Vol. 56. July 1820. No. 267.

Published the Last Day of every Month,
[PRICE 2s. 6d.]

THE PHILOSOPHICAL MAGAZINE AND JOURNAL:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,

THE LIBERAL AND FINE ARTS,

GEOLOGY,

AGRICULTURE,

MANUFACTURES AND COMMERCE.

NUMBER CCLXVII.
For JULY 1820.

WITH A PLATE BY PORTER
Illustrative of Mrs. Ibbetson's Paper on the Physiology of Botany.

BY ALEXANDER TILLOCH,
M.R.I.A. M.G.S. M.R.A.S. MUNICH, F.S.A. EDIN. AND PERTH, M.S.E.I.N. OF FRANCE, &c. &c. &c.

LONDON:
PRINTED BY RICHARD AND ARTHUR TAYLOR, SHOE-LANE:
And sold by Cadell and Davies; Longman, Hurst, Rees, Orme, & Brown; Highley; Sherwood and Co.; Harding; Underwood; Simpkin and Marshall; London: Constable and Co. Edinburgh: Brash and Reid; Duncan; and Penman, Glasgow: and Gilbert and Hodges, Dublin.

TO CORRESPONDENTS.

Capt. VEITCH's Projection of the Globe on the Cylinder of a Meridian, with the accompanying Memoir, has been received, and shall be noticed in our next.

ENGRAVINGS.

Vol. XLV. A Plate to illustrate the Nourishment produced to the Plant by its Leaves. By Mrs. IBBETSON.—A Plate to illustrate Mr. BAKEWELL's Sketch of the Arrangement of the Rocks and Strata in the Northern Counties of England.—Plates to illustrate Mr. ROBERTSON BUCHANAN's Description of the Steam-Boats on the Clyde; and Mrs. IBBETSON's Paper proving that Embryos the of the Seeds are formed in the Root alone.—A Plate to illustrate Mr. JOHN WALTER's Improvements in Naval Architecture.—A Quarto Plate on the Roots of Plants.—Plate of Mr. SINGER's Electric Columns; Mr. WALKER's Electrometer; ROCHON's Apparatus for ascertaining the Heat of coloured Rays.

Vol. XLVI. Mr. T. JONES's New Reflecting Compass.—Mr. WOOLF's Patent Boiler for Steam Engines and other Purposes.—A Plate to illustrate Mr. WOOLF's Improvement on the Steam-Engine, by which the possibility of Steam escaping past the side of the Piston is effectually prevented.—A Plate to illustrate some Electrical Experiments by M. DE NELIS of Malines; with an Extension of them by Mr. SINGER and Mr. CROSSE.—A Plate to illustrate the Electrical Experiments of M. DE NELIS of Malines.—WOOLF's improved Steam-Engine.—A Plate to illustrate Mr. EVANS's Paper on guiding Balloons through the Atmosphere.—A Plate illustrative of Dr. BREWSTER's Paper on Light.—A Quarto Plate to illustrate Sir H. DAVY's Paper on the Fire-damp of Coal-Mines, and on Methods of lighting the Mines so as to prevent its explosion; and the Account of Mr. STEPHENSON's Safe-Lamp for Coal-Mines.

Vol. XLVII. Illustrated with a Quarto Plate describing the PLANISPHERE of DENDERA.—A Quarto Plate to illustrate Mr. BROWN's Paper on Architecture.—A Plate to illustrate Sir GEORGE CAYLEY's Paper on Aërial Navigation; and Mr. LONDON's Hydrometer.—A Quarto Plate of the Temple of Kournou at Thebes.—A Plate of the new Baths at Ramsgate.

Vol. XLVIII. A Quarto Plate of the Strand or Waterloo Bridge erected over the Thames at the Savoy, London.—A Quarto Plate to illustrate Mrs. IBBETSON's Anatomy of Vegetables.—A Quarto Plate to illustrate Mrs. IBBETSON's Paper on the Physiology of Vegetables.—A large Quarto Plate to illustrate Mrs. IBBETSON's Paper on a new View of Vegetable Life.—A Quarto Plate to illustrate Mrs. IBBETSON's Paper on the Physiology of Vegetables; and Mr. MORNAY's Mass of Native Iron found in Brasil.

Vol. XLIX. A Plate to illustrate Dr. EVANS's Communication on Terrestrial Magnetism; a new Electro-atmospherical Instrument; and Mr. ANDREW HORN's Paper on Vision.—A Quarto Plate to illustrate Mrs. IBBETSON's Physiology of Vegetables.—A Plate to illustrate the Solar Spots which appeared during the Year 1816;—and Mr. BEVAN's Improvement on the Sliding-Rule.—A Plate descriptive of Mr. EMMETT's Instrument for the Measurement of the Moon's Distance from the Sun, &c.; also a New Reflecting Goniometer.—A Plate to illustrate Chevalier

Vol. 56. August 1820. No. 268.

Published the Last Day of every Month,
[PRICE 2s. 6d.]

THE PHILOSOPHICAL MAGAZINE AND JOURNAL:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,
THE LIBERAL AND FINE ARTS,
GEOLOGY,
AGRICULTURE,
MANUFACTURES AND COMMERCE.

NUMBER CCLXVIII.
For AUGUST 1820.

BY ALEXANDER TILLOCH,
M.R.I.A. M.G.S. M.R.A.S. MUNICH, F.S.A. EDIN. AND PERTH,
M.S.E.I.N. OF FRANCE, &c. &c. &c.

LONDON:
PRINTED BY RICHARD AND ARTHUR TAYLOR, SHOE-LANE:
And sold by Cadell and Davies; Longman, Hurst, Rees, Orme, & Brown; Highley; Sherwood and Co.; Harding; Underwood; Simpkin and Marshall; London: Constable and Co. Edinburgh: Brash and Reid; Duncan; and Penman, Glasgow: and Gilbert and Hodges, Dublin.

TO CORRESPONDENTS.

N's Communication has been sent to the Gentleman to whom it refers.

F. Z. is not suited to our Publication.

The proffered Communications of our Correspondent ASTROPHILUS will be gladly received, and as speedily attended to as the nature of the Engravings will permit.

ENGRAVINGS.

Vol. XLV. A Plate to illustrate the Nourishment produced to the Plant by its Leaves. By Mrs. IBBETSON.—A Plate to illustrate Mr. BAKEWELL's Sketch of the Arrangement of the Rocks and Strata in the Northern Counties of England.—Plates to illustrate Mr. ROBERTSON BUCHANAN's Description of the Steam-Boats on the Clyde; and Mrs. IBBETSON's Paper proving that the Embryos of the Seeds are formed in the Root alone.—A Plate to illustrate Mr. JOHN WALTERS's Improvements in Naval Architecture.—A Quarto Plate on the Roots of Plants.—Plate of Mr. SINGER's Electric Columns; Mr. WALKER's Electrometer; ROCHON's Apparatus for ascertaining the Heat of coloured Rays.

Vol. XLVI. Mr. T. JONES's New Reflecting Compass.—Mr. WOOLF's Patent Boiler for Steam Engines and other Purposes.—A Plate to illustrate Mr. WOOLF's Improvement on the Steam-Engine, by which the possibility of Steam escaping past the side of the Piston is effectually prevented.—A Plate to illustrate some Electrical Experiments by M. DE NELIS of Malines; with an Extension of them by Mr. SINGER and Mr. CROSSE. —A Plate to illustrate the Electrical Experiments of M. DE NELIS of Malines.—WOOLF's improved Steam-Engine.—A Plate to illustrate Mr. EVANS's Paper on guiding Balloons through the Atmosphere.—A Plate illustrative of Dr. BREWSTER's Paper on Light.—A Quarto Plate to illustrate Sir H. DAVY's Paper on the Fire-damp of Coal-Mines, and on Methods of lighting the Mines so as to prevent its explosion; and the Account of Mr. STEPHENSON's Safe-Lamp for Coal-Mines.

Vol. XLVII. Illustrated with a Quarto Plate describing the PLANISPHERE of DENDERA.—A Quarto Plate to illustrate Mr. BROWN's Paper on Architecture.—A Plate to illustrate Sir GEORGE CAYLEY's Paper on Aërial Navigation; and Mr. LONDON's Hydrometer.—A Quarto Plate of the Temple of Kournou at Thebes.—A Plate of the new Baths at Ramsgate.

Vol. XLVIII. A Quarto Plate of the Strand or Waterloo Bridge erected over the Thames at the Savoy, London.—A Quarto Plate to illustrate Mrs. IBBETSON's Anatomy of Vegetables.—A Quarto Plate to illustrate Mrs. IBBETSON's Paper on the Physiology of Vegetables.—A large Quarto Plate to illustrate Mrs. IBBETSON's Paper on a new View of Vegetable Life. —A Quarto Plate to illustrate Mrs. IBBETSON's Paper on the Physiology of Vegetables; and Mr. MORNAY's Mass of Native Iron found in Brasil.

Vol. XLIX. A Plate to illustrate Dr. EVANS's Communication on Terrestrial Magnetism; a new Electro-atmospherical Instrument; and Mr. ANDREW HORN's Paper on Vision.—A Quarto Plate to illustrate Mrs. IBBETSON's Physiology of Vegetables.—A Plate to illustrate the Solar Spots which appeared during the Year 1816;—and Mr. BEVAN's Improvement on the Sliding-Rule.—A Plate descriptive of Mr. EMMETT's Instrument for the Measurement of the Moon's Distance from the Sun, &c.; also a New Reflecting Goniometer.—A Plate to illustrate Chevalier

Vol. 56. September 1820. No. 269.

Published the Last Day of every Month,
[PRICE 2s. 6d.]

THE

PHILOSOPHICAL MAGAZINE AND JOURNAL:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,

THE LIBERAL AND FINE ARTS,

GEOLOGY,

AGRICULTURE,

MANUFACTURES AND COMMERCE.

NUMBER CCLXIX.

For *SEPTEMBER* 1820.

WITH A PLATE BY PORTER
Illustrative of Mr. Hall's Percussion Gun-Lock; and of Mr. Park's Mooring Blocks.

BY ALEXANDER TILLOCH,
M.R.I.A. M.G.S. M.R.A.S. MUNICH, F.S.A. EDIN. AND PERTH,
M.S.E.I.N. OF FRANCE, &c. &c. &c.

LONDON:
PRINTED BY RICHARD AND ARTHUR TAYLOR, SHOE-LANE:
And sold by Cadell and Davies; Longman, Hurst, Rees, Orme, & Brown; Highley; Sherwood and Co.; Harding; Underwood; Simpkin and Marshall; London: Constable and Co. Edinburgh: Brash and Reid; Duncan; and Penman, Glasgow: and Gilbert and Hodges, Dublin.

TO CORRESPONDENTS.

The Editor will with great pleasure receive and publish the Tables of the planet Venus, offered by ΑΣΤΡΟΦΙΛΟΣ. The negative Equations had better be altered in form, as he has suggested.

Mr. YEATES in Continuation on the Lunar Period is unavoidably deferred till next Month; as is also a valuable Correspondence on Mr. BONNYCASTLE's Dissertation on the Influence of Masses of Iron on the Mariner's Compass.

Vol. 56. October 1820. No. 270.

Published the Last Day of every Month,
[PRICE 2s. 6d.]

THE PHILOSOPHICAL MAGAZINE AND JOURNAL:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,

THE LIBERAL AND FINE ARTS,

GEOLOGY,

AGRICULTURE,

MANUFACTURES AND COMMERCE.

NUMBER CCLXX.

For *OCTOBER* 1820.

BY ALEXANDER TILLOCH,
M.R.I.A. M.G.S. M.R.A.S. MUNICH, F.S.A. EDIN. AND PERTH,
M.S.E.I.N. OF FRANCE, &c. &c. &c.

LONDON:
PRINTED BY RICHARD AND ARTHUR TAYLOR, SHOE-LANE:
And sold by Cadell and Davies; Longman, Hurst, Rees, Orme, & Brown; Highley; Sherwood and Co.; Harding; Underwood; Simpkin and Marshall; London: Constable and Co. Edinburgh: Brash and Reid; Duncan; and Penman, Glasgow: and Gilbert and Hodges, Dublin.

TO CORRESPONDENTS.

Mr. Farey on Tuning Musical Instruments in our next.

Mr. Holdred's Communication came too late for this Number. It shall have a place.

Mr. Pasley on the Dry Rot in Timber, also in our next.

ENGRAVINGS.

Vol. XLV. A Plate to illustrate the Nourishment produced to the Plant by its Leaves. By Mrs. Ibbetson.—A Plate to illustrate Mr. Bakewell's Sketch of the Arrangement of the Rocks and Strata in the Northern Counties of England.—Plates to illustrate Mr. Robertson Buchanan's Description of the Steam-Boats on the Clyde; and Mrs. Ibbetson's Paper proving that the Embryos of the Seeds are formed in the Root alone.—A Plate to illustrate Mr. John Walters's Improvements in Naval Architecture.—A Quarto Plate on the Roots of Plants.—Plate of Mr. Singer's Electric Columns; Mr. Walker's Electrometer; Rochon's Apparatus for ascertaining the Heat of coloured Rays.

Vol. XLVI. Mr. T. Jones's New Reflecting Compass.—Mr. Woolf's Patent Boiler for Steam Engines and other Purposes.—A Plate to illustrate Mr. Woolf's Improvement on the Steam-Engine, by which the possibility of Steam escaping past the side of the Piston is effectually prevented.—A Plate to illustrate some Electrical Experiments by M. De Nelis of Malines; with an Extension of them by Mr. Singer and Mr. Crosse —A Plate to illustrate the Electrical Experiments of M. De Nelis of Malines.—Woolf's improved Steam-Engine.—A Plate to illustrate Mr Evans's Paper on guiding Balloons through the Atmosphere.—A Plate illustrative of Dr. Brewster's Paper on Light.—A Quarto Plate to illustrate Sir H. Davy's Paper on the Fire-damp of Coal-Mines, and on Methods of lighting the Mines so as to prevent its explosion; and the Account of Mr. Stephenson's Safe-Lamp for Coal-Mines.

Vol. XLVII. Illustrated with a Quarto Plate describing the Planisphere of Dendera.—A Quarto Plate to illustrate Mr. Brown's Pape on Architecture.—A Plate to illustrate Sir George Cayley's Paper on Aërial Navigation; and Mr. London's Hydrometer.—A Quarto Plat of the Temple of Kournou at Thebes.—A Plate of the new Baths a Ramsgate.

Vol. XLVIII. A Quarto Plate of the Strand or Waterloo Bridge erecte over the Thames at the Savoy, London.—A Quarto Plate to illustrat Mrs. Ibbetson's Anatomy of Vegetables.—A Quarto Plate to illustrat Mrs. Ibbetson's Paper on the Physiology of Vegetables.—A large Quart Plate to illustrate Mrs. Ibbetson's Paper on a new View of Vegetable Lif —A Quarto Plate to illustrate Mrs. Ibbetson's Paper on the Physiolog of Vegetables; and Mr. Mornay's Mass of Native Iron found in Brasil.

Vol. XLIX. A Plate to illustrate Dr. Evans's Communication o Terrestrial Magnetism; a new Electro-atmospherical Instrument; an Mr. Andrew Horn's Paper on Vision.—A Quarto Plate to illustra Mrs. Ibbetson's Physiology of Vegetables.—A Plate to illustrate th Solar Spots which appeared during the Year 1816;—and Mr. Bevan Improvement on the Sliding-Rule.—A Plate descriptive of Mr. Emmett Instrument for the Measurement of the Moon's Distance from the Su &c.; also a New Reflecting Goniometer.—A Plate to illustrate Chevali Baader's Method of communicating Rotatory Motion; Lieut. Shul ham's improved Method of working a Capstan; and Steele's new M [illegible] Apparatus, &c.

Vol. 56. November 1820. No. 271.

Published the Last Day of every Month,
[PRICE 2s. 6d.]

THE PHILOSOPHICAL MAGAZINE AND JOURNAL:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,
THE LIBERAL AND FINE ARTS,
GEOLOGY,
AGRICULTURE,
MANUFACTURES AND COMMERCE.

NUMBER CCLXXI.
For NOVEMBER 1820.

WITH A PLATE BY PORTER
Exhibiting Sections, &c. of Mr. Malam's improved Gas-Meter.

BY ALEXANDER TILLOCH,
M.R.I.A. M.G.S. M.R.A.S. MUNICH, F.S.A. EDIN. AND PERTH,
M.S.E.I.N. OF FRANCE, &c. &c. &c.

LONDON:
PRINTED BY RICHARD AND ARTHUR TAYLOR, SHOE-LANE:
And sold by Cadell and Davies; Longman, Hurst, Rees, Orme, & Brown; Highley; Sherwood and Co.; Harding; Underwood; Simpkin and Marshall; London: Constable and Co. Edinburgh: Brash and Reid; Duncan; and Penman, Glasgow: and Gilbert and Hodges, Dublin.

TO CORRESPONDENTS.

Mr. WOOLLGAR's promised Communications will be gladly received and duly attended to.

A. B. on Aquatic Plants, in our next.

Mr. INNES's Article reached the Editor too late for this Number.

The Communication from the Rev. Mr. L. EVANS was also too late, but shall appear in our next.

As Mr. UTTING's Name appeared at his last Answer to PHILO-VERITATIS, the anonymous Reply will not be admitted.

Mr. FAREY on the Gases and Musical Sounds, in our next.

The Remarks on large Organic Remains also in our next.

VOL. 56. DECEMBER 1820. No. 272.

Published the Last Day of every Month,
[PRICE 2s. 6d.]

THE

PHILOSOPHICAL MAGAZINE AND JOURNAL:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,
THE LIBERAL AND FINE ARTS,
GEOLOGY,
AGRICULTURE,
MANUFACTURES AND COMMERCE.

NUMBER CCLXXII.
For DECEMBER 1820.

WITH A MAP BY PORTER
Exhibiting the Discoveries made by Capt. PARRY in the Polar Sea.

BY ALEXANDER TILLOCH,
M.R.I.A. M.G.S. M.R.A.S. MUNICH, F.S.A. EDIN. AND PERTH,
M.S.E.I.N. OF FRANCE, &c. &c. &c.

LONDON:
PRINTED BY RICHARD AND ARTHUR TAYLOR, SHOE-LANE:
And sold by CADELL and DAVIES; LONGMAN, HURST, REES, ORME, & BROWN; HIGHLEY; SHERWOOD and Co.; HARDING; UNDERWOOD; SIMPKIN and MARSHALL; London: CONSTABLE and Co. Edinburgh: BRASH and REID; DUNCAN; and PENMAN, Glasgow: and GILBERT and HODGES, Dublin.

ENGRAVINGS.

Vol. XLV. A Plate to illustrate the Nourishment produced to the Plant by its Leaves. By Mrs. IBBETSON.—A Plate to illustrate Mr. BAKEWELL's Sketch of the Arrangement of the Rocks and Strata in the Northern Counties of England.—Plates to illustrate Mr. ROBERTSON BUCHANAN's Description of the Steam-Boats on the Clyde; and Mrs. IBBETSON's Paper proving that the Embryos of the Seeds are formed in the Root alone.—A Plate to illustrate Mr. JOHN WALTERS's Improvements in Naval Architecture.—A Quarto Plate on the Roots of Plants.—Plate of Mr. SINGER's Electric Columns; Mr. WALKER's Electrometer; ROCHON's Apparatus for ascertaining the Heat of coloured Rays.

Vol. XLVI. Mr. T. JONES's New Reflecting Compass.—Mr. WOOLF's Patent Boiler for Steam Engines and other Purposes.—A Plate to illustrate Mr. WOOLF's Improvement on the Steam-Engine, by which the possibility of Steam escaping past the side of the Piston is effectually prevented.—A Plate to illustrate some Electrical Experiments by M. DE NELIS of Malines; with an Extension of them by Mr. SINGER and Mr. CROSSE. —A Plate to illustrate the Electrical Experiments of M. DE NELIS of Malines.—WOOLF's improved Steam-Engine.—A Plate to illustrate Mr. EVANS's Paper on guiding Balloons through the Atmosphere.—A Plate illustrative of Dr. BREWSTER's Paper on Light.—A Quarto Plate to illustrate Sir H. DAVY's Paper on the Fire-damp of Coal-Mines, and on Methods of lighting the Mines so as to prevent its explosion; and the Account of Mr. STEPHENSON's Safe-Lamp for Coal-Mines.

Vol. XLVII. Illustrated with a Quarto Plate describing the PLANISPHERE of DENDERA.—A Quarto Plate to illustrate Mr. BROWN's Paper on Architecture.—A Plate to illustrate Sir GEORGE CAYLEY's Paper on Aërial Navigation; and Mr. LONDON's Hydrometer.—A Quarto Plate of the Temple of Kournou at Thebes.—A Plate of the new Baths at Ramsgate.

Vol. XLVIII. A Quarto Plate of the Strand or Waterloo Bridge erected over the Thames at the Savoy, London.—A Quarto Plate to illustrate Mrs. IBBETSON's Anatomy of Vegetables.—A Quarto Plate to illustrate Mrs. IBBETSON's Paper on the Physiology of Vegetables.—A large Quarto Plate to illustrate Mrs. IBBETSON's Paper on a new View of Vegetable Life. —A Quarto Plate to illustrate Mrs. IBBETSON's Paper on the Physiology of Vegetables; and Mr. MORNAY's Mass of Native Iron found in Brasil.

Vol. XLIX. A Plate to illustrate Dr. EVANS's Communication on Terrestrial Magnetism; a new Electro-atmospherical Instrument; and Mr. ANDREW HORN's Paper on Vision.—A Quarto Plate to illustrate Mrs. IBBETSON's Physiology of Vegetables.—A Plate to illustrate the Solar Spots which appeared during the Year 1816;—and Mr. BEVAN's Improvement on the Sliding-Rule.—A Plate descriptive of Mr. EMMETT's Instrument for the Measurement of the Moon's Distance from the Sun, &c.; also a New Reflecting Goniometer.—A Plate to illustrate Chevalier BAADER's Method of communicating Rotatory Motion; Lieut. SHULDHAM's improved Method of working a Capstan; and STEELE's new Modification of NOOTH's Apparatus, &c.

Vol. L. A Plate to illustrate Sir HUMPHRY DAVY's new Researches on Flame, and Sir GEORGE CAYLEY's Paper on Aërial Navigation.—A Plate representing a Section of the Pneumatic Cistern, with the compound Blow-pipe of Mr. HARE; and a Sketch of a Steam-Vessel intended to run between London and Exeter.—Representation of Apparatus for Sublimation of Iodine—Model of a Safety Furnace by Mr. BAKEWELL;

THE PHILOSOPHICAL MAGAZINE AND JOURNAL:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,

THE LIBERAL AND FINE ARTS,

GEOLOGY,

AGRICULTURE,

MANUFACTURES, AND COMMERCE.

BY ALEXANDER TILLOCH,
M.R.I.A. M.G.S. F.S.A. Edin. and Perth, M.R.A.S. Munich, M.S.E.I.N. of France, &c. &c. &c.

"Nec aranearum sane textus ideo melior quia ex se fila gignunt, nec noster vilior quia ex alienis libamus ut apes." Just. Lips. *Monit. Polit.* lib. i. cap. 1.

VOL. LVI.

For JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, and DECEMBER, 1820.

LONDON:

PRINTED BY RICHARD AND ARTHUR TAYLOR, SHOE LANE:
And sold by Cadell and Davies; Longman, Hurst, Rees, Orme, and Brown; Highley; Sherwood and Co.; Harding; Underwood; Simpkin and Marshall, London: Constable and Co. Edinburgh: Brash and Reid; Duncan and Penman, Glasgow: and Gilbert and Hodges, Dublin.

CONTENTS

OF THE FIFTY-SIXTH VOLUME.

CONTENTS.

THE

THE

PHILOSOPHICAL MAGAZINE AND JOURNAL.

I. *On the Physiology of Botany.* *By Mrs.* Ibbetson.

To Mr. Tilloch.

Sir, — As I am precluded from presenting to the public that work now ready for the press, by an opposition that in my present state of weakness I am wholly unable to stem; yet I cannot but make one effort more to introduce to my countrymen that beautiful series of facts in botanical physiology, which appear to me unanswerable, and could only have been procured by means of *progressive dissection,* following each ingredient of flower-bud, seed, pollen, &c. &c. from the place in which they were made, and from the moment of their formation in the interior *one year,* till they are completed, and then decayed at the *exterior* the *next year.*

In my application to booksellers I was assured, that after consulting the first botanists, it was decided that no new facts were wanted. I confess I was so simple as to think, after a long progressive study, that no part of the physiology of a plant was known; that we neither knew where the flower-bud was formed, the embryo of the seed protruded, and particularly what caused the very visible motion so apparent in a plant; nor did we understand how the root differed from the stem, or the stem from the new shoot. Yet all these points are the chief foundation of vegetable œconomy, the laws by which they are governed, and follow each other with such perfect *precision,* that the first may be said almost mathematically to prove the rest.

It is the opinion of botanists in general, and of Sir Ed. Smith and Mr. Knight in particular, that the flower-bud (Plate I. fig. 1, *dd*) is formed in the alburnum. It is then made at the exterior of the wood: and it is rather impossible to conceive how the wood when cut into floors or planes, should be marked all the way not only with knots but with *young buds* just starting from the line of life next the pith.

View Plate I, fig. 2: these are the flower-buds of beginning branches, forcing their way through the wood, and thus displayed by the bark being taken off. How could these excrescences be formed outwardly, when botanists make the whole force to act in a contrary direction? for if they are supposed to run back into the wood (rather a strange method of proceeding forward), would they have made an excrescence at the exterior? Besides, at *b b* there are many young buds that have not *yet* reached the bark; they cannot have formed in the alburnum, for they have not yet touched it: and if one half of these cup-like forms be cut away at *a a*, fig. 2, the aperture for the bud will be seen to pierce the whole way to the line of life next the pith.

But *tear* down a young tree perpendicularly in the middle, what figure does it present? fig. 3, a small line which is the pith, the *canal medullaire* or line of life being on each side; *a a*, from which line flow many flower-buds well defined, some half way, some the whole way through the wood, and some have formed the bark scales, and entered the buds within them. If well examined it will be found that the bud (soft as it is) never begins to pass through the wood horizontally till it sends a juice which precedes it, and which evidently appears to make way for it. This liquid I call the *gastric juice;* as it often makes holes through the knots of the wood, and at other times prepares the passage, and arranges the wood both above and below, so as to make a covered way for the exit of the buds. If, as botanists assert, the bud is formed at the outside of the wood, how can they be discovered, thus forcing their way from the centre? and, if the power comes from the alburnum, would it not have formed at the exterior, *a cavity*, rather than a *projection?*

The next specimen I shall offer is cut across the stem horizontally. The dissector cannot be wrong; buds both old and young will present themselves, (see fig. 4.) running from the centre to the circumference, *a* to *b*; and the difference always observed in a tree between the leaf-bud and flower-bud, is that the first proceeds from the bark, the last from the line of life. This is so evident, that even after the branch has attained some size the mark of the flower-bud still remains (see fig. 3, *a a*), while the leaf-bud, *b b*, never passes within the wood. I have now led the flower-bud to the centre of the tree, proving by every different specimen (of the exterior and the interior cut *horizontally* and *perpendicularly*) that it *must cross* the wood. Is it formed there? Certainly not; for though many buds are seen to pass across the wood, yet a far greater number are observed to run up it from the root. Those therefore must come from some place where they are formed; and there must be *some power* which enables them, when arrived opposite where these bark

bark scales *form,* to *diverge* into an horizontal line, instead of a perpendicular one; what that power is, or how *managed,* I cannot pretend to *show*; I can only observe, that the size gives evidence of the fact. But it required a long progressive examination to discover the exact time the flower-bud moved from the root upwards: this secret I watched with the most careful attention, and found that there was one particular season in which the flower-buds moved up in the interior of the tree, and entered within the *scales* of the bark prepared for them. Though a few buds were to be seen at other times, yet this was the constant preparation for the flowering of the tree in spring. This is in *most trees* from September to October; this process never lasts but one fortnight in each tree; they then pass into the scales, where both bud and flower increase in such a manner, that before November diminutive bouquets will be discovered in the bud if *cut open,* and numbers hastening up the stem to increase the quantity; and thus they proceed, both buds and flowers increasing in size, till they all burst forth in that beautiful display of flowers in spring. But there are a few other curious processes before this can take place in a tree, and before the flower-bud can close on all its ingredients. I mean only in this letter positively to prove that the flower-bud is formed in the root. To increase the evidence, I shall show a specimen of the common furze or *Ulex Europæus.* I have chosen this plant because its buds turn black and decay when the stem is torn open. This furze was cut in the proper month, the beginning of September, when the buds were passing up, and their habit of blackening marks them plainer. It will be seen that wherever the buds are, the silver (*d d,* fig. 4) *bastard lines* always diverge (see fig. 5), and that as the bud mounts perpendicularly, *no gastric juice* is seen to precede, as in the horizontal specimen. This *would show* as if the present buds had not *half such difficulties* to encounter as those which *cross the wood:* nor can I think they have; for moving up the wood they have no lines to pass, except the silver grain or yearly circle in width, which however they always turn out of their place, forming an angle out of each circular line. I have also cut at the proper season most beautiful specimens of the walnut, oak, and lime, with the flower-buds mounting; it is therefore the season to cut the tree, if seeking *fancy wood.* Thus then if the bud forms in the root, the method I have shown will display it, and the root is surely the most natural laboratory of the tree. When the buds have run from the root upwards in their perpendicular line, and are arrived at the place opposite at which their several scales in the bark are to be formed, two small balls appear on each side of the projecting bud,

bud (see *d d d*, fig. 3), which seem to arrest its progress and prevent its running higher. It then sets off to cross the wood; when it does so, at first the silver grain bends a little inwards, but before it has proceeded half way the direction is again altered, and it begins to form its scales in the bark: but if by any accident the line which now attaches the bud to the line of life be broken, it becomes a useless matter or miss-bud, and is pushed about the wood till a number of buds coming out facilitates its entrance into the bark; where, after making a lodgement for a short time, it drops out.

I have now conveyed the bud to the scales, and brought it from the centre of the tree. It is within the scales in the alburnum it is supposed by botanists to form in trees (fig. 1, *d d*); but where it certainly only develops. In about a fortnight after the buds have entered their covering of bark, if the whole is cut with a very sharp knife longitudinally, the most beautiful sight will be discovered within the scales, which is the uncovering the interior flowers, which are all arranged in the most exquisite manner, other buds running up the stalk to bring fresh flowers under the scale, for it is not one bud alone that fills up the *contents* of the bark-covering. It will often contain large collections of flowers (see fig. 6 and 7): it would require a whole letter to show the beauty and various peculiarities of the flower-bud. But the flowers are all developed there as early as November in trees; and appear in various ways arranged in bouquets, in species of baskets, in figures resembling *cornucopiæ*, &c.; in short, the flowers are always covered with a sort of *transparent matter*, which seems to be thrown into various accidental folds, but in reality serves only to protect the flowers while moving in or just below the bud, which they do incessantly.

But before I close the subject of trees, I must observe that if the same sort of tree is cut down in December, all the flower-buds will be passed under the scales, for there will be scarce one left in the wood of the tree, though it was so crowded with them in September. I have been lucky enough to procure many specimens of foreign wood cut down at both seasons; a piece of mahogany quite covered with buds. No carpenter knew the wood in that state. A piece of satin-wood most beautifully spotted, and one quite plain; the Riabuca wood, which, as it is an excrescence, is as usual loaded with buds; and a fine purple wood from South America, with and without buds; the buds decaying, and therefore spotting it with black; and the Salamanda wood, also in the same situation covered with buds, with a piece that has but one bud in the whole specimen.

I mentioned that the gastric juice was always to be seen passing

ing before the buds, when crossing the wood horizontally. Many examples are given by most botanists of the buds piercing through stone-walls, and the mortar at the corner of the bricks. Is it not astonishing no one should have inquired the cause of this phænomenon? How could so delicate a substance have continued its way thus, being as it is the softest part of the tree? But it is preceded by a juice which clears the way before it. Did nature give this merely to make a few buds run astray? No, certainly, it had a more important office,—to pass the flower-bud of the tree through the whole thickness of the wood, for I have seen the bud run through a foot and a half on each side of the pith, lifting some of the lines, and sinking others, till a covered way is made the whole width of the wood, through which the juices pass. This reminds us of the basket makers, who wet their twigs to bend them to the form they wish, and scarcely a knot will be found without some diminutive holes made for the passing of the buds.

As to herbaceous plants which have single flower-stalks or peduncles, the bud is not only to be seen mounting the root most evidently, but when the bud appears above the root, they directly take in their pollen, and then the flower-stalk rises (while increasing the stem) under the bud till the hour of opening and being fructified arrives, as in the *Primula Cyclamen*, &c. Those herbaceous plants that have both leaves and flowers on the same stem, such as the *Saxifraga crassifolia*, the *Garstiana*, *Scrophulana*; all when first shooting in the spring have such large buds even under the earth, that if they will cut them open, no person need ask, whether the herbaceous plants flower in the root (see fig. 8, *d d d*), as each of these buds is a flower-bud with a quantity of flowers in each scale (fig. 8, *d d d*), with the pollen and pistil complete in each.

Some botanists have accidentally cut a bulb, and found a flower within: this has been the wonder ever since. Is it not extraordinary that no one should have followed this lead, and inquired whether other plants were not formed in the same manner? All bulbs take in their pollen in the root, which they could not do if both pollen and pistil were not formed there; and they are fructified the moment they leave it. Some botanists have said that the bulb is not a root. I wonder then what is the true definition of one; for I am sure the strings *are radicals*, and they always grow under or at the bottom of the root. Besides, the lower part of the bulb is that on which all the ingredients of the plant are made, another reason why it is undoubtedly the laboratory of the plant.

Then the water plants, the *Nymphæa*, the *Plantago*, &c. &c. so evidently form their bud in the root, that when they leave it, there

there is a peculiar *leaf* quite different from the one that swims, which is made on purpose to cover it, and inclose it from the air; it generally contains two or three buds, and conveys them safe to the surface of the water; and when they have passed just above it, the leaf drops.

There is also another beautiful fact which still lends its aid to the passing up of the flower on those plants that have leaves and flowers on the same stem: their roots are perfectly circular (see fig. 8); but as soon as the flower is to pass on, and be carried up to where it will issue from the bosom of the leaf, the stem becomes either *square*, pentagonal, hexagonal, or gains some form that will enable it in the *interstices* of these projections, to pass the flowers up, and convey them where they will issue from the axilla of the leaf, without pressure or difficulty; particularly in the *Pentandria digynia* plants. In the *Oenanthe*, in the *Heraclium spondylium* (fig. 9), the *Atriplex* (fig. 10), I have often seen when the stem has been cut with a sharp knife, and the plant then laid on the table a few hours, the flowers have appeared near the tenth of an inch above the edge of the stem, having lengthened within that time: and often, if closely watched, and the stem is very *clear* in the bark, the leaves may be seen at the interior.

In herbaceous plants when above the root, they have rarely buds: but a curious fact is observed when the flowers have attained their proper situation, and risen to the axilla of the leaves, the figure of the stem sometimes wholly *alters*, and part of the stem will show, by the outward skin falling in, that a large aperture was allowed for the passing up of the buds;—for the grooves will afterwards exhibit a very different appearance (see fig. 11, which was fig. 9). The *Datura* also totally alters its shape, losing almost one-third of the stem. In the *Sambucus*, which is hexagonal, one deep division is principally bent in, and sinks after the flowers have passed. I think therefore I need not press the evidence further. What I have already advanced would, I should conceive, convince any one. This will prove two of the laws I wish to establish. 1st. That the root is the laboratory of a plant; 2d. That the flower-bud is formed in the root.

In my next I shall show the third law: "That the heart or embryo of the seed is formed in the radical or lowest part of the root, but does not join the seed till it enters the seed-vessel for the purpose." That the heart of the seed should be formed in the *root*, cannot be such a wonder; when the flower-bud is protruded there, and when the embryo containing that shoot which forms the first *growth* of the next year is there taken in, where they are alone to be found: from hence they pass up the alburnum, and into the seed-vessel.

I am

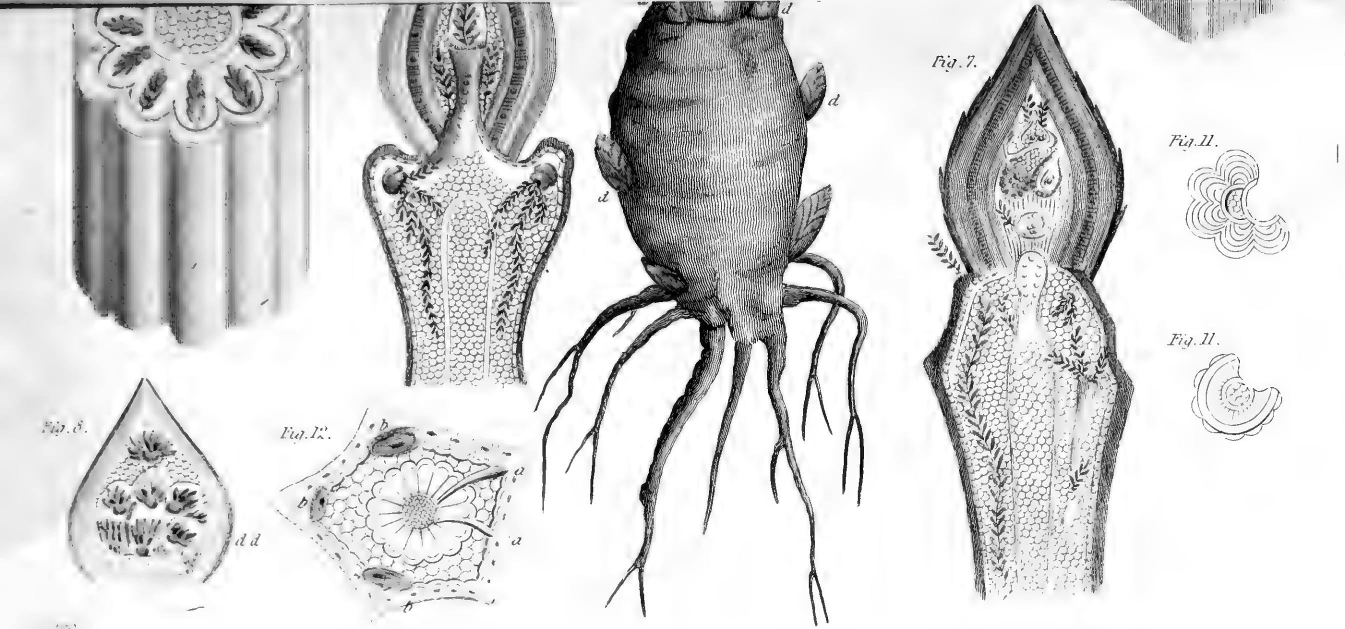


Fig. 7.
Fig. 11.
Fig. 11.
Fig. 8.
Fig. 12.
d
d
d
d d
a
a
b
b
b

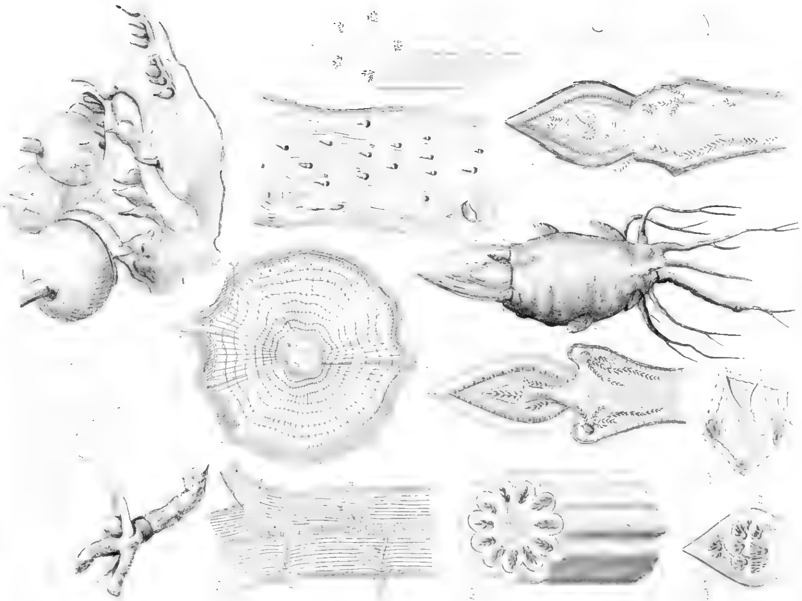
wims,
m the
them
ed just

aid to
es and
ar (see
arried
stem
some
ns, to
from
ularly
n the
have
, and
ve ap-
stein,
tched,
seen

rarely
e at-
eaves,
of the
aper-
ooves
g. 11,
hape,
ich is
sinks
press
uld, I
f the
y of a

art or
rt of
vessel
rmed
ud is
shoot
en in,
p the

I am



I am assured that it is supposed I am trying to alter the present system, which my sort of botany *touches not*, or the *Linnean*, on which the whole of my discoveries are really founded. But there are two very different sorts of botany: one is the *terminology* of plants with the sexual system and names; mine the physiology of plants, and their resemblance to animal life: no two sciences can differ more, though they are both absolutely necessary to each other.

Your obliged servant,
AGNES IBBETSON.

Description of the Plate.

Fig. 1. The flower-buds, having received their nucleus.
Fig. 2. The exterior of the buds and branches without the bark.
Fig. 3. The stem cut longitudinally, the flower-buds proceeding from the line of life at *d d d*.
Fig. 4. The stem cut horizontally, showing the flower-buds shooting from the line of life from *a* to *b*.
Fig. 5. The *Ulex Europæus*, with its blackish buds running up the stem perpendicularly; the lines diverging.
Figs. 6 and 7. Buds cut open, showing the flowers having taken refuge under their scales, and others running up the stem to increase the number.
Fig. 8. The root of an herbaceous plant, showing the flower bud, fig. 8*, cut open, even below the middle root.
Fig. 9. The highly-grooved *Heraclium*, with the flowers passing up the wood.
Fig. 10. The *Atriplex*, with the flowers passing up the grooves in the wood: the leaves are always found rolled in the bark.
Fig. 11. The alteration of the stem after the leaves have passed up.
Fig. 12. (I have forgotten to mention the different manner in which the flower-bud and leaf-bud are always discovered in the lower part of the herbaceous plant.) Flower-bud *a a*; leaf-bud *b b*.

* In the old practice of making fruit trees bear, by taking off a circle of the bark down to the wood itself, the communication is completely cut off between the lower and upper parts of the tree by means of the bark, as the wood is left bare all around; yet, the upper part of the tree puts forth bloom buds in great abundance. If the buds had their origin in the bark, the buds must be cut off, or greatly decreased; but the reverse is the case. And if the flower-branch proceeded from the alburnum, how could it be supported without the aid of the wood? it would even in its early state break off.

II. *Reflections on the Noachian Deluge, and on the Attempts lately made at Oxford, for connecting the same with present Geological Appearances.* *By* A CORRESPONDENT.

To Mr. Tilloch.

SIR, — I AM one of those, who, without surrendering my Reason to the Priests of any of the almost innumerable Sects, whose selfish interests, so frequently oppose them bitterly to each other, delight, not only generally "to look through Nature up to nature's God," but in a particular manner to do so, through the grand and highly impressive phænomena, which Geological research has brought to light, and in considerable degrees explained, since about the year 1792, when our ingenious and deserving, although hitherto much neglected countryman, Mr. *Wm. Smith* of Mitford, began his *practical* investigations of the Strata of our Island, and of the astonishing number and variety of the Organic Remains, with which its Strata are enriched, and as to the Alluvia which covers those Strata: and which Remains were, by his sagacity and perseverance, *for the first time*, so far as my Reading extends, made *useful*, as without doubt their beneficent Author intended them, in promoting and extending the knowledge of Man, into much of those subficial parts of the Earth, with which, before the Era alluded to, he was little acquainted, to any correct or useful purpose, and for extending his views of *the early history*, of the more superficial parts of the mass, of the Globe which he inhabits.

I have been induced to make the above remarks, from having just perused Professor Buckland's "Inaugural Lecture," delivered in May 1819, at Oxford, and observed, that he therein labours to prolong those errors and delusions, respecting *the evidences*, which *Geological phænomena* were so confidently said to present or afford, of the occurrence and circumstances attending *the Mosaic Deluge*.

I remember having seen Mr. Bakewell commended in your Work, for having in the year 1813 abstained, from introducing the Deluge of Moses into his "Introduction to Geology," as the previous Writers had almost invariably done, to the manifest injury of Geology on the one hand, and of Religion on the other: since which, the practice has almost entirely grown into disuse, while the number of writers on Geological subjects, have been greatly on the increase; and I regret therefore to see, the new Geological Professor at Oxford, attempting now to revive the exploded notion, that any of the phænomena at this time *visible*, on or within the Earth, are, with any proper regard to probability, referable to the Deluge of which Moses writes.

It

It is undoubted that the surface of the Earth, almost universally presents the evidences, of a most violent and over-whelming Torrent, or rather, perhaps, a succession of such, the Waters of which (assisted perhaps by some Tidal reversion of the action of Gravity, as has been maintained by Mr. Farey in your work) were able to move vast masses of earthy Matters, mixed with gravel Stones and even with large Bolders and very heavy Blocks of Stone, and to lodge them on tops of Hills,and on the surfaces of Plains of considerable elevation; such Hills and Plains, and the Valleys which intersect them, having most evidently existed in their present form and shape, at the time of these early or *gravel Floods*, which most evidently did not excavate the Valleys, or in any material degree abrade or alter the contour of the Hills.

Now the mistake of Professor Buckland, and of all those who have preceded him, in referring *these tumultuous events*, to the Deluge happening in the days of Noah, consists, in not having carefully considered *the words used by Moses in describing the Noachian Deluge*, which if they had done, instead of taking on trust, the absurd interpretations of those words, or rather the fabrications which were framed by Dr. Woodward and many other writers of the two last Centuries, the Professor must, by this *examination of Moses' words*, have found, that the same, throughout, refer to *a quiet effusion of Water upon the surface of the Earth*, for the avowed purpose and for no other, but that of *drowning the degenerate race of Mankind*, whose crimes and violences had filled the Earth; and that in point of fact, *according to Moses, the surface* of the Earth, was not torn up or moved, so as in any material degree to disturb and root up *the Vegetable races!*; nor did it annihilate any of *the race of Fishes*, not even the most torpid and helpless of the species of Shell-Fish! The vegetable earth or Mould, fit for the growth of useful plants (the evidently *slow result* of long periods of decomposition, and the accumulation of decayed vegetable matters) was not, *according to Moses*, either washed away, or covered, by naked and *fresh-moved Rubbish*, because Noah on quitting the Ark, or very soon after, *planted a vineyard!*.

Whereas, the Gravel Floods which the Professor has laboured to identify with this Noachian Deluge, must, undoubtedly, have left the entire surface of the earth, as *utterly unfit for the immediate reception and support of Men*, and of granivorous Animals, or even of Plants, as the Sea Beach and Sands now are, on which the Tide and Waves of the Ocean daily lash: besides which, *the Bones of Men*, and more especially their implements and *works of art*, ought to be found buried in or under the gravelly mixtures, if such had in reality been moved by the Noachian

Deluge, which is described as having extinguished a full, if not a crowded population: whereas no such Remains, or any other evidences of Man's existence upon earth, prior to these Gravel Floods, are any where found.

