	
M.	8	50	40	45	44	51	47.5	29.41	29.18	.27
T.	9	40	36	38	33	41	37	29.08	29.43	.06
W.	10	40	34	37	34	41	37.5	29.08	28.76	
T.	11	31	31	31	29	40	34.5	28.66	28.77	
F.	12	29	33	31	25	34	29.5	29.25	29.56	
S.	13	38	50	44	22	43	32.5	29.27	28.81	.63
S.	14	42	33	37.5	40	44	42	28.83	29.58	
M.	15	32	38	35	25	37	31	29.84	29.78	
T.	16	47	34	40.5	35	47	41	29.57	29.35	.20
W.	17	34	35	34.5	33	34	33.5	30·04	29.97	
T.	18	36	37	36.5	32	37	34.5	30.04	30.05	.19
F.	19	37	35	36	35	38	36.5	30.05	30.05	.16
S.	20	34	33	33.5	33	36	34.5	30.03	29.97	
S.	21	33	35	34	32	35	33.5	29.86	29.66	
M.	22	34	30	32	32	35	33.5	29.66	29.63	
T.	23	33	33	33	26	34	30	29.57	29.45	.44
W.	24	34	32	33	29	35	32	29.40	29.49	.65
T.	25	36	34	35	31	37	34	29.54	29.60	.15
F.	26	34	28	31	32	38	35	29.72	29.69	
S.	27	27	34	30.5	20	34	27	30.00	29.50	
S.	28	45	48	46.5	32	49	40.5	29.26	29.28	.09
M.	29	50	47	48.5	45	51	48	29.38	29.38	.03
T.	30	47	46	46.5	42	48	45	29.35	29.28	
W.	31	47	39	43	41	49	45	29.35	29.52	.39
	Sum	1147	1094	1120.5	962	1231	1098	914.60	914.68	3.33
	Mean	37	35.29	36.15	31.03	39.81	35.42	29.505	29.506	

FEBRUARY 1827.

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	37	34	35.5	33	40	36.5	29.75	29.81	.03
F.	2	35	34	34.5	32	36	34	29.89	30.19	
S.	3	33	33	33	25	37	31	30.41	30.41	
S.	4	37	38	37.5	27	40	33.5	30.40	30.25	
M.	5	42	38	40	37	43	40	30.20	30.16	
T.	6	40	37	38.5	37	42	39.5	30.25	30.34	
W.	7	37	35	36	35	39	37	30.38	30.39	
T.	8	35	34	34.5	32	37	34.5	30.41	30.42	
F.	9	32	35	33.5	31	36	33.5	30.43	30.53	
S.	10	39	35	37	33	42	37.5	30.18	30.01	
S.	11	36	36	36	32	39	35.5	29.87	29.81	.10
M.	12	35	34	34.5	33	38	35.5	29.86	29.97	
T.	13	34	35	34.5	28	39	33.5	30.06	29.88	.06
W.	14	36	33	34.5	27	42	34.5	29.87	29.85	
T.	15	31	28	29.5	28	33	30.5	29.88	30.00	
F.	16	30	31	30.5	20	35	27.5	29.99	29.66	
S.	17	32	28	30	26	34	30	29.56	29.83	.15
S.	18	28	25	26.5	20	30	25	30.06	30.03	.11
M.	19	29	27	28	24	30	27	29.93	29.76	
T.	20	32	31	31.5	26	33	29.5	29.66	29.61	
W.	21	36	31	33.5	28	38	33	29.62	29.68	
T.	22	33	31	32	23	37	30	29.80	29.75	
F.	23	35	34	34.5	29	42	35.5	29.70	29.64	
S.	24	37	34	35.5	30	42	36	29.73	29.83	
S.	25	34	36	35	31	37	34	29.59	29.33	15
M.	26	48	47	47.5	33	52	42.5	28.97	28.73	.75
T.	27	38	34	36	36	41	38.5	28.99	29.46	
W.	28	37	45	41	28	45	36.5	29.28	29.65	.25
		988	953	970.5	824	1079	951.5	836.70	836.90	1.58
		35.29	34.04	34.66	29.43	38.54	33.98	29.882	29.889	

INDEX TO VOL. VI.

DESCRIPTION OF PLATES IN VOL. VI.

PLATE I. Fig. 1. Illustrates Mr Whewell's paper on the analysis of Crystalline Forms.
Fig. 2 Is Professor Barlow's apparatus for the experiments on the Magnetism of Rotation.
Figs. 3, 4, 5, Represent the Crystals of Zinkenite.
Figs. 6, 7, 8, Represent Mr Robison's method of fixing Painted Glass.
Fig 9. Is a diagram illustrative of Mr D. Gilbert's paper on Suspension Bridges.
Fig. 10. Represents the Sea Serpent.
Fig. 11, 12, 13, 14, Represent Dr Buchanan's new Air-Pump.

PLATE II. Represents the Phenomena of the Comet which is supposed to revolve on its axis, as observed by Mr Dunlop.

PLATE III. The Map of the recent discoveries of Captain Parry and Captain Franklin.

PLATE IV. Figs. 1, 2, Are Fossil Horns found near Harborough.
Fig. 3. Shows Mr James Nasmyth's Instrument for measuring expansions.
Fig. 4. Illustrates Mr Robison's account of the failure of the Suspension Bridge at Paris.
Figs. 5, 6, 7, Represent Dr Brewster's Improvement on the Nautical Eye-tube.
Fig. 8. Shows Mr Deas Thomson's method of heating a Bath.
Fig. 9. Is a Crystal of Haytorite.
Fig. 10. Is a Crystal of Mohsite.

PLATE V. Illustrates M. Savart's paper on the modes of division of Vibrating Bodies.

PLATE VI. Illustrates M. Haidinger's paper on the regular composition of Crystallized Bodies.