If also, the Noachian and the Gravel Floods had been identic, the Animal Bones buried in the Gravel ought, in all cases to correspond exactly, with the present races of Animals, since these last, are the descendants by procreation, of the very race, out of which, according to Moses, Noah selected his pairs of Animals, for again replenishing the Earth, after the Deluge: and it is further observable, with respect to the Bones, which are sometimes found in Gravel (many of which Professor B. admits to be *different from those of any existing Animal*) are generally so found, *in Valleys and low Places,* amongst *Gravel which has been removed,* by far less and more local Floods, than the general Gravel Floods above spoken of.

These lesser Floods that buried Bones, seem with great probability to have happened, in the interval between the Creation of Animals, (as related by Moses, allowing, with all sensible Commentators, that not *Days,* literally, but *long and indefinite Periods* were by him assigned, to the great and multitudinous work of *creating,* the progenitors of the present Animals and Plants) and the last and *finishing work of the Creator,* in placing Man upon the Earth; which seems to have immediately preceded the ordaining of those *laws of Nature,* as we call them, which have since carried on the system of the Universe; but which laws, unassisted, could no more have formed or constituted the universe, than the laws of chemical and mechanical action, which now dispose of and change the dead Body of an animal or a vegetable, could have carried on its previous living functions, without the aid of *the principle of Life;* a principle, which to us is at present, a perfect mystery.

A Geologist, can now only see the chemical and mechanical principles at work, in changing, in inconsiderable degrees, the state of the superficial parts of the Strata:—by laborious observations and the collection of Facts, and through patient inductive reasonings upon these, he may go backwards, and perceive the indubitable marks of an epoch, when or beyond which, these mere laws of nature, are as utterly incompetent to account for the changes, which appear without doubt to have happened, to the solid matter composing the Earth, as these laws now are, to give existence and living functions to an animal or plant: this *grand epoch in Geological induction,* appears to me, well to accord with the period of Man's creation, and to require from the rational Geologist the acknowledgement, equally frank and explicit

plicit with that of Moses, that prior to this event, *the creative power of the Deity modified and gave immediate impulse,* to such of the chemical or mechanical laws, as were then in operation, in framing or changing the appearances of the Earth.

The truly laconic description in the first verse of Genesis, appears to me, as it seems also to have done to Professor Buckland, to refer to *the complete formation of the Earth,* including the creation of the myriads of living Beings which existed, between the successive creations of the Matter, composing the Strata which inhume them; of the subsequent account by Moses, of *the creation of Animals and Plants, to people the surface of the Earth* (already formed as at present, by long exposure to the elements, fitted to receive them) nothing therein contained, seems capable of contradiction, or having doubt thrown upon it, by any facts which the Geologist is able to adduce: nor have they, of late, shown any disposition to attempt the same.

The Noachian Deluge, according to Moses' description (and in accordance with its advance) retired from the surface of the Land, *by very slow degrees,* and in the most quiet manner, and so must have either left the Bones of Men and their contemporary Animals (and such parts of their adhering Flesh, as the Fish and aquatic Animals had not devoured, during the stay of the Waters) *lieing upon the very surface of the Ground,* or else these retiring Waters, must have borne these mangled Remains, along with them down into the Ocean; in either case, as these Remains, of Man in particular, *were not buried,* or the Wood and other light matters, or any of the Utensils or Buildings which the antediluvian Men had in use, a very few years of perfect exposure of these to the Elements, would moulder and decay the greater part, and no considerable lapse of Time, would witness the entire disappearance of these marks of the antediluvian Inhabitants, who are mentioned by Moses: excepting any of their hewn Stones, Bricks or other permanent Works; which, if any such existed, they must very long ago have been undistinguishable, from the works of the descendants of Noah.

The Geologists are therefore without any facts, and the rational part of them without the wish to possess any such, which would clash with or call in question, any part of the account of the Noachian Deluge, *as described by Moses:* of late, they have judiciously ceased from alluding to this Deluge in their Works, and thus left it to the Priests, to promulgate and support the history of this Event, and its causes and consequences, on their only true grounds, those of *revelation and the writings of Moses,* and of other early historians: and I cannot therefore conclude, without again lamenting, that the Reverend Professor, should have quitted this, his own proper and strong ground, to enter the lists with Geologists, on

this

this point, relying, on the nine positions which he has been pleased to denominate, *proofs of a recent Deluge*, although the whole of them, so evidently point, either to the Gravel and other Deluges, occurring before Man existed, or else to the period of the Excavation of valleys, and denuding or carving out the Hills, which still more evidently preceded, this grand Geological epoch.

I am, yours, &c.

July 6, 1820. A. B. C.

III. *Remarks on the Lunar Theory. By Mr.* James Utting.

To Mr. Tilloch.

Sir, — In the remarks on eclipses by Mr. Yeates, inserted in the last volume of the Philosophical Magazine, this gentleman seems desirous of proving, that the entire revolutions of the ☽ are limited to a period of 912 solar years, in which time her relative motions, with respect to the ⊙, and the whole phænomena of eclipses are completed. On examining the solar and lunar motions during the above period, I find that 912 solar years * contain 11279.8602955 lunations; consequently the ☽ has not completed her last revolution, wanting 50° 17′ 37″ of the line of conjunction: the time in which the ☽ would pass through this space would occupy about four days, two hours. The ☽'s perigee also falls short of the same time by 28° 56′ 46″; from which circumstance the ☽'s anomaly would evidently be 79° 14′ 23″ short of the same line of conjunction. The longitude of the ☽'s node also falls short of conjunction 49′ 7½″. The acceleration of the ☽'s longitude during this period amounts to only 14′ 23″; consequently from the above statement it is not possible to prove that 912 solar years constitute a complete lunar period; for either the solar year must be longer by 6′ 30″.842, or the synodic revolution of the ☽ must be 31′.6 shorter, than at the commencement of the present century, neither of which obtains, or is known to be the fact. In examining every conjunction of the ⊙ and ☽ that can take place during a period of upwards of ten thousand years, I find that the nearest coincidence of the solar and lunar periods obtains at the completion of 687 solar years, which are equal to 250921^{d} 9^{h} 45′ 36″.0. This period contains 8497 lunations, or 250921^{d} 9^{h} 44′ 31″.6: the difference in time is 1′ 4″.4; the ☽ having passed the line of conjunction by 32″.72. The acceleration of the ☽ in this period amounts to 8′ 7″.72.

* The solar year is here taken as stated by Mr. Delambre in his Theoretical and Practical Astronomy, 3 volumes quarto, 1814; and the lunar motions from the 4th edition of M. Laplace's System of the World.

In

In 39512 solar years are contained 488695 lunations, wanting about 5″ only of the line of conjunction of the ☉ and ☽. The ☽'s acceleration during this period amounts to upwards of two complete revolutions of the ☽ to the ☉, or nearly 760°. The acceleration of the ☽'s longitude in a period of 600,000 years, according with the present established theory, would exceed her mean motion by 3373 revolutions of the ecliptic!!! Hence the absurdity of instituting such long periods is evident. If in any period we could recognise a coincidence in the solar and lunar motions (including their anomalies and accelerations), the same circumstance would not again obtain, from the known perturbations in the lunar theory, or at least not till after a lapse of perhaps millions of years; for, on account of the irregularities in the lunar motions, their circuits must undergo new computations, in order to assign their relative situations during a preceding or subsequent period. *The Chaldean Period* is the most ancient and correct of any established; it consists of 223 mean lunations, which, according to mean motions at the commencement of the present century, is performed in $6585^{d}\ 7^{h}\ 42'\ 24''.4$; the motion of the ☽'s anomaly $11^{s}\ 27^{\circ}\ 10'\ 9''.4$; the ☉'s anomaly $0^{s}\ 10^{\circ}\ 29'\ 34''.7$; ☉ to the ☽'s node—$11^{s}\ 29^{\circ}\ 31'\ 33''.5$; whence the comp. ☉ to the ☽'s node $28'\ 26''.5$. Mr. Ferguson states it at $28'\ 12''.5$. There is about 18° on each side of the ☽'s node within which there is a possibility of eclipses; consequently the period of eclipses, so far as it affects the earth, contains a space of about 36° about that node, which taken from 360° leaves 324° remaining for the eclipse to travel in the *expansium*; and as this 36° is not gone through in less than 1370 years, the remaining 324° cannot be so gone through in less than 12330 years. The falling back of the line of conjunctions or oppositions of the ☉ and ☽ being $28'\ 26''.5$ with respect to the line of the nodes in every *Chaldean period* will wear it out in process of time, or in about 1370 years, as above stated; and after that time, it will not return again in less than 12330 years. The eclipses of the ☉ which happen about the ascending node, and begin to come in at the north pole of the earth, will advance a little southerly at each return, till they go off the earth at the south pole; and those which happen about the descending node, and begin to come in at the south pole of the earth, will proceed a little northerly at each return, till at last they quite leave the earth at the north pole.

The entire period of any respective eclipse is comprised in about 760 *Chaldean periods*, or about 13700 years; the whole terrestrial phænomena being completed in about 76 *Chaldean periods*, or 1370 years. But the irregularities in the lunar motions may lengthen or protract this period 100 years. The ☽'s acceleration

acceleration in an entire period is 66° 27′ 12″·7 ; in a terrestrial period 32′ 43″·3. This period of eclipses, although longer than Mr. Yeates appears to see through, is notwithstanding the least which comprises all the phænomena of any respective eclipse; and which I presume is not likely to be superseded by that which he is endeavouring to establish.

According to Mr. Ferguson, the entire period of an eclipse is 13380 years, and not 12492 as erroneously stated by Mr. Yeates; this being the time only in which the eclipse is passing through the *expansium.*—Vide Ferguson's Astronomy referred to by Mr. Yeates!

At page 443 we are informed that in 912 solar years there are 228 bissextiles, and seven intercalary days, in all 235 days. A little further Mr. Y. observes that in 912 solar years there are 940 lunations.—I cannot, I confess, perceive the existence of this harmony, although we are told it really subsists! and is confirmed by every evidence of observation!! In the first place there are but about 221 days over and above the common years of 365 days each, instead of 235. According to the Julian reckoning there are 228 bissextiles, but by the Gregorian account, seven are not bissextiles, being centenary years; of course there are but 221 in all (each of which is bissextile) instead of 235 as erroneously stated. With respect to 912 solar years, containing 940 lunations:—this I shall leave for *time* and the *curious to construe.* Mr. Yeates in reference to long lunar periods, p. 345, remarks—*All this arises from our imperfect knowledge of the lunar theory.* I beg leave to observe that modern astronomers are not quite so ignorant as Mr. Y. endeavours to make us believe; and as proof of this assertion I refer him to the articles Astronomy, Acceleration, Moon, &c. in most of our modern *Encyclopedias,* the Astronomical Works of Professor Vince, Gregory, Squire, and Woodhouse; also Lalande's Astronomy, Laplace's Celestical Mechanics, and System of the World; Delambre's Theoretical and Practical Astronomy; Biot's Treatise on Elementary and Physical Astronomy; and the Solar and Lunar Tables of Delambre, Burg, and Burckhardt. In perusing the above works the reader will there perceive the advances which have been made towards perfecting the *lunar theory,* and the theory of the celestial motions in general; originating with the fortunate idea of applying analysis to the celestial motions, and by reducing them to differential equations, which have been rigorously integrated, or by converging approximations. Thus the theory of gravitation has given an unexpected precision to astronomical tables.

The lunar tables in the time of Sir Isaac Newton gave the ☽'s longitude only to within about five minutes of a degree from the truth;

truth; whereas they now give it to within ten seconds, and generally much nearer. The principal object of importance towards cultivating more perfectly the *lunar astronomy* is a long and continued series of correct observations, whereby to furnish theory with the true data, in order to approximate more correctly to the inequalities in the lunar motions. And on instituting calculations on the solar and lunar theory, their present mean motions ought to be applied as deduced from the most correct observations, with the application also of the accelerations, otherwise we cannot expect to elicit from the theory of gravitation the various perturbations in the lunar theory.

Lastly; with respect to the astronomical question to be inquired into, viz. *Whether the recession of the conjunctions of the ☉ and ☽ in the ecliptic is any real and absolute anticipation, or whether it is produced by some unknown variation of the calendar reckoning during the above period.* In answer to the above, I beg to remark that the ancient eclipses have been carefully examined by several of the most eminent astronomers and chronologers, in order to establish particular epochs; and also the lunar theory: by which means the ☽'s acceleration was discovered, and which has been since completely verified and established by M. Laplace on the Newtonian theory of universal gravitation; it is therefore very improbable, and further, I may venture to add *impossible*, that a mistake of that magnitude should have crept into their calculations; for had this been the case, the lunar tables could not have given the ☽'s motions, agreeably to what they have been found to be from observation during the last 50 or 60 years only.

I remain, sir, yours respectfully,

Lynn Regis, July 10, 1820. JAMES UTTING.

IV. *Catalogue of Ancient Eclipses, with the Dates of their corresponding Eclipses at one and two Periods Distance. With Remarks. By Mr.* THOMAS YEATES.

[Continued from vol. 55, p. 445.]

To Mr. Tilloch.

SIR, — As a necessary supplement to what I have advanced respecting the lunar periods, as the same appears confirmed by the testimony of the eclipses recorded by the ancients, and attested by numerous corresponding examples, I beg permission to intrude a few notices of the lunar cycles and periods celebrated among the Chaldeans, the justly reputed fathers of astronomy, and as the same were afterwards improved by the Greeks.

 1. The

1. The lunar cycle among the Chaldeans was called the *saros* and *sara*, from סהרא, *sahara*, the moon. This cycle it is said contained two hundred and twenty-three synodical months, or eighteen Julian years, ten days, when the same cycle or period contains five leap days, and eleven days when it contains four leap days, seven hours, forty-eight minutes, and one-fourth; in which time all the corresponding new and full moons and eclipses return again.

2. The principal alteration of the time of the day in all eclipses depended on the excess of this period above an even number of days, which is computed at seven hours, forty-three minutes, and one-fourth; so that the cycle put every corresponding eclipse later than the foregoing almost eight hours; and three of those cycles amounted to fifty-four years and thirty-three or thirty-four days, which a single cycle could not do.

3. There are reckoned nine hundred years from the time that the moon begins to enter the ecliptic limit for eclipses of the moon on one side, till it goes out of it on the other; in all which time there will be fifty periods, and eclipses of the moon in each period: and there are reckoned to elapse twelve hundred and sixty years from the time that the moon begins to enter the ecliptic limit for eclipses of the sun on one side the node, till it goes out of it on the other, during which long time there will be seventy periods, and somewhere eclipses of the sun in each period, after which there will be no such eclipses for many centuries.

4. The Chaldean *saros* was improved by Meton, who first discovered, that in the course of nineteen years the new and full moons returned to the same days of the month, when a new cycle began; on which account it was called by the Greeks *Enneadecaeteris*, or cycle of nineteen years: in which time it was thought two hundred and thirty-five lunations were exactly completed, comprehending one hundred and ten new, and one hundred and twenty-five full moons.

5. The Metonic period being found defective in the time of Calippus, and one-fourth part of a day too much, the said Calippus added four whole periods of nineteen years, and instituted the cycle of seventy-six years, at the expiration of which he took off one day; and this was supposed a perfect correction of the lunar account until its further revision by Hipparchus.

6. Hipparchus having demonstrated the imperfection of the Calippic period by one whole day too much in four such periods, determined on a new period of three hundred and four years, when he deducted one day. The period of Calippus began in the summer of the same year that Alexander conquered Darius in the famous battle of Arbela, which was the third year of the 112th Olympiad, as proved from Ptolemy in his *Almagest*. lib. 7,

cap.

cap. 3, who produces four observations from Timocharis at certain years of the first Calippic period. In this period are reckoned nine hundred and forty lunations, equal to seventy-eight lunar years, and four lunar months.

These accounts of the cycles and periods of the ancients manifestly show their persevering attempts to establish a lunar theory on a perpetual principle; each theory correcting the foregoing by additions and subductions established on corresponding observations and eclipses, as indeed the experience of every succeeding age has proved in the same attempt.

With respect to the justness of the Chaldean theory, and how far the same is, or is not supported by modern observations, I shall not presume to enlarge, but refer the reader to Mr. Ferguson's explanations on the subject, chap. xviii. art. 320, and especially to a Dissertation on Eclipses quoted by this author, on the returns of eclipses according to the *saros*, wherein, among the rest, the great eclipse of the sun expected to happen in the month of September of this current year, is computed from four Chaldean periods, concerning which eclipse, and for the satisfaction of such as have not at hand Mr. Ferguson's book, I shall take the following extract, p. 252. "In 1820, August 26th (*i. e.* old style, or September 7, N. S.) betwixt one and two, there will be another great eclipse at London, about ten digits; but happening so near the equinox, the centre will leave every part of Britain to the west, and enter Germany at Embden, passing by Venice, Naples, Grand Cairo, and set in the Gulf of Bassora near that city. It will be no more visible again till 1874, when five digits will be obscured, the centre being now about to leave the earth on September 28th.

"In 1892 the sun will go down eclipsed at London; and again, in 1928, the passage of the centre will be in the expansion, though there will be two digits eclipsed at London in October the 31st of that year; and about the year 2090, the whole penumbra will be worn off; whence no more returns of this eclipse can happen till after a revolution of ten thousand years."

But to return: the cycle of nineteen years was found by experience to surpass every other in utility, and most convenient for its adaptation with the Julian calendar, insomuch that it was early adopted in the Christian church, and its characters marked in gold to show its distinguished importance in the regulation of the festival of Easter, and has ever since retained the name of the Golden Number. The ecclesiastical full moons were thought unalterably fixed by this cycle until the council of Nice, A.D. 325, discovered and corrected the errors of the sun's and moon's place in the calendar, and restored the equinoxes to their true seasons.

The solar reckoning being however imperfect, and the quantity

tity of the year not accurately known, proved the source of all the errors of those and preceding times. The Julian year exceeded the true measure by a certain unknown quantity, which in a lapse of time so affected the calendars as to require them to undergo new computations. Our countryman Roger Bacon, who flourished in the thirteenth century, deserves to be introduced on this occasion for his skill in astronomy, and the doctrine of time at that period, since it plainly appears, that he not only pointed out that error which occasioned the reformation of the calendar that since gave such distinction about the old and new style; but also afforded a much more effectual and perfect reformation than that which was made in the time of Pope Gregory XIII. This is abundantly illustrated in his book entitled *Opus Majus*, from whence we shall make only the following extract: "Julius Cæsar (says he, page 169) being well skilled in astronomy, settled, as well as it was possible in his time, the calendar: but Julius did not discover the exact length of the year; for he has fixed it in our calendar at 365 days, and the fourth part of a day, which fourth part is collected once in four years; so that in the bissextile year, one day more is reckoned in every fourth year, than in the common years. It is however manifest, not only by the old and new computations, but is also known from astronomical observations, that the solar year is not that length, but somewhat shorter; and this small difference wise men have computed to be the 130th part of a day, so that in the space of 130 years there is a superfluous day taken in, which if it were taken away, our calendar would be corrected as to this fault; and therefore as in our computation all things depend upon the quantity of the solar year, it is necessary to recede from this position, when it thus appears to be a fundamental error. From hence there arises still a greater error, that is, in fixing the equinoxes and solstices; and this error not only arises from the quantity of the year, but has also several mischievous consequences; for the equinoxes and solstices are thereby fixed to certain days, as if they were really upon them, and were so to happen for ever. But it is certain from astronomy, which cannot lie, that they ascend in the calendar, as by the help of tables and instruments may be unquestionably proved."

The Gregorian calendar, undertaken by Pope Gregory in 1582, reformed on the aforesaid principles as nearly as possible the errors of that which had obtained since the Council of Nice, when it was found that the equinoxes and solstices had removed ten whole days from their true places; and that the ecclesiastical full moons had removed four or five days from their situation in the calendar in the age of that council.

The Correction of the Calendar:—The errors of the old calendar

lendar being justly exploded, and the new style adopted by an act of parliament, which fixed the date of its commencement in the month of September 1752, and it being very necessary to understand the principles of this alteration, and useful to know in the exact computation of time embracing this period, I shall briefly state the chronological notes and other memoranda for that year from White's Ephemeris.

An. Dom. 1752, being the Bissextile or Leap-year.

Chronological Notes.

Golden number	5	Dominical letters	E D A
Cycle of the sun	25	Number of direction	8
Epacts	24 and 14	Roman indiction ..	15

Quarters of the Year.

		D.	H.	M.		
Spring	March	9	4	39	Morn.	App. time.
Summer	June	10	3	43	Morn.	
Autumn	Sept.	22	5	10	Aft.	
Winter	Dec.	21	8	39	Morn.	

New and full Moons.

				H.	M.	
Jan.	5	Sunday	New moon	2	57	Afternoon
	19	Sunday	Full	7	46	Night
Feb.	4	Tuesday	New m.	7	46	Morn.
	18	Tuesday	Full	7	49	Morn.
Mar.	4	Wednesday	New m.	9	37	Night
	18	Wednesday	Full	9	5	Night
Apr.	3	Friday	New m.	8	56	Morn.
	17	Friday	Full	11	25	Forenoon
May	2	Saturday	New m.	5	58	Aftern.
	17	Sunday	Full	2	38	Morn.
June	1	Monday	New m.	1	23	Morn.
	15	Monday	Full	5	55	Aft.
	30	Tuesday	New m.	8	7	Morn.
July	15	Wednesday	Full m.	8	45	Morn.
	29	Wednesday	New m.	3	16	Aft.
Aug.	13	Thursday	Full m.	10	57	Night
	28	Friday	New m.	1	57	Morn.
Sept.	23	Saturday	Full m.	0	27	Noon.
Oct.	7	Saturday	New m.	11	26	Foren.
	23	Monday	Full m.	1	14	Morn.
Nov.	6	Monday	New m.	5	2	Aft.
	21	Tuesday	Full m.	1	13	Aft.
Dec.	5	Tuesday	New m.	7	30	Night
	21	Thursday	Full m.	1	45	Morn.

Eclipses.

A.D. 1752.				Eclipses.
May	2	Saturday	⊙	Six o'clock in the evening; invisible in England.
Nov.	6	Monday	⊙	At five min. past two o'clock in the morning; invisible in England.

The Month of September XIX days.

Days.		
1	Tuesday	
2	Wednesday	
————		The New Style commences
14	Thursday	
15	Friday	
16	Saturday	
17	Sunday.	Sunday letter A.
18	Monday	
19	Tuesday	
20	Wednesday	
21	Thursday	
22	Friday	
23	Saturday	
24	Sunday.	Equal day and night.
25	Monday	
26	Tuesday	
27	Wednesday	
28	Thursday	
29	Friday	
30	Saturday	

Remarks.—1. The alteration of the style did not at all affect the days of the week, from Sunday to Sunday; but the numerical quantity of the days of the month only.

2. The days of the month expunged from the old calendar were eleven, 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. whose names, if required, in computations of the old style continued, take their succession immediately from the 1st day of the month; thus, 1. Tuesday; 2. Wednesday; [3. Thursday; 4. Friday; 5. Saturday; 6. Sunday; 7. Monday; 8. Tuesday; 9. Wednesday; 10. Thursday; 11. Friday; 12. Saturday; 13. Sunday;] 14. Monday, &c.

3. According to this representation, the 14th of September would have happened on a *Monday* in the old style account; whereas the new style has transferred it to *Thursday*, at the loss of two entire days of the weekly cycle; viz. Tuesday and Wednesday, which is found extremely perplexing in harmonising the old and new style calculations, wherein the days of the week are concerned.

4. If instead of *eleven* days the correctors of the calendar had expunged *fourteen*, the natural order of the days of the week would have stood common to both styles, thus:

1. Tuesday; 2. Wednesday; 3. *Thursday*; 4. *Friday*; 5. *Saturday*; 6. *Sunday*; 7. *Monday*; 8. *Tuesday*; 9. *Wednesday*; 10. *Thursday*; 11. *Friday*; 12. *Saturday*; 13. *Sunday*; 14. *Monday*; 15. *Tuesday*; 16. *Wednesday*; 17. Thursday; 18. Friday; 19. Saturday; 20. Sunday; 21. Monday; 22. Tuesday; 23. Wednesday; 24. Thursday; 25. Friday; 26. Saturday; 27. Sunday; 28. Monday; 29. Tuesday; 30. Wednesday.

5. The year 1800, and the fourth year after a bissextile, was no bissextile; it being that centenary year when one whole day was to be taken out of the calendar, which was the 29th day of February: thus, out of the two days lost in the weekly cycle, one has been recovered, although the elapsed time since the correction of the style has not amounted to half a century, and the Julian excess to little more than the third part of a day. In short, had two whole weeks been abolished in the September of 1752, the style had been more conveniently corrected for three centuries without disturbing the weekly cycle at all, as I have proved above.

6. But the grand object of the correctors was to restore the equinoxes and solstices to the true times of the year, as regulated by the motion of the sun, with the express design of marking the seasons in their proper places in the calendar; and this was the only reason why they determined not so much upon the weekly cycle as upon the precise days of the month when the sun made his passage through the celestial equinoxes and tropics.

7. The autumnal equinox having fallen back eleven whole days; viz. to September 12th in the year 1751, the year preceding the new style, the addition of so many days brought it up to the true time of the equinoctial passage of the sun, and to the same day of the same month of the year it was placed at the council of Nice A.D. 325; namely, September 22d, when the sun was observed to enter Libra.

8. The sum of the years between A.D. 325 and A.D. 1752 is 1427 years: in one day of twenty-four hours are precisely 1440 minutes, and eleven days gives the Julian excess for 1440 years, at the rate of eleven minutes per annum, which is very nearly the account.

9. The alteration of the calendar in the addition of the eleven days of the month, and in making the *third* day of September for the new style to be accounted and reckoned the *fourteenth* day, was

was in fact adding so many days to the Julian time, which clearly demonstrates that the Julian time was *too slow*, and that astronomical time was by so much *faster;* and therefore this numerical adjustment was absolutely necessary, and safe from the more known quantity of a solar year.

10. The days of the week are however of that importance in the computation of time, and especially long periods, that could it be known for certain on what days of the week certain eclipses of the sun and moon happened a century or many centuries ago, or other events, it would help to determine more accurately and positively the exact time, and greatly contribute to the perfection of astronomy, chronology and history, and for this plain reason, that the weekly cycle is as old as the creation, and is an account of time kept up inviolably, not by a few isolated astronomers and mathematicians, but preserved by the perpetual and unchangeable custom of whole nations!

To illustrate the excellent method of computing time by the cycle of weeks, I shall produce one example from the moon's motion for one hundred years, where the terms of this period are defined by the known days of the week. In the year 1715, O. S., April 22d, there happened a memorable eclipse of the sun on a Friday: the middle of the eclipse was observed at fifty-one minutes after nine o'clock in the morning, which we will take for the instant of the new moon. To correct this date for the new style it answers to May 3d, and from this date to May the 3d 1815, is one hundred years exactly. But the new moon which happened in May 1815, according to the Ephemeris, was on Tuesday the 9th day of the month, which by the cycle of weeks is found to have happened four days later than the cycle ending on the Friday nearest to May 3, 1815. Now it being impossible that an error of a whole week can fall into this reckoning for one century, and the day of the week being known when the new moon in April 1715 happened; and also the day of the week when the corresponding new moon fell in May 1815, the calculation is indubitably certain without any possibility of error as to the precise day and number of days from one new moon to the other.

In 100 Julian years are 5218 weeks, less one day: therefore from Friday April 22, 1715, to Friday May 5, 1815, are precisely 5218 weeks, or 36526 days, to which add the four days, and it will bring it up to the new moon in May 1815, and the day of the month and week as found in the Ephemeris, viz. Tuesday, May the 9th, and the measure of time in days is 36530; but the new moon in April 1715 was on Friday morning at fifty-one minutes past nine o'clock, and that in May 1815, at twenty minutes

nutes past six o'clock in the morning, which difference is to be deducted thus:

	H.	M.			H.	M.
Morn.	9	51	Days	36530	0	0
	6	20			3	31
	3	31		36529	20	29

Therefore from the New moon in April 1715 to the New moon in May 1815, is 36529 days, 20 hours, 29 minutes. To find the moon's motion from the sun, and the difference of their motions for 100 solar years, proceed thus:

	Days.	H.	M.
Lunations completed in	36529	20	29
100 solar years ..	36524	5	40
	5	14	49

In nineteen solar years are 235 lunations, and 5 × 19 = 95 years, and 5 × 235 = 1175 lunations; and in five years odd days are 62 lunations, so that in 100 solar years are 1237 lunations, less 5 days, 14 hours, 49 minutes: the difference of the sun and moon's motion in 100 years is therefore 5 days, 14 hours, 49 minutes, and this subtracted from one lunation gives the moon's motion from the sun.

To find the quantity of a mean lunation, divide 36529 days, 20 hours, 29 minutes, by 1237, the number of lunations, and the quotient is 29 days, 12 hours, 44 minutes, 38 seconds, 51-thirds, which is the precise mean quantity of a lunation, from which subtract 5 days, 14 hours, 49 minutes, and the difference is the moon's motion required in the above period.

	D.	H.	M.	S.	T.
One lunation	29	12	44	38	51
	5	14	49	0	0
	23	21	55	38	51

Therefore in 100 solar years there are 1236 lunar months, 23 days, 21 hours, 55 minutes, 38 seconds, 51 thirds; and this calculation is resolved on the principles of the weekly cycle.

[To be continued.]

V. *Experiments on the Alloys of Steel, made with a View to its Improvement.* By J. Stodart, *Esq.*, *and* M. Faraday, *Chem. Assistant at the Royal Institution.*

In proposing a series of experiments on the alloys of iron and steel, with various other metals, the object in view was two-fold; first, to ascertain whether any alloy could be artificially formed, better for the purpose of making cutting-instruments than steel in its purest state; and, secondly, whether any such alloys would, under similar circumstances, prove less susceptible of oxidation; —new metallic combinations for reflecting mirrors were also a collateral object of research.

Such a series of experiments were not commenced without anticipating considerable difficulties; but the facilities afforded us in the laboratory of the Royal Institution, where they were made, have obviated many of them. The subject was new, and opened into a large and interesting field. Almost an infinity of different metallic combinations may be made according to the nature and relative proportions of the metals capable of being alloyed. It never has been shown by experiment, whether pure iron, when combined with a minute portion of carbon, constitutes the very best material for making edge tools; or whether any additional ingredient, such as the earths, or their bases, or any other metallic matter, may not be advantageously combined with the steel; and, if so, what the materials are, and what the proportion required to form the best alloy for this much desired and most important purpose. This is confessedly a subject of difficulty, requiring both time and patient investigation, and it will perhaps be admitted as some apology for the very limited progress as yet made.

In analysing wootz, or Indian steel, only a minute portion of the earths alumine and silex is detected, these earths (or their bases) giving to the wootz its peculiar character. Being satisfied as to the constituent parts of this excellent steel, it was proposed to attempt making such a combination, and, with this view, various experiments were made. Many of them were fruitless: the successful method was the following. Pure steel in small pieces, and in some instances good iron, being mixed with charcoal powder were heated intensely for a long time; in this way they formed carburets, which possessed a very dark metallic grey colour, something in appearance like the black ore of tellurium, and highly crystalline. When broken, the facets of small buttons, not weighing more than 500 grains, were frequently above the eighth of an inch in width. The results of several experiments

periments on its composition, which appeared very uniform, gave 94·36 iron, +5·64 carbon. This being broken and rubbed to powder in a mortar, was mixed with pure alumine, and the whole intensely heated in a close crucible for a considerable time. On being removed from the furnace, and opened, an alloy was obtained of a white colour, a close granular texture, and very brittle: this, when analysed, gave 6·4 per cent. alumine, and a portion of carbon not accurately estimated. 700 of good steel, with 40 of the alumine alloy, were fused together, and formed a very good button, perfectly malleable; this, on being forged into a little bar, and the surface polished, gave, on the application of dilute sulphuric acid, the beautiful damask which will presently be noticed as belonging peculiarly to wootz. A second experiment was made with 500 grains of the same steel, and 67 of the alumine alloy, and this also proved good; it forged well, and gave the damask. This specimen has all the appreciable characters of the best Bombay wootz.

We have ascertained, by direct experiment, that the wootz, although repeatedly fused, retains the peculiar property of presenting a damasked surface, when forged, polished, and acted upon by dilute acid. This appearance is apparently produced by a dissection of the crystals by the acid; for though by the hammering the crystals have been bent about, yet their forms may be readily traced through the curves which the twisting and hammering have produced. From this uniform appearance on the surface of wootz, it is highly probable, that the much-admired sabres of Damascus are made from this steel; and, if this be admitted, there can be little reason to doubt, that the damask itself is merely an exhibition of crystallization. That on wootz it cannot be the effect of the mechanical mixture of two substances, as iron and steel, unequally acted upon by acid, is shown by the circumstance of its admitting re-fusion without losing this property. It is certainly true, that a damasked surface may be produced by welding together wires of iron and steel; but if these welded specimens are fused, the damask does not again appear. Supposing that the damasked surface is dependant on the development of a crystalline structure, then the superiority of wootz in showing the effect, may fairly be considered as dependant on its power of crystallizing, when solidifying, in a more marked manner, and in more decided forms than the common steel. This can only be accounted for by some difference in the composition of the two bodies; and as it has been stated that only the earths in small quantities can be detected, it is reasonable to infer, that the bases of these earths being combined with the iron and carbon render the mass more crystallizable, and that the structure drawn out by the hammer, and confused,

 (though

(though not destroyed,) does actually occasion the damask. It is highly probable, that the wootz is steel accidentally combined with the metal of the earths; and the irregularity observed in different cakes, and even in the same cake, is in accordance with this opinion. The earths may be in the ore, or they may be derived from the crucible in which the fusion is made.

In making the alumine alloy for the imitation of wootz, we had occasion to observe the artificial formation of plumbago. Some of the carburet of iron before mentioned having been pounded and mixed with fresh charcoal, and then fused, was found to have been converted into perfect plumbago. This had not taken place throughout the whole mass; the metal had soon melted, and run to the bottom; but having been continued in the furnace for a considerable time, the surface of the button had received an additional portion of charcoal, and had become plumbago. It was soft, sectile, bright, stained paper, and had every other character of that body: it was indeed in no way distinguishable from it. The internal part of these plumbago buttons was a crystalline carburet: a portion of it having been powdered, and fused several times with charcoal, at last refused to melt, and on the uncombined charcoal being burnt away by a low heat, it was found that the whole of the steel had been converted into plumbago: this powder we attempted to fuse, but were not successful.

It will appear by the following experiment, that we had formed artificial wootz, at a time when this certainly was not the object of research. In an attempt to reduce titanium, and combine it with steel, a portion of menachanite was heated with charcoal, and a fused button obtained. A part of this button was next fused with some good steel; the proportions were 96 steel, four menachanite button. An alloy was formed, which worked well under the hammer; and the little bar obtained was evidently different from, and certainly superior to, steel. This was attributed to the presence of titanium, but none could be found in it; nor indeed was any found even in the menachanite button itself. The product was iron and carbon, combined with the earths or their bases, and was in fact excellent wootz. A beautiful damask was produced on this specimen by the action of dilute acid. Since this, many attempts have been made to reduce the oxide of titanium; it has been heated intensely with charcoal, oil, &c., but hitherto all have failed, the oxide has been changed into a black powder, but not fused. When some of the oxide was mixed with steel filings, and a little charcoal added, on being intensely heated the steel fused, and ran into a fine globule which was covered by a dark-coloured transparent glass, adhering to the sides of the crucible. The steel contained no titanium, the

the glass proved to be oxide of titanium, with a little oxide of iron. These experiments have led us to doubt whether titanium has ever been reduced to the metallic state. From the effects of the heat upon the crucibles, which became soft, and almost fluid, sometimes, in fifteen minutes, we had in fact no reason to suppose the degree of heat inferior to any before obtained by a furnace:—that used in these last experiments, was a blast furnace, supplied by a constant and powerful stream of air; the fuel good Staffordshire coke, with a little charcoal; both Hessian and Cornish crucibles were used, one being carefully luted into another,—and even three have been united, but they could not be made to stand the intense heat.

Meteoric iron is, by analysis, always found to contain nickel. The proportions are various, in the specimens that have been chemically examined. The iron from the Arctic regions was found to contain three per cent. only of nickel, while that from Siberia gave nearly 10 per cent. With the analysis of this last we are favoured by J. G. Children, Esq., and, having permission from that gentleman, we most willingly insert the account of his very accurate process.

Thirty-seven grains of Siberian meteoric iron gave 48·27 grains of peroxide of iron, and 4·52 grains of oxide of nickel. Supposing the equivalent number for nickel to be 28, these quantities are equal to

	Iron	33·69
	Nickel	3·56
		37·25

Supposing the quantities to be correctly

	Iron	33·5
	Nickel	3·5
		37·

the proportions per cent. are

	Iron	90·54
	Nickel	9·46
		100·00

A second experiment, on 47 grains, gave 61 grains of peroxide of iron = 42·57 iron. The ammoniacal solution of nickel was lost by an accident; reckoning from the iron, the quantities per cent. are,

	Iron	90·57
	Nickel	9·42
		99·99

A third experiment, on 56 grains, gave 73·06 grains peroxide of of iron = 50·99 iron, and 5·4 of oxide of nickel = 4·51 nickel, or per cent,

Iron	91·00
Nickel	8·01
Loss	0·99
	100·00

The mean of the three gives 8·96 per cent. of *nickel.*

The meteoric iron was dissolved in aqua regia, and the iron thrown down by pure ammonia, well washed, and heated red.

In the first experiment the ammoniacal solution was evaporated to dryness, the ammonia driven off by heat, and the oxide of nickel re-dissolved in nitric acid, and precipitated by pure potassa, the mixture being boiled a few seconds.

In the third experiment the nickel was thrown down from the ammoniacal solution at once by pure potassa. The first method is best, for a minute portion of oxide of nickel escaped precipitation in the last experiment, to which the loss is probably to be attributed.

All the precipitates were heated to redness. J. G. C.

We attempted to make imitations of the meteoric irons with perfect success. To some good iron (horseshoe nails) were added three per cent. of pure nickel; these were inclosed in a crucible, and exposed to a high temperature in the air-furnace for some hours. The metals were fused, and on examining the button, the nickel was found in combination with the iron. The alloy was taken to the forge, and proved under the hammer to be quite as malleable and pleasant to work as pure iron; the colour when polished rather whiter. This specimen, together with a small bar of meteoric iron, have been exposed to a moist atmosphere; they are both a little rusted. In this case it was omitted to expose a piece of pure iron with them; it is probable that, under these circumstances, the pure iron would have been more acted upon.

The same success attended in making the alloy to imitate the Siberian meteoric iron agreeably to Mr. Children's analysis. We fused some of the same good iron, with 10 per cent. nickel; the metals were found perfectly combined, but less malleable, being disposed to crack under the hammer. The colour when polished had a yellow tinge. A piece of this alloy has been exposed to moist air for a considerable time, together with a piece of pure iron; they are both a little rusted, not, however, to the same extent; that with the nickel being but slightly acted upon, comparatively to the action on the pure iron; it thus appears that nickel, when combined with iron, has some effect in preventing oxidation,

oxidation, though certainly not to the extent that has at times been given to it. It is a curious fact, that the same quantity of the nickel alloyed with steel, instead of preventing its rusting, appeared to accelerate it very rapidly.

Platinum and rhodium have, in the course of these experiments, been alloyed with iron, but these compounds do not appear to possess any very interesting properties. With gold we have not made the experiment. The alloys of other metals with iron, as far as our experience goes, do not promise much usefulness. The results are very different when steel is used; it is only, however, of a few of its compounds that we are prepared to give any account.

Together with some others of the metals, the following have been alloyed with both English and Indian steel, and in various proportions; platinum, rhodium, gold, silver, nickel, copper and tin.

All the above-named metals appear to have an affinity for steel sufficiently strong to make them combine; alloys of platinum, rhodium, gold and nickel, may be obtained when the heat is sufficiently high. This is so remarkable with platinum, that it will fuse when in contact with steel, at a heat at which the steel itself is not affected.

With respect to the alloy of silver, there are some very curious circumstances attending it. If steel and silver be kept in fusion together for a length of time, an alloy is obtained, which appears to be very perfect while the metals are in the fluid state, but on solidifying and cooling, globules of pure silver are expressed from the mass, and appear on the surface of the button. If an alloy of this kind be forged into a bar, and then dissected by the action of dilute sulphuric acid, the silver appears, not in combination with the steel, but in threads throughout the mass; so that the whole has the appearance of a bundle of fibres of silver and steel, as if they had been united by welding. The appearance of these silver fibres is very beautiful; they are sometimes one-eighth of an inch in length, and suggest the idea of giving mechanical toughness to steel, where a very perfect edge may not be required.

At other times, when silver and steel have been very long in a state of perfect fusion, the sides of the crucible, and frequently the top also, are covered with a fine and beautiful dew of minute globules of silver; this effect can be produced at pleasure. At first we were not successful in detecting silver by chemical tests in these buttons; and finding the steel uniformly improved, were disposed to attribute its excellence to an effect of the silver, or to a quantity too small to be tested. By subsequent experiments we we were, however, able to detect the silver, even to less than one in 500.

In making the silver alloys, the proportion first tried was one silver to 160 steel; the resulting buttons were uniformly steel and silver in fibres, the silver being likewise given out in globules during solidifying, and adhering to the surface of the fused button; some of these when forged gave out more globules of silver. In this state of mechanical mixture the little bars, when exposed to a moist atmosphere, evidently produced voltaic action, and to this we are disposed to attribute the rapid destruction of the metal by oxidation, no such destructive action taking place when the two metals are chemically combined. These results indicated the necessity of diminishing the quantity of silver, and one silver to 200 steel was tried. Here, again, were fibres and globules in abundance; with 1 to 300, the fibres diminished but still were present; they were detected even when the proportion of 1 to 400 was used. The successful experiment remains to be named. When 1 of silver to 500 steel were properly fused, a very perfect button was produced; no silver appeared on its surface; when forged and dissected by an acid, no fibres were seen, although examined by a high magnifying power. The specimen forged remarkably well, although very hard; it had in every respect the most favourable appearance. By a delicate test every part of the bar gave silver. This alloy is decidedly superior to the very best steel, and this excellence is unquestionably owing to combination with a minute portion of silver. It has been repeatedly made, and always with equal success. Various cutting tools have been made from it of the best quality. This alloy is perhaps only inferior to that of steel with rhodium, and it may be procured at a small expense; the value of silver, where the proportion is so small, is not worth naming; it will probably be applied to many important purposes in the arts. An attempt was made to procure the alloy of steel with silver by cementation; a small piece of steel wrapped in silver leaf, being 1 to 160, was put into a crucible, which being filled up with pounded green glass, was submitted to a heat sufficient to fuse the silver; it was kept at a white heat for three hours. On examining it, the silver was found fused, and adhering to the steel; no part had combined. The steel had suffered by being so long kept at a high temperature. Although this experiment failed in effecting the alloy of steel with silver, there is reason to believe that with some other metals, alloys may be obtained by this process; the following circumstance favours this suggestion. Wires of platinum and steel, of about equal diameter, were packed together, and, by an expert workman, were perfectly united by welding. This was effected

effected with the same facility as could have been done with steel and iron. On being forged, the surface polished, and the steel slightly acted on by an acid, a very novel and beautiful surface appeared, the steel and platinum forming dark and white clouds: if this can be effected with very fine wires, a damasked surface will be obtained, of exquisite beauty. This experiment, made to ascertain the welding property of platinum, is only named here in consequence of observing that some of the largest of the steel clouds had much the appearance of being alloyed with a portion of the platinum. A more correct survey of the surface, by a high magnifying power, went far to confirm this curious fact; some more direct experiments are proposed to be made on this apparent alloy by cementation.

The alloys of steel with platinum, when both are in a state of fusion, are very perfect, in every proportion that has been tried. Equal parts by weight form a beautiful alloy, which takes a fine polish, and does not tarnish; the colour is the finest imaginable for a mirror. The specific gravity of this beautiful compound is 9·862.

Ninety of platinum with 20 of steel gave also a perfect alloy, which has no disposition to tarnish, the specific gravity 15·88: both these buttons are malleable, but have not yet been applied to any specific purpose.

Ten of platinum to 80 of steel formed an excellent alloy. This was ground and very highly polished to be tried as a mirror; a fine damask, however, renders it quite unfit for that purpose.

The proportions of platinum that appear to improve steel for edge instruments, are from 1 to 3 per cent. Experience does not yet enable us to state the exact proportion that forms the best possible alloy of these metals; 1·5 per cent. will probably be very nearly right. At the time of combining 10 of platinum with 80 steel, with a view to a mirror, the same proportions were tried with nickel and steel; this too had the damask, and consequently was unfit for its intention. It is curious to observe the difference between these two alloys, as to susceptibility for oxygen. The platinum and steel, after laying many months, had not a spot on its surface, while that with nickel was covered with rust; they were in every respect left under similar circumstances. This is given as an instance, showing that nickel with steel is much more subject to oxidation than when combined with iron.

The alloys of steel with rhodium are likely to prove highly valuable. The scarcity of that metal must, however, operate against its introduction to any great extent. It is to Dr. Wollaston we are indebted, not only for suggesting the trial of rhodium, but also for a liberal supply of the metal, as well as much

 valuable

valuable information relative to fuel, crucibles, &c.: this liberality enables us to continue our experiments on this alloy: these, with whatever else may be worth communicating, will be given in a future of number of this Journal. The proportions we have used are from 1 to 2 per cent. The valuable properties of the rhodium alloys are hardness, with sufficient tenacity to prevent cracking either in forging or in hardening. This superior hardness is so remarkable, that in tempering a few cutting articles made from the alloy, they required to be heated full 30° F. higher than the best wootz, wootz itself requiring to be heated full 40° above the best English cast steel. Thermometrical degrees are named, that being the only accurate method of tempering steel.

Gold forms a good alloy with steel. Experience does not yet enable us to speak of its properties. It certainly does not promise to be of the same value as the alloys of silver, platinum, and rhodium.

Steel with two per cent. of copper forms an alloy. Steel also alloys with tin. Of the value of these we have doubts. If, on further trial, they, together with other combinations requiring more time than we have been able to bestow on them, should prove at all likely to be interesting and useful, the results will be frankly communicated.

Our experiments have hitherto been confined to small quantities of the metals, seldom exceeding 2000 grains in weight; and we are aware that the operations of the laboratory are not always successful when practised on a large scale. There does not, however, appear to be any good reason why equal success may not attend the working on larger masses of the metals, provided the same diligence and means are employed.

From the facility of obtaining silver, it is probable that its alloy with steel is the most valuable of those we have made. To enumerate its applications, would be to name almost every edge-tool. It is also probable that it will prove valuable for making dies, especially when combined with the best Indian steel. Trial will soon be made with the silver in the large way, and the result, whatever it may be, will be candidly stated.

Table of Specific Gravities of Alloys, &c. mentioned in the preceding Paper.

Iron, unhammered	7·847
Wootz, unhammered, (Bombay)	7·665
Wootz, tilted, (Bombay)	7·6707
Wootz, in cake, (Bengal)	7·730
Wootz, fused and hammered, (Bengal) ..	7·787

Meteoric

Meteoric iron, hammered	7·965
Iron, and 3 per cent. nickel	7·804
Iron, and 10 per cent. nickel	7·849
Steel, and 10 per cent. platinum, (mirror) ..	8·100
Steel, and 10 per cent. nickel, (mirror) ..	7·684
Steel, and 1 per cent. gold, hammered ..	7·870
Steel, and 2 per cent. silver, hammered ..	7·808
Steel, and 1·5 per cent. platinum, hammered	7·732
Steel, and 1·5 per cent. rhodium, hammered	7·795
Steel, and 3 per cent. nickel, hammered ..	7·750
Platinum 60, and steel 50, unhammered* ..	9·862
Platinum 90, and steel 20, unhammered† ..	15·88
Platinum, hammered and rolled	21·25

(*Quarterly Journal of Literature, &c.*)

* The calculated mean specific gravity of this alloy is 11·2723, assuming the specific gravity of platinum and steel as expressed in this table.

† The calculated mean specific gravity of this alloy is 16·0766.

VI. *Tables of the Sun's Altitude and Zenith Distance, for every Day in the Year, when it passes the Meridian, in Latitude* 51° 29′ 8″. *By the Rev. Mr.* L. Evans.

To Mr. Tilloch.

Sir, — As every auxiliary is useful to the amateur of practical astronomy, I have thought the annexed Tables would not be an unacceptable article, in your valuable publication, The Philosophical Magazine, should you have the goodness to insert it. They were computed for the latitude of my Observatory, on Woolwich Common, and are applicable to other latitudes not considerably differing from it.

I remain, sir,

Your obliged humble servant,

L. Evans.

Woolwich Common,
July 19, 1820.

The first column, in the Tables, contains the days of the month; the second, the sun's meridian altitudes; and the third, the sun's zenith distances.

 JANU-

JANUARY.			FEBRUARY.			MARCH.		
D.	☉'s M. A.	☉'s Z. D.	D.	☉'s M. A.	☉'s Z. D.	D.	☉'s M. A.	☉'s Z. D.
	° ′ ″	° ′ ″		° ′ ″	° ′ ″		° ′ ″	° ′ ″
1	15 25 50	74 34 10	1	21 11 46	68 48 14	1	31 1 8	58 58 52
2	15 30 42	74 29 18	2	21 28 47	68 31 13	2	31 24 0	58 36 0
3	15 36 1	74 23 59	3	21 46 6	60 13 54	3	31 46 57	58 13 3
4	15 41 47	74 18 13	4	22 3 42	67 56 18	4	32 10 0	57 50 0
5	15 48 0	74 12 0	5	22 21 35	67 38 25	5	32 33 9	57 26 51
6	15 54 41	74 5 19	6	22 39 45	67 20 15	6	32 56 23	57 3 37
7	16 1 48	73 58 12	7	22 58 11	67 1 49	7	33 19 41	56 40 19
8	16 9 22	73 50 38	8	23 16 54	66 43 6	8	33 43 3	56 16 57
9	16 17 23	73 42 37	9	23 35 51	66 24 9	9	34 6 29	55 53 31
10	16 25 49	73 34 11	10	23 55 4	66 4 56	10	34 29 59	55 30 1
11	16 34 42	73 25 18	11	24 14 32	65 45 28	11	34 53 32	55 6 28
12	16 44 0	73 16 0	12	24 34 14	65 25 46	12	35 17 7	54 42 53
13	16 53 44	73 6 16	13	24 54 9	65 5 51	13	35 40 45	54 19 15
14	17 3 54	72 56 6	14	25 14 18	64 45 42	14	36 4 24	53 55 35
15	17 14 27	72 45 33	15	25 34 40	64 25 20	15	36 28 6	53 31 54
16	17 25 25	72 34 35	16	25 55 14	64 4 46	16	36 51 49	53 8 11
17	17 36 48	72 23 12	17	26 16 1	63 43 59	17	37 15 32	52 44 28
18	17 48 34	72 11 26	18	26 36 59	63 23 1	18	37 39 14	52 20 46
19	18 0 44	71 59 16	19	26 58 8	63 1 52	19	38 2 57	51 57 3
20	18 13 17	71 46 43	20	27 19 28	62 40 32	20	38 26 38	51 33 22
21	18 26 13	71 33 47	21	27 40 58	62 19 2	21	38 50 19	51 9 41
22	18 39 31	71 20 29	22	28 2 38	61 57 22	22	39 13 59	50 46 1
23	18 53 11	71 6 49	23	28 24 28	61 35 32	23	39 37 37	50 22 23
24	19 7 13	70 52 47	24	28 46 27	61 13 33	24	40 1 14	49 58 46
25	19 21 37	70 38 23	25	29 8 34	60 51 26	25	40 24 48	49 35 12
26	19 36 21	70 23 39	26	29 30 50	60 29 10	26	40 48 20	49 11 40
27	19 51 26	70 8 34	27	29 53 13	60 6 47	27	41 11 49	48 48 11
28	20 6 51	69 53 9	28	30 15 45	59 44 15	28	41 35 14	48 24 46
29	20 22 37	69 37 23	29	30 38 23	59 21 37	29	41 58 36	48 1 24
30	20 38 41	69 21 19				30	42 21 54	47 38 6
31	20 55 4	69 4 56				31	42 45 8	47 14 52

APRIL.			MAY.			JUNE.		
D.	☉'s M.A.	☉'s Z.D.	D.	☉'s M.A	☉'s Z.D.	D.	☉'s M.A.	☉'s Z.D.
	° ′ ″	° ′ ″		° ′ ″	° ′ ″		° ′ ″	° ′ ″
1	43 8 16	46 51 44	1	53 39 7	36 20 53	1	60 36 25	29 23 35
2	43 31 20	46 28 40	2	53 57 6	36 2 54	2	60 44 20	29 15 40
3	43 54 19	46 5 41	3	54 14 49	35 45 11	3	60 51 52	29 8 8
4	44 17 13	45 42 47	4	54 32 17	35 27 43	4	60 59 0	29 1 0
5	44 40 0	45 20 0	5	54 49 29	35 10 31	5	61 5 45	28 54 15
6	45 2 41	44 57 19	6	55 6 25	34 53 35	6	61 12 7	28 47 53
7	45 25 16	44 34 44	7	55 23 5	34 36 55	7	61 18 4	28 41 56
8	45 47 44	44 12 16	8	55 39 28	34 20 32	8	61 23 38	28 36 22
9	46 10 4	43 49 56	9	55 55 34	34 4 26	9	61 28 47	28 31 13
10	46 32 17	43 27 43	10	56 11 22	33 48 38	10	61 33 33	28 26 27
11	46 54 22	43 5 38	11	56 26 53	33 33 7	11	61 37 54	28 22 6
12	47 16 19	42 43 41	12	56 41 6	33 17 54	12	61 41 50	28 18 10
13	47 38 7	42 21 53	13	56 57 1	33 2 59	13	61 45 22	28 14 38
14	47 59 46	42 0 14	14	57 11 37	32 48 23	14	61 48 30	28 11 30
15	48 21 16	41 38 44	15	57 25 54	32 34 6	15	61 51 13	28 8 47
16	48 42 35	41 17 25	16	57 39 52	32 20 8	16	61 53 31	28 6 29
17	49 3 44	40 56 16	17	57 53 30	32 6 30	17	61 55 24	28 4 36
18	49 24 43	40 35 17	18	58 6 49	31 53 11	18	61 56 53	28 3 7
19	49 45 31	40 14 29	19	58 19 48	31 40 12	19	61 57 57	28 2 3
20	50 6 9	39 53 51	20	58 32 27	31 27 33	20	61 58 35	28 1 25
21	50 26 34	39 33 26	21	58 44 45	31 15 15	21	61 58 50	28 1 10
22	50 46 48	39 13 12	22	58 56 42	31 3 18	22	61 58 39	28 1 21
23	51 6 49	38 53 11	23	59 8 18	30 51 42	23	61 58 4	28 1 56
24	51 26 38	38 33 22	24	59 19 33	30 40 27	24	61 57 3	28 2 57
25	51 46 14	38 13 46	25	59 30 27	30 29 33	25	61 55 39	28 4 21
26	52 5 37	37 54 23	26	59 40 59	30 19 1	26	61 53 49	28 6 11
27	52 24 47	37 35 13	27	59 51 9	30 8 51	27	61 51 35	28 8 25
28	52 43 44	37 16 16	28	60 0 57	29 59 3	28	61 48 56	28 11 4
29	53 2 26	36 57 34	29	60 10 23	29 49 37	29	61 45 53	28 14 7
30	53 20 54	36 39 6	30	60 19 27	29 40 33	30	61 42 25	28 17 35
			31	60 28 8	29 31 52			

JULY.			AUGUST.			SEPTEMBER.		
D.	☉'s M.A.	☉'s Z.D.	D.	☉'s M.A.	☉'s Z.D.	D.	☉'s M.A.	☉'s Z.D.
	° ′ ″	° ′ ″		° ′ ″	° ′ ″		° ′ ″	° ′ ″
1	61 38 33	28 21 27	1	56 31 35	33 28 25	1	46 45 29	43 14 31
2	61 34 16	28 25 44	2	56 16 17	33 43 43	2	46 23 36	43 36 24
3	61 29 35	28 30 25	3	56 0 41	33 59 19	3	46 1 34	43 58 26
4	61 24 31	28 35 29	4	55 44 49	34 15 11	4	45 39 26	44 20 34
5	61 19 2	28 40 58	5	55 28 39	34 31 21	5	45 17 10	44 42 50
6	61 13 10	28 46 50	6	55 12 13	34 47 47	6	44 54 48	45 5 12
7	61 6 54	28 53 6	7	54 55 30	35 4 30	7	44 32 19	45 27 41
8	61 0 14	28 59 46	8	54 38 32	35 21 28	8	44 9 44	45 50 16
9	60 53 11	29 6 49	9	54 21 18	35 38 42	9	43 47 3	46 12 57
10	60 45 45	29 14 15	10	54 3 49	35 56 11	10	43 24 17	46 35 43
11	60 37 56	29 22 4	11	53 46 5	36 13 55	11	43 1 26	46 58 34
12	60 29 43	29 30 17	12	53 28 6	36 31 54	12	42 38 31	47 21 29
13	60 21 9	29 38 51	13	53 9 53	36 50 7	13	42 15 31	47 44 29
14	60 12 12	29 47 48	14	52 51 26	37 8 34	14	41 52 27	48 7 33
15	60 2 52	29 57 8	15	52 32 46	37 27 14	15	41 29 20	48 30 40
16	59 53 11	30 6 49	16	52 13 51	37 46 9	16	41 6 10	48 53 50
17	59 43 8	30 16 52	17	51 54 44	38 5 16	17	40 42 56	49 17 4
18	59 32 44	30 27 16	18	51 35 25	38 24 35	18	40 19 40	49 40 20
19	59 21 58	30 38 2	19	51 15 53	38 44 7	19	39 56 22	50 3 38
20	59 10 51	30 49 9	20	50 56 9	39 3 51	20	39 33 1	50 26 59
21	58 59 23	31 0 37	21	50 36 13	39 23 47	21	39 9 40	50 50 20
22	58 47 35	31 12 25	22	50 16 6	39 43 54	22	38 46 16	51 13 44
23	58 35 26	31 24 34	23	49 55 47	40 4 13	23	38 22 52	51 37 8
24	58 22 57	31 37 3	24	49 35 18	40 24 42	24	37 59 27	52 0 33
25	58 10 9	31 49 51	25	49 14 38	40 45 22	25	37 36 1	52 23 59
26	57 57 1	32 2 59	26	48 53 48	41 6 12	26	37 12 36	52 47 24
27	57 43 33	32 16 27	27	48 32 49	41 27 11	27	36 49 11	53 10 49
28	57 29 47	32 30 13	28	48 11 39	41 48 21	28	36 25 46	53 34 14
29	57 15 41	32 44 19	29	47 50 20	42 9 40	29	36 2 22	53 57 38
30	57 1 17	32 58 43	30	47 28 51	42 31 9	30	35 39 0	54 21 0
31	56 46 35	33 13 25	31	47 7 14	42 52 46			

OCTOBER.			NOVEMBER.			DECEMBER.		
D.	☉'s M.A.	☉'s Z.D.	D.	☉'s M.A.	☉'s Z.D.	D.	☉'s M.A.	☉'s Z.D.
	° ′ ″	° ′ ″		° ′ ″	° ′ ″		° ′ ″	° ′ ″
1	35 15 39	54 44 21	1	24 0 6	65 59 54	1	16 38 55	73 21 5
2	34 52 20	55 7 40	2	23 41 0	66 19 0	2	16 29 53	73 30 7
3	34 29 3	55 30 57	3	23 22 8	66 37 52	3	16 21 16	73 38 44
4	34 5 49	55 54 11	4	23 3 30	66 56 30	4	16 13 5	73 46 55
5	33 42 39	56 17 21	5	22 45 8	67 14 52	5	16 5 20	73 54 40
6	33 19 32	56 40 28	6	22 27 2	67 32 58	6	15 58 1	74 1 59
7	32 56 29	57 3 31	7	22 9 12	67 50 48	7	15 51 8	74 8 52
8	32 33 30	57 26 30	8	21 51 38	68 8 22	8	15 44 43	74 15 17
9	32 10 35	57 49 25	9	21 34 22	68 25 38	9	15 38 44	74 21 16
10	31 47 46	58 12 14	10	21 17 22	68 42 38	10	15 33 13	74 26 47
11	31 25 3	58 34 57	11	21 0 41	68 59 19	11	15 28 8	74 31 52
12	31 2 25	58 57 35	12	20 44 18	69 15 42	12	15 23 32	74 36 28
13	30 39 53	59 20 7	13	20 28 13	69 31 47	13	15 19 22	74 40 38
14	30 17 28	59 42 32	14	20 12 27	69 47 33	14	15 15 41	74 44 19
15	29 55 10	60 4 50	15	19 57 1	70 2 59	15	15 12 27	74 47 33
16	29 33 0	60 27 0	16	19 41 55	70 18 5	16	15 9 42	74 50 18
17	29 10 57	60 49 3	17	19 27 9	70 32 51	17	15 7 24	74 52 36
18	28 49 3	61 10 57	18	19 12 43	70 47 17	18	15 5 35	74 54 25
19	28 27 17	61 32 43	19	18 58 38	71 1 22	19	15 4 14	74 55 46
20	28 5 40	61 54 20	20	18 44 55	71 15 5	20	15 3 21	74 56 39
21	27 44 12	62 15 48	21	18 31 33	71 28 27	21	15 2 57	74 57 3
22	27 22 54	62 37 6	22	18 18 33	71 41 27	22	15 3 0	74 57 0
23	27 1 46	62 58 14	23	18 5 55	71 54 5	23	15 3 32	74 56 28
24	26 40 48	63 19 12	24	17 53 40	72 6 20	24	15 4 33	74 55 27
25	26 20 1	63 39 59	25	17 41 48	72 18 12	25	15 6 1	74 53 59
26	25 59 25	64 0 35	26	17 30 19	72 29 41	26	15 7 58	74 52 2
27	25 39 1	64 20 59	27	17 19 13	72 40 47	27	15 10 24	74 49 36
28	25 18 48	64 41 12	28	17 8 32	72 51 28	28	15 13 17	74 46 43
29	24 58 48	65 1 12	29	16 58 15	73 1 45	29	15 16 38	74 43 22
30	24 39 1	65 20 59	30	16 48 23	73 11 37	30	15 20 28	74 39 32
31	24 19 27	65 40 33				31	15 24 45	74 35 15

VII. *Bio-*

VII. *Biographical Memoir of the late Right Hon. Sir* Joseph Banks, *Bart. G.C.B. President of the Royal Society.*

Sir Joseph Banks is said to have been descended from a noble Swedish family; but, whatever truth there may be in this assertion, it is certain that he did not trace his pedigree higher than the reign of Edward the Third, when his ancestor, Simon Banke, married the daughter and heir of —— Caterton, of Newton in Yorkshire. By this marriage, the manor of Newton, in the wapentake of Staincliffe, came to the family of Banke, with whom it remained until it was sold in the middle of the seventeenth century.

From this Simon Banke, Sir Joseph was the eighteenth in lineal descent. His grandfather, Joseph Banks, Esq. was High Sheriff of Lincolnshire in the year 1736, and some time Member of Parliament for Peterborough. He possessed an ample fortune, which was inherited by the subject of this memoir.

Sir Joseph was born December 13, 1743. After a suitable preparatory education, he was sent to study at the University of Oxford. In every branch of liberal knowledge, he made great proficiency: natural history in particular engaged his fondest attachment, and at a very early age he conceived an ardent ambition to promote this great science, by those eminent exertions of which genius, fortune, and industry alone are capable.

At the time when Sir Joseph Banks began to cultivate the study of natural history, it was beginning to emerge from that neglect into which the exclusive pursuit of natural philosophy had, for the last hundred years, thrown it. Linnæus had produced for it an arrangement, and a nomenclature; and his pupils were travelling as naturalists, into every region of the earth, with an ardour not less zealous and intrepid than if they had gone to propagate a new religion, or to rifle the treasures of Mexican monarchs. In France, Buffon was beginning to render the study of natural history fashionable. In England, collections had been formed, which were eagerly consulted by every man of science, and praised with a warmth that might well encourage young men of fortune to seek the same approbation by the same means. The curiosity of naturalists was turned towards the new world, as containing ample treasures much less known, and more peculiar, than those which remained to be explored in the old.

To go the narrow round of the common fashionable tour, could appear but miserable trifling to a young man whose mind glowed with a love of scientific enterprise, and of the knowledge of nature. But to explore scenes unknown, and contemplate the beauty and majesty of nature where they had not yet been violated

lated by art, was a plan of travel worthy of the desire and the contrivance of virtue and genius.

It was with such views operating on his mind, that Mr. Banks, upon leaving the University of Oxford in 1763, went on a voyage across the Atlantic, to the coasts of Newfoundland and Labrador. That voyage was not without its difficulties and dangers; but it afforded a rich compensation in the new knowledge with which it filled his mind, and in those curiosities of natural history which it enabled him to collect.

The spirit of naval discovery, so eminently encouraged since the commencement of the last reign, soon presented a new opportunity by which Mr. Banks was engaged in a more distant and laborious voyage than that in which he made his first adventure of scientific inquiry. This was in the first voyage of Lieut. Cook, whom Government determined to send out for the double purpose of pursuing still further the discoveries which had been already made in the South Seas, and for the benefit of astronomy, and all the arts dependent upon it, to observe in the latitude of Otaheite an expected transit of Venus over the sun. In this voyage, young Mr. Banks resolved to sail with Cook. His liberal spirit and generous curiosity were regarded with admiration; and every convenience from the Government was readily supplied to render the circumstances of the voyage as little unpleasant to him as possible.

Far, however, from soliciting any accommodation that might occasion expense to Government, Mr. Banks was ready to contribute largely out of his own private fortune towards the general purposes of the expedition. He engaged as his director in natural history during the voyage, and as the companion of his researches, Dr. Solander, of the British Museum, a Swede by birth, and one of the most eminent pupils of Linnæus, whose scientific merits had been his chief recommendation to patronage in England. He also took with him two draughtsmen, one to delineate views and figures, the other to paint subjects of natural history. A secretary and four servants formed the rest of his suite. He took care to provide likewise the necessary instruments for his intended observations, with conveniences for preserving such specimens as he might collect of natural or artificial objects, and with stores to be distributed in the remote isles he was going to visit, for the improvement of the condition of savage life.

In the course of the voyage, dangers were encountered of more than ordinary magnitude. On the coast of Terra del Fuego, in an excursion to view the natural productions of the country, Mr. Banks and Dr. Solander had nearly perished in a storm of snow. After passing a night on land amidst the storm, they at last, and with much difficulty, made their way back to the beach, and were received on board the ship; but three of the persons who accompanied them were lost.

At Otaheite, where the Endeavour arrived on the 12th April, 1769, the voyagers continued three months, occasionally visiting the smaller contiguous isles, surveying the coasts, cultivating the friendship of the natives, collecting specimens of natural history, and making those scientific observations which constituted a principal object of the voyage. Quitting these islands, they next visited New Zealand and New Holland, where the same researches were as industriously pursued with considerable advantage; but the vessel unfortunately striking on a rock, injured it so much as to threaten the destruction of all on board. This occasioned a considerable injury to Mr. Banks's botanical collections, a great part of which were entirely destroyed. From this coast they steered for New Guinea. At Batavia, which they afterwards visited, every person belonging to the ship became sick except a sail-maker, an old man between seventy and eighty years of age, who got drunk every day. Seven died at Batavia, and three-and-twenty more in the course of six weeks after the departure of the ship from the harbour. At length, on the 12th of June, 1771, the survivors brought the vessel to anchor in the Downs, and landed at Deal.

Mr. Banks was received in England with eager admiration and kindness; and the specimens which he brought at so much risk and expense to enrich the science of natural history, placed him above every other person of rank and fortune in the age, both for personal qualities and as a benefactor to mankind. At court, among men of science and literature, he was equally honoured.

It was not one voyage, even though that voyage should be round the globe, and attended with infinite dangers, that could satisfy the inquiring mind of Mr. Banks; and although he did not accompany the new expedition of discovery that was sent out, as he at first wished, yet his directions and assistance were not withheld, so far as these could promote the success and usefulness of the voyage.

Iceland was soon after pointed out to Mr. Banks as fertile in natural curiosities, highly worthy of the inspection of one whose love of nature had led him to circumnavigate the globe. He therefore hired a vessel, and, in company with his friend Dr. Solander, visted that isle. The Hebudæ, those celebrated islets scattered along the north-west coast of Scotland, were contiguous to the track of the voyage; and these adventurous naturalists were induced to examine them. Among other things worthy of notice, they discovered the columnar stratification of the rocks surrounding the caves of Staffa,—a phenomenon till then unobserved

observed by naturalists. The volcanic mountains, the hot springs, the siliceous rocks, the arctic plants, and animals of Iceland, were carefully surveyed in this voyage. A rich harvest of new knowledge and new specimens compensated for its toils and expense.

After his return from Iceland, where he had much endeared himself to the inhabitants, Mr. Banks passed his time for some years, chiefly in London or at his seat in Lincolnshire, associating with men of letters and of rank, corresponding with men of science in the most distant parts of the globe, and unweariedly devoting his time and his fortune to the great purposes of scientific beneficence.

In the year 1777, when Sir John Pringle retired from the presidency of the Royal Society, the best friends of that Institution did not think that they could promote its dignity and usefulness better than by the election of Mr. Banks to fill the vacant chair. The honour was just such an one as a philosopher, who was at the same time a man of rank and fortune, might with laudable ambition desire. And it cannot be denied, that if the best judges had been desired to single out the individual who possessed the most eminent union of all those qualities which were best calculated to adorn the office and discharge its important duties, they could not easily have avoided fixing on Mr. Banks.

It was in the year 1778 that Mr. Banks entered upon the duties of the office of President of the Royal Society, and he immediately devoted himself with the most successful zeal to the faithful discharge of them. His attentions had the happy effect of procuring communications in the highest degree interesting and important, and of gaining an accession of persons of rank and talents to the list of members; as well as exciting the whole body to extraordinary diligence and activity in the proper pursuits of the Society.

The election of President is annual, but the Society considered itself too fortunate in its choice to think of changing him when the period of re-election returned. For the first three or four years of his Presidency, all went on in harmony and with extraordinary advantages to science: but, notwithstanding the zeal and assiduity with which Sir Joseph Banks (who had been created Baronet in 1781) devoted himself to the duties of his office, and notwithstanding the general success of his cares, discontents began to arise against him, even among the most eminent members of the Society. A variety of complaints, the fruit of misunderstanding and prejudice, were industriously circulated in regard to his conduct in the Presidency; it was said that Science herself had never been more signally insulted than by the elevation of a mere *amateur* to occupy the chair once filled by Newton. It was alleged against him, that he arrogated to himself the exclusive power of introducing new members to the Society, and by this means to fill it with ignorant and and trifling men of wealth and rank; while the inventor in art, the discoverer in science, and the teacher of knowledge, were driven away with scorn. It was said that his hostility to mathematical knowledge threatened to bring it into discredit and neglect in the Society; and it was sarcastically but unjustly observed, that "he possessed no scientific merits, but such as depended merely on bodily labour and the expenditure of money."

Such were the numerous complaints against the new President: but however respectable the persons from whom these complaints emanated,—however deep and general the impression which they made,—they have since been proved to have been exceedingly unjust.

When Sir Joseph Banks was raised to the Presidency, he found secretaries ambitious of assuming that power which alone belonged to his office, and that too great a facility was given to the admission of members: so much was this the case, that D'Alembert used jocosely to ask any of his acquaintance coming to England, if they wished to become members of the Society? and intimating, that if they thought it an honour, he could easily obtain it for them. Sir Joseph Banks, therefore, with wise and zealous attention to the true interests of the Society, resolved to use every just and honourable precaution to hinder the honours of its fellowship from being in future improperly bestowed. The first principle which he thought proper to adopt, with a view to this end, was, that 'all persons of fair moral character and decent manners, who had eminently distinguished themselves by discoveries or inventions of high importance in any of those branches of art or science which it was the express object of this Society to cultivate, ought, whatever their condition in life, to be gladly received among its members.' But, in the next place, he was of opinion, 'that of those who were merely lovers of art or science, and had made no remarkably ingenious contributions to their improvement, none ought to be hastily received into the Royal Society, whose rank and fortune were not such as to reflect on that society and its pursuits a degree of new splendour, as well as to endow them with the means of promoting its views on fit occasions by extraordinary expense.' It is impossible to deny that by these principles (and we know no better) has the conduct of Sir Joseph Banks been ever chiefly regulated in regard to the admission of new members. Against the specious philosophy of the theorist, the atheist, and the innovator delighting

delighting in mere change without regard of its consequences, Sir Joseph Banks had also to combat, and it was his duty to preserve the Royal Society from their intrusion.

At length, the mutual discontents between the President and a number of the members of the Society broke out into open discussion. In the course of its proceedings, Dr. Hutton, a name dear to science, was reduced to the necessity of resigning the office of Foreign Secretary, on learning that he had been accused of neglecting his duties. He however explained and defended his conduct, and a vote of the Society fully approved of his defence.

On the evening of the 8th of January, 1784, a resolution 'that this Society do approve of Sir Joseph Banks for their President, and will support him,' was moved in a very full meeting of the Society, by Sir Joseph's friends. It was strenuously opposed by several members, and in particular by Dr. Horsley; who having been interrupted in a speech of great force and argument, and being further irritated by a suggestion from Lord Mulgrave, arose and spoke with great eloquence, intimating a threat, that if he and his friends were disrespectfully treated by Sir Joseph Banks, they might probably *secede*, and form a rival society. 'Sir,' said he, in conclusion, 'we shall have one remedy in our power, if all others fail; we can at least *secede*. Sir, when the hour of secession does come, the President will be left with his train of feeble *amateurs*, and that toy (pointing to the mace) upon the table,—the ghost of that Society in which philosophy once reigned, and Newton presided as her minister.' The motion made in favour of Sir Joseph Banks was, however, carried by a great majority, and the dissention soon after subsided.

The Society now returned with new zeal and unanimity to the prosecution of their proper labours. These labours are before the public in their Transactions, which contain a multitude of discoveries of the highest importance.

All the voyages and travels that have been made during the last thirty years, have either been suggested by Sir Joseph Banks, or had his approbation and support. The African Association owes its origin to him; and Ledyard, Lucas, Houghton, and the unfortunate Mungo Park, all partook of that kind and fostering care which he extended to the enterprising lover of science. The culture of the bread-fruit tree in the West Indies, and the establishment of our colony at Botany Bay, originated solely with him.

It was not merely to the duties of President of the Royal Society, nor in the meetings of its members, that Sir Joseph Banks confined his sphere of usefulness; his purse was always open to promote the cause of science; and many a traveller, when in distant and inhospitable climes, has drawn on his bounty: and such

was

was the veneration in which his name was held, wherever it was known, that the draft was received like specie, and generously honoured by Sir Joseph Banks, though drawn without his permission.

At home, his Sunday evening converzationes were attended by persons the most celebrated in literature and science, whatever their rank in life; his valuable library was more accessible than that of any public institution; and he was always ready to give his advice, or to communicate his opinion, on every subject connected with science. Mr. Dibdin, in his Bibliographical Decameron, justly says, 'The incomparable library of Natural History of Sir Joseph Banks, in which, as in a wood of ancient growth and primeval grandeur, amidst insects of all hues, reptiles either nocuous or innocuous, and wild beasts that walk abroad or "love the lair," you may disport at ease, and solace yourselves without injury, and to your heart's delight. Such a collection should not be suffered to be dissipated; as neither years nor centuries can erase the name of the owner of it from the records of imperishable fame.'

For some years Sir Joseph Banks was much afflicted with the gout; and during the last few months his health was so much on the decline, that he expressed a wish to resign the office of President of the Royal Society. He was induced however to retain it until his death.

Sir Joseph in person was tall and manly, and his countenance expressive of dignity and intelligence. His manners were polite and urbane; his conversation rich in instructive information, frank, engaging, unaffected, and without levity, yet endowed with sufficient vivacity. His information was general and extensive. On most subjects, he exercised the discriminating and inventive powers of an original and vigorous mind; his knowledge was not that of facts merely, or of technical terms and complex abstractions alone, but of science in its elementary principles, and of nature in her happiest forms.

Sir Joseph Banks was a member of the Privy Council, and a Knight Grand Cross of the Order of the Bath. As he has died without issue, the Baronetage has become extinct. He has left the whole of his property to Lady Banks, during her life, with the exception of some few legacies, and a pension of 200*l.* per annum, to Mr. Brown, his secretary. To the nation he has bequeathed his valuable library, and a name that it will never cease to cherish while science is encouraged or respected.

VIII. *No-*

VIII. *Notices respecting New Books.*

Elementary Principles of Carpentry; being a Treatise on the Pressure and Equilibrium of Beams and Timber Frames; the Resistance of Timber; and the Construction of Floors, Roofs, Centres, Bridges, &c. with practical Rules and Examples. To which is added, an Essay on the Nature and Properties of Timber, the Method of Seasoning, the Causes and Prevention of Decay; with Descriptions of the Kinds of Wood used in Building: and numerous Tables of the Scantlings of Timber for different Purposes, the Specific Gravities of Materials, &c. By THOMAS TREDGOLD. 4to. pp. 250, with nineteen 4to and three folio Plates.—Taylor. Price 1*l.* 4*s.*

THE whole art of Building being dependant on the same theoretical principles as the art of Carpentry, the object aimed at in this work, cannot be regarded with indifference. Carpentry is in this work defined to be, "the art of combining pieces of Timber, for the support of any considerable Weight or Pressure;" a definition which informs us, that the theory of carpentry must be sought for in the mechanical sciences, and we accordingly find that the same has, since the time of Galileo, been more or less cultivated, by the most eminent mechanical philosophers.

The design of the work before us, will be well shown by the following extract from its preface; "There is," says the Author, "perhaps no class of the mechanical arts, so directly capable of receiving improvement from the researches of Men of Science, as those connected with Building; neither is there any that have received a greater share of their attention; but these researches have not benefited practical Men, in proportion to the extent to which they have been made, as they are either given in Works that are inaccessible to the bulk of Men of Business, or so completely scientific, as to be almost useless to any but Men of Science themselves. It has been my object to make these researches the ground-work of a practical Treatise."

In noticing a Work like the present, which abounds in new and important applications of Science, we can only point out the most prominent features: in doing so we shall notice some parts, wherein the Work seems to admit of useful improvement: it is divided into ten Sections.

The *first* Section treats of the principles of Equilibrium and Pressure of Beams and Timber Frames; with examples of their application in the practice of Carpentry: the example which is given, in the case of the common hoisting Crane, makes us regret, that the Author has not been less sparing of them.

In considering the doctrine of the equilibrium of a system of

Framing,

Framing, we are glad to observe, that the *curve of equilibrium*, is considered to coincide with the *neutral axis*, as it must do; also that this curve, is very properly determined from the nature of the Load. In these points the Author has followed the best examples, but by no means the most common ones. A few remarks found at the end of this Section, are worthy of being imprinted on the memory of every young Student.

The *second* Section presents matter of high value: it is on the Resistance of Timber; whereon we find a just distinction made, between the *strength* and the *stiffness* of Timber; and the latter is shown to be, the only kind of Resistance that it is of use to consider. The resistance to Tension, the resistance to cross Strains, and the resistance to Compression, are each considered; with practical Rules, and numerous Tables of Experiments, many of which are new.

The *third* Section is on the Construction of the Timbering for *Floors* of Rooms: hereon, the Author has shown the futility of the common method of Trussing Girders: which embraces the absurdity, of an attempt to strengthen a Beam without adding either to its dimensions, or the quality of its materials.

The Laws of Resistance are here made to furnish practical Rules, for calculating the dimensions of the different Floor Timbers: and at the end, a curious Floor is described, which was executed at Amsterdam, for a Room of 60 feet square: the Floor altogether, only $4\frac{1}{2}$ inches thick, and yet so bonded together, as to be sufficiently strong.

The *fourth, fifth* and *sixth* Sections are, respectively, on the Construction of *Roofs*, *Domes* and *Partitions*, with designs for different kinds of each, and rules for calculating the dimensions of their Timbers. It has been an opinion, that the Italians are better Carpenters than the French; two Roofs that have been executed in Italy, and are here described amongst the Examples, tend to confirm this opinion; but although such Roofs differ in principle, from those particularly described and calculated by the Author, he has omitted to give the proper proportions for their Timbers, which would have been valuable to the Student. Another of the Examples, describes a Russian Roof of 235 feet span! of which the design is very good.

The *seventh* Section, treats very fully of the temporary *Centring* for Stone Arches, and on the methods of computing the pressure of the Arch Stones, and strength of centring necessary for effectually supporting them: two original designs for Centres are here given, contrived according to the principles of construction pointed out by the Author.

The *eighth* Section is on the construction of *wooden Bridges*, and is by far the most complete Treatise on this subject, which is to be found in our language: we were glad to find here, in opposition to certain wild schemes which have been set afloat, that the extent of the span of wooden Bridges, is perfectly limited by the nature of the Material.

The *ninth* Section treats on *Joints, Scarfing* and *Straps*; on which many important and practical maxims and methods of construction are set down and shown.

The *tenth* Section contains matter, which we anxiously hope that the Author may find encouragement to enlarge upon, in a future Edition, or else in a separate Work: it is, on the Nature and Properties of the *Timber* furnished by different species of Trees, and here occupies 80 pages, of truly valuable details, on the nature of Timber, with reference to the Ages of the Trees, and the periods of the year in which they are felled: on the methods of *Seasoning*, the causes of Decay, and methods for its prevention: the whole preceded, by a simple yet scientific classification of the different kinds of Wood, as exhibited in their grain or structure, followed by a description of 22 useful kinds of Wood.

The Laws of Seasoning or drying, are here laid down, showing the rates at which pieces of different sizes become dry, and enforcing the advantages derivable, from reducing Timber into the smallest Scantling that its uses will admit, so soon as the Tree or its larger divisions, have become sufficiently seasoned to prevent splitting.

Several Tables of the weight of a cubic foot of Timber, in different stages of drying, are collected: but as the shrinkage has been omitted to be observed and recorded, in all of these except the first in p. 160, our Author has not been able to deduce from these Tables, any satisfactory mean loss of weight;—we find the mean of all the experiments on different Woods mentioned in these Tables, to give 24·4 per cent. as the loss in drying, or very near $\frac{1}{4}$ of the whole weight; but for the above and other reasons drawn from experience, the average degree of loss of weight which has been sustained, by Woods fit for the Joiner's uses, is in p. 163 stated by our Author, at $\frac{1}{3}$ of the whole weight. Resinous Woods may be presumed to lose less than others, and probably, each kind of Wood may approximate to some particular degree of loss; the whole subject requires a closer experimental investigation, and this we hope that the Author may be enabled to supply, in a future Edition.

Two species of English *Oak* are pointed out by our Author, and one of them shown to possess very valuable properties, compared with the other: Gentlemen intending to plant for future Timber, or those concerned in Naval Architecture, cannot too soon

soon be made acquainted with these distinctions, which hitherto appear to have been overlooked, or unattended to.

Copious new Tables of the *Scantlings* or dimensions of Timbers, proper for all the Carpenter's uses, are given near the end of the volume; followed by a synoptical Table, of properties of the various species of Wood, and a Table of Specific Gravities; rich in all those Articles which concern the Builder.

The Work is arranged with such a regard to method, as is highly creditable; having a full Table of Contents, a copious Index, and such numerous references in the body of the work, and in the Plates, as will render them easy and pleasant for the frequent reference of the Student and the practical Man; to the latter of whom, whether in the higher rank of an Engineer or an Architect, or whether in the somewhat humbler capacity of a Builder or Carpenter, we can confidently recommend this Work, as one of sterling merit and utility.

The drawings are by Mr. R. Tredgold, the Author's younger Brother; which, as well as the Engraving by Mr. Davis, do much credit to these Artists; and the whole is well got up.

Medical Notes on Climate, Diseases, Hospitals, and Medical Schools, in France, Italy, and Switzerland; comprising an Inquiry into the Effects of a Residence in the South of Europe, in Cases of Pulmonary Consumption; and illustrating the present State of Medicine in those Countries. By James Clark, M.D. 8vo. pp. 246.

The leading object of this work is one of very considerable importance. A residence in the south of Europe has been long regarded as the only hopeful curative for that disease which makes annually such havoc among the inhabitants of this northern climate, pulmonary consumption. But neither are all places in the south of Europe alike healthy, nor are all constitutions equally suited to the same places. To have distinct information as to what particular situation deserves in each case a preference over others, is obviously therefore a matter of the first importance: yet, strange to tell, there is no branch of medical practice in which physicians are more in the dark, or patients disposed of more at random. About half a century ago Montpelier was the place almost invariably recommended in cases of consumption, and continued to be so for many years; so that its name came to be commonly applied as a characteristic epithet to places supposed to be particularly healthy. In later times, however, it has been discovered that Montpelier is not suited at all to such invalids, and in winter is one of the worst imaginable; so that, now, no English physician ever thinks of prescribing the air of Montpelier for a consumptive

consumptive patient. The recommendation of Smollet brought Nice into fashion next; but the fame of that place vanished also as the number of tombs in the *Croix de Marbre* * increased. Various other places got subsequently into repute, as Marseilles, Hieres, Pisa, &c. But the preference given them respectively, being founded not on experience, but on theoretical deductions from latitude, vicinity of mountains, and so forth; it is not surprising that we should have only to record a succession of disappointed hopes. It seems now confessed, that on this subject the minds of English practitioners are quite undecided. "I had abundant proofs of this," says the author of the work before us, "in the contradictory advices which I found some of our most celebrated physicians had given to the invalids I met with; some of these being sent to the South of France indiscriminately; others being recommended to Marseilles; others to Hieres; many to Nice; while not a few of their medical advisers candidly avowed their ignorance of the most desirable residence, and left the choice to the discretion of their patients."

To assist in supplying the blank in our information on this subject, is the design of the work now before us, which the author modestly desires to be considered "literally what it is designated, as detached *Notes* on a few of the very numerous and important objects presented to his view" in the course of two years residence in different parts of the South of Europe. The places which Dr. Clark treats of are Marseilles, Hieres, Nice, Villa Franca, Pisa, Rome, Naples, Lausanne, and Geneva. He gives first a short topographical account of each place, but limited to those circumstances which are interesting in a medical point of view; secondly, observations on its climate; and thirdly, remarks on the diseases in which it seems useful or injurious, founded on these observations, and on a knowledge of the ailments to which the inhabitants are most liable.

The information which the author furnishes on these heads is extremely valuable. His remarks are acute and sensible; and have uniformly a strict reference to facts, to the exclusion of all hypothetical speculation. We extract his general conclusion, which the reader will find amply verified by a perusal of the details on which it is founded.

"I have now brought to a conclusion the observations I had to make concerning the climates of those situations most frequented by consumptive patients in France and Italy; and I hope I have put medical men in possession of some information that may at least assist them in making up their minds on the propriety of sending their patients to these climates, and also on

* The English burying-ground at Nice.

the selection of the most advantageous place of residence. I think I have shown that little is to be expected from sending them to the South of France, or Nice. Without having adduced equal evidence on Naples, I am nevertheless of opinion that it is as bad as either. The choice, then, as far as my observation goes, appears to lie between Rome and Pisa. Future observations must determine which of these deserves the preference; and, perhaps, whether the benefit to be derived from a winter's residence at either, is sufficient to repay the inconveniences attending so long a journey, when the disease has made any progress.

"There are two principal circumstances in considering a place of residence in a medical point of view—First, the general nature of its climate, and, secondly, the effects of this on disease. The first may be ascertained without much difficulty. The second is attended with very considerable difficulty, requires much cautious observation, and the experience of a far greater number of cases than generally come under the observation of any individual. It is on this point that much information is still wanted, as it is by experience alone that the question of the propriety or impropriety of sending our consumptive patients abroad, can finally and for ever be set at rest. To repeat what I have before observed—I am not without hopes that these remarks may have at least this utility, namely, of inducing the medical men who have visited, and who are annually visiting, these climates, to make their observations public. I shall only further add, that if from future observation I find that any opinion I have given in these pages has been too hastily formed, or is contradicted by further experience, I shall take the earliest opportunity of making it known, as my only object is to ascertain the truth.

"To sum up in few words the opinion I have formed from all the observations I have been enabled to make on the effects of climate in pulmonary consumption—It appears to me, then, that the change of our English climate for a residence in the milder ones of the south of Europe, is much more beneficial as a preventive of the disease, than, I fear, it will ever be found as a means of cure of it when formed. In the young and growing members of delicate, scrophulous, and consumptive families, however, continued for some winters during that age when the body is attaining its full growth, and when catarrhal affections are attended with the greatest danger, it may have great influence in checking the tendency to hereditary disease. Even when tubercles already exist in the lungs in a state of irritation, a residence for some years in a mild temperature, together with the adoption of a proper regimen, may be the means of allaying the irritation, and consequently of preventing the suppuration of these tubercles.

cles. By a little future attention in guarding against the known exciting causes of inflammation, these may long, and perhaps for life, remain in a state of quiescence. By such measures, and a strict adherence to the other means most proper for strengthening the constitution, and by acquiring habits calculated to inure the body to the cold and inequalities of its native climate, (among which I consider the habitual use of the cold bath as pre-eminent,) I have no doubt that many lives might be saved *. When, however, suppuration has actually taken place in the substance of the tubercles, my opinion is, that little or no benefit is to be expected from a change of climate in the cure of the disease; and further, that by the great and numerous inconveniences and discomforts of so long a journey, the fatal termination of it is more frequently accelerated than protracted. That this is very frequently the case in the very advanced stages of the disease, such as I have frequently met with on the continent shortly after their arrival from England, I have no manner of doubt.

"There is still a circumstance connected with the object of this essay, on which I must beg leave to say a few words, I mean the state in which many consumptive patients are sent abroad. In the remarks I am about to make, I beg explicitly to state that I have no intention to censure any one. I am aware of the difficult situation in which a medical man is placed, when called to decide upon a point where he must often find his information deficient, and where the wisest and best-informed may err.

"During my residence on the continent, I have had frequent occasions to remark with surprise the very advanced stages of the disease in which many of our consumptive patients were sent abroad. This is the more remarkable, as, however medical men may differ about the propriety of sending such patients abroad in the earlier, there surely ought to be no question about its impropriety in the latter stages. For my own part, I have seen enough to convince me that it is not only a very useless, but often a very cruel thing to banish such patients from all the comforts of home, and send them forth to undertake a long journey through a foreign country, deprived probably of all they hold dearest to them, and without those thousand nameless comforts by which the watchful care of friends may cheer even the last

* See Author's Thesis "De Frigoris Effectibus in Corpus vivum," published at Edinburgh in 1817, for detailed observations on the influence of the cold bath in strengthening the body and enabling it to bear cold.

It is the opinion of some medical men, that cold alone is sufficient for the production of tubercles in the lungs, and certainly it is a common cause of inflammation and suppuration of them.—Dr. Broussais's observations of the comparative rarity of pulmonary consumptions among the French troops after their entering Italy is deserving of remark.

period

period of a hopeless disease. The medical man who reflects on the distresses that such patients must be liable to during such a journey, arrested perhaps in their progress by the increase of some of those symptoms which attend the advanced stages of consumption,—in very indifferent accommodations, probably, and far from any medical advice in which they can confide,—will surely long hesitate ere he condemns the fated victim of this remorseless malady to the additional evils of expatriation: And his motives for hesitation will be increased, when he considers how often the unfortunate patient sinks a prey to his disease long before he reaches the place of his destination; or, at best, arrives at it in a much worse condition than when he left England, and doomed, shortly, to add another name to the long and melancholy list of his countrymen that have sought out, with pain and suffering, a distant country, only to gain in it an untimely grave!

"In the foregoing observations I have perhaps viewed matters in the worst light; but it is the duty of the physician, in giving his advice in such cases, to keep in mind the possibility of such occurrences. This is in a more peculiar manner necessary with females, upon whom all the inconveniences of travelling fall with double severity. To those acquainted with travelling in many parts of the continent, it is not necessary to enter into particulars on this subject; and those who are not, may rest assured of the accuracy of what I state. That I do not exaggerate, and to show that these opinions were formed from actual observation, I shall state a few of the cases that came to my own knowledge in one season.

"The first was that of a young man who was carried from Bourdeaux the greater part of the way on men's shoulders. When he reached Aix, about eighteen miles from Marseilles, he could be carried no further. An English physician, then at the latter place, was immediately sent for, and arrived in time to see him expire! This is an extreme case, I grant, but shows how far the eager hopes of relations will lead them in such cases, if not informed of their error. Several other patients came to my knowledge, the same season, who never reached their destination. One died at Paris; another at Tours; and a third on the way down the Rhine.* One young man reached Hieres with difficulty, and lived ten days. One lady left England in December, to linger a few weeks under the cloudless skies of Nice, where she died in the end of February or beginning of March. What a recompense for such a journey over the roads of France,

* It is no unfrequent thing to observe in the newspaper obituary reports, the death of a person at Paris, or some other place, 'on his way to the South of France.' This is some consumptive patient sent abroad probably in the last stage of his disease, to have the short career he had to run shortened, and to die long ere he reached the place of his destination.

and

and with the discomforts a lady must encounter in many of the smaller inns of that country!

"Should what I have just related reach the eye of the relations of any of the individuals whose cases I have alluded to, I entreat them not to think I wish to excite a painful recollection. I have sympathized with the affliction of several of them at the events I have mentioned; and surely they will not be adverse to my making the only use of this melancholy experience that it is susceptible of, namely, to prevent others of their countrymen from suffering under similar circumstances. It is from such experience being generally lost to all but the sufferers, that I have had to record so many instances of the kind here. It is surely the duty of the physician to caution the relations of the patient from indulging hopes which he knows are soon to be cruelly disappointed, and that, perhaps, under circumstances which greatly aggravate the calamity.

"I admit that it is natural for the relations to feel a satisfaction in doing every thing that presents even a prospect of relief, or of delaying as long as possible the event which cannot be prevented; and change of climate is often considered in this light—as the *anceps remedium.* But the relations should surely be informed, in such cases, that the period had passed when a change of climate presented any prospect of advantage; and that, by dragging the unfortunate victim of this terrible disease to the distant shores of the Mediterranean, they are hurrying on the occurrence of the event they vainly hope to keep off. Patients in the *advanced* stage of consumption would act more wisely in trying the effects of the milder parts of our own island; and where that fails, they will pass the winter months with more comfort, and I believe with as much prospect of advantage, in rooms kept at a graduated temperature, amidst friends and all the comforts of home, as they would do by a residence at most of the places frequented abroad,—still taking into the account the inconveniences of the journey thither. This remark is more particularly applicable to females, whose habits are much more congenial to such a mode of living, and who suffer in a far greater degree all the inconveniences and hardships of travelling."

Voyages dans la Grande Bretagne, entrepris relativement aux Services publics de la Guerre, de la Marine, et des Ponts et Chaussées, en 1816, 1817, 1818, *et* 1819. Par M. Ch. Dupin, Membre de l'Institut Royal de France, &c. *Partie Militaire.* 2 vols. 4to. avec Planches folio. Paris 1820.

Among the numerous French travellers who have recently visited this country, none has been more honourably distinguished than the author of the volumes before us. Of various and profound

found information; habits of keen observation and persevering inquiry; sensible, candid and ingenuous; M. Dupin has brought with him exactly those qualities which are best fitted to enable him to form a just appreciation of the merits of our institutions, and to recommend them to the notice of his countrymen. The highly favourable impression left upon us by the volume which he published in 1818, "Sur la Marine, et les Ponts et Chaussées de France et d'Angleterre," made us turn with avidity to two additional volumes embracing the same course of inquiry; and it is with pleasure we have to record the increased satisfaction with which we have perused this continuation of his valuable labours.

The present volumes are devoted to the military branch of our establishments. The first relates to the organization of the army and ordnance; and is especially of a political nature. The second treats of our military schools, our arsenals, our forts, and other works of defence; and is accompanied with an atlas of plates in folio, satisfactory enough in point of accuracy of drawing, though inferior in every other respect to the productions of our own school of engraving. In this part we meet with a good deal of matter which is strictly of a scientific nature; and in some of our future Numbers we shall take an opportunity of bringing what is of this description more particularly under the notice of our readers.

A Treatise on Heat, Flame, and Combustion. By T. H. Pasley.

This is a very adventurous production. The author avows that he has broached opinions in these pages which "will appear to the chemist and philosopher not only *perfectly new*, but *the very contrary* of what have been *universally admitted*, and on which *the fabric of science at present is built*." Mr. P. however entreats a dispassionate investigation of the principles he has laid down, and this on a ground which might justify a higher tone of challenge. "So far as they are sufficient to account for the phænomena of nature *without any exception whatever*—so far only" does he ask that they should be considered "worthy of attention."

The inquiry embraced by this new theory, is of too general a character to admit of any justice being done to it within the space to which our analytical notices of new works is restricted. We must therefore content ourselves with referring the reader to the work itself, which he will find at least ingenious in its conceptions, if not invincible in its conclusions, and withal clearly and well written. The following outline of the heads of the work is furnished by the author himself:

"Natural bodies not objects of perception; and their existence known

known only by the necessity of matter existing externally, in order to produce those mental effects which are all that human knowledge consists in.—Ideas only being perceived, no argument in favour of the non-existence of matter.—All the senses excited by the same elementary causes.—No more elements in Nature, than the sum of simple ideas, which a single sense is accessory to the formation of.—Heat not a property of matter, but state of the mind.—Flame the only heat-exciting cause in Nature.—All ponderable bodies whatever contain flame as their gravitating base.—The animal body contains the heat-making cause within it.—Flame attracts elements from bodies, but communicates none.—Ignition, the state of a body the gravitating base of which is unsaturated with imponderable elementary matter.—The attractive power of the flame of fire, that which renders bodies unsaturated, and prepares them for the decomposing process of combustion, by means of oxygen gas.—Combustion, the act of giving out the internal flame of decomposable bodies.—Carbon, the necessary consequence of the carbor of the combustible when set free, uniting with some one peculiar chemical imponderable element.—Heating a body, the act of rendering its gravitating base deficient of elementary matter; and cooling, that of recovering the deficiency.—Radiation the act of flame, or a body in deficient state depriving the surrounding medium of elementary matter.—Expansion, the result of elementary matter occupying a larger space in a body when the opposite kind of elementary matter is attracted from it by flame, or the carbor of fire."

Notes on Rio de Janeiro, and the Southern Parts of Brasil, taken during a residence of ten years in various parts of that country; embracing agriculture, commerce, and mines; with anecdotes illustrative of the character, manners and customs of the inhabitants. By Mr. John Luccock.

A Tour in Normandy, undertaken chiefly for the purpose of investigating its architectural Antiquities, illustrated with numerous Engravings. By Dawson Turner, Esq. F.R.S. &c. 2 vols. royal 8vo.

A Series of Engravings from Drawings made in Savoy, Switzerland, and on the Rhine; accompanied with descriptive Letterpress. By John Dennis, Esq.

Narrative of a Chinese Embassy from the Emperor of China, Kang Hy, to the Khan of the Tourgouth Tartars seated on the Banks of the Volga, in the years 1712, 1713 and 1714, published at Pekin by the Emperor's authority. Translated from the Chinese by Sir George Thomas Staunton, Bart. LL.D. F.R.S.

Practical Observations on the Symptoms, Discrimination and Treatment of some of the most common Diseases of the lower Intestines and Anus. By John Howship, Member of the Royal College of Surgeons, &c.

A Work on Medical Jurisprudence. By Dr. J. Gordon Smith.

IX. *Proceedings of Learned Societies.*

ROYAL SOCIETY.

Dr. Wollaston has been appointed President *ad interim* of the Society, until the election of a successor to the late lamented Sir Joseph Banks.

Sir Humphry Davy is expected to be the new President. The Society could not make a choice more acceptable to the friends of science.

ASIATIC SOCIETY.

On Saturday evening, the 13th Nov. 1819, a meeting of the Asiatic Society was held at the Society's apartments in Chouringhee, the Marquis of Hastings in the chair.

The Committee elected for the present year consists of the Bishop of Calcutta, Sir E. H. East, Colonel Hardwicke, W. B. Bayley, Esq. Vice-presidents; Messrs. G. Swinton, H. Mackenzie, J. Bentley, J. Atkinson, G. J. Gordon, Rev. J. Parson, Rev. Dr. Carey, Dr. Wallich, and Capt. Roebuck, Committee of Papers: Captain Lockett officiates as Secretary during the absence of Mr. Wilson from the presidency.

A letter was read from Dr. MacCulloch, of Baltimore, who some time ago presented to the Society his ingenious Essay on the Aborigines of America. He has been induced to make some inquiries interesting in the history of the human family, and of especial use in the particular investigation he has long been employed upon, which he has addressed to the members of the Asiatic Society. He conceives it highly desirable to obtain further descriptions, and, if possible, drawings of the Morias (Hindee, *Murê*) and other monuments to be found in various islands of the Pacific Ocean, particularly those of the Friendly, Society, Sandwich, and Eastern Islands. The island of Tinian, one of the Marianne Islands (see La Perouse, and subsequent navigators), contains some singular monuments which Dr. MacCulloch says are entirely unknown to him, except from the very brief description given of them by Lord Anson in his voyages*.

* The Jesuit Gobien has published a particular history of the Ladrones, or Marian Islands. See also the Supplement of De Brosses, ii. 492, for an ample account of the Ladrones.

The

The deities worshipped in the islands of the Pacific he recommends as deserving of investigation, no particular account of them having hitherto appeared.

Dr. MacCulloch observes, that Gen. Valancy has stated, in the 87th page of his Irish Grammar (Dublin 1781), that the Persians, instead of intercalating, as is customary, one day every four years, to adjust their years with the course of the sun, regarded no hours until they amounted to 30 days, which does not take place in less than 120 years. These thirty days were then added to the year (making a year of 13 months), which year was called *Bihreck.* This mode of intercalation is said by Dr. MacCulloch to bear a singular resemblance to the method of the Mexicans; and he is therefore anxious to ascertain, through the medium of the Society, whether there are any other parts of an astronomical system to be found among the Persians, to which such a mode of intercalation would seem properly to belong.

At the last meeting, Mr. Palmer presented to the Society a marine production, called the *Soonge* plant, obtained on the coast of the newly acquired island of Singapore. Colonel Hardwicke, one of the most distinguished naturalists of this country, has favoured the Society with a description of it. He observes, that in the *Systema Naturæ* of Linnæus, it belongs to the natural class *Vermes*, and to the genus *Spongia*. In its form it resembles that kind of drinking-cup called a goblet, with a well defined base or root, a cylindrical stem, and a capacious bowl or cup. Its texture is non-elastic, composed of numerous tubes or anastomosing cells; the external surface or epidermis not thicker than the coats of the tubes, and covered with innumerable stellated pores, which under a lens appear to be the mouths of as many vessels, and ramifications of the internal structure. The root is formed of several irregular perpendicular shoots, in their origin apparently cellular, but enlarged by an accumulation of earthy, sandy particles, and broken in shells, and of rather a fragile texture. The bowl is circular or sub-conical, with several nodes or protuberances, and covered both within and without with circular pores of various diameter, the mouths of which are closed with fine cottony fibres radiating from the circumference to the centre; and the same fibrous substance extends over the surface of the bowl, giving to it, when viewed under a lens of common powers, a tomentous appearance. The stem is cylindrical, of proportional height and thickness, and of the same cellular substance as the bowl.

The foregoing description is taken from a specimen something larger than the one in the Society's museum, the dimensions being as follow: the greatest diameter of the bowl is at its brim 17 inches; the smallest at the bottom $7\frac{1}{2}$, in the middle $12\frac{1}{2}$; the

 circum-

circumference of the stem 17, but near the root is a tumescence increasing it to a larger dimension. The cavity is capable of containing 36 quarts.

Colonel Hardwicke further observes, that in an essay on British sponges by George Montague, Esq., published in the 2d volume of the Transactions of the Wernerian Society, is described a sponge, under this specific denomination of *Scypha*, and this sponge in its characters has affinity to the subject here mentioned. The Indian species, however, is gigantic in all its parts, compared with *Spongia scypha*, and a more appropriate specific distinction may perhaps be given to this, in denominating it *Spongia patera*, The goblet sponge.

Several articles have been selected as presents for the Edinburgh College Museum, in conformity with the resolution passed at the last meeting. They will be forwarded by the Marquis of Hastings*.

Some beautiful models in ebony, of the instruments used by the natives of India in manufactures and husbandry, were laid before the Society.

Colonel Fitzclarence presented, through the medium of the most noble the President, his Travels through India and Egypt to England.

A copy of *Recherches sur la Découverte de l'Essence de Rose*, par M. Langles, was also received.

The Narrative of a Journey from Soobat'hoo to Shipkè in Chinese Tartary, by Lieut. A. Gerard, of the Bengal Infantry, was presented by Mr. Metcalfe, at the desire of Sir David Ochterlony. The journey occupies a period from the 22d of September to the 22d of November 1818.

Soobat'hoo lies in lat. 30° 58′ and 77° 2′, and is 4,200 feet above the level of the sea. On the 26th September Lieut. Gerard reached Gujyndee, in Nawar, a small district of Busehur, famous for its numerous iron mines. It contains but few spots fit for cultivation, and the inhabitants, who are miners, live chiefly by their trade in iron. They work the mines only about three months in the year, and commence digging them in March, after the snow has sufficiently melted.

* The collection of natural curiosities at the College Museum is on the increase, and ere long promises to be one of the most scientific and beautiful in Europe. The classical zoological cabinet of Dufresni of Paris has been purchased for a great sum by the College, and is now on its way to Edinburgh. The sale of Bullock's Museum in London was attended by a gentleman on the part of the University, and he is understood to have made purchases to a considerable amount. Every month collections and specimens are pouring into the Museum from different parts of the world, as donations by those who feel an interest in the advancement of natural history, and in the Edinburgh Museum.

On

On the 2d of October he pitched his tent on the crest of the Brooang Pass, 15,095 feet above the level of the sea. It is situated in lat. 31° 23′ and long. 78° 12′. The country is secluded, rugged, and barren, and the villages very thinly scattered, not more than one or two occurring in a stage. The inhabitants wear a frock of white blanket, often twofold, reaching down to the knees, and having sleeves, a pair of trowsers and girdle of the same, a cap of black blanket like a bonnet, and shoes of which the upper part is woollen, and the sole alone leather. The people are very dark and extremely dirty. The villages are generally large, and the houses spacious, and even elegant. They are built of stone or wood, and either slated or flat roofed; the last is most common. The temples of the Deotas (Delties) are magnificent, and adorned with a profusion of ornaments. In Koonawur the crops are extremely poor; and in time of scarcity small pears and horse chesnuts, after being steeped in water to take away their bitterness, are dried and ground into flour. Bears are very numerous; and the dogs are of a large ferocious breed, covered with wool, and generally chained during the day, otherwise it would be dangerous to approach a village. The language differs much from the Hindee, most of the substantives ending in *ing* and *ung*, and the verbs in *mig* and *nig*.

At Rispé he first saw Lamas, and near that place he passed several tumuli, from 10 to 40 feet in length, two broad, and about four high. They are constructed of loose stones without cement, and upon their tops are numerous pieces of slate of all shapes and sizes, carved with strange characters. They are called *Mané*, and are erected over the graves of the Lamas. There are invariably roads on each side of them; and the natives, from some superstitious custom, always leave them on the right hand, and will rather make a circuit of half a mile than pass them on the wrong side.

The course from Brooang to Shipkè had been about N. E. Lieut. Gerard arrived at the latter place on the 12th of October.

Shipkè is a large village in the district of Rongzhoong, under the Deba or governor of Chubrung, a town, or rather collection of tents, on the left bank of the Sutluj, eight marches to the eastward. The houses are very much scattered, and are built of stone with flat roofs. There are gardens before each, hedged with gooseberries, which give them a neat appearance. Lieutenant Gerard and his brother were the first Europeans the inhabitants had ever seen. The Tartars pleased them much; they have none of that ferocity of character so commonly ascribed to them; they have something of the Chinese features, their eyes are small; they go bareheaded even in the coldest weather, and have their hair plated in a number of folds, ending in a tail two or three feet

feet long. Their dress consists of a garment of blanket, trowsers of striped woollen stuff resembling tartan, and stockings or boots of red blanket, to which are sewed leather shoes. Most of them wear neck-laces, upon which are strung pieces of quartz or bone. They have also knives in brass or silver cases, and all carry iron pipes of the same shape as those used by the labourers at home. The women, whose dress resembles that of the men, literally groan under a load of ornaments, which are mostly of iron or brass, inlaid with silver or tin, and beads round their necks, wrists and ancles, and affixed to almost every part of their clothes. While at Shipkè the Chinese officers, of whom there are several to regulate the affairs of the country, brought to Lieut. Gerard and his brother 16 seers of flour, as a present. A short time afterwards the principal officer showed them a long piece of parchment, written in a character supposed to be Chinese, and said that it was an express order from the Garpan of Garoo, under whose authority the debas are, prohibiting strangers from entering the country. He at the same time observed, that Lieut. Gerard had so many people with him (nearly 100) that he could not oppose his progress, but it would cost him his head if he afforded him the means of going on, and therefore he would not supply him with provisions.

The latitude of Shipkè is 31° 48′, the long. 78° 48′. The people are affable and good-natured. Lieut. Gerard exchanged a gold button for a goat, which he took with him to Soobat'hoo. The wool was extremely fine, and almost equal to what is used for the manufacture of shawls. He was informed that the best was procured further to the eastward near Garoo, or Gartop, which is the famous mart for wool, but its fineness seems to depend almost entirely on the elevation and coldness of the climate. At Soobat'hoo, 4200 feet above the sea, the wool is little better than in the plains of Hindoostan; but it gradually grows finer as you ascend; and in Koonawur, where the villages are more than 8000 feet high, it is fit for making coarse shawls. Gartop is said to be eleven marches from Shipkè.

The traders who cross Guntung-pass put on so many clothes to defend themselves from the excessive cold, that they can scarcely walk. They wear a long garment with sleeves made of sheep skin with the woolly side inwards, trowsers and stockings of the same material, a kind of rude gloves of very thick woollen stuffs, and caps and shoes of blanket. They likewise occasionally wrap three or four blankets round them, and thus accoutred set out on their perilous journey. No herbage is to be met with for two days. Leh or Leo is the capital of Laduk, and about midway between Cashmeer and Garoo.

The Wangtoo J'hoola, a rope bridge over the Sutluj, consists

of

of five or six cables close together, upon which is laid half a hollow fir tree, about two feet long, with pegs driven through it to prevent its coming off. From this hangs a loop of three or four ropes, in which the passenger takes his seat. It is pulled across by two pieces of rotten twine, that from constantly breaking occasions this to be a tedious mode of transporting baggage. The conveyance is a pretty safe one, but greatly alarming to a novice, for the J'hoola is elevated 20 feet above the stream, which runs with great rapidity and a deafening noise.

The Sutluj has a variety of names, being called Sutlooj, Sutroodra, Sumudrung, Sampoo, Langa hing, Kampa, Muksung and Zung Tee, in different parts of its course. Sutroodra is the most commonly used, by which name it is known from its source to the plains. By the accounts of many people who have travelled along its banks to its source, it issues from lake Rawunrud, called also Rawathud and Lanka, which was confidently said by every body Lieut. Gerard saw that had been there, to communicate with Mansurowur, although Mr. Moorcroft could not discover the outlet of the latter lake. The circuit of Rawunrud is represented as seven days' journey, but it is most likely both lakes were included.

But we must abstain from further notice of this interesting and valuable paper, as it will probably be included in the fourteenth volume of the Researches now in the press.

Mr. Wilson presented a copy of his Sanscrit and English Dictionary to the Society.

Several sculptured antiquities were received from Dr. R. Tytler, and amongst them a curious black stone, with three female figures upon it, presented by Major Thomas, of the Bengal Infantry.

X. *Intelligence and Miscellaneous Articles.*

PREVENTION OF FORGERY.

THE greater part of our readers must have seen in the newspapers, the Petition of Mr. Tilloch to both Houses of Parliament, setting forth that the Plan adopted by the Governor and Directors of the Bank of England for printing their new issue of Notes, and ascribed by them to another person, had been by him laid before the Bank so far back as the year 1797, and praying to be heard by himself or counsel against the Bill then before Parliament, passing into a law.

He was refused to be heard, though he offered to produce evidence before the House of Peers, that the Plan appropriated by the Bank was his, and that he had never received any remuneration.

ration. As some of the facts connected with this transaction are of a singular nature, we shall lay before our readers certificates tending to prove the originality and merit of Mr. Tilloch's invention, which we intend to follow up in some of our future Numbers, with further particulars. In the mean time the public will not be a little surprised to find that the Bank, notwithstanding that it had means offered so many years ago for lessening, if not preventing, the forging of their Notes, should have so long continued their old system, at such an expense for prosecutions, and attended with the death of so many victims.

Certificate, No. I.

London, 5th April 1797.

Mr. ALEXANDER TILLOCH, of Carey-street, London, having submitted to our inspection a Specimen of an Art invented by him, for the purpose of producing Checks to prevent the Forgery of Bank Notes, Bills of Exchange, Drafts, &c. &c. &c., we have examined the same with care and attention, and we DECLARE, each of us for ourselves, that we could not make a copy of it, nor do we believe that it can be copied by any of the known arts of Engraving. It therefore appears to us to be highly deserving of the notice of the Bank of England and private Bankers, as an Art of great merit and ingenuity, calculated, not merely to DETECT, but to PREVENT the possibility of forging Bank and other circulating Bills.

FRANCIS BARTOLOZZI, R.A. Engraver to His Majesty, &c. &c.
JAMES HEATH, Engraver to His Majesty and to the Prince of Wales.
JAMES FITTLER, Engraver to His Majesty.
J. LANDSEER, Engraver to His Majesty.
J. R. SMITH, Engraver to the Prince of Wales.
FRANCIS HAWARD, Engraver to the Prince of Wales.
JAMES BASIRE, Engraver to the Royal Society and to the Society of Antiquarians.
WILLIAM SHARP.
WILLIAM BYRNE.
THOMAS HOLLOWAY.
W. S. BLAKE, (Writing Engraver.)
JOHN PUKE, (Writing Engraver.)
WILLIAM BLAKE.
WILLIAM SKELTON.
MARIANO BOVI.
ROBERT DUNKARTON.
WILSON LOWRY.
JOHN ANDERSON, (Engraver on Wood.)
RICRARD AUSTIN, (Steel Letter Cutter and Engraver on Wood.)

No.

No. II.

London, 6th July 1797.

We whose names are hereunto subscribed do hereby certify, that we were called, on the 4th July instant, to examine an attempt, made at the Bank of England, to produce a *fac simile* of Mr. Tilloch's Specimen of an Art invented by him to prevent Forgery; that two Imitations, the one from a Wood-cut, the other from a Copper-plate, were then produced by Mr. Terry, the Bank Engraver; that the one from the wood-cut was so totally unlike Mr. Tilloch's Specimen, that Mr. Terry did not endeavour to make it be received as a likeness, but withdrew it; and that the one from the copper-plate which was produced as a Copy, was so far from being an exact Copy, that it was not even executed in the same manner; Mr. Tilloch's being printed from the *surface* of his work, by means of the letter-press; but Mr. Terry's from the *bottom* of his, by means of the rolling-press.

We declare besides, that, in other respects, the imitation was so unlike the original, that we believe it by no means probable that any person, in the habit of taking Bank Notes, would ever take the one for the other. We believe that one of Mr. Terry's Imitations would be easily detected among a thousand of Mr. Tilloch's Specimens; and that one of the latter, put among the same number of the former, might, from its singularly peculiar effect, and very superior execution, with equal facility be taken from among them by any person of common discernment—Mr. Terry's being not more like to the Specimen, than a brass counter, with the king's head upon it, is to a guinea.

We think it but justice to Mr. Tilloch's Invention to add, that if once the public eye were habituated to Bank Notes executed by his Art, the security against Forgery would be infinitely greater than the Bank Directors, with whom we were at the examination, seemed to have any idea of. This declaration we make, not from any personal acquaintance with Mr. Tilloch, or from that bias which may sometimes be supposed to result from habits of intimacy, (for the greater part of us never were in his company, or knew any thing of him, till the moment we were desired to give our opinion of his Art,) but we do it as a duty which we believe in our conscience we owe to the community, who ought to be secured, as far as possible, against the losses to which they are subjected, by the facility with which all the Bank Notes now in circulation may be, and, as the Directors themselves confessed, are, frequently forged.

JAMES HEATH.
JAMES FITTLER.
WILLIAM BYRNE.
WILLIAM SHARP.
WILSON LOWRY.

No. III.

London, 6th July 1797.

We whose names are hereunto subscribed, not having been at the Bank to witness the comparison there made on the 4th inst. between Mr. Terry's Imitation and Mr. Alexander Tilloch's Specimen of an Art invented by him to prevent Forgery, and not having seen the wood-cut Imitation, can say nothing respecting it; but we have examined the copper-plate Imitation then produced by Mr. Terry, and we hereby declare, that we perfectly agree in opinion with the Gentlemen who have signed the preceding Declaration of this date respecting the merits of Mr. Tilloch's Invention—the security that its adoption would afford to the Public, and the great difference between his Specimen and the Copy produced by Mr. Terry. And we further declare, that we give this testimony from the same motives that influenced the Artists who signed the preceding Declaration.

Francis Bartolozzi.	Robert Dunkarton.
James Basire.	John Anderson.
Mariano Bovi.	Thomas Holloway.
William Skelton.	J. R. Smith.

No. IV.

London, 6th July 1797.

I beg leave to re-assert my opinion, that Mr. Tilloch's Specimen of an Art invented by him, is, to the utmost of my belief, not copyable by any known art of engraving; and to add, that the foundation of this opinion, in truth, is rather proved than contradicted by the attempt Mr. Terry has made to produce an Imitation. Mr. Terry's Imitation, besides that it posseses no correct resemblance of its original, is radically different in the manner of its production, being evidently printed from engraved lines or incisions, and by means of the rolling-press; whereas Mr. Tilloch's Work is as evidently produced from the surface of his plate or block, and by means of the letter-press, or some such instrument. It is moreover, according to my perceptions, an obvious fact, that Mr. Terry's Imitation is so much unlike the original in most of its particulars, that I find it difficult to suppose that Forgeries thus executed could impose on any one; and when I go further, and imagine Bank Notes executed by means of Mr. Tilloch's Art, and the public eye accustomed thereto, the difficulty is increased to a degree so considerable, that Mr. Terry himself will hardly affirm, that in such a case persons of ordinary discernment would be liable to mistake the one for the other. On this point I the rather dwell, as few persons will be found who cannot distinguish a counterfeit halfpenny from one coined at the Tower, or a brass counter, bearing the king's likeness, from a guinea; both of which are resemblances that approach

proach nearer to their Originals than Mr. Terry's Imitation to Mr. Tillock's Specimen.

Yet, as this fact of the resemblance, or want of resemblance, between the Copy and the Original, is not a subject for argument, being determinable only by direct appeal to the organ of vision; and as each party concerned will therefore determine for himself, I would not be thought to aim at more than simply a statement of the truth, as it appears to me.

If the distant general resemblance of the Imitation to the Original was admitted, and that persons might be found of perceptions so gross as to mistake one for the other, it would still, as I apprehend, be a proper subject for consideration, whether Mr. Tilloch's Art would not be worthy of the adoption of the Bank; because, even though it should not remove the possibility of Forgeries, it would at least diminish their practicability, and consequently their number, by rendering extremely difficult what, at present, to an engraver of the most ordinary talents, is very easy. In short, until means are discovered of rendering the Forgery of Bank Notes utterly impracticable, it should seem to be a duty the Bank Directors owe to the Public and to themselves to render it as difficult as possible.

That Mr. Tilloch's Art would increase the difficulty of Forging on the Bank, and that to an incalculable degree, has not been, and, I venture to think, cannot be, denied. I therefore considsr him as having tendered to the Bank what must, had it been adopted, have been a benefit to the Community. I am obliged to consider him as the Inventor of a new and distinct species of engraving, if engraving it may be called, and (it is but just to add) to consider the Specimen offered to the Governor and Directors of the Bank of England for their inspection, as a first effort in a new Art. A new art it certainly is, and, by a parity of reasoning, capable of extension and improvement; for no art was ever carried to its *ne plus ultra* of perfection in the beginning.

J. Landseer, One of the Six Engravers who attended the Committee of Bank Directors on the 4th instant.

No. V.

London, 10th July 1797.

I have seen both the wood-cut and the copperplate attempt at an Imitation of Mr. Tilloch's Specimen, and I hereby declare that neither of them were Copies, and that Mr. Tilloch's Work deserves the commendations which have been bestowed upon it by the different Artists who have signed the preceding Declarations.

Richard Austin.

THE PHŒNIX OF THE ANCIENTS.

To Mr. Tilloch.

Sir,—Since I communicated the little paper on the adjustment of our civil chronology [see p. 314 of vol. 55], I have met with "An Essay on the Identity of the Phœnix of the Ancients with the great Comet of 1680;" and thinking that there is full as much reason for concluding that the accounts of this fabulous bird would be more satisfactorily explained by reference to the correction of time amongst the Egyptians, I take the liberty of sending you the grounds of my opinion. The authorities quoted are taken from the above-mentioned Essay, which appeared in the New Monthly Magazine of February last.

And first I premise the shrewd opinion held by the author of the cometary explanation, that "not to astronomical imagination only may this type be attributed, but to astronomical secrecy and jealousy also."

Herodotus:—"It comes but once in *five hundred years* into the country where its father dies."

Artemidorus, the Ephesian, in the time of Antoninus Pius,—"*A certain time elapsed*, a worm is produced from the ashes [of the former phœnix], and this worm being transformed, becomes again a phœnix."

According to Philostratus, "the phœnix resembles an eagle, and *emits rays of light* from its feathers."

Achilles Tatius:—"It comes *from Ethiopia* into Egypt: it vaunts the sun as its lord, as is testified by *the image of that luminary* with which its head is crowned: it is of a cerulean colour, of a rosy aspect, and its feathers *project like the solar rays*."

Sir William Drummond informs us, that "the bird called the phœnix owes its imaginary existence to the Egyptians. It was a type of the renovation of the year, and of the sun, and indeed its picture was a mere hieroglyphic."

Clemens Romanus:—"The Egyptian priests search into the records of time, and find that the phœnix returned precisely at the end of 500 years."

Now holding to most grave and very authentical Herodotus*, who like other *foreigners* saw but its picture, and gathered from 'the report of the people of Heliopolis' (incredible to him), "that *coming out of Arabia*, it carries to the temple of the Sun its father, wrapped up in myrrh, and there buries him,"—it would

* Solinus, Suidas, Pliny, Tacitus, give contradictory accounts of the duration of the phœnix. I therefore adhere to 'the earliest writer who gives a detailed account of the phœnix,' as received from the priests. Achilles Tatius likening the bird to a peacock is at issue with Philostratus.

seem

seem that *a deduction of* A DAY *from the hundredth lustrum* was thus symbolized by the astronomers of Egypt. They knew full well six hours was too much in addition to the 365 days to make up the year's complement; therefore by reckoning 366 days for the fourth year's, an *ideal existence* of a portion of future time was assumed: this error they at first considered insignificant as *a worm* (whether in reference to the chrysalis, or to the spiral motion of the sun, I am not bold to affirm); but in the calculation of revolving years the priests of Sol were thoroughly versed in the respect due to the great arbiter of time; they feigned that deity to avenge the insult offered to his dignity by the constant flight of the swift-winged phœnix, but suited the god's patience with the vain bird's endeavour to the convenience of an epoch best adapted for their astronomical renovation of the flow of time. The bird of fable was supposed to have out-stripped the sun, but before distancing the luminary a full circuit of the earth, the orb of light and heat must be repassed. Urged on by its ambitious nature the bird persists in the attempt, although it feels the consumption of its vitality to have commenced: invigorated too by a foreboding of resuscitation in its offspring, it gathers as it flies its costly funeral pile, and perishes in act to pass the goal.

Ethiopia and *Arabia* point out the sun in the southern signs, when the phœnix day arises, after rejection of the former anticipation—mysterized by the interment at the solar temple. The "feathers, golden and red," may possibly mean the early hours of glorious promise and the closing moments of heliacal sacrifice.

Sir, yours respectfully,

June 30, 1820.

W. W.

ACCOUNT OF THE FORMATION OF THE ISLAND OF SABRINA OFF THE ISLAND OF ST. MICHAEL.

On Thursday morning, the 13th of June, at about half-past one o'clock, a strong shock of an earthquake was felt at the city of Ponta Delgada, and for nearly eight hours the shocks continued with more or less violence, with intervals of from fifteen to twenty minutes between each shock, and more particularly at the west end of the island, where a number of cottages were thrown down, and other more substantial buildings considerably injured. On Friday morning a submarine volcano burst forth, about a mile from the shore, to the N.N.W. ½W. of the Pico das Camarinhas, which threw up stones and sand to a considerable height, but it subsided in the afternoon of the same day. On Saturday, the 15th, the volcano burst forth again in the same place, though not with so much violence; the shocks of the earthquakes were also more mild, but considerable damage had already been done in the districts of Ginetes, Varzea, and Morteyros.

On

On Sunday morning early, accompanied by some friends, I rode to the west end of the island to observe this phænomenon, and was much gratified at seeing one of the most awful and sublime spectacles that nature can present to human observation. I took my station on the brink of a steep precipice, impending over the sea-shore, at the nearest possible distance from the volcano, which was raging with immense fury, throwing up stones and sand to a height of upwards of a thousand feet above the level of the sea, attended with a hollow thundering noise like a distant cannonade, and accompanied with some smart shocks of earthquakes. The mephitic vapour was at times so strong, as to affect the breathing, even to danger of suffocation, as the wind blew direct on shore from the N.N.W. The sea was agitated around the volcano, to a considerable distance, and boiling like an immense cauldron, the diameter of which appeared to be about 500 feet; the stones (some of which were apparently above a ton weight), being thrown up nearly perpendicular several hundred yards, fell with tremendous noise in every direction about the volcano, and kept the sea in a continual foam. The appearance of the clouds, rising in a spiral form, and spreading several leagues to the southward, attracted particular notice, from the water-spouts which formed from the black denser clouds, and drew up the water in a variety of directions—at one time I counted eleven water-spouts in full action; occasionally the clouds burst over us with light rain, charged with ashes and small scoria drawn up from the volcano; the smell of sulphur was so strong as greatly to incommode the inhabitants of Ponta Delgada, a distance of nearly twenty miles. On Tuesday the 18th of June, I returned to the same spot, accompanied by Captain Tillard, of His Majesty ship Sabrina, Mr. Nicholes purser of that ship, and a Portuguese gentleman; and on our arrival at half-past ten, we discovered the mouth of a crater several feet above the surface of the sea; the quantity of sand and ashes thrown up from the centre of the crater formed an embankment as it fell, which kept out the sea, except in one place, where an *embouchure* of about thirty feet wide was discernible; the sea rushed into this part with incredible fury at every interval of the eruption, which subsided only for a few minutes, returning with redoubled force; in less than three hours the crater had increased in height above the level of the sea nearly sixty feet: having a pocket-compass, we took the bearings of the volcano, and having measured a base line of 800 feet, we found the distance from the spot of observation to be 5100 feet, or nearly an English mile. About one P.M. a most tremendous explosion took place, which lasted nearly twenty minutes, and darkened the atmosphere for several miles around; the flashes of lightning were very vivid, and produced

duced a grand effect on the black dense smoke of the volcano; the rocks thrown up were red hot, and caused a hissing noise on falling into the sea, which was distinctly heard at intervals, when the subterraneous thunder ceased; part of the cliff, on whose banks we were seated, fell into the sea, from the shock of an earthquake, and obliged us to make a precipitate retreat for fear of a repetition. At five o'clock we quitted this awful scene with reluctance; nothing could exceed the gratification felt by all parties: on our road to the city we had frequent opportunities of observing the damages done by the earthquakes: many cottages were entirely thrown down, and others totally uninhabitable; the roads were choked and almost impassable, from the hills having fallen in upon them in various places. On the following day, Captain Tillard being anxious to have a view of the volcano from the ship, he invited a party to take an excursion by water, and I had the pleasure of making one. On rounding the west end of the island, we found that the volcano during the night had increased to a mountain, nearly conical, whose base formed almost an equilateral triangle, so that within the space of a few hours it had increased upwards of 600 feet in height, and was still in full action: in passing to leeward of it, nearly six miles distant, some of the clouds burst over the Sabrina, and covered the ship with sand and ashes, so as to oblige the ladies to leave the deck; another grand explosion took place about four P.M., and at six a repetition. During the night the volcano was pretty quiet; at intervals streams of fire were discernible; but it coming on to blow hard from the N.W., we were obliged to keep a good offing; at day-light the next morning we returned to Ponta Delgada. Since the 22d the eruptions have entirely ceased; a strong smoke, however, continues to issue from the centre of the crater, which is still boiling, and the water of the sea is perfectly warm at the distance of more than half a mile from the island. Several persons have landed on the island, but found the ground so hot as to oblige them to re-embark immediately; had the eruption continued much longer, in all probability a safe harbour would have been formed between the volcano and the Bahia dos Mosteyros. About a century ago, an eruption broke out on the land, which burnt for several months. The extinct crater is composed of lava, pumice, and calcined earth and sand, which, having been in a state of fusion, resembles the dross of ore.

SINGULAR GEOLOGICAL APPEARANCE.

M. Palissot de Beauvois has acquainted the Royal Academy of Sciences at Paris with a rather singular geological appearance, which he observed in the county of Rowan in North Carolina. There is found, in the middle of a hill formed of very find sand, mixed

mixed with small quartzose stones, and with numerous pieces of silver-coloured mica, a vein of stones so regularly placed, that the inhabitants, who for a long time have noticed the appearance, give it the name of The natural wall; and some naturalists have even maintained that it was a true wall, which might have been constructed in very remote ages by some people now unknown. The stones have generally four faces, are narrower at one of their ends, and have a small notch below their top. They are ranged horizontally. The kind of wall which they form is about eighteen inches thick, its height, in the place where it is uncovered, is from six to nine feet; but upon digging into the ground, it has been followed to twelve and eighteen feet deep, and it is already known to extend three hundred feet, and even more, in length. A kind of argillaceous cement fills the intervals between the stones, and coats them externally; each of the stones is also covered with a layer of ochreous sandy earth.

M. de Beauvois has brought some of these stones to France, and, upon being examined by the mineralogists of the Academy, they appeared to possess the characters of basalts; but, as there have not as yet been found any traces of basalts or of volcanoes in the United States, and as the place where this wall is found is, generally speaking, of a primitive nature, it is possible that this pretended wall is nothing but a bed of trap; an amphibolic rock, very similar to certain kinds of basalts.

STATISTICS.

The superficies of the territory of the United States from the Atlantic to the Great Ocean is estimated at 2,257,000 square miles, and the population at eleven millions. The proportion of Whites to Blacks has increased as follows since the year 1790: in that year there were 27 blacks to 100 whites; in 1800 the proportion was 20 to 100; and in 1810 only 19. The number of emigrants that arrived in the different states in 1794 was about 10,000; in 1817, 22,240, of whom 11977 were British or Irish. From the British possessions in America there arrived the same year 2901 individuals.

By a late survey, finished 26th Feb. last, the population of Glasgow and its suburbs appeared to be 148,798.

EFFECT OF HEAT UPON THE COLOURS OF METALS.

M. Chaudet has published a set of experiments, which may have their utility, to determine the appearances which different pure metals exhibit when kept for some time in a strong heat on the cupel, and how these appearances are modified when these various metals are alloyed together. The following are the principal facts which he has observed:

(1.) Pure

(1.) Pure tin becomes covered with a greyish-black oxide, increases much in bulk, then exhibits the appearance of combustion, and at last leaves a red-coloured oxide, which, on cooling, becomes first yellow, and at last white.

(2.) Antimony becomes first black, then melts, resuming its metallic splendour, and allowing a vapour to fly off. The whole metal is volatilized in a white smoke, leaving yellowish and reddish spots on the cupel.

(3.) Zinc melts, blackens on the surface, takes fire all of a sudden, and burns with a very brilliant greenish-white flame, giving out a white thick smoke. The oxide is gradually elevated into a cone. When removed from the fire, it is at first greenish, but, on cooling, becomes snow-white.

(4.) Bismuth soon melts, and is covered with a coat of oxide which melts likewise. A small portion of the oxide sublimes; the rest sinks into the pores of the cupel, leaving it of a fine orange-yellow colour with some spots of green.

(5.) Lead exhibits exactly the same phænomena, and differs from bismuth merely in the colour which it leaves on the cupel, which, when lead is used, is always lemon-yellow, becoming pale and dirty by exposure to the air.

(6.) Copper assumes on its surface different iridescent shades, which succeed each other with rapidity, leaving at last a coating of black oxide, which is detached as the metal cools. If the furnace be hot enough, the metal melts, and is soon covered with a coating of black oxide.

When tin is contaminated by any iron, the presence of this last metal becomes manifest by the spots of rust with which the white oxide is tarnished after the metal has been exposed on the cupel.

The presence of a quarter per cent. of antimony in tin may be recognised by the greyish-black spots with which the white oxide of the metal is mixed after exposure on the cupel.

When a small quantity of zinc is alloyed with tin, this last metal loses the property of burning by covering itself with incandescent points, as happens when the tin is pure. The oxide, when cold, has a shade of greenish-grey even when the zinc does not exceed one per cent.

Bismuth alloyed with tin, even when the proportion does not exceed five per cent., gives to the oxide a greyish colour mixed with yellow, or, if it does not exceed one per cent., merely a greyish colour.

Less than five per cent. of lead may be detected in tin by the colour of rust which it communicates to the oxide of this last metal.

Less than one per cent. of tin can be detected in lead, because the

the lead in that case, when exposed on the cupel, remains tarnished, and exhibits on the surface small quantities of oxide of tin.

When tin is alloyed with some per cents. of copper, this last metal may be distinguished on the cupel by the rose-red colour which makes its appearance.—(*Ann. de Chim. et de Phys.* xii. 342.)

BRECCIA OF MONT D'OR.

There are found rather abundantly in a ravine of Mont d'Or, in Auvergne, fragments of a breccia, the hardness and other external characters of which having led to the supposition of its being of a siliceous nature, mineralogists did not pay much attention to it, except on account of some particles of sulphur which it sometimes contains in small cavities.

M. Cordier, having submitted this breccia to different trials, found that it yielded by heat a notable proportion of sulphuric acid; and upon this important indication he proceeded to make a complete analysis of it, by which he found that this stone contained about 28 per cent. of silica, 27 of sulphuric acid, 31 of alumine, 6 of potash, and a little water and iron. These are very nearly the same ingredients as are found in the celebrated ore of Tolfa, which yields Roman alum. In reality, upon treating this breccia from Mont d'Or in the same manner as is practised at Tolfa, that is to say, by breaking it, roasting, and exposing it to a moist air, from 10 to 20 per cent. of very pure alum was obtained from it; and this breccia even yielded alum without being roasted, but merely by exposure in a damp situation.

It is probable, from the researches made upon the spot by M. Ramond, that, with some pains, the beds from which the fragments scattered in the ravines were detached, may be discovered; and that quarries may be opened, the working of which cannot but be of advantage.

M. Cordier regards these sorts of stones as a mineralogical species, consisting essentially of sulphuric acid, alumine, and potash. The silica found in it is not essential for quarries of a stone not containing any silica; but all the other consistent principles exist at Montrone, in Tuscany, and yield the same products as that at Tolfa. Those varieties of this species in which silica enters, are easily distinguished by the jelly they form when they are treated in succession with caustic potash and hydrochloric acid diluted with water.

M. Cordier reduces to this species several volcanic stones, hitherto vaguely designated by geologists by the general denomination of altered lava.

MEDALLIC

MEDALLIC BIOGRAPHY.

A subscription is opened for striking a hundred medals in bronze, silver, and gold, in honour of those men, in all countries, who have acquired the greatest real glory by the distinguished services they have rendered to society and to the world at large. H. M. the king of Sweden has subscribed nearly 5,000*l.* towards the completion of this undertaking.

MILK.

Professor Schubler has published in the Dictionary of Medical Sciences, a paper entitled "Researches on Milk and its constituent Principles." The results of his analysis differ greatly from those lately published by Berzelius; and hence, in the author's opinion, prove the great influence of food and climate on the lacteal secretion. 1000 parts of new milk contain 110 of fresh cheese, 50 of fresh *serai*, 24 of butter, 77 of coarse sugar of milk, and 739 water; or, in a dry state, 42·6 cheese, 7·87 *serai*, 24·0 butter, 77·0 sugar of milk, and 848·53 water. 1000 parts of skimmed milk contain 43·64 dry cheese, 8·06 dry *serai*, 78·94 sugar of milk, and 869·34 water. 1000 parts of cream contain 240 butter, 33 cheese, 6 *serai*, and 721 whey. Lastly, 721 parts of whey contain 60 coarse sugar of milk. These observations were made at Hofwyl, which is some distance from the mountains, and where the cows are kept constantly in the stable, so that the milk must be nearly the same as in other flat countries.

RED SNOW OF BAFFIN'S BAY.

The nature of this substance was explained in Mr. Bauer's paper read before the Royal Society on the 11th of May, as noticed in a former number. In the winter he put some of the red globules forming this substance into a phial with compressed snow, and placed the phial in the open air. A thaw having melted the snow, he poured off the water and added fresh snow. In two days the mass of fungi was found raised in little heaps, which gradually rose higher, filling the cells of the ice. Another thaw came on, and the fungi fell to the bottom, but of about twice their original bulk. They appeared capable of vegetating in water, but in this case the globules produced were not red, but green. The author found that excessive cold killed the original fungi; but their seeds still retained vitality, and if immersed in snow produced new fungi, generally of a red colour.—Snow, then, seems to be the proper soil of these fungi.

LIVERPOOL MUSEUM.

A public museum of natural history has been attached to the Royal Liverpool Institution, and opened to proprietors and strangers. The opulence of that town, and the extensive intercourse it is

 carrying

carrying on with all quarters of the globe, have long excited surprise that a public repository for the productions of distant countries has not been sooner established: it is, however, expected that the liberality of its inhabitants and of the friends of science will soon increase the foundation now laid of such a laudable undertaking, as many valuable donations have already been received. The zoological part (filling two commodious rooms) is systematically arranged with reference to the modern discoveries and improvements, by Mr. Wm. Swainson, F.L.S., who has superintended the whole. The collection of Zoophytes are uncommonly fine, and are arranged after the admirable system of Lamarck.

The gallery of pictures and sculptures has likewise been enriched by a fine series of casts from the Phygalian marbles, deposited there by John Foster, jun. esq. well known as the companion of Mr. Cockerell, while prosecuting those interesting researches in Greece which led to their discovery. An academy of painting is to be immediately established.

ASTRONOMY.

The true angular *distances* of the moon, from a certain number of fixed stars throughout each month, and from the sun also in the first and last quarters of each lunation, are calculated, for every third hour at Greenwich, and published in the Nautical Almanack, which furnish the means to navigators of finding the longitude; through observations which they may make of the distance of the moon from a star or from the sun, for comparison with the Greenwich distance of the same luminaries, at that instant, obtained by interpolation. The defect of this method of finding the longitude, highly useful as it is, consists in the slow apparent motion of the moon, in approaching or receding from a star, which is fixed, and more so from the sun, which has itself a slow apparent motion in the same direction with the moon: on the contrary, several of *the planets*, according to the rate of their own motions visibly recede from or approach towards the moon, through a considerable portion of each lunation, and these planets, when so circumstanced, have a considerably greater apparent velocity of approach or recession from the moon, than the sun or any stars have therefrom. For want of tables of the apparent distances of the moon and the planets, being published in the Almanacks, navigators have not yet been able to avail themselves of the planets, in their *lunar observations;* but this defect the Danish Government is about to supply, by the Almanack for 1822, which is to appear in June or July next, and contain the planets' distances from the moon every three hours at Copenhagen, calculated under the directions of M. Schumacher, Professor of Astronomy.

DR. JOHN MURRAY.

It gives us much regret to have to announce this month the death of that eminent chemist Dr. John Murray, of Edinburgh. He died at his house in Nicolson's street on Thursday, 22d July. The death of this distinguished philosopher, snatched from us in the prime of life, and full vigour of his faculties, will long be felt as a national loss. His works, now of standard celebrity at home and abroad, have, from the spirit of profound and accurate analysis, which they everywhere display, and from the force, clearness, and precision of their statements, most essentially contributed to advance chemistry to the high rank which it now holds among the liberal sciences. His very acute, vigorous, and comprehensive mind has been most successfully exerted in arranging its numerous and daily multiplying details, defining its laws, and, above all, in attaching to it a spirit of philosophical investigation, which, while it lays the best foundation for extending its practical application, tends at the same time to exalt its character, and dignify its pursuit. As a lecturer on chemistry, it is impossible to praise too highly the superior talents of Dr. Murray: always perfectly master of his subject, and very successful in the performance of his experiments, which were selected with great judgement, his manner had a natural ease and animation, which showed evidently that his mind went along with every thing he uttered, and gave his lectures great freedom and spirit. But his peculiar excellence as a teacher was a most uncommon faculty, arising from the great perspicuity and distinctness of his conceptions, of leading his hearers step by step through the whole process of the most complex investigation, with such admirable clearness, that they were induced to think that he was following out a natural order which could not be avoided, at the very time when he was exhibiting a specimen of the most refined and subtle analysis. With him the student did not merely accumulate facts, note down dry results, or stare at amusing experiments: he was led irresistibly to exercise his own mind, and trained to the habits of accurate induction. To those solid attainments which entitled Dr. Murray to stand in the first rank as a man of science, was united a refined taste, and a liberal acquaintance with every subject of general interest in literature. His manners were easy, polite, and unpretending, regulated by a delicate sense of propriety, with much of that simplicity which so often accompanies strength of character and originality of mind. He rose to eminence by the intrinsic force of his talents; he was above all the second-hand arts by which so many labour to attract attention; and a native dignity of sentiment, and manly spirit of independence, kept him aloof from all those petty intrigues which are so often employed with success to bolster up inferior pretensions.

LIST OF PATENTS FOR NEW INVENTIONS.

To John Read, of Horsmanden, in the county of Kent, gentleman, for improvement on syringes.—11th July 1820.—Two months allowed to inroll specification.

To James White, of Manchester, for certain new machinery adapted to preparing and spinning wool, cotton, and other fibrous substances, and uniting several threads into one; also containing combinations of the said new machinery with other machines, or with various parts only of other machines already known and in use.—11th July.—6 months.

To Samuel Fletcher, of Walsall, in the county of Stafford, for his improvement on or addition to saddles, saddle straps, saddle girths, and saddle cloths, by the application of certain known materials hitherto unused for that purpose.—11th July.—4 mo.

To William Davis, late of Brimscomb, but now of Bourne, near Minchinhampton, Gloucestershire, for certain improvements in machinery for shearing or cropping woollen and other cloths requiring such process.—11th July.—6 months.

To John Grafton, of the city of Edinburgh, for his new and improved method or methods of distilling of the products of coal and carbonizing coal in the process of making gas used for the purpose of illumination.—11th July.—2 months.

To Matthew Bush, of Battersea Fields in the county of Surry, for an improvement on a machine now in use for printing silks, linens, calicoes, woollens, and other similar fabrics; by means of which improvement, shawls and handkerchiefs can be printed with one or more colour or colours, and whereby linens, calicoes, silks, woollens, and other fabrics of the like nature, intended for garments, can be printed with two or more colours.—11th July. 6 months.

To Robert Bowman, of Manchester, for improvements in the construction of looms for weaving various sorts of cloths, which looms may be set in motion by any adequate power.—20th July. —6 months.

To Job Rider, of Belfast Foundry, Ireland, for certain improvements which produce a concentric and revolving excentric motion applicable to steam-engines, water-pumps, mills, and other machinery.—20th July.—6 months.

To William Dell, of Southampton, for an improvement in gun-barrels.—20th July.—2 months.

To Henry Bolfield Thomason, of Birmingham, for certain improvements in the making and manufacturing of cutlery, viz. that class of cutlery called or styled table knives, dessert knives, fruit knives, pocket knives, scissars, razors, and surgical instruments.—20th July.—2 months.

METEORO-

METEOROLOGICAL JOURNAL KEPT AT BOSTON, LINCOLNSHIRE.

[The time of observation, unless otherwise stated, is at 1 P.M.]

1820.	Age of the Moon.	Thermometer.	Barometer.	State of the Weather and Modification of the Clouds.
	DAYS.			
June 15	5	53·5	29·58	Cloudy—rain A.M.
16	6	6c·	29·73	Fine
17	7	60·	29·73	Cloudy
18	8	58·5	29·80	Fine
19	9	59·	29·43	Ditto
20	10	53·	29·46	Showery—heavy rain P.M.
21	11	64·5	29·62	Cloudy
22	12	71·5	29·76	Fine
23	13	72·5	29·76	Ditto
24	14	77·	29·80	Ditto
25	15	84·	29·84	Ditto
26	full	80·5	29·85	Ditto
27	17	81·	29·87	Ditto
28	18	80·	29·73	Ditto
		60· (8 P.M.)		
29	19	72·	29·70	Ditto
30	20	53·5	29·76	Rain—thunder-storm A.M.
July 1	21	60·	29·94	Cloudy
2	22	58·	29·80	Rain
3	23	59·	29·70	Cloudy—rain A.M.
4	24	56·	29·70	Ditto
5	25	58·5	29·90	Ditto
6	26	58·	29·90	Ditto
7	27	59·	29·90	Ditto
8	28	57·	29·94	Ditto
9	29	62·	29·95	Ditto
10	new	65·5	29·90	Ditto
11	1	68·	29·80	Fine
12	2	67·	29·70	Ditto
13	3	61·5	29·14	Cloudy
14	4	64·	29·13	Ditto

METEORO-

METEOROLOGICAL TABLE,

By Mr. Cary, of the Strand,

For July 1820.

Days of Month. 1820.	Thermometer. 8 o'Clock Morning.	Noon.	11 o'Clock Night.	Height of the Barom. Inches.	Weather.
June 27	74	83	70	30·51	Fair
28	75	84	68	·40	Fair
29	64	74	64	·22	Fair
30	60	66	53	·05	Showery
July 1	54	61	53	·30	Cloudy
2	57	62	54	·15	Rain
3	56	59	55	·01	Showery
4	56	61	54	·10	Cloudy
5	53	58	50	·20	Cloudy
6	53	60	55	·20	Cloudy
7	57	64	56	·25	Fair
8	55	59	55	·30	Cloudy
9	56	63	57	·25	Fair
10	57	68	59	·20	Fair
11	60	69	55	·15	Fair
12	59	68	56	·02	Fair
13	57	61	55	29·91	Cloudy
14	58	64	62	·94	Cloudy
15	63	74	63	30·05	Fair
16	67	73	68	·01	Thunder showers
17	66	68	56	29·63	Rain
18	58	63	56	·46	Stormy
19	59	70	58	·65	Showery
20	63	73	61	·84	Fair
21	62	69	63	·98	Fair
22	59	68	61	30·01	Fair
23	58	67	60	·01	Cloudy
24	59	70	62	·02	Fair
25	66	69	57	·01	Fair
26	63	70	60	·10	Fair

N.B. The Barometer's height is taken at one o'clock.

XI. *On the true Measure of a Lunar Cycle, as compared with the Lunar Tables in the Nautical Almanack.* By Mr. THOMAS YEATES.

To Mr. Tilloch.

SIR, — THE true quantity of a mean lunation is obtained by taking the precise number of days, hours, &c. between two distant solar or lunar eclipses, or the known times of new or full moons, and dividing the elapsed period by the number of lunations from the one to the other. By this means, whatever errors may be committed by stating the times of the mean conjunctions or oppositions, those errors will become divided among so many lunations, as will render insensible the error of one or any small number of lunations affected thereby, so that the greater the distance of time and number of lunations, the precise quantity of one mean lunation is the more safely ascertained.

But this measure of time between any two distant eclipses, conjunctions, or oppositions of the sun and moon must be limited within reasonable and well defined bounds, or the calculation will be subject to fatal mistake. The space of one hundred years seems preferable to any smaller number, and is certainly preferable to that of a thousand years. It is on this principle, and on the indubitable method of computing by the weekly cycle, that I have attempted to ascertain the mean quantity of a lunation from an indisputable epoch, one hundred years distant from its corresponding new moon, a quantity I have stated at 29 days, 44 min. 38 sec. 51 thirds, which is the solar measure as computed by the Julian reckoning unequated.

A lunar cycle of 19 years, containing 235 lunations, compared with the aforesaid quantity, brings the sun and moon within one hour of Julian time.

	D.	H.	M.	S.	T.		Days.	H.	M.	S.
235 Lunations at	29	12	44	38	51	=	6939	18	52	10
19 Julian years	..		..		..	=	6939	18	0	0
						Diff.			52	10

The difference of 52 minutes, 10 seconds, by which the moon's motion is slower than the sun in this period, if multiplied into 100 Julian years, will scarcely amount to five hours, which may be attributed to the known variation of the moon in every lunation.

Having fairly stated these simple principles, and showed my reason for correcting the above quantity, viz. by subtracting the excess, 52′ 10″,

	D.	H.	M.	S.	T.	F.
Common measure	29	12	44	38	51	00
Julian measure	29	12	44	25	31	51

 I pro-

I proceed to examine the true measure of a lunar cycle, and how far the same is confirmed by the lunar tables in the Nautical Almanack.

From the full moon, Sept. 1801, 21 days, 19 hours, 24 min. Greenwich time, to the corresponding full moon 1820, Sept. 21 days, 18 hours, 48 min., is precisely 6940 days, less 36 minutes, which is thus proved. In 6937 days is a complete number of weeks, to which place the day of the week in the year 1801, and the excess of days, will answer to the day of the week in the corresponding year 1820, thus:

Astronomical time.	D.	H.	M.	Civil time.	D.	H.	M.	
1801 ☽ Full m. Sept.	21	19	24	Tuesd. Sept.	22	7	24	morn.
1820 ☽ Full m. Sept.	21	18	48	Friday Sept.	22	6	48	morn.
			36				36	

By the weekly cycle.

Days 6937	..	Tuesday,	Sept. 22	7	24	morn.
6938	..	Wednesday				
6939	..	Thursday				
6940	..	Friday,	Sept. 22	6	48	morn.
		6940 00 00			36	
		36				

235 Lunations	= 6939	23	24
19 Julian years	= 6939	18	00
Diff.		5	24

235 Mean lunations, at 29 days, 12 hours, 44 min., 25 sec., 31 thirds, 51 fourths, are equal to 19 Julian years, or 6939 days, 18 hours, as I have already corrected the common measure of one lunation by Julian time, the comparative difference is therefore the same as the former.

	D.	H.	M.
235 Lunations by Ephemeris	6939	23	24
Ditto by computation ..	6939	18	00
Diff.		5	24

This difference arises from the variation of the lunar quarters, and the excess of one quarter above another, as I shall show presently.

If from the New moon in September 1801 to the New moon in September 1820, we would know the exact interval, and consequently the mean of 235 lunations, we proceed as before.

Astrono-

	Astronomical time.	D.	H.	M.	Civil time.	D.	H.	M.	
1801 ●	New m. Sept.	7	17	39	Tuesday, Sept.	8	5	39	
1820 ●	New m. Sept.	7	1	52	Thursd. Sept.	7	1	52	aft.
			8	13			8	13	

By the weekly cycle.

1801	Days 6937	Tuesday	Sept.	8	5	39	morn.
	6938	Wednesday	Sept.				
1820	6939	Thursday	Sept.	7	1	52	aft.
					8	13	

The measure of this cycle is 6939 days, 8 hours, 13 minutes, for 235 lunations; viz.

	D.	H.	M.
235 Lunations from new moon to new moon by Ephemeris	6939	8	13
19 Julian years	6939	18	00
Diff.		9	47

This difference is to be imputed to the same known cause remarked above, as I shall prove from a further examination of this cycle, and a comparative statement of the quarters in each lunation:

1801 September.				1801 September.				
Astronomical time.	D.	H.	M.	Civil time.	D.	H.	M.	
● New moon	7	17	39	● Tuesday	8	5	39	morn.
☽ First quarter	15	2	48	☽ Tuesday	15	2	48	aft.
○ Full moon	21	19	24	○ Tuesday	22	7	24	morn.
☾ Last quarter	29	17	49	☾ Tuesday	29	7	49	night.
1820 September.				**1820 September.**				
● New moon	7	1	52	● Thursday	7	1	52	aft.
☽ First quarter	15	2	19	☽ Friday	15	2	19	aft.
○ Full moon	21	18	48	○ Friday	22	6	48	morn.
☾ Last quarter	28	15	2	☾ Friday	29	3	2	morn.

		D.	H.	M.
From new moon Sept. 1801	to new moon Sept. 1820,	6939	8	13
From first quart. ..	to first quart. ..	6939	23	31
From full moon ..	to full moon ..	6939	23	24
From last quart. ..	to last quart. ..	6939	16	47

Subtract these differences from 6939 days, 18 hours, in which period are contained 235 mean lunations, at 29 days, 12 hours, 44 minutes, 25 seconds, 31 thirds, 51 fourths, Julian time unequated.

 The

	Days.	H.	M.
The new moon difference	6939	8	13
	−6939	18	00
Moon's motion faster than sun		9	47
First quarter difference	6939	23	31
	−6939	18	00
Moon slower than sun		5	31
Full moon difference	6939	23	24
	−6939	18	00
Moon slow		5	24
Last quarter difference	6939	16	47
	−6939	18	00
Moon fast		1	13

	H.	M.		H.	M.
New moon fast	9	47	Full moon slow	5	24
Last quarter fast	1	13	First quarter slow	5	31
Moon fast	11	00	Moon slow	10	55

The difference in the aggregate amounts to no more than five minutes in 19 Julian years, or 6939 days, 18 hours, which convincingly shows that this method of calculating by the lunar quarters, and bringing their variations into the account, is the most correct way of ascertaining the true mean quantity sought.

The aggregate sum of the times between the corresponding quarters according to the Ephemeris of 1801 and 1820, stands as follows:

					D.	H.	M.
From	● Sept. 1801	to	● Sept. 1820		6939	8	13
From	☽ first quarter	to	☽ first quarter		6939	23	31
From	○	to	○		6939	23	24
From	☾ last quarter	to	☾ last quarter		6939	16	47
					27758	23	55

	D.	H.	M.			
4 ×	6939	18	00 =	27759	00	00
Diff.						5

This difference in 48 cycles or 912 years amounts to six hours, by which the moon anticipates the sun. Could we proceed in the same manner in computing the moon's mean quantity in

100 solar years, and from the corresponding quarters ascertain their exact times, it would be vastly satisfactory; but since that is not to be known but from tables, we must be content to determine the nearest possible by the aids we are possessed of.

The quantity of a mean lunation obtained from 1237 complete lunations from the memorable solar eclipse April 22d, 1715 O. S. to its corresponding New moon in May 1815, N. S., and computed by me at 29 days, 12 hours, 44 min. 38 sec. 51 thirds, in page 25 of this volume, allows 6939 days, 18 hours, 52 min., 10 sec., for the completion of the cycle of 235 lunations, and corresponds exactly and to a minute with the middle time of that eclipse and the instant of the new moon in May 1815, as I shall now show.

In 100 Julian years are 36525 days, and in 36526 are an even number of weeks: the eclipse happened on a Friday at 51 min. past 9 o'clock in the morning, and the corresponding New moon was on Tuesday, May 9th, at 20 minutes past 6 o'clock in the morning.

			H.	M.	
	36525	100 Julian years			
1715	36526	Friday	9	51	morn.
	36527	Saturday			
	36528	Sunday			
	36529	Monday	20	29	
1815	36530	Tuesday	6	20	morn.

Among the ancient historical eclipses published in Mr. Ferguson's Astronomy, is a total eclipse of the sun at Wittemburg, on June 6th, in the year 1415, at 43 minutes past 6 o'clock. I find this same eclipse mentioned in Fox's Acts and Monuments, vol. i. page 792, and according to this historian the eclipse happened on Thursday, the seventh of June, *when the sun was almost wholly eclipsed somewhat after seven of the clock:* now, that the seventh day of June 1415 was Thursday, is proved from a document in the same history, page 824, signed, *Thursday the* 28' *day of June Anno* 1415. I presume the date in Ferguson's Catalogue was computed and inserted from some Ephemeris, but the latter the observed time when this remarkable eclipse did happen. From June 1415 to June 1815, is 400 years, and from the new moon at the time of this memorable eclipse to its corresponding New moon in 1815, there are 4918 complete lunations, or 4 × 1237 = 4948. The day of the week when this eclipse happened being ascertained, I shall show the importance of this date in determining the precise measure of 4948 lunations in solar days.

The historical date June 7th, according to the old calendar, must

must be corrected up to the new style, not by adding 10 days, which is the correction of that calendar to 1582, nor by adding 11 days, for that is the correction down to the year 1752, but to the year 1415, which amounts to no more than eight or nine days, and brings the date to June 16th. In 100 years five days are 1237 complete lunations; therefore to seek in the New style calendar the corresponding New moon in the year 1815, add five days for each century, or 20 days for four centuries, to the corrected date, and the nearest New moon in the Ephemeris will be the corresponding New moon sought.

			D.
1415	● New moon and eclipse,	Thursday, June	7
		Calendar correction	+9
		June	16
1815	400 years and 4 × 5 days	..	20
			36
		Days in June	30
	Corresponding New moon	July	6

The corresponding New moon by the Ephemeris for the year 1815, was on Thursday, July 6th, at 47 minutes past 11 o'clock at night. Subtract the New style date of the New moon 1415; viz. June 16 days, 7 hours, 15 minutes, from the date of the New moon 1815, and it will give the number of days by the weekly cycle from Thursday, the epoch of the eclipse 1415, to the Thursday on which its corresponding New moon happened 1815.

			D.	H.	M.	
1415	New moon and eclipse,	Thursd. June	16	7	15	morn.
1815	New moon	Thursd. July	6	11	47	night
			20	16	2	

But nine days for the Julian correction is too much; for at the rate of 11 minutes per annum, the correction amounts to little more than eight days, six hours, from A.D. 325 to A.D. 1415, omitting fractions: therefore to the old calendar date add eight days, six hours; viz.

1415	New moon	Thursday, June	7	7	15	O. S.
		Julian correction	8	6	0	
		N. S. Date June	15	13	15	N. S.
		Days in June	30	0	0	
			14	10	45	
1815	New moon	Thursday, July	6	23	47	
	Days above 400 years	..	21	10	32	

In

In 400 solar years are 146097 days, less two hours, 40 minutes, containing 2871 weeks; and in 21 days, 10 hours, 32 minutes, are three entire weeks; therefore, from Thursday, June 1415, to Thursday, July 1815, add 146097 days, and the additional days will show the day of the month and week of the corresponding New moon, and the exact number of solar days elapsed.

					H.	M.	
1415	June	15	Thursday	....	7	15	morn.
1815	June	15	Thursday	146097			
		22	Thursday	146104			
		29	Thursday	146111			
	July	6	Thursday	146118	11	47	night
				146118	16	32	
	Difference of meridians				0	52	
					15	40	
	Excess of solar time			..	2	40	
				146118	13	00	
				146118	10	32	
					2	28	

The mean of these differences brings the elapsed period to 146118 solar days, 12 hours; then

		Days.	H.	M.	S.	T.
4948 Lunations	..	146118	12	0	0	0
1237 Lunations	..	36529	15	0	0	0
235 Lunations	..	6939	17	49	18	15
12 Lunations	..	354	8	52	41	24
1 Lunation	..	29	12	44	22	48

This computation so nearly approximates with Julian time, that whatever equations may be requisite in conforming it with solar tropical time, there is a stability given to the lunar reckoning which cannot fail to recommend it as a basis in all, and especially large calculations, as I shall now explain.

In 912 Julian years are 48 lunar cycles, and 940 lunar years, consisting of 11280 complete lunar months, in which time the moon anticipates the sun eight hours, three minutes, 24 seconds.

		Days.	H.	M.	S.
912 Julian years	..	333108	0	0	0
940 Lunar years	..	333107	15	56	36
			8	3	24

There is another method of computing the measure of the lunar

lunar year, and consequently of a mean lunation, which is this: The precise number of lunar years in 912 Julian years being known, and the number of days in four Julian years, here are three numbers given to find the fourth; viz. 912 : 940 :: 1461 : 1417. $\frac{452}{940}$ = 4 lunar years.

	D.	H.	M.	S.	T.
4 lunar years. 4)	1417	11	32	25	32
1 Lunar year	354	8	53	6	23
1 Lunation	29	12	44	25	27

This measure of a mean lunation corresponds with Julian time exactly, and differs not a minute in the lunar cycles and periods above named: so that if a table was constructed on this plan, eight calendar years would contain 99 synodical months, and the sun and moon's place very nearly correspond: this was a period of the ancient astronomers, which added to eleven more years, constituted the cycle of 19 years, called the *Enneadecaeterida*, as I have noted in a former number.

It is a curious part of historical astronomy to see how philosophers have exercised themselves in these investigations in different ages; and notwithstanding their differences between themselves in former and latter times, it is admirable to see how nearly the ancient astronomers agree with the moderns in the general estimate of the lunar motions.

	D.	H.	M.	S.	T.
Eudoxus, who flourished in the 100th Olympiad, reckoned the mean lunation at	29	12	43	38	11
Meton, the author of the lunar cycle. An. ante Chr. 422	29	12	41	26	48
Calippus. An. ante Chr. 330 ..	29	12	44	12	45
Hipparchus the Bythinian. An. ante Chr. 136	29	12	44	3	15
Ptolomy. A.D. 140	29	12	44	3	20
Prutenic Tables	29	12	44	3	10
Alphonsine Tables	29	12	44	3	3
Tycho Brahe	29	12	44	3	9
Dr. Keil	29	12	44	2	0
Mr. Whiston	29	12	44	0	0
La Caille	29	12	44	3	0
Ferguson's Tables	29	12	44	3	2
Mayer	29	12	44	1	53

The principal causes of the disparity of these quantities are the different quantities assigned to the solar year, and the different denomination of years, solar, Julian, or sidereal time. One second of difference in a cycle of 19 years produces 3 minutes, 55 seconds, and in a period of 912 years amounts to 3 hours, 55 minutes; and one minute in a lunation produces 3 hours, 55 minutes in a cycle of 19 years, and in 912 such years amounts to 7 days, 20 hours; and if in any quantity the measure of 235 lunations

lunations is found to exceed or fall short of another quantity by one hour and a half in a cycle, the same will amount to three whole days in a period of 48 such cycles, or 912 years.

The several quantities for the mean measure of a lunar month or year adduced from my calculations are these: —

One lunation.

No.	D.	H.	M.	S.	T.	
(1)	29	12	44	38	51	From 100 years.
(2)	29	12	44	25	31	From 19 Julian years.
(3)	29	12	44	25	27	From Julian time.
(4)	29	12	44	22	48	From 400 years.

Lunar Year of 12 lunar Months.

No.	D.	H.	M.	S.	T.
(1)	354	8	53	46	12
(2)	354	8	53	6	12
(3)	354	8	52	41	24
(4)	354	8	52	33	36

Lunar Cycles of 235 Lunations.

No.	D.	H.	M.	S.	
(1)	6939	18	52	10	
(2)	6939	17	55	0	
(3)	6939	17	54	30	
(4)	6939	17	49	18	15

Lunar period of 912 Julian years.
940 Lunar years.
11280 Lunar months.

Days.	H.	M.	S.	
333108	0	0	0	in 912 Julian years. Pag. 87.
333107	15	56	36	in 940 Lunar years. Ibid.

[To be continued.]

XII. *Account of the Loss of the French Ship of Discovery,* Urania. *By Capt.* Louis de Freycinet *.

To His Excellency the Minister of the Marine and Colonies.

Malouine Islands, French Bay, April 22, 1820.

Sir, — Expeditions of maritime discovery would excite little interest for those who perform them, were voyages of that kind accompanied by fewer privations and dangers. Hitherto, in rendering an account to Your Excellency of the progress of my voyage, I have had to speak only of the advancement of my labours, and of the hopes we had cherished of accomplishing without accident the tedious enterprise we had undertaken; but that power which smiles at the prudence and the vain projects of men had ordained that we should undergo at the end of our voyage a very severe trial.

The corvette Urania will never again enter the ports of France. In announcing this misfortune to Your Excellency, I at the same time feel much satisfaction in informing you, that it did not occasion the loss of a single individual, and that all the stores,

* From the *Gazette de France.*

all the instruments of the expedition, were saved. The expedition itself was, I may say, finished: I have now, in fact, nothing more to do than to effect my return to France, seeing that the duty I ought to execute at the Cape of Good Hope was in effect only the verification of the instruments, which can be done equally well at Paris on my return.

These considerations support our courage; and as we believe that we are the only sufferers by this event, we are pleased to think that the object of the expedition will be fulfilled upon our arrival in Europe. As I intend to give Your Excellency a brief account of my proceedings since my departure from Sidney, I will not interrupt the historical order of my account, but will immediately refer to the period when I set sail from Port Jackson.

I departed from this harbour on the 25th of December, and directed my course between Van Diemen's Land and New Zealand. On the 7th of January 1820, I doubled the southern extremity of the latter island, passing in sight of Campbell's Island, of which I determined the position, and made the geography. From this moment till my making land at Terra del Fuego I experienced an uninterrupted course of favourable winds; I stood southward to the latitude of 59 degrees, and met with floating ice to an extent of about five or six degrees of latitude, but which quitted me as I advanced further towards the south.

On the 5th of February I made the land of Terra del Fuego, on the passage from the Cape of Desolation of Cook; the weather was as frightful as the coast. I made many attempts to enter Christmas harbour, but the unfavourable weather prevented me. I then determined to steer for the Bay of Good Success, in Lemaire's Straits, which Cook mentions as affording very good shelter.

I doubled Cape Horn on the night of the 5th: the next morning the weather was very fine; and although the clearness of the sky was the indication of an approaching tempest, I was far from anticipating the violence of that which we were about to experience.

I, however, arrived in safety at Good Success Bay: but scarcely had we let fall the anchor, when some violent squalls from the south-east, blowing from the mountains, compelled us to drive before the wind. The violence of the storm was such as left no time for hesitation; I therefore immediately ordered the cable to be cut, lay-to under try-sails, and it soon became necessary to take in every bit of sail. We passed a dangerous night in Lemaire's Straits, and as soon as we got through them we were obliged to leave the ship to the mercy of the wind. This hurricane (the most violent that any of us ever recollected) continued two days, and it was not until the expiration of that time

that

that I could recognise my position with certainty. I found the wind had driven us so far to the north, that it would occasion the loss of much time to seek to return to the south in the Bay of Good Success.

I consequently preferred putting into French-bay, Falkland-islands, which Bougainville and Pernetti praise so highly, because I judged that place perfectly proper for the business I had to perform.

We were off these islands on the 12th of February: but the maps I had were so inaccurate, that it was very difficult for me to determine on what point we were. We arrived, however, at the mouth of French-bay on the afternoon of the 14th, at which time the weather was fine, the sea magnificent, and the wind favourable.

We were trying to double a point which I took for that called L'Aigle by Bougainville, when some little rocks that we observed in the offing obliged us to bear up. We sounded continually from the main chains; and the look-out man, placed on the fore-top-gallant cross-trees, was every moment interrogated.

Finally, about three o'clock, when we believed that we had only to sail into a spacious harbour, the ship was all at once stopped by a severe shock, occasioned by striking against a submarine rock; our soundings gave at this time 14 fathoms on the starboard and 12 on the larboard side. By backing all the sails, we got the corvette afloat again without difficulty.

We did not at first perceive that the corvette had sprung a leak; but it soon exhibited itself with such violence, that, notwithstanding all our pumps were at work, we could not master it. I saw then that it was absolutely indispensable to seek a place to run ashore, in order to save at least my crew, and the fruits of the voyage: but, to add to our distress, we had before us only perpendicular rocks, in attempting to land among which we should, without doubt, have been lost without the possibility of saving a single man.

In this dreadful situation I beat to windward a great part of the night, in order to work into the centre of the bay, towards which I had already dispatched a boat under the command of M. Duperrez, to look out for a part of the beech free of rocks; but as if, in this night of grief, every thing was to concur to disappoint us, the wind, which was weak, left us all at once. I now cast anchor and got out my boats, which the manœuvering of the ship and the working of the pumps had hitherto prevented me from doing.

The corvette was already half under water; but a light breeze having sprung up, I wished to try my fortune by advancing with the corvette towards a part of the middle of the bay, near which

Pernetti had marked a sandy coast. I veered out the cable, and sailed with a wind scarcely strong enough to steady the ship. M. Duperrez, whom I met on the way, conducted the ship to a suitable place. Arrived at the borders of the beach, the corvette ran aground, without any shock, at 3 o'clock in the morning of the 15th.

I will not undertake now to give you an account of all the attempts I made to get the vessel off and repair her; it must suffice to tell you, that the damage was too great, and our resources too weak, to allow us to effect our object. As soon as I found it impossible to save the ship, I occupied myself in landing, under tents, all that could possibly be saved; but the acquisitions of the expedition were placed in safety immediately.

My long-boat was already decked, and about to depart to seek assistance at Rio de la Plata, when an American vessel which had sustained serious damage, and was obliged to put in here to refit, undertook to convey us to Rio Janeiro for the sum of 18,000 piastres. It is necessary to remark that we had with us every thing requisite for the support of the officers and crew during the voyage. Observations on magnetism were made daily during our voyage from Port Jackson to the Falkland Islands; they have been continued here with the greatest exactness; I have even been fortunate enough, notwithstanding the great impediments which have occurred, to make some experiments with the pendulum. Upon departing we will resume the course of our labours.

It is for me a pleasing duty to have to render an account to Your Excellency of the excellent conduct which my officers and crew never ceased to exhibit during our great and painful labours. Their discipline was never relaxed for an instant in the midst of privations of all kinds, and of the sickness which they occasioned; but which, however, has disappeared under the care and skill of M. Quoz, senior surgeon.

MM. Lamarche and Duperrez have given proofs of possessing as much talent as activity. MM. Berard, Raillard, Guerin, Pellion, and all the other cadets, have shown a steadiness and a character that belong only to experienced officers. Among the crew I could cite a great number of seamen worthy of praise; but I ought particularly to recommend to Your Excellency's notice M. Baltaraza, the master, and M. Roland, the gunner, who merit for their zeal and talents the particular consideration of Your Excellency.

This letter will be carried to Europe by an English whaler, which has put in here for water. As for me and my crew, we set sail to-morrow, unless a contrary wind prevent us.

I have the honour to be, &c.

(Signed) Louis De Freycinet.

XIII, *Ac-*

XIII. *Account of the new Discovery of a Southern or Antarctic Continent**.

An opinion of the existence of an Antarctic Continent has prevailed ever since the discovery of America rendered us more intimately acquainted with the figure of the earth; nor, when all the circumstances that led to it are considered, can it be called an unreasonable opinion. The vast quantity of floating ice in the higher southern latitudes justly indicated its origin to be in fresh water rivers and lakes at no great distance. And again, the immense space of ocean, in the southern hemisphere, in the absence of such a continent, led to an inference that that beautiful arrangement and disposition of land and water, so conspicuous in the northern, was overlooked, and the equilibrium neglected in the southern hemisphere.

These considerations led many voyagers to search after this *terra incognita*, and particularly influenced the last voyage of Captain Cook. But is it not surprising that it should have escaped the observation of the circum-navigators of all nations, and have baffled the laborious perseverance of Cook himself? and that the numerous vessels (whalers and others) that have navigated the sea contiguous to such land for nearly two centuries, should have remained in ignorance of its existence? Yet such is the fact; and it is equally surprising, that the honour of its discovery should have been reserved for the master of a small trading vessel, nearly fifty years after the question seemed to be set at rest by the unsuccessful result of Captain Cook's navigation.

Captain Cook first explored the Southern Ocean between the meridian of the Cape of Good Hope and New Zealand; consequently far to the east of the land now discovered. In November 1773, he left New Zealand, and employed several weeks between 180° and 90° west longitude, and 45° to about 72° south latitude; so that he never approached within 30 degrees (on the Antarctic circle) of the new continent. The only passages we think it necessary to quote from him, as illustrative of our present subject, are the following:

"In lat. 67° 20′, long. 137° 12′," he says, "while we were taking up ice, we got two of the antarctic peterels so often mentioned, by which our conjectures were confirmed of their being of the peterel tribe. They are about the size of a large pigeon; the feathers of the head, back, and part of the upper side of the wings, are of a light brown; the belly, and under side of the wings, white; the tail feathers are also white, but tipped with brown:

* From the Literary Gazette.

brown: at the same time, we got another new peterel, smaller than the former, and all of a dark gray plumage. We remarked that these birds were fuller of feathers than any we had hitherto seen; such care has nature taken to clothe them suitably to the climate in which they live. At the same time we saw a few chocolate-coloured albatrosses; these, as well as the peterels above mentioned, we no where saw but among the ice; hence one may with reason conjecture that there is land to the south. If not, I must ask where these birds breed? A question which perhaps will never be determined; for hitherto we have found these lands, if any, quite inaccessible. Besides these birds, we saw a very large seal, which kept playing about us some time. One of our people who had been at Greenland, called it a sea-horse; but every one else took it for what I have said."

Again, in lat. 65° 42′, long. 99° 44′: "I now came to the resolution to proceed to the north, and to spend the ensuing winter within the tropic, if I met with no employment before I came there. I was now well satisfied no continent was to be found in this ocean, but what must lie so far to the south as to be wholly inaccessible on account of ice; and that if one should be found in the Southern Atlantic Ocean, it would be necessary to have the whole summer before us to explore it. On the other hand, upon a supposition that there is no land there, we undoubtedly might have reached the Cape of Good Hope by April, and so have put an end to the expedition, so far as it related to the finding a continent; which indeed was the first object of the voyage. But for me at this time to have quitted the Southern Pacific Ocean, with a good ship expressly sent out on discoveries, a healthy crew, and not in want either of stores or of provisions, would have been betraying not only a want of perseverance, but of judgement, in supposing the South Pacific Ocean to have been so well explored, that nothing remained to be done in it. This, however, was not my opinion; for though I had proved that there was no continent but what must lie far to the south, there remained nevertheless room for very large islands in places wholly unexamined: and many of those which were formerly discovered, are but imperfectly explored, and their situations as imperfectly known. I was besides of opinion, that my remaining in this sea some time longer, would be productive of improvements in navigation and geography, as well as in other sciences."

In the absence of a more detailed narrative of the important discovery (now made of the actual existence of a southern continent) which we presume is retarded for obvious reasons, resulting from the impolicy of making premature disclosures, the following few particulars may not only gratify curiosity, but will, in a great measure, we trust, counteract the ill effects of garbled and

and incorrect statements, which are beginning to find their way into the periodical press.

One of the evils attending mis-statements, in the origin of an important discovery, is that of involving the question in a labyrinth of contradictions, from which in after-times it is difficult to unravel the truth. In the present instance too, as in former cases, a meritorious and enterprising though obscure individual is in danger of being deprived of the credit he so justly deserves, by probably adding to his native country a new source of wealth; the full worth of which would only be truly known by its possession by a rival in commercial enterprise.

A Mr. Smith, Master of the William, of Blythe, in Northumberland, and trading between the Rio Plata and Chili, in endeavouring to facilitate his passage round Cape Horn, last year, ran to a higher latitude than is usual in such voyages, and in lat. 62° 30′, and 60° west longitude, discovered land. As circumstances would not admit of a close examination, he deferred it until his return to Buenos Ayres, when he made such further observations as convinced him of the importance of his discovery. On making it known at Buenos Ayres, speculation was set on the alert, and the Americans at that place became very anxious to obtain every information necessary to their availing themselves of a discovery which they saw was pregnant with vast benefit to a commercial people. Captain Smith was however too much of an Englishman to assist their speculations, by affording them that knowledge of his secret which it was so necessary for them to possess; and was determined that his native country only should enjoy the advantages of his discovery; and on his return voyage to Valparaiso, in February last, he devoted as much time to the development of it as was consistent with his primary object, a safe and successful voyage,

He ran in a westward direction along the coasts, either of a continent or numerous islands, for two or three hundred miles, forming large bays, and abounding with the spermaceti whale, seals, &c. He took numerous soundings and bearings, draughts, and charts of the coast; and, in short, did every thing that the most experienced navigator, dispatched purposely for the object of making a survey, could do. He even landed, and in the usual manner took possession of the country for his sovereign, and named his acquisition, "New South Shetland." The climate was temperate, the coast mountainous, apparently uninhabited, but not destitute of vegetation, as firs and pines were observable in many places; in short, the country had upon the whole the appearance of the coast of Norway. After having satisfied himself with every particular that time and circumstances permitted

permitted him to examine, he bore away to the North and pursued his voyage.

On his arrival at Valparaiso he communicated his discovery to Captain Sherriff of H. M. S. Andromache, who happened to be there. Captain S. immediately felt the importance of the communication, and lost not a moment in making every arrangement for following it up; he immediately dispatched the William, with officers from the Andromache: and in this stage the last letter from Chili left the expedition, with the most sanguine expectation of success, and ultimate advantages resulting from it: and, if we are correctly informed, a fully detailed narrative has been forwarded to Government.

On taking a cursory view of the charts of the Southern Atlantic and Pacific Oceans, it will be seen, that though Captain Cook penetrated to a much higher latitude, and consequently drew his conclusion from observing nothing but vast mountains of ice, it will be seen also that his meridian was 45 degrees further to the west of New South Shetland, leaving a vast space unexplored on the parallel of 62° between that and Sandwich Land, in longitude about 28° west. He again made 67° or thereabouts, but in longitude 137° to 147° west. Perouse ascended no higher than 60° 30′; Vancouver about 55°; other navigators passing the Straits of Magellan and Le Maire; and most of them passing as close to Cape Horn as possible, in order, as they thought, to shorten the passage to the Pacific, are circumstances that reasonably account for the protracted period to which so important a discovery has been delayed.

XIV. *Description of a Volcanic Eruption in the Island of Sumbawa. By Mr.* G. A. Stewart*.

In the month of April, 1815, there occurred on the island of Sumbawa a volcanic eruption as tremendous perhaps in its nature, and as destructive in its effects, as any on record.

The mountain from which this took place is called Tanbora. Its summit is calculated to be in latitude 8° 20′ S. and in longitude 118° E. The calculations for this were made from solar lunar observations taken near the mountain by Captain Eatwell, then commanding the Honourable Company's cruizer Benares. Its base is of great extent; but its summit did not to me appear higher than from 5000 to 7000 feet above the sea, which washes the base of the hill for three-fourths of its extent. From ships passing near it, it has been often observed to throw out smoke and

* From the Transactions of the Literary Society of Bombay, vol. ii.

dust

dust with some noise. In the month of December, 1814, the Honourable Company's cruizer Ternate passed near it, and we had an opportunity of observing the hill, though at a very considerable distance. It was then emitting smoke in a dense column of immense circumference. So very great was the diameter of the column of smoke, and so dense was it, that we at first took it for part of the mountain; for at the distance we were off, the mountain and the smoke had nearly the same colour.

From the 5th to the 11th of April, 1815, the mountain emitted dust and frequent loud sounds every day. The dust caused a haziness of the atmosphere at places many degrees distant from Tanbora; and the noises which were heard equally far off, sounded at Beema (a town about sixty miles east of the hill) generally like the firing of the largest cannon close to the ear; at other times the noises were of a rumbling kind.

On the night of the 10th and morning of the 11th of April the loudness and frequency of the reports increased. The showers of greyish black dust which had been falling at Beema increased so much by 7 A.M. on the 11th, as to produce there a total darkness. This complete darkness continued until 7 A.M. on the 12th, after which the dust fell in less and less quantity, and at noon it entirely ceased.

Pumice-stone of a brown colour was thrown out in immense quantity at the crater of the mountain. Great fields of it, with scorched trunks and branches of trees, were afterwards found floating in the neighbouring sea; and much of these were thrown up on the shores of Bally Java, Madura, Celebis, &c. These shoals were troublesome, and even somewhat dangerous, to ships passing near them. The country ship Dispatch fell in with many fields of this pumice-stone and wood, and was obliged to steer clear of them; some of the pieces of wood were noted in its log-book as being about "six feet in diameter, and of very great length."

Trees of great size (many from sixty to eighty feet long) were thrown into the sea, some of which I saw in the bay of Beema; they seemed to have been scorched, and to have had their small branches and roots torn off. Some of those trees I saw sticking in the mud near the shores of the bay, with one end uppermost.

Some of the houses of the town of Beema were materially injured by the eruption; and I understand from our resident there, Mr. Pilott, that this had been occasioned by the discharges from the mountain.

In the bay of Beema the nature of the bottom was for some little depth changed from a soft mud to a firm mud, resembling a greyish-black clay, which did not allow our ship's lead to sink in it. This change, I presume, was occasioned by the depth of volcanic

volcanic dust which fell in the bay of Beema; for on mixing any quantity of the same dust with water, it soon sank to the bottom of the vessel containing the water, and formed there a firm substance, much the same in colour and consistence as the clay-like matter which our lead and anchor brought up from the bottom of the bay of Beema. It is necessary, however, to mention, that although our lead could not penetrate through the layers of clay-like matter then on the bottom of the bay of Beema, our anchor did, and, on being heaved up when we left Beema, showed us both the soft mud which we had before the great eruption found all over the bay, and above that the layers of firm mud which seem to have been made by the falling dust.

It was reported by Captain Eatwell, of the Honourable Company's cruizer Benares, that the earthquake attending the eruption had raised a bank on which that ship struck, in a place where the Honourable Company's cruizer Ternate some months before it had floated in safety.

The people living on the peninsula formed by the mountain had traded much in horses, of which their country produced a very good small breed. Thousands of them and their horses were, according to all accounts, destroyed by the eruption: the vegetation was ruined, and multitudes of the people obliged to emigrate in order to obtain subsistence.

I understand that at the town of Tanbora, situated at the bottom of the west side of the mountain, the sea has made a permanent encroachment, burying that town to the depth of three fathoms.

Three distinct streams of a dark-coloured lava, according to the report of the people on the island, issued from the hill; of these I could observe something as I passed going to Beema in July following. One stream on the east side of Tanbora seemed to be emitting smoke and vapour even at that time.

During the darkness the sounds before described were particularly loud and frequent. At times, indeed, they were so loud as to produce momentary earthquakes of no inconsiderable violence.

All this while there was no wind in any direction in the neighbourhood of the mountain, or at some distance from it; yet the sea was so violently agitated as to wash away some houses near it on Sumbawa, and to throw on the beach near the town of Beema several large trading boats that had been at anchor in the bay.

One of the most remarkable circumstances of the eruption is the experience of its effects at immense distances. At Samanap, on the island of Madura, in lat. 70° 5′ S. and in long. 113° 57′ E., there was, according to the information I received from Mr. Liddel, master attendant there, and who was at Samanap at the time,

time, total darkness, in consequence of the falling dust, from 5 P.M. of the 11th of April until 11 A.M. of the 12th. The explosions were very loud at that place, and were heard for several days.

At Somabaya the darkness was complete from about 6 P.M. on the 11th until 4 P.M. on the 12th. The sounds were described to me as being exceedingly loud. They had been heard at Samabaya, and dust had been observed to fall for several days before the 11th, during which time the wind was eastwardly and light: on the afternoon of the 11th a very thick haze resembling a cloud was observed coming from the eastward. It proved to be the cloud of dust from Mount Tanbora. The anchorage in Somabaya roads is in lat. 7° 14′ S. and in long. 112° 58′ E., *i. e.* about five degrees distant from Tanbora.

Similar but slighter effects of the eruption were felt at Batavia in lat. 6° 10′ S. and in long. 106° 51′ E.; at Java Head, still further off, being in lat. 6° 48′ S. and in long. 105° 11′ E.; at Minto, on the island of Barca, in lat. and in long. ; and at Bencoolen, or Sumatra, in lat. 3° 48′ S. and in long. 102° 28′ E.

At Macassar, in lat. 5° 10′ S. and in long. 119° 38′ E. the effects of the eruption were felt nearly at the same time as at Somabaya, but in a degree more violent.

The explosions from the volcano were so violent there, as to astonish every one; they shook the earth, and broke panes of glass in the windows of several houses. The cloud of dust was seen coming from the south. There was no wind.

With a view to ascertain the quantity of dust falling in a certain time, Mr. Paterson, surgeon of the residency there, put a table into the open air for an hour, between 6 and 7 P.M., at which time the dust was falling in great quantity, and the darkness total. The dimensions of the surface of the table were five feet two inches by four feet eight inches; the quantity of dust which fell upon it by 7 P.M. was 15,064 grains at Beema; the quantity of dust found lying on the ground after the eruption was guessed to be at a medium of three inches and a half in depth: at Somabaya the depth of it was something less.

At the island of Ternate, in lat. 0° 49′ N. and in long. 127° 29′ E., the explosions were distinctly heard about noon on the 11th of April; dust was not perceived to fall there, nor did any person notice that that day, or any one of those immediately following, was at all darker than ordinary.

On the island of Amboyna, on the 11th or 12th day of April in the same year, a violent earthquake was felt. In the ground of a gentleman near the Government-house, the earth was observed to open, to throw out a gush of water, and immediately after to close. The sea in the neighbourhood of Amboyna was violently agitated during that month, rising to high-water mark and sinking to low-water mark in the course of ten minutes. For several days, at the same time, the sun appeared (according to a letter from the late Lieutenant White, of the Bombay marine, then at Amboyna) of a green colour, encircled with a haze. Fort Victoria, on Amboyna, lies in lat. 3° 40′ S. and in long. 128° 14′ E.

The inhabitants of the island of Banda, one of the Moluccas, experienced shocks of an earthquake at the time of the eruption of Mount Tanbora.

N. B. Some of the facts here mentioned are from my own personal knowledge, some from the information of individuals and from written documents on which I can rely; and some of them, more especially those concerning Sumatra, Banca, Amboyna, and Banda, are taken from the Java Government Gazette.

XV. *Observations on the Phænomena of the Universe.* By A Newtonian.

To Mr. Tilloch.

Sir, — Having lately perused the Essays on the proximate mechanical Causes of the general Phænomena of the Universe, by *Sir Richard Phillips*, in which he endeavours to eclipse the immortal memory of the illustrious Newton, I have been induced to offer a few remarks respecting the theory of *Sir Richard*, which, like many other systems lately published, has, in my opinion, little or no foundation to support it.

Previously to offering any remarks, I shall make a few extracts from the above Essays:

1. Whatever be the origin of its own motion, the sun acts in the œconomy of the planetary bodies, of the *solar* system, like the heart in the œconomy of the animal system. Its own motion may be created by some arrangement within itself—by a perpetual motion of unknown contrivance, by the cross and reciprocal actions of the planets. The continued impulse of the sun on the medium of space, or solar atmosphere, or both, must necessarily communicate to the entire sphere of its influence a simultaneous rotation like the atmosphere of the earth. The orbicular motions of the planets will in that case be governed by a ratio of their distance, compounded with their densities, p. 65.

2. *Sir Richard* inclines to think from reasoning *à priori* that every fixed star as a sun puts in revolution its own gaseous sphere, and by a revolving and diverging agency governs the general motions of the planetary bodies placed within its system or sphere of action, impulse, or rotation, p. 59.

3. Nor

3. Nor is it important whether the medium be dense or rare, for it is the moving agent; it may answer that purpose whatever be its density, and may produce its particular result, whatever be its rarity: as an agent of motion it is like a current which moves a ship, not through itself with resistance, but within itself without resistance, p. 53.

4. We know too that a mechanical action or protrusion may be produced between bodies, through a fluid or gaseous medium, as well as through an organization of fixed matter; the effect however, which is imperfect in our expanding atmosphere, is perfect in the unyielding medium which fills universal space, p. 55.

5. That motion transfers motion throughout all the bodies of infinite space, and that all motion is produced by motion, p. 48.

6. No attraction or effect without mechanical cause is in this theory supposed to be concerned in producing phænomena; every mass remains inert in space, and when moved, it moves in the degree only in which it is acted upon, and has no natural or innate inclination to move one way rather than another. Consequently the progressive impulse of the rare medium of universal space is as efficient in producing orbicular motion, as would be a current of water or mercury, p. 66. The momentum in every line radiating from the origin of motion, being inversely as the square of the length of the line, p. 60. If the density of a projectile were equal to the density of the medium, then the projectile would float in the medium, and be carried round the earth in the circular vortex of the earth like the medium itself, p. 36.

7. A body *elevated* from an *inferior* circle of rotation into one where a more *rapid motion exists*, or where a motion exists which does not accord with the density of the elevated body, is necessarily repelled from superior strata to inferior strata, till it finds its due level or balance of motion and density. Thus, if a projectile have a specific density equal to the air or fluid into which it has risen, it will be carried round the earth in the concentric circle of that stratum, because the momenta are there equal; but if it be lighter than the air, it will then be reflected by the denser strata till its own momentum and the momenta of the surrounding bodies are equalized: on the other hand, if it be heavier than the circumambient air or fluid, then the air or fluid will rise over it and deflect it to the earth, with a force which must be in a fixed ratio of their distances, p. 24.

8. The momenta of each of the strata being equal, and consisting of the velocity multiplied by the quantity of matter; and the density of an equal quantity of matter in a sphere being as the cube of the radius, the densities of the successive strata in a series of concentric strata having equal momenta, must be inversely to each other as the cubes of the radii.

9. The

9. The density of each stratum is inversely as the increasing bulks in each stratum, that is, inversely as the cubes of the radii.

10. The momenta of every equal bulk in different strata are inversely as the density, which is inversely as the cube of the radii.

11. But the momenta are also directly as the angular velocities, which are directly as the radii, p. 25.

Whence the following results obtain.

1. That the density of the gaseous medium, the density of the planets, and their velocities in their orbits, decrease from the sun to the confines of the solar system.

2. That the planets revolve or swim in this medium in strata of equal density with that of the respective planet which revolves in those strata; otherwise the planets must sink, or fall to the sun, or ascend into a medium of a uniform density with itself.

3. The orbicular motions of the superior planets in a gaseous medium, must be accelerated motions, as the rotation of this medium at the sun's surface is performed in the same time as the rotation of this luminary about its axis, (as the velocity of rotation of the medium cannot be admitted to exceed that of the sun,) or in the space of 25 days 10 hours. But at the distance of the Herschel planet, its period occupies 30688 days 17 hours, whence an acceleration must be produced in the superior strata of the gaseous medium; and consequently in the superior planets, from the effects of friction produced in the respective strata of circumambient matter, as there must be a natural tendency existing in the respective strata of the medium in which the planets revolve, to produce an equalization of motion.

And, according to *Sir Richard's* Universal System of co-equal re-action, a retardation must also necessarily result in the rotation of the sun, and the circumambient medium in its vicinity, as this inherent principle of rotatory motion by the laws of mechanics ought to be retarded at its seat of action, and accelerated in the superior orbits of its rotation, till the angular velocities in the orbicular motions of the planets, and the corresponding strata of the gaseous medium become equalized. Moreover, as this theory is applicable to all other planetary systems, the planets in each system ought ultimately to revolve round their primaries, with equal angular velocities, or in equal times, whatever may be their distances from their respective primaries; as accelerations and retardations, natural results of the effects of friction on the medium, must exist, till the above uniform motion obtains.

4. The planes of the orbits of the planets must also approximate towards the plane of the sun's equator, from effects the result

sult of the angular motion of the planets with that of the gaseous medium. If the sun and its circumambient medium was originally put, or continue to be kept in motion by some unknown contrivance or internal movement in the body of the sun (as Sir Richard conjectures), the plane of the orbits described by the medium ought to coincide with the plane of the sun's equator. But that this was not originally the case, appears evident; a convincing proof that this mechanical medium was not originally put, or continues to be kept in motion, by any fanciful arrangement within itself, such as a perpetual motion of unknown contrivance, creating or transferring motion to the respective planets, satellites, and comets, in the solar system. In fact, this theory of the planetary motions is more incomprehensible than that of gravity.

5. The elliptic motion of the earth in its orbit (on Sir Richard's Theory) can only be accounted for by a variation in the density of the gaseous medium. The earth's diurnal rotation on its axis being uniformly the same can produce no variable effect on the orbicular motion. In fact, this rising and falling of the planets in the gaseous medium, or variation in the radii of their orbits, is inexplicable by this theory.

6. The *hypothesis* (vide art. 7) is applicable to the sun and its circumambient gaseous medium; otherwise the theory of Sir Richard cannot obtain whence the motions of the planets in superior orbits are quicker than those which are situated nearer the sun. But that this is not the case is evident, their respective motions in feet, in one second of time, being as follows:

Mercury 158825; Venus 116188; Earth 98817; Mars 80054; Jupiter 43329; Saturn 31997; Georgian 22562.

From the above statement, their velocities decrease instead of increase. Here is also a strange breach in the analogy; for according with the above velocities, the motion of the gaseous medium, by which the planets are impelled in their orbits, ought in the vicinity of the sun to move with a velocity far exceeding that of Mercury; whereas the motion of rotation on the sun's surface is but 6617 feet per second, being but one twenty-fourth part only of that of Mercury. In pursuing this investigation *I discovered* that the *velocities* of the planets in their orbits multiplied by the *square roots* of their respective *mean distances* is always a *constant quantity*. Whence the rotation of the gaseous medium at the surface of the sun in one second of time ought to be 1.447.628 feet, instead of 6617, being only about a two hundred and nineteenth part of what it ought to be by this theory: from which it is evident that the motions of the planets are not effected by solar transferred motions, or by a revolving or diverging agency, resulting from an internal movement in the body of the sun.

For

For we might as well suppose, that the motion of a cannon ball in its flight *acquired* a velocity exceeding by upwards of 200 times that which was communicated to it when it left the cannon's mouth! Hence an *experimentum crucis*, which undeniably proves the fallacy, and absurdity, of the *Phillipian doctrine*.

6. Art. 3 and 7. Admitting the earth to swim in this gaseous medium, it is requisite that an uniform density exist between them; and as our atmosphere is subject to the laws of contraction and expansion, by what *hocus pocus* or conjuration is its condensation prevented? If a mechanical action or protrusion is produced through an organization of fixed matter, it is a notorious absurdity to suppose our atmosphere to be encompassed with this miraculous mechanical *gas*, without its being compressed to a uniform density with that of the earth, and its circumscribing medium. Our atmosphere might be protected from its action, it is true, supposing the medium to be constituted of fixed matter; but in this case the orbits of the earth and planets would be circles instead of ellipses, and any tendency to deviate from this track would produce a condensation in our atmosphere equal to the density of the medium, compounded with the paramount velocity of the earth and medium. Otherwise, *on the principles of Sir Richard*, our atmosphere would abandon its present circumscriptive situation, and ascend into a rarer stratum, till its density and momentum and that of the gaseous medium are equalized. And in consequence of the rushing in of this dense gaseous medium to supply its place, the human-race would undoubtedly be annihilated; and all loose or detached bodies or fluids, inferior to the earth's mean density, or particles of matter not united by mechanical cohesion of atoms, would take their aërial flight from our globe, never more to return! What a sublime theory!! What an elegant elucidation of the *modus operandi*!!!

7. Action and re-action being every where equal—By what means does the earth or other planet acquire a renovation of motion? As *Sir Richard*, to account for the rotatory motion of the earth on its axis, supposes it to be generated by a mass of various density moving rapidly through the gaseous medium of space, certain points of which would act on the medium, and turn the whole, the effect would be a retardation in the earth's *orbicular* motion. But suppose we for the present admit, that the earth's motion in the opposite part of its orbit is accelerated in order to establish a compensation of motion, how does it happen that the rotatory motion of the earth on its axis is not alternately accelerated and retarded accordingly, which we know to be contrary to observation?

Another obstacle also presents itself in respect to *rotatory* motions.

motions. The elevated and mountainous parts of the planets being repulsed by the continued action or resistance of the gaseous medium, must produce a retardation also in their rotatory motions. An unequal rotatory motion must also be produced in consequence of a variation of density in the planets, which would retard their motions, when the hemisphere of preponderating density was ascending from the sun, or rising into a superior stratum, or rarer medium; but on descending towards the sun, as on its opposite hemisphere, the contrary effect would take place, so that an acceleration and retardation would result alternately in every diurnal rotation of a planet, provided its mathematical centre did not coincide with its centre of gravity. In fact, uniform rotatory motions could not exist on this theory, as a retardation would evidently predominate till the line passing through the centre of each planet and the point of preponderating density, acquired a relative position with the radii of their orbits. The final results of their rotatory motions would be similar to that of the moon in respect to the earth; but which is supposed to be retained in its relative position by the effects of their mutual attractions, or principally by the attraction of the earth on the paramount density on this side the lunar globe, so that a revolution in its orbit and a rotation on its axis are performed in the same period of time.

8. We are informed, page 26, that the *momenta* in bodies of *equal density* in *different strata* or shells are inversely as the squares of the radii. And the momenta of different densities in the same strata are as the densities respectively. But the momentum in bodies of equal density in different strata must be directly as the radii, and not as the squares of the radii, as erroneously stated; for the bulks being supposed equal in either case, and their densities being equal, their masses must also be equal; whence their momentum is compounded of their mass and *velocity*, which is directly as the radii.

The densities and velocities of the planets in their orbits being the same as that of the gaseous medium in which they circulate, neither the perturbations in the motions of the planets, satellites, or comets, or their elliptic motions in their orbits, can be accounted for on the above principles, as the essential properties of bulk and momentum are the same in each planet, as in spheres of the medium under equal radii (in which the planets circulate), and consequently can have no more effect on the sun or on each other, than the medium which they displace, or no more effect than if they did not exist.

9. Page 25. We are told that the *increasing bulk* in *each stratum* is inversely as the cube of the radii. But this I deny. For the diameter of the spherical strata, their bulk, velocity,

and momenta, are fixed quantities, the density only being variable: whence it is evident that the solidity of the spheres only is as the cubes of their radii. The solidity of each spherical stratum bears no analogy to this proportion; and so far from the *increasing bulk* in *each stratum* being inversely as the cube of the radii, it is absolutely in a direct arithmetical proportion. In ascertaining the solidity of a spherical shell, it is requisite that the solidity of all the interior spherical shells be deducted from the solidity of a sphere whose diameter is equal to that of the superior shell, in order to obtain the solidity required.

10. Sir Richard, page 91, objects to the words *attraction* and *repulsion:* as *to attract* and *to repel* are active verbs implying an *agent* and a *patient*, it would be evidently absurd, he remarks, to say of two ships sailing towards each other at sea, that they *attract* one another. The impropriety in the sentence I acknowledge, but the absurdity originates in his reference of that effect to attraction which in reality is produced by the wind. The absurdity therefore evidently attaches itself with the impropriety of his allusion, or in misapplying the word. In respect to *agents*, I answer that the effects of an *agent* cannot be visible unless another body exist, on which it operates. In short, such quibbles are beneath notice.

11. The rotation of a point on the earth's equator in one second of time is stated at 1250 feet, vide page 17: but this statement is erroneous, as it ought to be 1523 feet; the earth's diameter being 7912 miles.

12. The orbicular and rotatory motions of the planets are in a direction from west to east; the orbicular motion of Saturn in one second is 31997 feet: its rotatory motion round its axis in one second, is 34987 feet in the same direction; consequently its combined motions are 66984 feet per second. It is therefore preposterous to assert that a detached body can rest on his surface in this situation without being hurled off in the direction of a tangent, to the radii of its orbit. On the contrary side of the planet its rotatory motion is in the opposite direction, and its secondary velocity equal to 2990 feet, its motion in this case being retrograde. Hence all loose or detached bodies would be hurled from its surface, the gaseous medium being insufficient to constrain it to revolve in a circle.

13. Sir Isaac Newton investigated the properties of *vortices*, in order to ascertain whether the celestial motions could be accounted for thereby; and he has proved that the celestial bodies are not carried round in *vortices*, which he has shown to be absurd and impossible: as comets move in orbits in all directions, these *vortices* must be composed of such fluid matter as has neither friction nor resistance, and that one *vortex* must be penetrable

netrable to another. By what extraordinary *mechanical phæ-nomena* are these *vortices* created, and how constituted so as to be able to produce the *tides*, or cause the motions of comets, since these *vortices* must all run counter to one another, and penetrate each other, and yet wonderfully preserve their motions entire?

14. The comet of 1680, according to the calculation of Mr. Pingre, when in its perihelion, actually moved with a velocity of 1,240,000 miles in an hour.

The maximum horary motion of a comet descending to the sun from an infinite distance can never exceed 1,395,856 miles from the effects of their mutual attractions. The velocity of the comet of 1680 is a near approximation between observation and theory, and which undeniably corroborates the truth of the *Newtonian theory*.

On the other hand, the planet Mercury, whose motion is the swiftest of any planet with which we are acquainted, moves with a velocity of only 108,290 miles in an hour; and the maximum horary motion of the gaseous medium is but 4512 miles! For the sun evidently cannot communicate a greater impulse of motion, than that of its rotation about its axis!! PHILLIPIANS, *pause and reflect, ere reason forsake her empire, and do not persist in this sophistical doctrine, unsupported by any authority, false, and replete with absurdities and inconsistencies.*

15. In reference to page 10, I answer that the projectile force was first communicated to the planetary bodies by the hand of the Deity, who implanted in matter the principle of universal attraction, and that no immaterial power is requisite to maintain the planetary motions. It has been demonstrated that the reciprocal actions of the planets and the deviation of their figures from the spherical form, can never produce any alteration in their mean motions or mean distances. All the inequalities in the system are periodical. The planetary orbits change their inclinations. Their eccentricities vary within certain limits, but the greater axes of their orbits, and their periods round the sun, remain perpetually the same. Amidst the multiplied derangements which affect the bodies of the planetary system, the general harmony is always apparent; and the little disorders which have so long perplexed the ingenuity of astronomers seem only to evince the permanence and stability of the whole. What a sublime view of the great arrangements of the universe! What an affecting proof of the goodness and wisdom of its Author!!

I am, sir, with respect, yours truly,

Tennitajugs, Aug. 8, 1820. A NEWTONIAN.

XVI. *Some Account of the Caves near Baug, called the Panch Pandoo. By Captain* F. DANGERFIELD, *of the Bombay Military Establishment**.

BEFORE entering on a description of these caves, a slight sketch of the wild, mountainous, woody tract of country in which they are situated may perhaps be desirable.

This mountinous tract is contained between the twenty-second and twenty-third degrees of north latitude, ranging for a considerable extent in the direction of the course of the Nurbuddah, leaving however generally an intermediate plain, about ten or twelve miles broad, between it and the banks of that river. In this range few towns or villages are to be found, it being for the most part peopled by Bheels of the wildest description, few having any fixed habitations.

In the midst of this range, in north latitude 22° 22′ 15″, and in nearly 75° east longitude, is the small town of Baug, three miles and a quarter S. S. E. of which the caves are found.

The town is situated at the foot of a low range of hills about one hundred feet high, which forms the western boundary of a pleasant valley extending north and south about three miles, by an average breadth of one mile. It contains, within a small area surrounded by a low mud wall, about four hundred houses. At the summit and extremity of the range near which it is placed, overlooking the town, is a rudely built stone fort now falling fast to decay. The ascent to it is by a small footpath very steep.

Baug is on the road leading from Guzerat to Malwa, by what is termed the Oudipoor Pass. From this place the two roads leading into the latter province diverge; one constituting the Tanda Gaut to the eastward, the other the Tirrella Gaut, leading to Indore, Oujein, or by Rajghur to the northward: this last is by far the best carriage road.

Previous to these last twenty years of anarchy and desolation Baug is said to have contained between two and three thousand houses, and to have covered a considerable portion of the plain in which it is situated; but, with the exception of two or three pagodas, few vestiges now remain to point out its former extent.

As a town, however, Baug does not claim any antiquity, it having risen into importance about a hundred years ago, from becoming the occasional residence of Jassoo Baumeah, a celebrated freebooter, who possessed himself of the Kotra district, and who built as places of security for his followers and plunder the forts of Soosaree, Baug, and Kooksee.

* From Transactions of the Literary Society of Bombay, vol. ii.

Jassoo

Jassoo Baumeah becoming by his bold depredations, which extended not only into Malwa but even to the Deckan and Guzerat, so formidable as to excite the serious attention of the Mahratta princes, he was besieged by a large army during forty days in the fort of Kooksee; at the end of which period, finding the place no longer tenable, he made his escape to Baug. To this last place he was pursued, and again besieged; but not being able there to make any stand, he retired to the mountains, from which period nothing further of him is known. His country was divided among the conquerors; Baug, with its dependent villages, falling to the share of Scindiah, to whom it still belongs.

The jungle for some distance round Baug is very open, and the hills do not rise to any considerable height, seldom exceeding one hundred and fifty or two hundred feet. They appear for the most part to be composed of the flœtz and transition rocks, chiefly trap and flint slate; and both these and the valleys abound with iron ore, the brown ironstone, and clay ironstone.

There are at this place some iron works on a small scale, consisting of three smelting furnaces and three forges; giving employment to twenty-four blacksmiths, and many men, women and children, in transporting, pounding, and sifting the ore, which produces about fifty or sixty per cent. of iron of an indifferent quality, chiefly arising from the imperfect fusion and forging of the metal. It is at once wrought into ploughshares weighing about two pounds each. From the little demand, however, the ore is only wrought about three or four months in the year. Each forge pays forty rupees to Government.

The whole of the alluvial soil, which on the hills seldom exceeds six feet in depth, is for ten or twelve miles round Baug strongly coloured with oxide of iron.

On leaving Baug to visit the caves, you proceed for three miles along the high road to Kooksee, when turning to the left, a small footpath, after a quarter of a mile, leads you across the Waugrey river to the hills in which these caves are cut, and which rise close to the left bank of that river.

This range of hills does not exceed in height one hundred and fifty feet, having a direction nearly N.N.E. and S.S.W., the entrance to the caves facing the westward. The lower half of the hill is sloping, but steep; the upper perpendicular. The hill in which these caves are excavated is composed entirely of horizontal strata of sandstone and claystone alternating with each other.

The sandstone, which has an argillaceous cement, is coloured with oxide of iron varying from the deep red to perfect white. With its colour vary also its hardness and the fineness of its grain, the dark red being fine-grained and tolerably hard, the white

white coarse-grained, and so soft as to be rubbed to pieces between the fingers, and containing many organic impressions. Different shades of the red sandstone occupy the upper or perpendicular part of the hill, with thin layers of the claystone interposed. A broad stratum, however, of the claystone runs about six feet above the top of the caves; and it may here be observed, that it is solely from this stratum that the rock has given way beneath, causing the destruction of those caves hereafter mentioned.

The caves occupy the centre of the hill, commencing at its perpendicular part. It is through the lower half of the caves, for about six feet from their floor, that the stratum of white sandstone runs; this however reposes on the old red sandstone. The upper part of the caves is mostly formed of the light red sandstone.

The caves are four in number; one only of which, the most northern one, can however be said to be in a state of preservation.

Immediately after crossing the river you ascend up the sloping part of the hill, to the first or most northern cave, by a flight of seventy rudely formed stone steps, and arrive at a small landing-place for the most part overhung by the hill. This bears the marks of having once been formed into a regular viranda, supported by columns, the roof plastered and ornamented, as shown by its fallen fragments. The front of the cave still retains this plaster. At each end of this viranda is a small room containing small ill-covered figures, evidently of modern workmanship, that on the left being a female one much mutilated, that on the right a bad representation of Ganesa.

You enter this cave at the centre, by an unornamented rectangular doorway five feet and a half wide. There is also a similar one to the right, but much choked with the fallen fragments of the roof. The cave derives its sole light from those two entrances; consequently, to examine its remoter parts, the aid of torches is necessary; and as tigers, which abound in this country, have been found in the interior of the caves, this precaution becomes the more requisite.

On entering the cave you are impressed with its gloomy grandeur: it is not, however, till you have been a few seconds in it that you perceive its great extent. The open area of this cave is a regular square, measuring eighty-four feet each side. Its height is fourteen feet and a half. The roof is supported by four ranges of massy columns; the two centre ones being round; those on the right and left square at the base, but at the heights of five and eight feet formed into hexagons and dodecagons. The roof, but no other part of this cave, bears the marks of having

having been once ornamented with paintings in square compartments of about one foot. From the frequent smoke of torches, however, sufficient of the design is not at present apparent to admit of any judgement on its merits.

Passing between the centre range of columns, to the end of the caves, you enter an oblong recess, or viranda, measuring twenty feet by twelve, open in front towards the cave, and supported by two hexagonal columns.

In niches on the remaining three sides of this apartment are carved in bold relief, three figures; the centre is a female figure nine feet and a half high; and those to the right and left are male ones nine feet high. On each side of the doorway of the inner apartment described below, there is also a figure of nearly nine feet.

From this recess, or viranda, you enter in its back part, through a small doorway, an inner apartment measuring twenty feet by seventeen; in the centre of which, cut out of the solid rock, is what the natives term "The Churn," being a regular hexagon of three feet three inches each side, surmounted by a plain dome reaching nearly to the roof, to which it is joined by a small square ornament.

Around the large cave also, on three sides, are small apartments, called the *dookans*, or shops, each measuring nine feet in depth, with a separate entrance towards the cave. There are seven of these to the right, six to the left, and four at the end of the cave, two on each side of the recess.

Entering the second to the left of these small apartments, you perceive, at about four feet from the ground in the opposite wall, a small oblong excavation of about three feet by two; creeping through which, you enter a small apartment of about twelve feet square, in the opposite wall of which is a similar excavation leading to a like apartment; and so on successively for five small rooms, gradually ascending the hill, the floor of each inner apartment being on a level with the lower part of the entrance from the outer one.

These secret apartments appear originally either to have led, or to have been intended to lead, to the top of the hill: at present, however, they receive neither light nor air, excepting from the first entrance.

The cave I have described, which is the largest, though in the best preservation by far of the whole, still bears the marks of rapid decay. The shafts of five columns are wanting; and a kind of terrace has been raised with their ruins. The left hand circular column on entering has also once shared the same fate; but has been rebuilt with rude fragments of the same stone, and afterwards plastered to resemble the other pillars. This plaster has,

has, however, almost entirely given way, leaving the rude construction of the column apparent.

Leaving this first cave, and proceeding southward twenty or thirty paces by a narrow ledge round a projecting part of the hill, you enter a second cave, evidently never completed, the columns being left in a rude state with deep marks of the chisel still remaining. This cave is nearly the same in length as the first, by about half the depth. It has originally been open in front, but with the exception of a small part it is now choked up with large fragments of the hill from above. It contains little worthy of notice.

Leaving the second cave, and returning by the same road, you descend the stone stairs, and proceed along the bottom of the hill southward for about a hundred yards, and then reascend by a rugged steep footpath to the third cave.

This cave, which measures eighty feet by sixty, has been nearly similar in its arrangement to the first; but it is now in a ruinous state from the giving way of a great part of the roof, bearing down in its fall several beautiful columns. This cave, which has none of the gloominess of the first, has been once finished and decorated in a very superior style, and it is apparently the most ancient of the whole. It has some similar features with the other. In the inner apartment is the octagon, called The Churn, mentioned in the first; but it wants the recess, or viranda, with the sculptures.

The whole of the walls, roof, and columns of this cave have been covered with a fine stucco, and ornamented with paintings in distemper of considerable taste and elegance. Few colours have been used, the greatest part being merely in *chiaro scuro;* the figures alone, and the Etruscan border (for such it may be termed), being coloured with Indian red.

On many places of the lower parts of the wall and columns have been painted male and female figures of a red or copper colour; the upper parts of the whole of which have, however, been intentionally erased. Such of the lower parts (the legs and feet) as remain, show them to have been executed in a style of painting far surpassing any thing in the art which the natives of India now possess.

Leaving this cave by the right hand doorway, and proceeding a few paces further along the hill, you enter a fourth cave nearly similar in dimensions and arrangement to the second. It has however been finished, and is falling fast to decay.

There appears at the extremity of this cave the rude commencement, or perhaps the ruins, of a fifth. It is not however sufficiently accessible, on account of the large fragments of fallen rock, to admit of any correct judgement of its former state.

The

The above is a slight description of these caves from a short visit to them during a day's residence at Baug.

In the total absence of books, or references of any description, it would be temerity in me to indulge in any speculations, or advance any opinion respecting the figures or other parts of these caves. This part of the subject I must therefore leave to the slight sketches which my time enabled me to make.

Concerning the origin or use of these caves the natives have no tradition. They derive their name from the same fabulous tradition as all remains of Hindu antiquity. They were excavated by the "Panch Pandoos," those celebrated heroes of Indian mythology to whom all wonders are referred.

In concluding I may remark, that the jungle covering this mountainous tract presents (at least at this season of the year) nothing novel for the gratification of the botanist. The northern and the thickest parts consist for the most part of the teak (*Tectona grandis* Thunb.) and blackwood trees (*Dalbergia latifolia* Roxb.) with the *Feronia elephantum* and *Erythrina Indica* Linn. The more open parts consist chiefly of the *Butea frondosa;* the babool (*Acacia Arabica* Linn.), the gum tree (*Cordia obliqua* Wild.), the bayr tree (*Zizyphus Jujuba* Kœnig), and *Morinda umbellata;* the digging the roots of the latter plant, for the use of the dyers, giving employment to many of the poorer class in the villages skirting the jungle.

Both this last and the *Morinda citrifolia* are cultivated also in many parts of this country. In one place there were several of the pudding pipe trees (*Cassia Fistula* Linn.); but as they were near the site of a ruined village, these were most probably not natives of this jungle.

Camp at Mhow, May 1818.

NOTE BY MR. ERSKINE.

Captain Dangerfield having politely permitted me to add any observations to his paper which the subject suggests, I shall be excused for observing that it exhibits a very complete account of a Bouddhist temple, and of the first excavation of that class that has been described in the country in which it is situated. It adds another to the examples of Bouddhist excavations found in India, in countries where we have no historical record that the religion of Bouddh ever existed, and where not a single individual of the sect is now to be found. That the excavations are Bouddhist there seems to be no reason to doubt. The figure and attitude of the contemplative Bouddh are not to be mistaken; the *Churna,* or as it is sometimes called, the *Daghop,* in this as in other Bouddhist temples, is the principal object of veneration; it it is generally conical, and is considered as a tomb, or mausoleum, containing the remains or any of the reliques, sometimes only a few hairs, of a Bouddh or Bouddhist saint, to whom the temple is dedicated.—Another circumstance which marks the origin and design of the excavations is the number and arrangement of the small apartments round the temple, called *dookans*, or shops: these we might expect to find in such a place: they are the cells of the priests, who are always found living in a monastic state round the chief Bouddhist temples in Siam, Pegu, and wherever the religion exists. The numerous smaller excavations at Kanara have the same object, as well as those at Karli. There is no trace of the Brahminical mythology in the whole excavation, except the mutilated figure of Gunesh at the entrance, which, as Captain Dangerfield remarks, is evidently of a later date. There are no unnatural or distorted human figures, nor any with many heads or limbs. The largest temple leading up to the principal object of veneration at Kanara and Karli is arched; at Baug it is flat; which might be owing either to choice, or to a necessity arising from the nature of the stone at Baug, which seems to be in some places deficient in strength.

William Erskine.

Note.—It has been thought proper to subjoin the following letter from Captain Dangerfield to Sir John Malcolm, as it contains some further interesting particulars respecting remains of antiquity in Malwa, that have never been visited by Europeans.

Kurgoond, April 24, 1819.

Dear General,—I have just returned from Wone, and start to-morrow towards Chiculda, which I expect to reach in five marches. I was obliged to halt two days at Wone, to enable me to make even the slightest sketches of the pagodas, or notices of the inscriptions, of which there are several, few of which any person I can procure can make any thing of. However, I have copied some of them as well as I could; but they are mostly very much worn out, and appear never to have been cut very deep. From all I can as yet make out, they are *Jain* remains, certainly not Hindu; and are from seven hundred years upwards old. Thus much I have deciphered from the pedestals of some statues scattered about.

There is in one of the largest pagodas an immense statue in bold relief of thirteen feet high, a single block of granite, with similar ones of eight feet two inches high on each side. All these smaller ones have inscriptions on their pedestals, said however by the Shastries I got from Kurgoond to be *Muntrums*, which they were very unwilling to read or repeat. One however bears *Sumvit* 13; but this is beyond all probability without something else following. One pagoda (but which evidently differs from the rest) bears the name of Rajah Bular as the builder.

The town is entirely in ruins, and contains but seventy houses inhabited: these are in tolerable preservation. There are also eight large and four small pagodas, with vestiges of as many more.

The pagodas are of singular construction, of exquisite workmanship, and extreme superfluity of fine carving and ornaments of all kind. They are of hewn granite without cement, but clamped with iron every three or four inches. Some of the blocks supporting the upper parts of the doorways and entablatures are fourteen or fifteen feet long, and proportionably broad and thick.

They were intentionally thus much destroyed by the Mahomedans; and most of the houses of the town are built with part of the materials.

The figures are ill-proportioned (in general), have curly hair, thick lips, very long ears, and are entirely naked, without string, bracelets, armlets, or any ornament, with the exception of one female figure with a species of sash. There are abundance of small figures in relief, in the entablatures, columns, &c. well carved; and female figures also well executed, in general in graceful attitudes, support brackets, the capitals of the columns, and other parts of the building.

I have troubled you thus far in advance with a sketch of Wone. It is well worth looking at, though at first you experience a feeling of disappointment. It would require, however, many days to take good sketches and decipher the inscriptions, particularly the former, as both outside and inside there is scarcely an inch uncarved in any of them. I could not therefore attempt it, believing you would not like so much of my time devoted to this pursuit whilst my duty required me elsewhere: I have got however one or two scratches, which will perhaps convey some notion of their style of building and figures. Yours, &c.

(Signed) F. Dangerfield.

XVII. *On apportioning the Supply of Oil, Naphtha, or Gas, necessary for Street-Lamps, according to the varying Lengths of the Nights of the Year.* *By* A Correspondent.

To Mr. Tilloch.

Sir, — We happily live in an Age, when Science has assumed a more correct and practicable form, and its deductions become more applicable to the affairs of Life, than at any former period of the World;—when it is no longer considered beneath the dignity of Science, for its Votaries to investigate and apply its principles, to any, even of the most humble, of the Mechanic Arts or Trades amongst us; and your Philosophical Magazine has already signalized itself so much, in the career of usefulness, by diffusing information on these interesting subjects, as, apparently to render any apology unnecessary, for requesting you to give insertion to some deductions lately made (from the Tables given in the Nautical Almanack) for the use of a Board of Commissioners of Paving, Lighting, &c. in the north-western part of London, applicable to the *Contracts*, which such Boards in some districts, the Parish Vestries in others, and also the Trustees of Roads, entering or surrounding the Metropolis, are in the habit of making, *for the Lighting* of the public Streets and Roads, severally committed to their care.

This public Lighting was, until about 10 years ago, exclusively performed by a class of Persons called *Lamp Contractors*, whose Trade consisted, in keeping a dead Stock, of semi-globular *Lamp-Glasses*, with their respective *Covers* and *Oil-holders*, of Tinned Iron, of Oil *Casks* and *Canns* of diffrent sizes, and of *Ladders* and large hand Lamps, of a peculiar construction, called *Flambeaus;* and also a live or consumeable stock of whale *Oil* and of Cotton *Wick;* which two last articles, these Contractors serve out, either daily or at intervals of a few days apart, to Men in their employ called *Lamp-Lighters*, each one having a small district of Lamps appointed to him, the Glasses of which, he is to keep clean, to supply Cotton to their Burners, and a nightly supply to the Oil-holders, of the Oil so served out to him by his Master the Lamp Contractor.

Within a few of the last years, this system has, in a considerable degree been broken in upon, by the partial introduction of *Gas Lights*, in great numbers of the central Streets of the Metropolis, and in others (particularly since the taking out of Lord Cochrane's patent) by the use of Lamps, more or less improved in construction, for the burning of animal Oil, and in some recent instances also, for the burning of essential Oil of Coal-Tar, or *Naphtha:* yet after all, very considerable lengths of the Streets and Roads of the Metropolis remain lighted with common Oil-Lamps as formerly, and are likely, many of them, long to remain so lighted.

It is usual for Lamp Contractors to engage, to keep their Street or Road Lamps burning, from the time of *Sun setting* daily, until the time of its *rising* on the following morning, and they are in the habit, with few exceptions I believe, of serving-out Oil to their

their Lamp-Lighters, for such purposes, at short Intervals, and in variable quantities, suited, as they imagine and allege, to the different seasons of the year, as well as to the number of Lamps: but of the suitableness of which adjustment, there is often room to doubt, from the very frequent complaints, which Boards and Vestries have occasion to make, of the Lamps going out, before Morning, and the known frequency, of the Contractors, in such case, charging the fault on their Lamp-lighters, who often are alleged, to have purloined a part of the Oil which had been served out to them; and from the almost equal frequency, of the Men retorting, by alleging the quantity of Oil intrusted to them, to have been insufficient for the number of Lamps and the lengths of the Nights, for which it was served-out: It appears therefore not unreasonable to suppose, that more correct information on the subject, might greatly lessen the numbers of these instances, of defective lighting, and the consequent charges and counter-charges of the blame, by the Contractors and their Servants.

And towards supplying this information, the numbers of Hours and Minutes, on each Night in the year, have been ascertained, during which *the Sun is invisible* at London, because below the horizon, after applying a due correction for Refraction, to the time of Sun set and Sun rise, which is set down in the Nautical Almanack, independently of refraction; and these times or lengths of Nights, have been arranged in a Table, commencing with the 29th of September, (such being the day on which Lighting Contracts most commonly commence) of a common or non-Bissextile year: and these, on being cast up, appear to amount, annually, to $4259^{h}\ 42^{m}$. This divided by 365, gives $11^{h}\ 40^{m}{\cdot}22$ for the mean length of Night, for which Lamp-lighters contract; and this last multiplied by 7, gives their mean length of Week, equal to $81^{h}\ 41^{m}{\cdot}57$.

By long experience, or else by communicating with others in the Trade, most Lamp Contractors are enabled, to calculate, pretty accurately, the whole *annual quantity of Oil*, necessary for the supply of each Lamp, of the kind and size which they have in use; answering to the above stated $4259^{h}\ 42^{m}$; and if, as is done above, this quantity of Oil (either in pounds, or in pints, &c.) be divided by 365 and multiplied by 7, the average weekly quantity for each Lamp, will be obtained, and this multiplied by the number of Lamps, will show the quantity, that should be served-out to each Lamp-lighter, on each of 52 days respectively, which will be found in Table I. sent herewith.

TABLE

TABLE I.

Dates.	No. of Nights.	Sum of Do. H.	M.	Excess.	Defect.	Dates.	No. of Nights.	Sum of Do. H.	M.	Excess.	Defect.
Sept. 29	7	86	48	·06		Feb. 17	6	82	0	·00	
Oct. 6	6	76	49		·06	23	6	79	41		·02
12	6	79	12		·03	March 1	6	77	0		·06
18	6	81	31		·00	7	7	86	48	·06	
24	6	83	47	·03		14	7	83	32	·02	
30	6	85	57	·05		21	7	80	16		·02
Nov. 5	6	88	3	·08		28	8	87	53	·08	
11	5	74	55		·08	April 5	8	83	44	·02	
16	5	76	10		·07	13	8	79	33		·02
21	5	77	20		·05	21	9	84	45	·04	
26	5	78	20		·04	30	9	79	59		·02
Dec. 1	5	79	15		·03	May 9	10	83	51	·03	
6	5	79	55		·02	19	10	79	20		·03
11	5	80	20		·02	29	11	83	12	·02	
16	5	80	37		·01	June 9	11	80	48		·01
21	5	80	39		·01	20	11	80	34		·02
26	5	80	24		·02	July 1	11	82	30	·01	
31	5	79	59		·02	12	11	86	18	·06	
Jan. 5	5	79	23		·03	23	10	83	5	·02	
10	5	78	45		·04	Aug. 2	10	88	20	·08	
15	5	77	41		·05	12	9	84	27	·05	
20	5	76	31		·06	21	8	79	13		·03
25	5	75	18		·08	29	8	83	23	·02	
30	6	88	34	·08		Sept. 6	8	87	28	·07	
Feb. 5	6	86	31	·06		14	7	79	49		·02
11	6	84	17	·03		21	7	83	4	·02	
						28	1	12	8		
	141	2097	1				224	2162	41		

This Table exhibits, the most simple amongst the various modes, by which the *giving-out of the Oil*, might be regulated, so as to suit the unequally varying lengths of the Nights; and it will perhaps be sufficiently exact, for every useful purpose, to serve out *equal quantities* of Oil, on each of the 52 days, whose dates are set down in the 1st column; to serve for as many of the next following Nights, as are set down opposite, in the 2d column. But in case that greater precision should be required, column 3 shows, the Number of Hours and Minutes, contained in the number of Nights set in the preceding column, and the 4th and 5th columns show, by how many *hundredth parts*, these exceed or fall short, of 81^{h} $41^{m}{\cdot}6$, the measure of the mean 7-days supply: and by this it will be easy, to increase or decrease the weekly supply, so as to suit exactly the number of Nights, through which it is intended to last.

The castings of the two half-yearly portions of the above Table are added, in order to show in col. 2, how very unequal the number

number of Nights are, answering to 26 servings in the first, and 27 in the last period: in a common year, when one odd night occurs at the end, equal to $12^h\ 8^m$; but in a *Leap-year*, two such days will occur, and (including $13^h\ 4^m$ for the 29th of February) will amount together, to $25^h\ 12^m$. If the common Year be thus considered, in serving Quarters, of 13, 13, 13, and 14 servings each, respectively, they appear, from so casting the Table, to be as follows, viz.

	Nights.	H.	M.
1st.	73	1048	2
2d.	68	1048	59
3d.	101	1068	22
4th.	123	1094	19
	365	4259	42

The great inequalities of the different usual *Quarters* of a common Year, will appear from the following statement, viz.

Quarters.	Nights.	Sum of Do. H.	M.
1st. From 29th Sept. to 24th Dec.	87	1273	31
2d. From 25th Dec. to 24th March	90	1278	47
3d. From 25th March to 23d June	91	806	17
4th. From 24 June to 28th Sept. ..	97	901	7
	365	4259	42

Whence it appears (and the same is not sufficiently known to persons in general) that the legal Quarter, for Rents, Rates, &c. ending at Michaelmas in any common Year, contains 10 more Days (and Nights) than the following Quarter ending at Christmas; whilst the two first Quarters of the Year, ending at Lady-day and Midsummer, are equal to each other, in number of Days (and Nights) in Leap-years, and they differ but one Day in common Years; and yet, so unequal are the collective lengths of the Nights in the latter case, that the first of these Quarters requires, more than half as much more Lamp-light, as the latter!: and of the other two Quarters, 87 Nights of one, require more than one-third as much more Lamp-light, as the 97 Nights, in the other of these Quarters! Again,

	Nights.	Sum of Do. H.	M.
The Summer Half-year	188	1706	24
The Winter Half-year	177	2553	18
	365	4259	42

From these last numbers it appears, that the public Lamp-Contractor's

Contractor's consumption of Oil (and the same with *Gas, Naphtha,* &c. in public Lanterns) in the Winter, and in the Summer half-years, is very nearly in the proportion of 3 to 2: Strictly speaking, none other of his heads of Expenditure, differ much from an equable rate, throughout the year, viz. Interest upon, and wear and tear of his dead Stock, with Cotton, and Wages to his Lamp-lighters: but as these uniform Expenses, have been said, by experienced Contractors, not to exceed 10 per cent. or $\frac{1}{10}$th part of the whole of the Contractor's Expenses, including Oil, the proportions of $\frac{3}{5}$ths and $\frac{2}{5}$ths, in the Winter and the Summer Half-years, or $\frac{3}{10}$ths in each of the Winter Quarters, and $\frac{2}{10}$ths in each of the Summer Quarters, seem proper proportions, which the Contractor might draw Money, *on Account* of the Annual Sum contracted for; or according to which, any single Quarter might be separately paid for: and with considerably less unfairness to either party, than either, simply taking $\frac{1}{4}$th of the yearly sum, as applicable to each Quarter, and $\frac{1}{2}$ thereof for each half-year, as is very commonly done; or than, taking $\frac{2}{3}$rds and $\frac{1}{3}$rd, as the proportions of the Winter and the Summer half-years, as is said to have been contended for, lately, by a Contractor.

I am your obedient servant,

London, August 10, 1820. J. I. H.

XVIII. *Some Observations made at Clapham Common, Surrey, on the heavy Storm that took place on the Night of Sunday the 30th of July* 1820.

To Mr. Tilloch.

Sir, — Having for several years paid some little attention to meteorology, keeping a daily journal, and recording at stated hours the pressure and temperature, as well as the general appearance of the atmosphere, you will readily imagine the extremely interesting storm that took place on the 30th of last month arrested my attention.

If the inclosed observations on the same should meet your approbation, and be deemed worthy an insertion in your valuable Magazine, your making use of them in that way might possibly be gratifying to some engaged in similar pursuits, and would at the same time oblige a constant reader.

Yours very respectfully,

Clapham Common, Aug. 21, 1820. Philobius.

P. S.—In the inclosed account, no notice has been taken of the *effects* of this storm, conceiving such information to be as readily

and

and far more extensively, obtained from the daily public prints. These have all concurred in describing it as a very severe visitation, in which the hail was large, abundant, and destructive both to vegetation and the feathered tribe. The latter, indeed, absolutely strewed the ground in some places (at Worthing, and some parts of Kent), and were picked up on the following morning by barrow loads. Two instances of its effects occurred in our own immediate vicinity. A house situated on Croydon common was struck by the lightning; the fluid passed directly down the chimney, disordered the brick-work here and there in its descent, and finally broke a large kitchen slab, under the range, into many fragments. A house at Banstead Downs was likewise considerably damaged.

Observations, &c.

In attempting to trace the progress of a storm, particularly of one so formidable in its appearance as that of the 30th of July last, it will doubtless be considered more correct to notice the state of the atmosphere some hours prior to its commencement: indeed, when we reflect, that the variation produced on the barometer and thermometer, by sudden and violent changes in the higher regions of the air, must be regarded as the only datum from which meteorologists are warranted in deducing the causes of the effects they observe in atmospheric phænomena, such a step appears indispensable.

The morning of the day on which the storm took place was remarkably fine; the thermometer at 9 o'clock A.M. stood at 68°; barometer 30·18 inches; the former is hung out of doors at the back of the house, the aspect of which is nearly due north. The wind blew from S.S.E. The general appearance of the sky was fair, being covered with *cumuli*, not of the fleecy-white kind, but partaking more of the gray cast. At noon these appeared to resolve themselves into *cirro-cumuli*, and entirely covered the face of the sky, rather indicating rain. At 3 o'clock in the afternoon the thermometer stood at 75°, the barometer having sunk to 30·15 inches; wind blowing from the south. At about five in the evening the face of the sky was again covered with *cumuli*, and the sun shone: the lower part of these clouds was dark, and portended rain. Between 6 and 7 o'clock a strong haze began to make its appearance in the east, and gradually extended itself over the west, causing the sun-light to appear of a much yellower tint, usually denominated a gleam. Between 8 and 9 o'clock this appearance was much increased in the east, which indeed assumed quite an inky blackness, accompanied with an oppressive heat, so that all who observed it prognosticated a storm. This threatening aspect continued to increase until 10 o'clock, about which time the wind blew briskly

 from

from the S.W., when a vivid flash of lightning made its appearance in the east. This was followed by a clap of thunder after a lapse of about 30 seconds; and for the space of an hour the lightning flashed every few minutes, followed by thunder at shorter and shorter intervals. At 11 o'clock it succeeded the flash in about 12 seconds. By this time the blackness in the west had put on a formidable appearance, and at about a quarter past 11 the first flash of lightning was observed in that quarter; here the thunder was less loud, and followed the flash in 15 seconds.

It was remarkable that the lightning elicited from the *nimbus* in the west was forked, of a reddish hue, and seemed to run along, or rather parallel to, the earth; while that in the east produced a vivid blue extended sheet of such dazzling splendour that the eye could scarcely bear its effulgence: there was, however, at intervals, a light yellow-coloured flash seen with the forked lightning in the west.

Very soon after the *nimbus* in the west had begun to discharge the electric fluid, a perpetual flashing of a yellow-coloured lightning was observable at its southern limb, and, what is highly curious, the same was visible at the southern limb of that in the east: this, on each side of the heavens, continually diverged towards the south, till at length it met in that point, forming a zone or band of light on the horizon about 12 degrees broad; and so rapidly successive were the flashes, that the light appeared to be constant, illuminating objects as brilliantly as moonlight.

It was about 12 o'clock at night when the band of light was complete, and then the storm raged for the space of an hour with unabated fury. The rain poured down in torrents, and the thunder appeared one prolonged rumbling. It must not be overlooked however, that quite independently of this constant zone of light, both the eastern and western *nimbi* continued, in intervals of about eight or ten minutes, to discharge extremely vivid flashes of lightning just as at first; that from the east so brilliant as quite to overpower for the moment the constant light in the horizon. The *nimbus* in the west continued also to emit the forked lightning as at the commencement of the storm.

At 1 in the morning a very large dense black *cumulus* was seen sailing majestically in the northern part of the heavens, coming towards the south; it moved slowly; and when it had reached the zenith, or a little to the southward of it, exactly between the extreme confines of the two *nimbi* bearing due east and west as already described, a discharge took place at the same moment of time, both from or into its eastern and western sides (or rather base), of two inconceivably vivid spheres of light, of a sulphureous blue colour, having a *nucleus* (if such expression may be allowed) of brilliant red: the lightning issuing forth with them

was

was forked, and a most tremendous clap of thunder followed instantly, which absolutely shook the house. From this moment the grandeur and sublimity of the storm began to decline; not a flash of lightning, after this, issued from either of the *nimbi*, the zone of light became fainter, and less frequent in its coruscations, and in the course of twenty minutes, or half an hour at furthest, all was darkness and silence.

It may be proper here to remark, that the thermometer indicated no difference of temperature during the storm, nor the barometer, except that the surface of the mercury was concave: in the morning following, at 9, it had sunk $\frac{20}{100}$dths of an inch, being 29·95. The wind also remained, and has continued ever since, in the S.W. quarter. It is pretty evident there were two storms in opposite points of the heavens at the same time, one of which came up with, and one against the wind; this seems confirmed by their distance from each other, and the totally different complexion of the lightning. Owing to the extreme brilliancy of the latter, the appearance of the clouds in the *nimbi* could be easily ascertained; they seemed to consist entirely of *cumuli* huddled together in a thin watery medium of inky blackness; the edges of these clouds were ill defined, but at their bases they appeared so dark as, at the first glance, to resemble more the *stratus* than the *cumulus*. The constancy and brightness of the lightning that seemed confined to the horizon, and its very long duration in the heavens, existing undiminished in splendour for the space of an hour and a quarter, were truly astonishing. In the yellowness of its hue, the quivering motion it assumed on issuing from the clouds, and in being unaccompanied with thunder, it strongly resembled the harmless lightning often seen in the evenings of midsummer, after a close sultry day. It was very evident this lightning was unattended with thunder, since the latter ceased at intervals for the space of one or two minutes, sometimes more, during which cessation of tumult this beautiful light continued coruscating and illuminating the embattled plain with "all its airy forces." It seemed like an excess of the electric matter silently escaping from the over-charged clouds. Judging from the different appearance of the lightning, and the sudden subsiding of the storm when the dense black *cumulus* became situated between the two *nimbi*, as well as the violent clap and vivid flash observable at that time, may it not be probable these two great magazines were in opposite states of electricity? and that, like the connecting wire in a galvanic battery, ("*parvis componere magna!*") this neutral cloud simply brought them within the sphere of each other's attraction, thus completing the grand circle of communication.

Clapham Common, Aug. 5, 1820.

 XIX. *Re-*

XIX. *Recent Accounts respecting Pitcairn's Island.*

THE first of the subjoined accounts is a copy of a letter from Captain Henderson, of the ship Hercules, addressed to the editor of the Calcutta Journal, dated 15th July 1819.—The second is the narrative of a Taheitan woman, transmitted to a gentleman of Sydney (New South Wales) by a correspondent writing from the Society Islands, published in the Sydney Gazette of 17th July 1819. It will be seen that she names some of the Europeans who left the other mutineers of the Bounty, at Otaheite, and proceeded with that vessel to Pitcairn's Island, differently from other accounts. By *John Main*, she seems to mean *John Mills*; by *Isaac Madden*, *Martin;* and by *Adam Smith*, old *John Adams* himself.

Captain Henderson's Narrative.

"In looking over Capt. Bligh's narrative of his voyage in the boat, I observe he says: 'The secrecy of this mutiny is beyond all conception. Thirteen of the party who were with me had always lived among the people; yet neither they, nor the messmates of Christian, Steward, Haywood, and Young, had ever observed any circumstance to give them suspicion of what was going on.'

"The conversation that I had with old Adams, while on shore at Pitcairn's Island, will set this at rest: but I shall give you the history of my intercourse with these islanders as it occurred.

"We made Pitcairn's Island on the morning of the 18th of January 1819, and I make it to lie in lat. 25° 58′ south, long. 130° 23′ west, nearly the same as Sir Thomas Staines. On getting within two or three miles of the shore, we observed a boat coming off, which was very small, being one given to them by an American that had touched at the island about eighteen months before. On approaching us, the first thing they asked was, whether we were a man of war or a merchantman, American or English? On being answered that we were a trading ship under British colours from India, they came on board, nine in number, and all young men.

"After breakfast I went on shore, at 7 A.M., and was received on the rocks by old Mr. Adams, and all the other inhabitants of the island; but not before the islanders that were in the boat with me had given a shout or cry peculiar to themselves, to signify my being a friend. I delivered to Adams the box of books from the Missionary Society in London, and a letter from Adams's brother, who is still living at Wapping in London. I read this letter to him, giving him a description of his family, mentioning the death of one sister, and prosperity of another. This affected him

him much, and he often repeated that he never expected to see this day, or indeed one of his countrymen more.

"I then ascended the rocks, and was led through groves of bread-fruit, cocoa-nut, plantain, and what they call the tea-tree, till we reached their village, forming an oblong square. Their dwellings are all of wood, and very ingeniously contrived, so as to be shifted at pleasure, and were uncommonly clean. They had also built one or two houses with second stories since the frigates were there.

"The following particulars were related to me by Adams, respecting the mutiny of the Bounty, and I believe it to be correct, as old Adams said several times to me, 'You shall hear nothing from me but the truth.'

"A few days after leaving Otaheite, while still to windward of the Friendly Islands, Christian and Capt. Bligh had a quarrel before Capt. B. went to bed. When Christian came on deck in the middle watch, he called one of the quarter-masters named Quintal, aft, and said he wanted to leave the ship, as the conduct of the captain was insupportable, and wished Quintal to assist in making a raft of the spare spars, as he was determined to leave the ship, and did not wish to distress the crew or thwart the voyage by taking any body away with him Quintal remonstrated, and said if he went all would go, and proposed to seize the captain and turn him off in the long boat; which was agreed to by the whole watch then on deck, and put into execution immediately.

"Adams was in his hammock at this time, as he belonged to the watch below, which was called up one by one, told what had taken place, and asked whether they would go or stay, leaving it entirely to themselves, no force being used to any one but Capt. Bligh.

"They then went to one of the islands, Tubi, to make a settlement, but could not agree with the natives. The majority were then disposed to steer for Otaheite, and there they went, taking with them two of the natives who would not leave them.

"When they arrived at Otaheite, the stores, sails, and all other movable articles, were shared out among the crew. The Bounty fell to the lot of Christian and eight others, who after taking on board live stock, women, the two natives of Tubi, and two of Otaheite, left the island in the night, Christian not acquainting any person where he was going, until out of sight of the island. He then communicated his intention to his shipmates, who approved of his determination, and they then steered for Pitcairn's Island, where they landed all the useful articles from the Bounty, and set her on fire off the north-east end of the island, to prevent being discovered; but she drove on shore before

fore she was entirely consumed, though there is not a vestige of her now to be seen. They carried their precautions so far, as even to destroy all the dogs, for fear the barking of these animals might at any future time betray them.

"About four years after they landed on the island, one of their wives died, which was Williams's. The rest agreed to give him one of the black females, or natives of Otaheite, as a wife, to supply the place of his former one; and this caused the first disturbance on the island, and the consequent death of Christian and four others, viz. Brown, Martin, John Mills, and John Williams, as also two of the Otaheitans. Christian was the first, who was shot while at work in his yam plantation.

"The next disturbance took place about three years afterwards, and arose from one of the remaining Otaheitans refusing to work: but he was killed before he could do much mischief, except his wounding old Adams in the right shoulder. He attempted indeed after this to knock his brains out: but Adams being a strong man, parried off the blow, having his left hand much shattered, and losing his fore-finger. Before he could repeat this blow Quintal dispatched the first Otaheitan, and the other, his companion, ran off to the woods; but coming back a few days afterwards, the women killed him in the night, while asleep, as they were afraid he might treacherously kill some of the Englishmen, to whom they were more attached than to their countrymen. Thus only four Englishmen were left, of whom one went mad and drowned himself, and two died natural deaths; 'the last, about eighteen years ago, leaving me,' says Adams, 'to bring up their children, which I have done in the most christian-like manner my means would allow.'—They say a prayer in the morning, one at noon, and another at night, and never omit asking a blessing, or returning thanks at meals.

"Adams is now fifty-seven years of age; has three daughters and one son; the last is about fourteen years old. The whole of this little community are in number forty-five, including men, women and children. Christian left three sons, who are now all alive on the island. They have had two births since the frigates were there; they were then forty-three, and not forty-eight, as stated by Sir Thomas Staines. Adams said this must have been a mistake, as no deaths had occurred since the ships left them. They have plenty of fowls, goats, and hogs, on the island, and I left them a ram, two ewes and a lamb of the South American breed; as well as some potatoes, wheat, and paddy, for cultivation; with such other useful articles as the ship afforded.

"Adams reads the bible to the islanders every Sunday evening; but he has not been able to get any of them to learn to read, for want of a spelling book, of which he had only a few leaves.

Their

Their greatest want was implements for agriculture, mechanic tools, and cooking utensils, of which we could only supply them with our pitch-pot, one or two spades, and a saw, with a few knives and forks, some plates, a few pair of shoes, and the reading glass of my sextant for old Adams, whose sight was failing.

"There are five Otaheitan women, and old Adams, that alone remain of the original settlers. Two ships had been seen from the island before the frigates appeared; but although they were near enough to see the people on board them, and made signs to them from the shore, they did not land. There were no canoes built on the island at that time, so that they could not go off.

"These are the principal facts with which my memory furnishes me at present; but I hope I shall be able to give you a better description of the island and its inhabitants when I return again to Calcutta."

Narrative of a Taheitan Woman.

"The following account I have just received from a Taheitan woman, who was the wife of Isaac Madden, one of the mutineers. She has been apparently a good-looking woman in her time, but now begins to bear the marks of age. She is marked on the left arm A. S. 1789, which was done by Adam Smith, to whom she attached herself at first, and sailed with him both before and after the ship was taken. She has lately arrived hither in the King George from Nugahiva, at which place she was left by an American ship, the captain of which took her from Pitcairn's Island to the Spanish main, and afterwards left her at Nugahiva. She has resided at Nugahiva about three months, and it is more than double that time since she left Pitcairn's Island.

"When Fletcher Christian cut his cable and left Taheite, the following persons were on board the Bounty: Fletcher Christian, John Main, Bill M'Koy, Billy Brown, Jack Williams, Neddy Young, Isaac Madden, Matt or Matthew, and Adam Smith—*nine Europeans.* Teirnua, Nain (a boy), and Manarii—*Taheitans.* Tarara, a *Raiateau,* and Oher and Titahita, *Tubuans.*—The *Taheitan women* were Manatua, Christian's wife; Vahineatua, Main's wife; Teio, the wife of M'Koy, who was accompanied by her little daughter; Sarah Teatuanirea, Brown's wife; Faahotu, Williams's wife; Terrura, Young's wife; Teehuleatuaonoa or Jenny, Madden's wife, before mentioned; Obuarei, Adam Smith's wife; Tevarua, Matt's wife; Toofaiti, Tararo's wife; Mareva, common to the two Taheitans; and Tinafornea, common to the two Tubuans.

"In their passage to Pitcairn's Island they fell in with a low lagoon island, which they call Vivini, where they got birds, eggs, and

and cocoa-nuts. They also passed between two mountainous islands, but the wind was so strong they could not land.

"When they arrived at Pitcairn's Island they ran the ship ashore. Fletcher Christian wanted to preserve the ship, but Matt said, 'No, we shall be discovered;' so they burnt her. The island is small; has but one mountain, which is not high but flat, and fit for cultivation. They put up temporary houses of the leaves of the tea, and afterwards more durable ones thatched with the palm, as at Taheiti. They found the bread-fruit there, and all were busily engaged in planting yams, taro, plantains, and aute, of which they made cloth. The account this woman gives of their proceedings in this new country is very amusing to the Taheitans. Neddy Young taught them to distil spirits from the tea root. They made small canoes, and caught many fish. They climbed the precipices of the mountain, and got birds and eggs in abundance

"In the mean time many children were born. Christian had a daughter, Mary, and two sons, Charles and Friday. John Main had two children, Betsy and John. Bill M'Koy had Sam and Kate. Neddy Young had no children by his own wife; but by Tararo, the wife of the Raiotean, he had three sons, George, Robert, and William. Matt has had five children, Matt, Jenny, Arthur, Sarah, and a young one that died when seven days old. Adam Smith has Dinah, Eliza, Hannah, and George, by his wife. The Taheitans, &c. have left no children. Jack Williams's wife died of a scrophulous disease, which brake out in her neck. The Europeans took the three women belonging to the natives, Toafaiti, Mareva, and Tinafarnea, and cast lots for them, and the lot falling upon Toafaiti, she was taken from Tararo and given to Jack Williams. Tararo wept at parting with his wife, and was very angry. He studied revenge, but was discovered, and Oher and he were shot. Titahiti was put in irons for some time, and afterwards released; when he and his wife lived with Madden, and wrought for him.

"Titahiti, Niau, Teimua, and Manarii still studied revenge; and having laid their plan, when the women were gone to the mountain for birds, and the Europeans were scattered, they shot Christian, Main, Brown, Williams, and Madden. Adam Smith was wounded in the hand and face, but escaped with his life. Ned Young's life was saved by his wife; and the other women, and M'Koy and Matt fled to the mountain.

"Inflamed with drinking the raw new spirit they distilled, and fired with jealousy, Manarii killed Tiemua, by firing three shots through his body. The Europeans and women killed Manarii in return. Niau, getting a view of M'Koy, shot at him. Two of the

women

women went, under the pretence of seeing if he was killed, and made friends with him. They laid their plan, and at night Niau was killed by Young. Taheiti, the only remaining native man, was dreadfully afraid of being killed; but Young took a solemn oath that he would not kill him. The women, however, killed him in revenge for the death of their husbands. Old Matt, in a drunken fit, declaring that he would kill F. Christian, and all the English that remained, was put to death in his turn. Old M'Koy, mad with drink, plunged into the sea and drowned himself; and Ned Young died of a disease that broke out in his breast. Adam Smith, therefore, is the only survivor of the Europeans. Several of the women also are dead. Obuarei and Tavarua fell from the precipices when getting birds. Teatuabitea died of the dropsy, and Vahineatua was killed, being pierced by a goat in her bowels when she was with child. The others were still alive when the women left.

"The descendants of the Europeans, for there are no descendants of the natives, are very numerous. Of Christian's family, Mary Christian remains unmarried. Charley Christian married Sarah, the daughter of Teio. She has borne him Fletcher, Charley, and Sarah, and was with child again. Friday Christian has got Teraura, formerly the wife of Ned Young. She has borne him Joe, Charley, Polly, Peggy, and Mary. All these descendants of Christian, together with Manatua, or old Mrs. Christian, yet survive. John Main was killed by falling from the rocks. Betsy Main is the wife of young Matt, and has borne him two sons, Matt and John. Sam M'Koy has taken Sarah Matt, and has by her Sam and M'Koy. Kate M'Koy is the wife of Arthur Matt, and they have children, Arthur, Billy, and Joe. Dinah Smith is the wife of Edward Matt by Teraura. She has a young son.

"They have hogs and fowls, and are very diligent in cultivating the ground. They dress their food like the Taheitans, having no boilers. They make cloth, and clothe themselves like the Taheitans, the men with the maro and tibuta, the women with the paren and tibuta. They have sent away their still, the fruitful cause of so much mischief, in the American that called last; and they have obtained a boat from him, which greatly adds to their comfort. The women work hard in cultivating the ground, &c. This woman's hands are quite hard with work. They have a place of worship, and old Adam Smith officiates three times every sabbath. He prays extempore, but does not read. Their ceremonies of marriage, baptism, and at funerals, are very simple. It does not appear that any of the people have learnt to read. The first settlers discouraged the Taheitan language, and promoted the speaking English. This woman, however, can

 speak

speak neither English nor Taheitan, but a jumble of both. They speak of seeing two ships some years ago, which kept in the offing, and did not come near the island, except Master Folger, as they call him, and the two King's ships; they have seen no ship till the American that brought away Jenny. Jenny says they would all like to come to Taheiti or Eimao. We were thinking that they would be a great acquisition at Opunohu, along-side of the sugar works, as they have been accustomed to labour, for the Taheitans will not labour for any payment."

XX. *Description of the Count* De la Boulaye-Marsillac's *new Discovery in the Art of Dyeing.*

It is well known that cloth dyed in the piece is never saturated throughout with the colouring matter. Indeed such cloths may be distinguished from those dyed in the wool, by examining their edge when cut; for their interior is always of a fainter tint than the surfaces—sometimes almost white. If, to avoid this, the cloth be made of wool dyed before spun, it is more expensive, but becomes more agreeable to wear, never showing white edges.

Some colours can only be given to cloth after it is manufactured; for example, cochineal scarlet, the beauty of which would be impaired by carding, spinning, and fulling. Scarlet is therefore always dyed in the piece, and liable to exhibit white edges. The discovery of the Count de la Boulaye-Marsillac, director and professor in the school of the Gobelins, entirely removes this defect.

His theory is, that the water with which the cloth is soaked before immersion in the dye-vat, occupying already the interstices of the cloth, prohibits the entrance of the colouring liquid; so that the cloth, though strongly wrung to displace the water, is able only to receive the colouring matter to a certain depth. His aim then was to have the cloth so moistened as to be fit for the process, and yet to have the water so completely removed from the interior of the cloth as to permit the dye to enter; and this he effects by making the moistened cloth pass through between rollers placed within and at the bottom of the dye-vat; so that, the web passing from one windlass through the dye-vat, and being strongly compressed by the rollers in its passage to another windlass, all the remaining water is driven out into the colouring liquid (and diluting it to that extent), and is replaced by the colouring liquid, so as to receive colour to its very centre. The winding is continued backwards and forwards from one windlass to the other, and through the rolling-press, till the dye is of sufficient intensity.

Cloths

Cloths thus dyed are of so intense a colour as to appear less bright than scarlets are by the common process; but this deeper reflection of red rays may be obviated by adding to the bath some turmeric or fustic.—[*Bibliothèque Physico-Economique.*]

XXI. *On the Conversion of Animal Matter into new Substances, by the Action of Sulphuric Acid.* *By M.* H. Braconnot.

Having discovered in previous experiments that woad, barks, straw, hemp, and every other kind of woody fibre, could by the agency of sulphuric acid be changed into gum and sugar, I resolved to extend my researches to animal substances; and as many of these, such as skin, cellular membrane, cartilage, tendon, and tendinous sheath, are entirely dissolved into gelatine by boiling water, I determined first to operate on this substance.

Action of Sulphuric Acid on Gelatine.

Twelve grammes of glue, reduced to powder, were digested with a double weight of concentrated sulphuric acid without artificial heat. In twenty hours the liquid was not more coloured than if mere water had been employed; I then added a decilitre of water, and boiled the whole for five hours, renewing the water from time to time as it wasted. I next diluted it, saturated it with chalk, filtered, and evaporated to a syrupy consistence, and let it stand for about a month. In this period a number of granular crystals had separated, which adhered pretty strongly to the bottom of the vessel, and had a very decided saccharine taste. These crystals were collected by pouring off the supernatant syrup, then washed with weak spirit to dissolve out the adherent syrup, then pressed through a cloth, redissolved in a little water and again crystallised, whereby they became tolerably pure. This sugar might in strictness form a new species of saccharine matter; its properties are the following:

Sugar of Gelatine.

This sugar crystallises much more easily than cane-sugar. If its solution be ever so little concentrated by heat, a crystallised pellicle speedily forms itself, which is quickly renewed when the former is broken down; but when the evaporation is allowed to proceed slowly, we obtain very hard granular crystals, grating under the teeth like sugar-candy, and in the form of flattened prisms or tabular groups. Its taste is nearly as saccharine as grape-sugar; its solubility in water scarcely exceeds that of sugar of milk. This solution mixed with leaven gives no signs of fermentation. Boiling alcohol, even when diluted, has no action

 on

on this sugar. It is less fusible than cane-sugar, and better resists decomposition in a raised temperature. By distillation, it gives a light white sublimate, and an ammoniacal product, which shows the presence of azote. This saccharine matter seems on the first view to have some analogy with sugar of milk; but the latter (as M. Vogel has observed) is changed by sulphuric acid into a sugar very soluble in water and in alcohol; and besides, the sugar of gelatine, when treated by nitric acid, gives no mucous acid, but a new species of acid, which I have named the *nitro-saccharine*, and will be described in the following paragraph.

Of the Nitro-Saccharine Acid.

If nitric acid be poured on sugar of gelatine while still coloured, it does not appear to dissolve in the cold, but becomes very white, and the acid appears to take up the colouring matter: if this mixture be then heated, a solution takes place, but without the evolution of red nitrous vapour, and the effervescence that occurs when other animal and vegetable matters are heated with this acid. This nitrous solution being now evaporated (slowly towards the end), gives a residue which congeals on cooling into a single crystalline mass. This, when pressed between paper and re-dissolved, yields the *nitro-saccharine acid* in purity. The quantity of this acid is much more than that of the saccharine acid from which it is obtained. It is very soluble, and crystallises with the greatest ease in beautiful, colourless, transparent, flattened prisms, slightly striated like Glauber's salt. Its acid and somewhat saccharine taste resembles that of the acid of tartar. When heated by itself, it puffs up considerably, melts indistinctly, and gives out a pungent vapour. It produces no change on earthy or metallic solutions. With potash, it forms a super-acid and a neutral salt, both of which crystallise in fine needles, and have a cooling nitrous taste leaving an after-flavour of sugar. When thrown on hot coals they detonate like saltpetre. The nitro-saccharine acid dissolves carbonate of lime with strong effervescence, and the liquor, gently evaporated, entirely passes into fine needled prismatic crystals, which do not deliquesce in the open air, are little soluble in concentrated alcohol, melt on hot coals, and then detonate. This acid forms with oxide of copper a crystallisable salt unchangeable in the air: with magnesia, a deliquescent, uncrystallisable salt, which puffs up excessively when heated, melts, and leaves a brown spongy residue resembling a vegetation. With oxide of lead it gives a permanent gummy mass that will not crystallise: with iron and zinc it produces metallic salts, evolving hydrogen during solution.

These

These are the properties of some of the salts of this acid, which appears to be a compound of sugar and gelatine with nitric acid, and it is remarkable that this kind of sugar has its elements so intimately combined, as to resist the disorganising power of nitric acid, which decomposes with evolution of nitrous gas the other vegetable compounds.

Examination of the Syrup separated from Sugar of Gelatine.

This syrup, decidedly saccharine in its taste, still retained a quantity of the sugar above described, but mixed with a matter slightly azotic, and in part separable by tannin under the form of a reddish precipitate. The syrup, diluted with water, mixed with leaven, and kept a long time in a warm place, assumed neither the spirituous nor the putrid fermentation. When strongly heated it puffed up, and burned without the fetid smell that distinguishes animal matter, and left a coal of very easy incineration. Indeed the gelatine had lost much of its animal character, and approached more to the vegetable substances slightly animalised: as no azotic gas was given out during the action of sulphuric acid on gelatine, I had reason to suppose that ammonia was formed, and accordingly this alkali was evolved on rubbing the syrup with potash.

This syrup is but little acted on by alcohol; but when the spirit is diluted and boiling, it dissolves a portion of the syrup, and on cooling deposits a sediment consisting of sugar, and a peculiar white matter which will be presently examined. The spirituous solution gave by evaporation a syrup with a decided odour of honey, and some tendency to crystallise.

The greater part of the syrup, which was the portion insoluble in weak alcohol, still retained a saccharine taste mingled with that of animal jelly. I could not succeed in precipitating all the animal matter by tannin.

Action of Sulphuric Acid on Muscular Fibre.

Some lean beef pulled into small pieces was soaked in a large quantity of water, which was frequently renewed to separate all the soluble matter, and then strongly and in small portions pressed between folds of cloth. Thirty grammes of the beef fibre, thus prepared, were mixed with as much sulphuric acid, in which they softened and dissolved without changing the colour of the acid, or disengagement of sulphurous acid. The solution was then heated to promote the solution of some remaining particles, and cooled to allow of the separation of a layer of fat which rose to the surface, though the precaution had been taken to choose a very lean piece of meat. The solution was then diluted with about a decilitre of water, and boiled for nine hours, renewing the

the water from time to time; then saturated with chalk and evaporated, and it yielded an extract not sensibly saccharine, but which had such a decided taste of osmazome, that it appeared to me fit to be used in preparing soup. This extract rubbed with potash disengaged ammonia. In the fire it swelled and burnt, leaving a coal easy to incinerate. The solution of the extract did not putrefy in a gentle and long continued heat. Some of the extract was boiled at several intervals with alcohol of 34° (Baumé), the different portions of spirit were mixed together, and deposited, on cooling, about a gramme of a peculiar white matter, which for the present I shall term *leucine*.

Of Leucine.

Leucine when dry is white and pulverulent, but still retains a little animal matter, precipitable by adding tannin with precaution to the solution. After some hours standing, I filtered the liquor, which passed colourless. I then evaporated it till a pellicle formed on the surface; under which, after twenty-four hours standing, one could distinguish small mamillated crystals somewhat crisp in the mouth, and of a dead white, lining the bottom of the dish. If, on the other hand, the solution of leucine in tepid water be left to spontaneous evaporation, there form on the surface a multitude of small detached, flattened, circular crystals, exactly resembling button-moulds, with an inverted edge on their circumference, and a depression in their centre. Leucine has an agreeable taste of gravy or broth. It is lighter than water, swimming on its surface. When heated in a small glass retort it melts, but at a much higher temperature than boiling water gives out a smell of boiled meat, and partly sublimes in small granular opake-white crystals: the remainder, which is liquid, contains empyreumatic oil, and renders blue the reddened colour of litmus.

The solution of this sublimate in water is not troubled by subacetite of lead, nor any other of the usual metallic tests, except nitrate of mercury, which entirely separates it from its solvent, in the form of a white flocculent precipitate, the supernatant liquid assuming a rose-colour.

Leucine dissolves readily in nitric acid. If this solution be heated to expel the greater part of the acid, a very slight effervescence is perceptible, but no production of red nitrous vapour; and the remaining solution, after gentle evaporation, congeals into a crystalline mass, which, after pressure between filtering paper and re-solution in water, crystallises into thin, divergent, colourless needles. This forms a peculiar acid, analogous to the nitro-saccharine above described.

This *nitro-leucic acid* forms peculiar salts with the several

bases.

bases. With lime it produces a permanent salt crystallised in rounded groups. With magnesia the salt formed appears as small granular crystals, which do not deliquesce in the air, in which respect it differs from the nitro-saccharate of magnesia.

Examination of the alcoholic Liquid from which the Leucine had precipitated.

The solution still retained a quantity of leucine. On evaporation it left a thick granulated residue, out of which cold alcohol dissolved a reddish extractive matter, leaving the leucine untouched. This extract is slightly deliquescent, and has rather a bitterish taste of burnt roast meat. It was not changed by sulphuric acid; its solution in water was hardly troubled by subacetite of lead and infusion of galls, and not altered by sulphate of iron.

Of the Substance insoluble in Alcohol.

The extractive matter resulting from the muscular fibre treated with sulphuric acid was only partially soluble in alcohol, as before described; the portion insoluble in this re-agent was the most abundant. I dissolved it a second time in water, to separate the sulphate of lime with which it was mixed, and obtained by evaporation a yellowish-brown extractive matter, slightly deliquescent, and having a taste of broth, probably owing to the leucine which it still retained. In the fire it swelled and burnt like matter moderately animalised, and left a coal easy to incinerate. The solution of this extract in water gave a reddish precipitate with infusion of galls, which was loose and flocculent, like that which arises from matter little animalised. Persulphate of iron gave a copious reddish flocculent precipitate; nitrate of silver, a grey precipitate; nitrate of mercury, a white coagulum. As the sub-acetite of lead gives also a copious white precipitate with this extract, and does not disturb the solution of leucine, I hoped to be able by this means to separate the two; and in consequence added this re-agent, and obtained the white precipitate, and from the filtered liquor I first separated the lead which it retained by carbonate of ammonia, and evaporated the syrupy residue; but I procured very little leucine by this process.

Action of Sulphuric Acid on Wool.

Fifteen grammes of white woollen cloth, cut into small shreds, were moistened with sixty grammes of sulphuric acid, lowered with a quarter of its weight of water. A little sulphurous acid gas was given out, and the wool became reddish, but without perceptibly softening; the mixture was then exposed to a water-boiling heat, on a sand bath, and with shaking it was changed to an uniform mucilage. The digestion was continued till a

complete

complete solution was effected, and the whole became a red liquid, and ceased to give out sulphurous acid: it then deposited a sediment, which on further examination was easily burnt to ashes, and proved to be sulphate of lime, with a fat bituminous matter, an animal substance, and a very little silex.

The acid solution, diluted with water, was boiled for nine hours, then was saturated with chalk, and evaporated to the consistence of an extract, which was yellowish, and had a taste like the extractive matter of broth, giving the same appearances when burnt, and yielding ammonia by trituration with potash.

This extract was treated with weak boiling alcohol, in successive portions, which dissolved out of it a small quantity of leucine, and a substance a little animalised. As to the portion insoluble in this weak spirit, which was the most considerable, it had the same taste of broth, and all the other properties which were found in the analogous substance produced from fibrine.

Wishing to know in what state the wool existed immediately after its conversion into mucilage, I moistened eight grammes of it with sixteen grammes of sulphuric acid, diluted with four grammes of water; and after some minutes digestion in a boiling-water heat, and subsequent shaking, there resulted a thick red mucilage, which totally dissolved in water, except a little whitish matter, which was only a portion of the wool, but little changed. The acid liquid was saturated with chalk, and gave by evaporation a substance having exactly the appearance of common glue, but with little cohesion, not deliquescent, and easily reducible to powder. Its taste was disagreeable. In the fire it puffed up and burnt with a smell like scorched wool, but less fetid, but without giving out any sulphurous acid: the coal burnt to ashes as easily as vegetable coal. This substance gave out ammonia when rubbed with potash. Infusion of galls poured into the solution of this substance decomposes it entirely: the precipitate is white, flocculent, and does not collect into an elastic cohesive mass like that which forms in the solution of gelatine. Acetite of lead hardly troubles it; but on adding nitric acid there forms a small insoluble deposit of sulphate of lead. Nitrate of mercury and sub-acetite of lead produce copious white precipitates. Persulphate of iron acts on this as it does on solution of gelatine, it coagulates it entirely into an orange-red mass. Boiling alcohol hardly touches it.

It appears, therefore, that the principal facts contained in this Memoir are the following:

1. That animal substances may be changed by the action of sulphuric acid into substances containing a much less proportion of azote.

2. That this change is brought about by a subtraction of hydrogen

drogen and azote, in the proportions necessary to form ammonia; and probably by an absorption of oxygen from the sulphuric acid.

3. That gelatine may be converted in this way into a species of sugar, *sui generis,* which does not appear to exist any where naturally.

4. That this sugar combines intimately with nitric acid, without sensibly decomposing it, even with the assistance of heat, and there results a peculiar crystallised acid, to which I have given the name of *nitro-saccharine.*

5. That wool, and especially fibrine, when treated with sulphuric acid, yields a peculiar white matter, which I have denominated *leucine.*

6. That this matter, heated with nitric acid, does not sensibly decompose it, and produces a crystallisable *nitro-leucic* acid.

7. Lastly, That other uncrystallisable and sapid substances, analogous to certain vegetable principles, are also produced by the action of sulphuric acid on the most insoluble of the animal principles.

XXII. *On the Culture of Turnips. By* George Webb Hall, *Esq.**

Having executed the instructions of the Board of Agriculture, "to condense the whole of the information contained in the several Reports and Communications to the Board on the Culture of Turnips," into one general view, that the practice of all the counties in England and Scotland, on this most interesting and important branch of agriculture, might be laid fairly before the public in a compressed form, for the benefit of those to whom all the County Reports and Communications might not be accessible; I am tempted to step a little beyond the line of my instructions, in offering to the consideration of the Honourable Board a few observations of my own on the culture of this invaluable root; for which the laborious investigation I have now given the subject, added to my own experience, may render me not altogether unqualified.

If, on the completion of this work, I were to be asked by the Honourable Board, Upon a review of the practice of the whole island, which county do you consider to approach nearest to maturity in the culture of turnips? I should answer, without hesitation, The county of Middlesex stands unquestionably pre-eminent to every other in the kingdom in the manner of cultivating turnips; inasmuch as the system there pursued is calculated to produce the best crops at the least expense, and at the same

* From the Communications of the Board of Agriculture.

same time promote, nay ensure, the best and cleanest crops of grain in succession.

Let us examine what the very able Reporter of Middlesex, John Middleton, Esq. says on this subject; for it can never be too often printed or read.

"Turnips," he says, "are undoubtedly the basis of the best husbandry, and in every part of this island they will always be a principal crop in the most improved methods of cultivating loamy sands. They also grow very well on well-drained black peat earth, and on such strong loams as are rich. They support and make fat a very increased quantity of animal food, and by the dung and urine of fat cattle the land becomes more highly enriched than by any other means. It is an advantage of great importance, that they require such late sowing as to give the farmer an opportunity of reaping two green crops on the same land in one year, both of which may be fed by cattle. A succession of these crops (tares and turnips) may be raised and consumed on dry land till it acquires any desired degree of richness, and will feed more bullocks and sheep than the best grass-land in the kingdom; and, what is of great consequence, it will be perfectly clean, and fit for every sort of corn during the whole time; but they are crops that are perfectly incompatible with common fields, and for that reason, more than any other, they are so little grown in England. Inclose the common fields, and the tare and turnip husbandry will become general, which will be the most effectual means of loading our shambles with meat, and filling our granaries with corn."

We will now investigate in detail how this system operates, "to produce the best crops at the least expense, and at the same time ensure the best and cleanest crops of grain in succession," as I have above asserted.

The man who, the moment his wheat is cut, and even before it is carried, begins to break up his stubble for tares, is at no more expense in this operation, than those who give their land a winter-ploughing as a preparation for turnips; and in the spring, while the latter are laboriously and expensively giving their lands three, four, and sometimes five ploughings, as a preparation for turnips, and carting out their dung, his tares are growing on the land intended for turnips; by the consumption of which, by sheep, on the same land, in the month of May, he not only manures his land by their dung and urine, in a much cleaner way than those who haul out their farm-yard and stable dung for their turnips, but he is afterwards enabled, by two ploughings at most, and in some seasons, and on some lands, with one, to produce a fallow, after the consumption of the tares, that for cleanliness and friability shall rival, if not surpass, the fallows of the most

expensive

expensive spring-ploughing without tares. But even this is only half the benefit which this system confers; for, by obtaining such a redundancy of green food by the latter end of April and all May, the man who follows the tare system is enabled to hain, during May, all his summer pastures for his sheep; which, by having such a provision in tares, he may bite as closely as he pleases, without any reserve, during all March and April, until his sheep go to tares: thus will every man be enabled to enlarge his flock, on this system, to an extent of which no one, who has not tried it, can have any conception; and thus will he be enabled to apply all his farm-yard and stable dung to his Swedes, his potatoes, and, above all, to his pasture land; the ability to do which, from the high condition of the tillage land, by means of green crops and good tilth, not needing the dung, I consider to be the highest pinnacle on which any man can stand in the art of agriculture.

Again, the man who pursues the tare system, and can apply a large portion of his dung to his pasture land, will have grass on such manured pasture land, by winter haining the same, that shall rival in the month of March any water-meadow in the kingdom in verdure, and surpass it in proof for his couples: this enables him to maintain a larger flock than he could do on any other system, and that will enable him, by folding his lands, when in fallow for wheat after clover, in addition to the consumption of so many green crops on his tillage lands, to bring those to equal fertility, and superior cleanliness, to what he can do by any other method, even if he had the manure of the metropolis at command for his tillage lands. In exact proportion, therefore, as every agriculturist approaches to, or recedes from, the tare system, reported to be pursued in the county of Middlesex, and his ability to apply a great portion of his dung to his pasture lands, I consider him to be in the infancy, youth, or manhood of agriculture; and that those farmers, I will not call them agriculturists, who continue to apply farm-yard or stable dung as a dressing for their wheat fallows, which many do at this day, are only begotten, and not yet born to the light of agriculture.

Having cast so strong a reflection on so numerous a body of men as still continue, in various parts of the kingdom, to apply their farm-yard and stable dung to their wheat fallows, it seems incumbent on me to state the reasons of my dissent from this practice. This I will do in very few words: All dung applied to fallows must generate weeds, and, therefore, it ought universally to be applied on lands of all descriptions immediately preceding a green crop, by which, and the hoe, they may be well subdued, before we trust a crop of grain to a competition with weeds, on the same land.

Dung applied to wheat fallows, invariably makes the plant winter-proud, long and weak in the straw, and light in the berry, to say nothing of the endless, expensive, and inefficacious practice of weeding wheat; and if these objections are not enough to deter aay man from this absurd practice, who will give himself the trouble to reflect one moment on the subject,—which I do not believe any man ever did who adopted it,—I am certain nothing I can advance will, and I must leave such farmers to time and opportunity for improvement; but as the Memoir which I had the honour to present to the Board last year, on the Culture of Turnips, in mistake for the Condensed View of the practice of all the Counties on this subject, now respectfully submitted to the Board, is in the outset so completely in unison with Mr. Middleton's Report, which I had not then seen, and also contains some observations on manures, in which I have the misfortune to differ with some of the highest authorities in this kingdom, I subjoin such Memoir to these observations, that the public may decide on its correctness, or demerits.

I cannot take leave of Mr. Middleton, without offering a just tribute to his Report of the County of Middlesex; in doing which, I trust I shall be acquitted of all improper partiality or flattery, when I declare it has been my misfortune never to have seen, or ever to have heard, of this distinguished Agriculturist, except by his Report above mentioned; but in that, I find the most masterly delineations of the practice of the county, the most sound and judicious principles of general agriculture enforced, and the true bearing and effect of tenures upon its success, described;—in short, there is no part of rural economy touched, but it is illuminated by this very distinguished writer; and I find in his whole Report, only one subject upon which we materially differ, and that is the system of *folding sheep*, which he reprobates; but which I consider to be the most certain and perpetual basis of the most perfect agriculture that can possibly be pursued.

Memoir laid before the Board in March 1817.

The introduction and cultivation of turnips in this island, may be considered almost as important an æra in the agricultural world, as the Reformation was in the moral; and the right cultivation of this root, may be considered as the pivot on which successful agriculture on all turnip soils depends.

For, independently of its superseding altogether the necessity of summer-fallows, on such soils, I consider the annual weight of animal food which it supplies, to have had no inconsiderable share in enabling us to victual the increasing population of the united kingdom, and producing at all seasons of the year that regular

regular and abundant supply of animal food, which, before their general cultivation, could only be supplied during the summer and autumn months: independently, therefore, of the general amelioration of every crop in succession from turnips, which may be derived from their proper cultivation, this circumstance may be considered as a most valuable consequence of their general adoption.

If, then, to the general rotation, on all turnip soils, of turnips, barley, or oats, clover, one year only, and then wheat, we add an intervening crop of winter tares, on such part, at least, of the shift intended for turnips as is not appropriated for Swedes, I think we shall then have attained the *ne plus ultra*, in system, of advantageous cultivation upon all the turnip soils of the united kingdom; and after this arrangement, success will mainly depend upon the *manner* of executing this plan.

Without possessing any prejudice against the drill system of husbandry, or disapproving the use of it in others; I must here confess, I have never considered its adoption as necessary to ensure a more clean and perfect culture than can be maintained on the broadcast system; and I believe, on most of the experiments which have been made to endeavour to ascertain the pre-eminence of the drill to the broadcast husbandry, each party may boast of such alternate success and defeat, as still to leave the question undecided; and therefore, permitting every man to pursue his own taste on this part of the question, I shall proceed to consider of the best mode of cultivating and cleaning the land for turnips, so as to produce the greatest weight of this valuable root, and at the same time ensure the best possible rotation of crops in successsion. In preparing my land for turnips, notwithstanding the adoption of the method of applying *recent* dung in drills, by the highest practical authority in this kingdom, Mr. Coke; and the sanction of this practice by the highest chemical authority in this or any other nation, Sir Humphry Davy; I am bold enough to declare, that I prefer, infinitely prefer, that fermented putrescent manure from the dung-heap, which adequate and sufficient fermentation can alone produce from the dung of the barton aud stable-yard; and without which fermentation, the component parts of all farm-yard and stable-dung are crude, inefficacious, and weak, compared with the effect of dung that has been well fermented, and lain together for a twelvemonth, and then haulded out on the land. Having ventured to differ from these two highest authorities, in so essential a point, as a preference of putrescent to recent dung, it will be incumbent on me to submit my reasons for such difference, to this Honourable Board, by whom, as well as by the great Professor I have named, all facts and arguments submitted to them with humility and diffidence,

fidence, as I do most humbly and diffidently at this time, will be candidly and condescendingly considered, and fairly weighed and determined.

The reasons which have led me, for upwards of twenty years, to use and prefer putrescent to recent dung, are as follow: I have invariably observed that all dung, except the dung of sheep, which falls from animals while grazing, produces little or no benefit to the land; let us add either chopped or long straw to the dung so deposited on the land, and the effects of both will be small, or nugatory: next collect stable or barton dung in a recent state, and apply it to the land before any fermentation and consequent putrescency have take place; and, in my experience, it has been only a little better than the dung dropped on the land from the animal: but, ferment and putrefy these very same ingredients, before they are applied to the land, and we obtain one of the most powerful and valuable manures every discovered; and powerful and valuable in exact proportion to the quality of the food eaten by the animal from whence the dung is obtained, and its consequent putrescency and strength, by which its duration and effect on the land may be practically known.

But it has been said by the highest chemical authority above cited, that the volatile parts, which fly off from a dung-heap during fermentation, are the most valuable and most efficient in promoting vegetation:—I have not practically found this to be the case, because my dressings of putrescent dung have invariably produced more luxuriant crops the second, the third, and sometimes even the fourth year on pasture land, than they have the first; and if the volatile parts were the most valuable and efficient in promoting vegetation, it should seem this effect could not be produced by putrescent dung—and on arable land a dressing of dung, whether recent or putrescent, renders the land unfit to bear a crop of grain, of any kind, until green crops and good tilth have amalgamated the dung and the earth, and rendered the land fit for a crop of corn.

I also consider it to be the most beneficial mode of applying putrescent dung to the land, to spread it on the surface, and then plough it in, and afterwards harrow the land, by which much of the dung is brought again to the surface; because, contrary to the opinions of those who suppose the richness of the dung to be exhaled in vapour by the sun, I humbly submit to this Honourable Board, that the effect of a scorching sun, in this climate at least, will be to drive all the moisture of this rich dung downwards into the earth, by which it is absorbed, and not to exhale it in vapour; and by this operation,—which is renewed after every shower and heavy dews which fall on the dung, and so passes into the land,—more than by any other, I consider soil

to

to be improved by the application of dung; and thus, by the agency of the sun and air, and rain, upon the dung which is uppermost on the land, is the work of vegetation, in Nature's laboratory, more successfully promoted and carried on, than by any other means. Let the man who doubts this, only observe, as I have often done, the effect of a piece of putrescent dung on the surface, which has happened to be hoed near a potatoe or a turnip when growing, and he will soon be satisfied of the truth of this observation.—For these reasons, and on these principles, without being at all able to state chemically how the effects are produced, I prefer using dung in a putrescent to a recent state. I practise spreading it on the surface, and ploughing it in, and then harrowing the ground, instead of burying my dung in the furrow, and there leaving it, that its effects may be spread and felt as universally as possible over the whole surface; and on these principles, my course of crops are as follows:

As soon as my wheat is cut, I haul out my putrescent dung, say forty to fifty cart-loads to the acre; I plough it in with the stubble, harrow the ground, and sow winter tares;—eat off the tares in April and beginning of May with sheep, and then give the land two or three earths, as occasion may require, or the season permit, for the turnips;—sow broadcast;—hoe incessantly, so long as weeds will grow; the third hoeing requires very little labour;—eat off my turnips with sheep;—give two ploughings for my barley or oats;—harrow and hand-rake the surface thoroughly after each ploughing, and pick up every weed on the land, which I constantly haul off to a putrescent dung-heap preparing for pasture land;—sow *clover only* with the barley or oats, which remains but one year, and is mown twice for hay:—immediately after the crop is carried, break up the clover-ley, run the sheep-fold over the land, and plough thrice for wheat, (never forgetting to harrow well, and pick up and haul off every weed found on each earth,) which I invariably sow under the furrow; and this completes my course of tillage, which may be repeated to all eternity, while the land will be perpetually in heart, like a horse above his work, and will seldom deceive the industrious cultivator who does not deceive his land; and by this succession I have five crops in four years. I have now pursued this system without variation for years, and I have every reason to prefer it to all others, from the luxuriance of my crops, the cleanliness of my fallows, and the perpetual amelioration of my soil. The farm I now occupy was overwhelmed with couch and colt's-foot at my entrance six years ago, and was incapable of bearing clover; and, in confirmation of this practice, I can only say, that I have repeatedly obtained from fifty

fifty bushels to eight quarters of barley and oats per acre, although at my entrance, when I took to the crops on the ground, I had no more than ten bushels of wheat and fifteen bushels of barley per acre; and last year I cut thirty-two large waggon-loads of clover, at two mowings, from seven acres. I am yet unable to speak of more than twenty-five bushels of wheat* per acre, because wheat being my last crop, after the application of my dung, I have yet had but one crop of wheat from the land since it has been cleaned and manured; and in 1816, every body knows how the wheat crop failed: but in the present, or any future year, I am ready to submit my whole rotation of crops on the ground to the inspection of any person or persons the Board of Agriculture may appoint to examine them; and as the land lies within two miles of Clifton, this may be done with little trouble and no expense, by any person resorting there, and afterwards submit the produce of them, for quantity and quality, to a comparison with any other crops of the same description, under any other culture than what is similar to my own, in the united kingdom.

I cannot chemically explain to this Honourable Board, why putrescent is superior to recent dung, in its use, any more than I can explain, why flour and water, after being mixed, shall by kneading, fermentation, and baking, become most nutritious, powerful, and wholesome food for man, commonly called bread; which it would not be, I presume, if consumed or applied to his stomach in the simple shape of flour and water;—or why sweet-wort shall, by being hopped, boiled, fermented, and stored, become a stronger and better liquor than if drunk while it was a simple infusion of malt and water; and I can only appeal to experience for results. But I have always considered those cultivators who have used and recommended recent dung, in preference to putrescent, to be as erroneous and impolitic in their judgements and practice, as those who should contend that simple flour and water, unfermented and unbaked, equals bread; or that an infusion of malt and water, unfermented and unstored, equals old stingo.

* Since this was written, my wheat of 1817 has been thrashed; the produce was exactly 38½ bushels per acre, weighing 58½lb. per bushel.

XXIII. *No-*

XXIII. *Notices respecting New Books.*

Transactions of the Literary Society of Bombay. With Engravings. Vol. II. 4to.

The following are the contents of this interesting volume:

I. Notice and Extracts of the *Miritolmemalik* (Mirror of Countries) of Sidi Ali Capoodawn. By Mr. Joseph Hammer, of Vienna.—II. A small but true Account of the Ways and Manners of the Abyssinians. By Mr. Nathaniel Pierce.—III. An Essay on Persian Literature. By Capt. Vans Kennedy.—IV. Description of a Volcanic Eruption in the Island of Sumbawa. By Andrew Stewart, Esq. Assistant Surgeon of the Bombay Establishment.—V. Remarks on the Chronology of Persian History previous to the Conquest of Persia by Alexander the Great. By Capt. Vans Kennedy.—VI. On the Ruins of Boro Budor in Java. By John Crawford, Esq. Resident at Djocjocarta in Java.—VII. Account of a curious Case in Surgery. By Charles Linton, Esq.—VIII. Account of the Progress made in deciphering cuneiform Inscriptions. By Mr. Charles Bellino.—IX. Some Account of the Caves near Baug called the *Panch Pandoo*. By Capt. F. Dangerfield, of the Bombay Military Establishment.—X. An Account of the Province of Cutch, and of the Countries lying between Guzerat and the River Indus: with cursory Remarks on the Inhabitants, their History, Manners, and State of Society. By Capt. James Macmurdo, Resident at Anja.—XI. Notice respecting the Religion introduced into India by the Emperor Akbar. By Capt. Vans Kennedy.—XII. Description of a curious Bird of the *Otis* Genus. By Capt. John Stewart, of the Bombay Military Establishment.—XIII. Notices respecting the Trial by Punchiet, and the Administration of Justice at Poona, under the late Peishwa. By Thomas Coats, Esq. Surgeon of the Bombay Establishment.—XIV. Some Account of Mahummed Mehdi, the Wali or Saint of the Mehdivis: translated and abridged from the Books of his Disciples and Followers.—XV. On the Sacred Books and Religion of the Parsis. By Wm. Erskine, Esq.—XVI. On the Authenticity of the *Desâtîr*, with Remarks on the Account of the Mahabadi Religion contained in the *Dabistân*. By Wm. Erskine, Esq.

Vetch's *Projection of the Sphere.*

In this new projection by Capt. J. Vetch, the globe is supposed to be inscribed in a cylinder, the axes of the globe and cylinder being at right angles to each other, and hence their surfaces coinciding at a meridian. The eye is supposed to be at rest in the

 centre

centre of the globe, and every point in the earth's surface is transferred to the surface of the cylinder by a right line passing from the earth's centre through each point of its surface. The cylinder being then opened longitudinally on one side, and spread out, a view of the earth is obtained on a plane surface. Every student of geography ought to be possessed of this projection.

Recently published.

Pyne's History of the Royal Residences in England, illustrated by 100 Graphic Representations of State Apartments, beautifully coloured. 3 Vols. 4to. 25*l.* 4*s.* Boards. Large paper 37*l.* 16*s.*

A Catalogue of the Pictures at Grosvenor House, London; containing Etchings of the whole Collection, and a historical Notice of each Picture. By John Young, Keeper of the British Institution. 4to. 2*l.* 2*s.* India paper 3*l.* 3*s.*

Picturesque Delineations of the Southern Coast of England, Part X. Engraved by W. B. and G. Cooke, from Drawings by J. M. W. Turner, R. A. &c. Royal 4to. 12*s.* 6*d.*

Geographical descriptive Delineations of Van Diemen's Land, one of the Dependences of New South Wales. By Lieut. C. Jefferys, R. N. 8vo. 5*s.*

The Architectural Antiquities of Normandy. By John Sell Cotman. With historical and descriptive Notices. Part II.

The Heraldic Origin of Gothic Architecture, in answer to all foregoing Systems. By Rowley Lascelles, Esq. Barrister, of the Middle Temple. Royal 8vo.

Robinson, Hurst, and Co.'s Catalogue of engraved Copperplates by the most esteemed Artists, after the finest Pictures and Drawings of the Italian, Flemish, German, French, English and other Schools. 2*s.*

Twenty-four Select Views of the principal Ruins of Rome; with a Panoramic Outline of the modern City from the Capitol. By Henry Abbott, Esq. from Drawings taken on the Spot.—To be completed in Eight Numbers at 1*l.* 1*s.* each.

A Geographical, Statistical, and Historical Description of Hindostan and the adjacent Country, composed from the most authentic printed Documents, and from the MS. Records deposited at the Board of Controul. By Walter Hamilton, Esq. With Maps. 2 Vols. 4to. 4*l.* 14*s.* 6*d.*

Historical

Historical Account of Discoveries in Asia, from the earliest Ages to the present Time. By Hugh Murray, F.R.S. E. With Maps. 3 vols. 8vo. 2*l.* 2*s.*

Preparing for Publication.

Select Cabinet of Natural History, with an Account of the Silkworm, and an elegant Method of obtaining very exact and pleasing Representations of Plants. By the late Dr. Shaw, F.R.S. Principal Naturalist of the British Museum.

Ariconensia: or, Archæological Sketches of Ross and its Vicinity. By the Rev. T. Fosbrooke.

XXIV. *Proceedings of Learned Societies.*

ASIATIC SOCIETY.

On the 8th of January, The Marquis of Hastings in the chair, a letter from Mr. Moorcroft was read, announcing, that having learnt that there were four large sheets of copper, covered with small but deeply engraved characters, deposited at Punk-hesur, a dependency of Budree Nat'h, and midway between the temple and Joshee Mut'h (the place whence Mr. Moorcroft's letter was dated), and said to contain the history of the temple and the tenets of the Budha faith, he had succeeded in borrowing them from the high priest of Budree Nat'h to be sent to Calcutta, on a promise that, when copied, they should be returned, and that within eighteen months. He was induced to borrow them, to avoid the risk of errors in copying them, likely to occur from the inscriptions being in a language wholly unknown to the Brahmins in attendance at the temple.

☞ [We have given a place to this notice in our pages, though it has as yet led to no result, for the purpose of offering a suggestion or two to gentlemen who find themselves circumstanced like Mr. Moorcroft; or, perhaps even worse, by not being able to borrow the plates. On such an occurrence, an impression from the plate will often be found preferable to any hasty copy: thus, in our old churches have been found many monumental plates, with inscriptions, from some of which we remember to have seen impressions that were printed in the same manner as copper-plates, under the direction (if we rightly remember) of that veteran in typography, the well known John Nichols, esq. Another method is to take an impression from them in the manner of letter-press or wood-cuts, by daubing them over carefully with (for want of printer's ink) any kind of oil paint, and then pressing on them a sheet of moistened white paper: if a printing-press be not at hand, the impression may be taken off by treading them all over with the bare foot, taking care to interpose a few sheets of paper between the foot and the sheet that is to receive the impression: if oil paint cannot be had, the smoke of a candle will answer. Another method of procuring a copy, is by taking a cast from the plate in plaster of Paris: in this case the reading will be more easily discerned if the incisions have some dark-coloured paint rubbed into them before the cast is made; or, if paint cannot be procured, by first smoking the plate all over, and then wiping the surface clean, which will leave the lamp-black in the incisions. A fourth method, and which gives a very good impression, is by laying over the plate several folds of soft white paper, previously soaked for some hours in water, and then with care forcing the paper, by mere pressure with the fingers, to enter to the very bottom of the incisions: if it is apprehended that the paper has not entered deep enough (which however may be easily known by gently lifting up one of the corners of the paper for inspection), it may be more effectually forced in by laying two or three folds of linen over the paper; and then, gently and patiently, beating it all over with a light wooden mallet: in this way a very accurate impression may be taken in *papier maché*; the paper should be left for some time in contact with the plate, but not till quite dry, as shrinkage takes place during the drying, which might hurt the sharpness of the impression if then found entangled in the engraved incisions. All these impressions will be reversed, but may be read forward with the help of a mirror.]

In the museum of this Society there are, among other curiosities, a piece of rattan from Nepaul, 84 feet long, a snake with two heads, specimens of Mosaic from Agra and Golconda, crystal images from Nepaul, and sculptures from Persepolis, Java, &c.

ROYAL ACADEMY, COPENHAGEN.

This Academy has proposed the following as a prize question respecting the variation of the compass: "Num inclinatio et vis acus magneticæ iisdem, quibus declinatio, diurnis variationibus sunt subjectæ? Num etiam longiores, ut declinatio, habent circuitus? Num denique has variationes certis finibus circumscribere possumus?"—Prize, 50 Danish ducats.

SOCIETY OF SCIENCES, HAERLEM.

This Society has proposed the following prize question: "What advantage has medicine derived from the reformation and extension of chemistry since the time of Lavoisier, in making us better acquainted with the chemical agency of the medicines usually

usually employed for the cure of several diseases of the human body; and what means should be taken, in order to acquire a solid knowledge, useful in medicine, of the hitherto unknown chemical agency of several medicines?" The Essays to be sent to the Secretary before the 1st January 1821.

XXV. *Intelligence and Miscellaneous Articles.*

WATER NOT A NON-ELASTIC FLUID.

Mr. Perkins, the inventor of the curious and useful art of siderography, or of multiplying engravings, (by executing them on soft steel plates, which when hardened are employed to transfer the lines in relief, to steel rollers, which rollers are again used to impress other steel or copper-plates with all the lines of the first engraving) has ascertained and proved by actual experiment, that water subjected to a pressure of 326 atmospheres is diminished about 1-29th in bulk, or $3\frac{1}{2}$ per cent.

BORACIC ACID.

By experiments made by Dr. Pleischl, of Prague, on crystallized boracic acid, it appears to be a compound of pure anhydrous acid 54, water 45 = 99. Experiments made by this chemist on anhydrous boracic acid confirm those of Gay Lussac and Thenard. It is not able to decompose fused chloride of barium—no decomposition or chemical combination was obtained.

VEGETABLE ALKALIES.

The number of these is daily increasing, and chiefly by the labours of the German chemists. *Delphia, Daturia, Hyoscyama,* and *Atropia,* were discovered by Dr. Brandes.

Atropia is the ingredient which gives to the *Atropa belladonna* its peculiar properties. It crystallizes in long needles, is a brilliant white, tastless, and little soluble in water and in alcohol; withstands a moderate heat; and forms regular salts with acids, neutralizing a considerable portion of acid. Sulphate of atropia contains sulphuric acid 36·52, atropia 38·93, water 24·55 = 100. Atropia mixed with potash and exposed to a red heat yields ashes, which when mixed with muriate of iron strike a lively red colour.

Hyoscyama (the alkali extracted from the *Hyoscyamus niger*) is not easily altered by heat, even when brought to redness with charcoal. It crystallizes in long prisms; and gives with sulphuric or with nitric acid very characteristic salts.

Great care and circumspection should be employed in examining

amining the alkaline constituents of narcotic plants; for in them are concentrated the whole poisonous properties of the plants. The vapour is highly prejudicial to the eyes; and the smallest portion put on the tongue is very dangerous.

ANTIDOTE FOR VEGETABLE POISONS.

It results from a number of experiments made by M. Drapiez, that the fruit of the plant *Feuillea cordifolia* is a powerful antidote against vegetable poisons. He poisoned dogs with the *rhus toxicodendron*, hemlock, and *nux vomica*. Such of them as were left to the effects of the poison, all died; but those to which the above fruit was given recovered completely after a short illness. With two arrows dipped in the juice *manchenille* he slightly wounded two cats: to the one he applied a poultice of the same fruit, and it soon recovered: to the other nothing was done, and it fell in a short time into convulsions, and died. In the countries which produce this plant, its virtues have long been highly esteemed, and from these experiments, it would appear, not without good reason.

SUCCEDANEUM FOR PERUVIAN BARK.

M. Ré, Professor of the *Materia Medica* at the Veterinary School of Turin, has announced that the *Lycopus Europæus* of Linnæus, called by the peasants of Piedmont, where it is found in great abundance, principally in the marshy places, where of course it is most needed, the Herb of China, is a complete succedaneum for Peruvian bark.

ARAKATSCHA.

If we may credit what is stated respecting this root, which grows in Santa Fe de Bagota, we may expect before many years to see it brought to Europe and cultivated as extensively as the potato. It is said to be as prolific, and more nourishing, and resembles the Spanish chesnut in taste and firmness. It is indigenous to the Cordilleros, a climate as temperate as Europe, and may be cultivated with the same facility as the potato.

PLANTAIN ROOT.

According to Dr. Perrin, the roots of plantain (*Plantago major, minor, et latifolia*, Linn.) may be employed as a febrifuge, and with great advantage in intermittents. The plant is common in all parts; and its leaves are well known as a vulnerary.

TO PRESERVE CURRANTS FRESH.

Select, when the fruit is ripe, those bushes, enjoying a southern aspect,

aspect, which are most convenient in shape, and best loaded with fruit. Surround them with thick straw mats (or thatch them) so that they shall be completely sheltered from cold air and other changes. Thus treated, the fruit may be preserved quite fresh till January or February.

CURE FOR THE HYDROPHOBIA.

Dr. Lyman Spalding, one of the most eminent physicians of New-York, announces, in a small pamphlet, that for above these fifty years the *Scutellaria lateriflora* L. has proved to be an infallible means for the prevention and cure of the hydrophobia, after the bite of mad animals. It is better applied as a dry powder than fresh. According to the testimonies of several American physicians, this plant, not yet received as a remedy in any European *Materia Medica*, afforded a perfect relief in above a thousand cases, as well in the human species as the brute creation (dogs, swine, and oxen). The first discoverer of the remedy is not known: Drs. Derveer (father and son) first brought it into general use.

GASTRONOMY.

M. Lemare, director of the Athenæum of Languages, has invented a utensil which he calls *autoclave*. M. Lemare engages to dress his dinner in less than half an hour; and lately made the experiment with complete success before a numerous company. He had put into the vessel a piece of meat, vegetables, and as much water as is necessary for a dish for five persons. The vessel was placed over a fire, which was kept up with some pieces of charcoal. In 36 minutes the vessel was taken off, and left a few minutes to cool; and the reporter affirms, that the broth was excellent, and the meat thoroughly done. It is not necessary to open the pot to skim it so much as once during the boiling; for at the end of the operation the scum is found at the bottom of the vessel, and does not mix with the broth. The advantages of this *autoclavian* cookery are: 1st, that the soup is excellent, which is very natural, because the apparatus is hermetically closed, and nothing therefore is lost. 2d. That the produce is much increased by the quantity of jelly yielded by the bones. 3d. That the cookery is far more expeditious than in the ordinary kettles, &c. This mode of cookery will be highly advantageous to the poor in particular. We leave the detailed description of the autoclave to those journals which are especially devoted to such subjects. If satisfactory and repeated trials confirm the utility of the invention, it will become highly important in its results, as it will then be evident that cooking may be performed in much less than the usual time, and with one-tenth part of the

fuel

fuel now employed. M. Lemare's process is a very simple, and, for that reason, very ingenious improvement of Papin's digester. It speaks much in favour of the invention, that, as appears from a letter of the Minister of the Interior, the autoclave has been in use above a month in the School for the Blind at Paris. Should it come into general use, M. Lemare will doubtless derive more profit from the sale of this apparatus than from all his discoveries in etymology, and his excellent precepts on orthography; and this is in the nature of things. In this enlightened age, we undoubtedly set a high value on correctness of language, but a well-dressed dinner is far more valuable.—(*Foreign Journal.*)

EXTRAORDINARY COPPER-PLATE PRINTING.

The following is from the Report of the Central Jury, on the production of French industry exhibited in the Louvre, in 1819.

"M. Gonord exhibited, in 1806, porcelain on to which copper-plate engraving had been transferred by mechanical means. He has again appeared at the exhibition of 1819, with some specimens of the same art perfected. He has arrived at a singular but undoubted result. An engraved copper-plate being given, he will use it for the decoration of pieces of different dimensions, and, by an expeditious mechanical process, enlarge or reduce the design in proportion to the piece, without changing the plate."

In a note, it is said, that "M. Gonord has made a discovery of which the announcement has excited the surprise of the public. If an engraved copper-plate is given to him, he can take impressions from it of any scale he pleases. He can at pleasure make them larger or smaller than the plate, and this without requiring another copper-plate, or occupying more than two or three hours. Thus, if the engravings of a large atlas size, as for instance, those belonging to the *Description de l'Egypte,* were put into his hands, he would make an edition in octavo without changing the plates.

The certainty of the process has been corroborated by the members of the Jury, who were admitted by M. Gonord into his works. In consequence of their report the Jury decreed a gold medal to M. Gonord.—*Annales de Chim.* xiii. p. 94.

MEASUREMENT OF THE MERIDIAN.

The operations now carrying on, by order of the King of Denmark, for measuring an arc of the meridian in Denmark and Holstein, are to be continued through the kingdom of Hanover. For the purpose of ascertaining with accuracy the vegetable productions of Hanover, His Majesty has been pleased to approve of the appointment of a physiographer for that purpose, and of the nomination of Dr. G. F. W. Meyer to the office.

TEMPLE OF JUPITER AMMON.

M. Frediani, an Italian traveller, writes from Egypt, that he has succeeded, after sixteen days of excessive fatigue across the deserts of Libya and Marmorique, in reaching this famous edifice, called the Great Temple, which it is supposed has not before been visited since the time of Alexander the Great.

M. Frediani was accompanied by an escort of 2000 men, and had to fight his way to this celebrated monument of ancient superstition.

NATURAL HISTORY.

A species of the armed or Cambrian goose, a native of Africa, belonging to a person on the north side of Garngad-hill, was observed for some time to pay particular attention to a dog which was in the chain, and, what is singular, the dog would never before allow any poultry to come within his reach: but in this case he laid aside all his former animosity, and received his new acquaintance with every mark of affection. The goose finding she had nothing to fear from her canine friend, entered his box, in the centre of which, among the straw, she made her nest and deposited her eggs, which was not known till one of the family mentioned that the goose slept in the dog's bosom. The singularity of the circumstance led to an examination of the box (but not without the greatest reluctance on the part of the dog, who appeared determined to protect what was left to his care). On removing the straw, five eggs were discovered in a fine bed of down and feathers. The dog was in the habit of going into his house with the greatest care not to disturb the nest. On boiling and opening one of these eggs for eating, the spoon came in contact with a hard substance at the internal end of the egg; when, part of the contents being removed, the hard substance proved to be another egg about the size of a partridge's, complete in every respect, slightly adhering to the white of the outer egg, but quite independent of it. This is unquestionably a rare and extraordinary occurrence; but it is well known to naturalists that monstrous productions are more common to the goose species than to any other domestic bird. The egg is in the possession of the proprietor of the goose.—*Glasgow Courier.*

LIST OF PATENTS FOR NEW INVENTIONS.

To John Hudswell, of Addle-street, city of London, for an improvement in the manufacture of wafers.—20th July 1820.—Two months allowed to enroll specification.

To James Harvie, engineer, late of Berbice, now in Glasgow, for improvements in the construction of machines commonly called ginning machines, and which are employed in separating cotton wool from the seeds, which will be of great use, benefit and advantage.—18th Aug.—2 months.

To George Millichap, of Worcester, coach-maker, for his improvement on axletrees and boxes.—18th Aug.—6 months.

LECTURES.

St. George's Medical, Chirurgical, and Chemical School.—The first week of October next, the Lectures will commence:

1. On the Practice of Physic, with the Laws of the Animal Œconomy, and Pathological Demonstrations, at 9 in the Morning, George-street, Hanover Square, on Mondays, Wednesdays, and Fridays, by George Pearson, M.D. F.R.S. Senior Physician to St. George's Hospital, &c.

2. On Chemistry, at the Royal Institution, Albemarle-street, by W. T. Brande, Sec. R.S. Professor of Chemistry at the Royal Institution.

3. On Surgery, at the Chirurgical Lecture Rooms, Windmill-street, at 7 in the Evenings, by B. C. Brodie, F.R.S. Assistant Surgeon to St. George's Hospital.

Five gratuitous Lectures on Surgery will be given to the Pupils at St. George's Hospital, by Sir E. Home, Bart. F.R.S., &c.

Dr. Taunton's Autumnal Course of Lectures will commence on Saturday the 7th of October, at Eight o'clock in the Evening, at his House in Hatton Garden.

THE GREAT ECLIPSE.

[From the Norfolk Chronicle.]

Sir,—The eclipse, which is fast approaching, will take place on the 7th of September next, being the largest visible on this part of the globe previous to the solar eclipse which will happen in the year 1847. The particulars of this eclipse are calculated for the meridian of Norwich, and which are as follows, viz. Beginning of the eclipse 0 ho. 29 min. 25 sec. P.M. visible conjunction 1 ho. 55 min. 40 sec. true ecliptic conjunction 1 ho. 56 min. 48 sec. greatest obscuration 1 ho. 58 min. 10 sec. Eclipse ends 3 ho. 21 min. 55 sec. Total duration of the eclipse at Norwich, 2 ho. 52 min. 30 sec. Digits eclipsed 10 deg. 50 min. on the sun's north limb.

At Yarmouth and Lowestoft, 1 min. 46 sec. must be added; but at Lynn, 3½ min. must be deducted from the time at Norwich, in order to obtain the respective times at the above places.

Owing to the moon being nearly at her greatest distance from the earth, her apparent diameter will be less than that of the sun; consequently, where central, a beautiful annulus, or ring of light, will present itself, of about one twenty-ninth part of the sun's sun's diameter, surrounding the moon's dark body. But in no part of Great Britain will this appearance be visible. The central eclipse will commence at 12 ho. 54 min. 40 sec. apparent time at Greenwich, in lat. 81 deg. 39 min. 30 sec. north—and long. 149 deg. 33 min. west of Greenwich. The sun will be centrally eclipsed on the meridian at 1 ho. 8 min. 15 sec. in lat. 76 deg. 6 min. 20 sec. north—and long. 17 deg. 3 min. 20 sec. west. It will traverse the supposed polar basin and the north-east coast of Greenland; the object of so much curiosity at the present time; so that if the discovery ships, which sailed in 1818, viz. the Dorothea, Captain Buchan and Lieut. Morrel, and the Trent, Lieutenants Franklin and Beechey, to the Pole direct, should chance to be in those parts, they may probably observe the eclipse in those high northern latitudes, as may also the navigators returning from the Greenland Whale Fishery, should they not be home at the time.

The centre of the moon's shadow, after quitting the coast of Greenland, passes a little to the west of Mayness's Island; it thence proceeds up the North Sea, about midway between the Shetland Isles and the coast of Norway, leaving every part of Britain to the west. It thence enters the Continent of Europe, between Embden and the Weser, and in crossing the Confederation of the Rhine it passes by Cassel, Wurtzburg, and Munich. It thence crosses a part of Italy, and enters the Gulf of Venice between Venice and Trieste, and proceeding in its track it leaves the Island of Tremiti a little to the west. It thence crosses the heel of Italy and enters the Mediterranean, passing over the Gulf of Tarento, leaving the coast of Morea and Candia about a degree to the east, whence it enters Egypt, passing by the city of Alexandria, leaving the Egyptian Pyramids a little to the south, whence it passes over Grand Cairo and the north end of the Red Sea: it then enters Arabia, and finally leaves the earth near the Persian Gulf, at 3 ho. 8 min. 10 sec. in lat 27 deg. 10 min. 30 sec. north, and long. 46 deg. 2 min. east of Greenwich. Total duration of the central eclipse 2 ho. 13 min. 30 sec. The general eclipse commences at 11 ho. 23 min. in lat. 59 deg. 43 min. north, and long. 90 deg. 50 min. west; and finally leaves the earth at 4 ho. 39 min. 45 sec. in lat. 3 deg. 21 min. north, and long. 20 deg. 25 min. east. Total duration of the general eclipse to the inhabitants of the earth 5 ho. 16 min. 45 sec.

The duration of the annular eclipse cannot at any particular place exceed six minutes of time.

The eclipse will be annular, or the whole body of the moon will appear on the sun's disc, over a space of about 150 miles in breadth, on each side of the central line.

And where the eclipse is of the magnitude of 11 digits and

 one-

one-tenth, the *obscuration* will be as great as if central. This eclipse, after traversing the *expansium* from the creation of the world, first came in at the south pole of the earth about 88 years after the Conquest, or in the last of King Stephen's reign, since which time it has proceeded more northerly, and will finally leave the earth at the North Pole, A.D. 2090, whence no more returns of this eclipse will take place from the latter period till after a revolution of 12,300 years.

I am, sir, yours respectfully,

Lynn Regis, Aug. 15, 1820. JAMES UTTING.

COMETS.

M. Encke, Assistant Director of the Observatory at Gotha, has traced out the track of the comet which appeared in 1786, 1795, 1805 and 1819. It is by means of an ellipsis of an uncommon form, if not absolutely unique, that the orbit of this body (rather to be reckoned among the *planets* than comets) has been traced. That this body is not self luminous, may be considered as fully ascertained. That the tail or radiance emanating from it, was a lucid vapour through which rays of light passed, cannot be doubted, and so probably is the tail of all comets; and if confidence might be placed in an accidental observation of the face of the sun, at the time when, by calculation, this body should have been passing over it, the body was also diaphanous;—otherwise it was so small as to escape the notice of the observer, who was then most intent on examining the spots visible on the face of the sun.

METEORIC SUBSTANCES.

A meteoric stone, which fell in India on the 18th of February 1815, is now in the East India Company's Museum. The following particulars are extracted from a letter to Major Pennington by Capt. G. Bird:—"On the above day, about noon, some people at work in a field near, about half a mile from the village of Dooralla*, were suddenly alarmed by an explosion which they conceived to be of a large cannon, succeeded by a rushing noise like that of a cannon ball in its greatest force. Turning their eyes towards the quarter whence the sound proceeded, they saw a large black body in the air, apparently moving directly towards them: it passed them with inconceivable velocity, and buried itself in the earth at the distance of about sixty paces from the spot where they stood. As soon as their terror would suffer them, they ran to the village, where they found the people no less terrified than themselves, from an apprehension (for they had not seen the meteorolite) that an armed marauding party was approaching. When the Brahmins of the village were told

* In the territory belonging to the Pattialah Rajah.

what

what had really happened, they proceeded, followed by the people, and, digging up the spot, indicated by the broken surface and fresh earth and sand scattered round it, at the depth of about five feet, in a soil of mingled sand and loam, they found the stone. The Brahmins conveyed the stone to the village, where they commenced a Poosa, and, covering it with flowers, set on foot a subscription for erecting a temple over it, not doubting that they should soon turn it to a profitable account. The explosion was heard to the distance of twenty-five miles from Dooralla.—Major Pennington, on hearing of the circumstance, wrote to Captain Bird to endeavour to procure the stone; and the latter, on application to the Rajah. found no difficulty in obtaining an order for its removal. Indeed the Rajah seemed rather to consider the stone as an omen of evil; for he gave special orders that it should not approach his place of residence. It was carried to Captain Bird, then at Lodiana (about eighty miles from the place where it fell), escorted by a party of Brahmins and some Seik horse. It weighs rather more than twenty-five pounds, is covered with a thin black pellicle, is somewhat triangular, and exhibits on a corner whence a piece has been broken off iron pyrites and nickel. While it remained with Capt. Bird, the Brahmins in the neighbourhood went to his tent to pay adoration to it; nor would any Hindoo venture to approach it but with closed hands in apparent devotion."

A very singular meteoric substance has lately been recognised in the Museum of M. Von Grotthuss, of Curland. It is distinguished in Germany by the name Mourning paper. According to the Ephemeris of the Leopold Academy, it fell in great quantities in Curland on the 31st of January 1686. The specimen found in M. Von Grotthuss's collection, and which was labelled as of meteoric origin, consists of a mass of black leaves, like burnt paper, but harder; it coheres together, and is brittle. When examined by chemical reagents, it was found to consist of silica, magnesia, iron, and some nickel, with traces of chromium. Black substances like beans fell at the same time.

An aërolite which fell at Jonzac, 13th of June 1819, has been analysed by M. Laugier, and gave

Oxide of iron	36·0
Silica	46·0
Alumina	6·0
Lime	7·5
Oxide of manganese	2·8
Magnesia	1·6
Sulphur	1·5
Chrome	1·0
	102·4

The

The increased weight is ascribed to the oxidizement of the metals during the analysis. As observed by the author (*Ann. de Chim. et de Phys.* xiii. 441) the above stone is remarkable, not only from the absence of nickel, but on account of the proportions of the other contents, the sulphur and magnesia being much less, and of the alumina and lime greater than usual. The author also suggests that the presence of chrome rather than of nickel should be considered as characteristic of meteoric stones.

REMARKABLE HAIL-STORM.

The south-eastern part of the county of Mayo has been visited by one of those awful visitations which occur but very rarely in our happy and temperate climate. Of its devastating effects we have the following description and appalling particulars from a respectable gentleman residing in the vicinity of Ballyhannes:—"A shower of ice-stones, accompanied by a tremendous thunder-storm, fell in this district on the 29th June, and in its course has caused general destruction. Its breadth did not exceed half a mile, which it left a perfect ruin—the potatoe crop cut close to the earth—the flax bruised as in a mill—the corn shattered and blasted, never to rise again! All the windows within its limits are broken—numerous tame and wild fowl killed by it. Some of these stones were flat, heavy, and as large as a watch! the greater part of the shape, but of a larger size than a pigeon's egg. I have seen a bog turf penetrated by them as if bullets had been shot into it. How far this frightful phænomenon may have run its course I cannot as yet say—possibly into the Western Sea.—A poor lad, unfortunately bathing, disregarded its terrific approach; his head is dreadfully cut and injured: his body partially quite black, and covered with contusions."

ATMOSPHERICAL PHÆNOMENON.

One of those very singular and curious phænomena which are occasionally seen among the Hartz mountains in Hanover, and have once or twice been observed on Souter Fell in Cumberland, has been seen in Huntingdonshire. About half past four o'clock on Sunday morning, July 16, the sun was shining in a cloudless sky, and the light vapours arising from the river Ouse were hovering over a little hill near St. Neot's, when suddenly the village of Great Paxton, its farm-houses, barns, dispersed cottages, trees, and its different grass fields were clearly and distinctly visible in a beautiful aërial picture which extended from east to west about 400 yards. Nothing could exceed the astonishment and admiration of the spectator, as he looked at this surprising phænomenon from a gentle declivity in an opposite direction at the distance of half a mile, or his regret at its disappearance in about ten minutes.—*Cambridge Chronicle.*

METEOROLOGICAL JOURNAL KEPT AT BOSTON, LINCOLNSHIRE.

[The time of observation, unless otherwise stated, is at 1 P.M.]

1820.	Age of the Moon.	Thermometer.	Barometer.	State of the Weather and Modification of the Clouds.
	DAYS.			
July 15	5	69·	29·66	Fine
16	6	75·	29·63	Ditto
17	7	63·5	29·23	Cloudy—heavy rain at night.
18	8	59·	29·10	Rain
19	9	66·5	29·15	Fine
20	10	72·	29·34	Ditto
21	11	64·	29·54	Cloudy—rain P.M.
22	12	61·	29·54	Ditto
23	13	63·	29·60	Ditto
24	14	67·	29·63	Ditto
25	full	63·	29·50	Fine—rain P.M.
26	16	65·	29·63	Cloudy
27	17	72·	29·56	Ditto
28	18	69·	29·60	Ditto
29	19	76·5	29·66	Fine
30	20	77·5	29·60	Ditto
31	21	80·5	29·35	Ditto
Aug. 1	22	74·5	29·26	Cloudy
2	23	74·5	29·60	Ditto
3	24	73·5	29·44	Ditto
4	25	74·	29·28	Ditto
5	26	67·	29·36	Fine
6	27	63·5	29·24	Cloudy—rain A. M., heavy rain with thunder and lightning [in afternoon
7	28	63·5	29·42	Ditto
8	new	67·	29·80	Ditto
9	1	69·	29·55	Fine
10	2	73·	29·84	Ditto
11	3	74·	29·74	Ditto
12	4	67·	29·77	Ditto
13	5	69·5	29·72	Ditto
14	6	67·	29·50	Ditto

METEORO-

METEOROLOGICAL TABLE,

BY MR. CARY, OF THE STRAND,

For August 1820.

Days of Month. 1820.	Thermometer. 8 o'Clock Morning.	Noon.	11 o'Clock Night.	Height of the Barom. Inches.	Weather.
July 27	66	73	65	30·15	Fair
28	66	74	66	·14	Fair
29	66	76	67	·17	Fair
30	67	76	68	·16	Fair. Violent thun-
31	70	80	70	29·96	Fair [der in the
August 1	69	76	64	·87	Fair [night
2	64	72	64	30·19	Fair
3	68	68	63	·02	Cloudy
4	65	74	60	29·85	Fair
5	64	68	60	·95	Fair
6	63	63	60	·67	Rain
7	64	70	58	·95	Fair
8	62	68	60	·92	Fair
9	63	73	62	30·17	Fair
10	63	74	64	·37	Fair
11	64	75	65	·30	Fair
12	63	73	61	·29	Fair
13	60	72	61	·17	Fair
14	64	76	62	·10	Fair
15	61	74	65	29·95	Fair
16	68	74	66	·92	Cloudy
17	67	73	60	·86	Cloudy
18	62	69	60	·93	Fair
19	58	68	52	·80	Slight thunder
20	51	65	52	·95	Fair [storm
21	51	59	50	·89	Rain
22	55	59	51	·89	Cloudy
23	52	64	53	30·06	Fair
24	55	67	55	·22	Fair
25	56	67	53	29·94	Cloudy
26	57	68	54	·77	Showery

N.B. The Barometer's height is taken at one o'clock.

XXVI. *A Review of some leading Points in the Official Character and Proceedings of the late President of the Royal Society.* *By* A Correspondent.

[The writer of the following Review relies upon the established liberality and candour of the Editor of the Philosophical Magazine, when he transmits for insertion in that valuable publication an article which may, probably, run counter to the usual train of his own sentiments and feelings. The main object of the writer is to enable the members of one of the most honourable of British Institutions, by a calm retrospect of past occurrences to diminish the evil effects which have resulted from them, as well as to prevent the recurrence of similar practical errors in future. He has advanced nothing as facts, but what he has carefully verified; and as he wishes those facts alone to make their due impression, he does not think it necessary to accompany them with his name.]

The Royal Society, as Chamberlayne remarks, "chose for its motto *Nullius in verba*, to testify their resolution not to be enslaved by any of the greatest authority in their inquiries after nature:" and so long as their Presidents were changed with moderate frequency, and no one acquired any more authority or influence than was due to his talents and his virtues, independently of his rank (whatever that might be), all continued to go on well. The arts and sciences, in their numerous departments, were promoted by the labours and inquiries of the different members of the Society; each brought from his own stock to deposit in the general storehouse; all was harmony; and bickering and usurpation were alike unknown. The distinctions which prevail in human society were not *forgotten;* but they were not permitted to operate injuriously in a society where all were, by its original constitution, FELLOWS. An authorized list of the members of the Royal Society circulated in 1693, only thirty years after its incorporation by charter, terminates thus:—"The reader may perceive by this list, how many sober, learned, solid, ingenious persons, of different *degrees*, *religions*, *countries*, *professions*, *trades*, and *fortunes*, have united and conspired, *laying aside all names of distinction*, amicably to promote experimental knowledge."

Indeed, it is only by determining thus to "lay aside all distinctions," except those which talents and genius confer, that a Society formed for the purpose of augmenting the sphere of natural knowledge in all its branches can be adequately efficient: for if it be "with wise intent" that

> "The Hand of Nature on peculiar minds
> Imprints a different bias, and to each
> Decrees its province in the common toil,"

it is surely wise for such an institution to collect, arrange, and classify, the results of the individual energies of its members, however diversified their several pursuits, or however varied the stations in political society which they occupy. Thus has the Royal Society proceeded in different periods of its history. It did not expel *Isaac Newton* at a time when he was too poor to defray the weekly charges of the Society; nor did it refuse to admit *Edmund Stone*, or *Thomas Simpson*, or *James Ferguson*, although one had been *a gardener's son*, the other *a weaver*, and the third *a shepherd*.

These, and other important benefits, likely to accrue from the voluntary association of men of science, may undoubtedly be preserved, although any one of their number chosen to be their President should continue such for a series of years, or although he be a man of elevated or noble rank. The history of the Royal Society presents instances of this kind; as will be evident from the subjoined list of Presidents from the commencement of the Society to the present time*. But, in order that benefits like these may continue to result, be it recollected, as has always been observed, and will doubtless in future be found, that the Presidents of the Royal Society who most successfully promote its interests, are men ardently attached to some one branch of science, yet not depreciators of other departments of human research, men of candour, men free from the love of political intrigue, and free from its usual associate—the love of domination.

It will appear evident, then, without further preliminary observation, that the character, disposition, and talents, of a President

* Presidents of the Royal Society from its origin.

	Elected.	*Years in office.*
Lord Viscount Brouncker	April 1663	14
Sir Joseph Williamson, Knt.	Nov. 1677	3
Sir Christopher Wren, Knt.	Nov. 1680	2
Sir John Hoskins, Bart.	Nov. 1682	1
Sir Cyril Wyche, Bart.	Nov. 1683	1
Samuel Pepys, Esq.	Dec. 1684	2
Earl of Carbery	Nov. 1686	3
Earl of Pembroke and Montgomery.	Nov. 1689	1
Sir Robert Southwell, Knt.	Dec. 1690	5
Earl of Halifax (Cha. Montague, Esq.)	Nov. 1695	3
Lord Somers	Nov. 1698	5
Sir Isaac Newton, Knt.	Nov. 1703	24
Sir Hans Sloane, Bart.	Nov. 1727	14
Martin Folkes, Esq.	Nov. 1744	11
Earl of Macclesfield	Nov. 1752	12
Earl of Morton	Nov. 1764	4
James Burrow, Esq.	Sept. 1768	
James West, Esq.	Nov. 1768	4
James Burrow, Esq.	July 1772	
Sir John Pringle, Bart.	Nov. 1772	6
Mr. afterwards Sir Joseph Banks, Bart.	Nov. 1778	41

dent

dent of a literary or a scientific society, will have an influence upon its members, its proceedings, and its utility, bearing some natural proportion to the interval during which he presides over it. Consequently, since the late Sir Joseph Banks occupied the chair of the President in the Royal Society for more than forty years, at an age of the world when science in almost every department and in every country of Europe was making the most rapid advances, it will become the duty of the impartial historian of British science to ascertain what were the qualifications of this gentleman to preside for so many years over that illustrious body, what were the topics of inquiry which he most encouraged, what were those which he uniformly repressed, and what have been the consequences with regard to certain sciences of Britain, in comparison with the cultivation and augmentation of the same in other parts of the world.

The following pages may probably assist in this inquiry: and I would simply premise, that though I shall throughout employ the language of frankness, as best calculated to elicit and exhibit truth, yet I have not the remotest inclination to violate the laws of propriety and decorum, or to lose sight of the solemn consideration that the subject of animadversion is now alike indifferent to human praise and blame. So far as my judgement and information will enable me, I shall represent things as they were; so that while on the one hand I shall "nothing extenuate," I should be equally resolved "to set down nought in malice," even (which however is not the case) if my personal intercourse with Sir Joseph had called into exercise that baneful passion.

Several of the eulogists of the late President have fancied that they could render his merits more prominent by placing them in contrast with those of his immediate predecessor, Sir John Pringle. I shall therefore be the more readily pardoned for adopting a like proceeding in this review.

Sir John Pringle was elected a fellow of the Royal Society in the year 1745, and had even then a high reputation for medical knowledge and skill. Afterwards he wrote pretty copiously upon many subjects connected with his profession, and communicated several interesting papers to the Transactions of the Royal Society; in this manner, as well as in consequence of an extensive practice, becoming very eminent both as a practical physician, and as a medical writer. But his reputation, exalted as it was in these respects, was not confined to them. He had a great love for science generally, and he cultivated it with corresponding ardour. Early in life he had read the works of Bacon with great attention, and his mind became in consequence predisposed to the genuine mode of philosophizing by means of well conducted experiments: he never suffered himself to be seduced

by

by mere theory, but most valued and most promoted those sciences which rested on the firm basis of fact. With the exception that he had no relish for poetry, he had a well formed taste; and he was a man of extensive reading and of deep reflection. He was not too much of a philosopher to be ashamed of avowing his belief in a divine revelation; but read and thought much on the momentous subject of religion. He maintained for some time an active correspondence with the celebrated *Michaelis*, who addressed to him some valuable letters, in Latin, on Daniel's Prophecy of *the seventy weeks*, which Sir John published in 1773.

During the six years that Sir John had the honour of being President of the Royal Society, he adopted the practice of delivering an oration on the assignment of Sir Godfrey Copley's medal to the author of some valuable invention or discovery. He was led to this almost entirely by accident; but the addresses thus delivered, being intended to point out what was actually due to the individual who received the medal, by showing what had been effected before in the same department of research, became exceedingly valuable as brief historical disquisitions; and being each directed to a different topic of inquiry, they evinced such an extent and variety of reading, such a correctness of judgement, and such a freedom from bias or partiality, as were at once honourable to him, and to the Society who had elected such a President. Of these discourses the 1st was "On the different kinds of air," delivered November 30, 1773, on the assignment of the Copleian medal to Dr. *Priestley:* the 2d, "On the Torpedo," in 1774, on presenting the medal to Mr. *Walsh:* the 3d, "On the attraction of mountains," in 1775, on presenting the medal to Dr. *Maskelyne* for his observations at Scheballien: the 4th, "On preserving the health of mariners," delivered in 1776, on assigning the medal to Captain *Cook:* the 5th, "On the invention and improvements of the reflecting telescope," in 1777, on assigning the medal to Dr. *Mudge* of Plymouth: the 6th and last, "On the theory of gunnery," was delivered on the day of his resignation, when he presented the medal in the name of the Society to Dr. *Hutton* of Woolwich, on account of his important experiments on that subject.

Diversified as were the topics of these discourses, their author seems "at home" in each. His researches were often erudite; his remarks ingenious and solid, sometimes profound; his language elegant and perspicuous, occasionally passing into a stream of genuine eloquence which really enchants and captivates the reader.

Sir John was a man not merely of scientific, but of high moral character.

character. He was of cheerful habits, but an enemy to all kinds of intemperance. His manners were kind, respectful and obliging: but, says one of his biographers, "his sense of integrity and dignity would not permit him to adopt that false and superficial politeness which treats all men alike, though ever so different in point of real estimation and merit, with the same show of cordiality and kindness."

Such was Sir John Pringle. Let me now attempt to delineate the character of his successor.

Sir JOSEPH BANKS (born 1743, elevated to the rank of baronet in 1781,) was a man of good fortune, and is said to have received a liberal education, partly at Oxford. He early evinced an attachment to the pursuit of natural history, and in 1766, at twenty-three years of age became a fellow of the Royal Society. In 1768 he set sail with COOK in the Endeavour, and during the whole of that interesting voyage paid considerable attention to the natural productions of the various parts of the world they visited. He was assisted in his zoological and botanical researches by Dr. Solander, a pupil of Linnæus. I am not minutely acquainted with the nature and extent of the benefits mutually received and communicated by these two celebrated men; but one of the wicked wits of the day, who affected to be in the secret, attempted to develop it in a single couplet:

> "Though east, or west, or north, or south, they wander;
> You'll find on shallow *Banks* feeds fat *Solander.*"

After the return from Cook's first voyage, Mr. Banks made considerable preparations to accompany him a second time: but the circumnavigator and the naturalist had agreed so ill while they were together in the Endeavour, and Cook had been so thoroughly disgusted with the assumption of the great man and the unaccommodating airs of his companion, that he took effectual measures to free himself from like vexations during his second voyage. Mr. Banks, to hide from the world his chagrin and mortification, and to appropriate to some useful purpose the expensive apparatus he had prepared to accompany Captain Cook, projected a voyage to Iceland: soon hiring a vessel, he was again accompanied by Dr. Solander. Sir Joseph's biographer in the paper called The *New Times* says on this occasion, "His hazards were rewarded by the *discovery* of the cave of Staffa." What was the nature of this *discovery* I cannot conjecture. Staffa had been then long known, and even described, though slightly, by Buchanan. Von Troil, Banks and Solander, were conducted to Staffa, by Mr. Maclean, a Scotch gentleman of fortune, who had often been there before, and enabled our voyagers to *discover* precisely what he showed them.

Almost

Almost immediately after Mr. Banks's return from this northern voyage, he began to take an active part in some of the measures then carrying on in the Royal Society; and on the resignation of Sir John Pringle, in November 1778, he was appointed to succeed him. The world began anxiously to inquire what were his requisites for this exalted station; but did not then receive a very satisfactory answer. He was known to be a man of enterprise and of strong passions; a warm friend while his friends were subservient to his purposes, and, if otherwise, what Dr. Johnson denominated "a good hater." He was notoriously fond of farming, fond of grazing, fond of gardening, fond of "damming and sinking*," and fond of domineering: these, however, were qualifications for the office so dubious that the public naturally sought for something more. What, they asked, has he published? Where are the *volumes* that bear his name? When they were answered "*No-where*," they asked again, What are his *pamphlets*, and on what subjects? Where are his papers in the Philosophical Transactions of the Society over which you have appointed him to preside, and on what do they treat? To these and such inquiries no answer could then be returned: and if similar questions were *now* to be proposed, his friends would have little else to say, except they felt inclined to exult in his little Essay on *blight*, and perhaps a diminutive disquisition or two on the manufactory of gooseberry-wine, or something like it, in the Horticultural Transactions.

Indeed, during the whole course of his long presidency he evinced an absolute ignorance of several of the most interesting and useful sciences. Of mathematics, either pure or mixed, he knew nothing. The sublime investigations of Landen, Euler, Lagrange and Laplace, had no more charms for Sir Joseph, than for the rudest peasant that laboured on his Lincolnshire estates. Nor was he merely ignorant of these sciences. He had a *dislike* to them; and for many years indicated this dislike by some waspish and petulant expression from the chair whenever a mathematical paper was read. Up to more than forty years of age, I am positively assured that he knew scarcely any thing of chemistry; but in this department of knowledge, it was afterwards said, he made a respectable proficiency. Natural history has been generally acknowledged to be the only study which he pursued with ardour and relish; yet even here, if I am correctly in-

* This strange phrase was one which Sir Joseph delighted to give in shape of a toast, among the Lincolnshire farmers. "Success to damming and sinking," meant success to draining the fens; but then it was delivered in an enigmatic approximation to profanity, which he thought he might venture upon without losing his character as a gentleman and a philosopher.

formed,

formed, he made no eminent attainments. A friend of mine had an opportunity, a few years ago, of ascertaining the opinion of a very competent judge, one of the most eminent members of the Linnæan Society, as to this point. The following is an account of what passed between them.

Q. Will you allow me, sir, to ask what is your opinion of Sir Joseph Banks as a man of science?

A. I should conceive, sir, there cannot be much need to ask such a question. You know he is called *the patron of science.*

Q. Yes, I know he is: but that does not prove that he *possesses* it. *I* have some doubts about the matter, and take the liberty to inquire of you, as one who knows him well. Is he really eminent as a natural historian?

A. He has a very extensive and valuable *library* in the department of natural history.

Q. So I have always understood: but pardon me, sir, this does not meet my question. Allow me to ask again, Is he really eminent as a natural historian?

A. Natural history is a very comprehensive classification of knowledge; what department of it do you principally allude to?

Q. Really, sir, I scarcely know how to direct my inquiries to a narrower point, as I am but little conversant with these matters. I have understood, however, that he is an eminent *botanist:* what is your opinion on that head?

A. Why, that if he be so reckoned, *it must have been in a company of washerwomen!*

Thus terminated the inquiry.

Well, but, say some, If Sir Joseph was not a man of profound knowledge in any one department, or of an excursive turn of mind which made him at least speciously acquainted with several, we presume he was a man of address, and probably one with some pretensions to eloquence. We presume he trod in the steps of his predecessor with regard to the anniversary oration on assigning the Copleian medal. No such thing. For some years Sir Joseph made no attempt of the kind: but it having been insinuated in the course of the discussions of which I shall presently have to speak, that he was incompetent to prepare and deliver a set discourse on any subject,—to put to silence these impudent calumniators, he delivered an address at the anniversary, November 30, 1784. In that year the medal was assigned to Dr. Waring, for one of his papers *On the Summation of Series.* Of the address delivered on that occasion I have the happiness to possess a copy, probably the only one now in existence: to gratify the natural curiosity of the public on so interesting a matter, I here present the speech, retaining *bona fide,* the original orthography, punctuation, &c.

Sir

Sir JOSEPH BANKS's Speech, November 30, 1784*.

[Exactly copied, both as to Orthography, Punctuation, &c.]

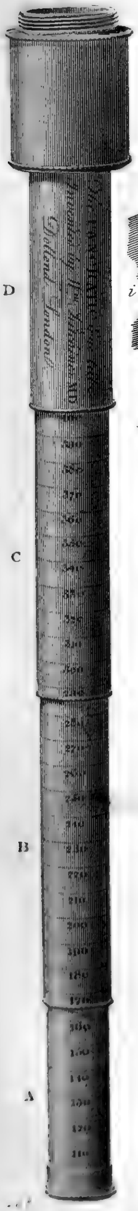
Atho' your Council, whose Office it [is] to allott Sir Godfrey Copleys Annual Bounty to the Person by whose Communications the Progress of Science has received the most usefull Assistance; observ'd with pleasure, that the Papers read at the meetings of this Year, which independant of Competition with each other, deserv'd that valuable testimony of the Societies approbation, were more numerous than usual; they felt little hesitation in Forming their decision: remembering how materially Science had already Profited by Dr Waring's successfull Labors, considering the subject matter of his Essay as congenial to the Views of the Royal Society and above all admiring the able & Scientific manner in which he has treated that subject, more abstruse & complicated perhaps, Than any other in which the institution of the Royal Society Interests itself. They were enabled to decide with Speed & perfect unanimity.

To Edward Waring then Dr of Physic Lucasian Professor of the Mathematic's in the University of Cambridge Fellow of the Royal Society of London & Member of the Academy of Sciences at Bologna I am directed to deliver that tribute which the Royal Society annually pays to the most approved merit, for his Paper entitled—on the Summation of Series, whose general term is a determinate Function of Z the distance from the first term of the Series.

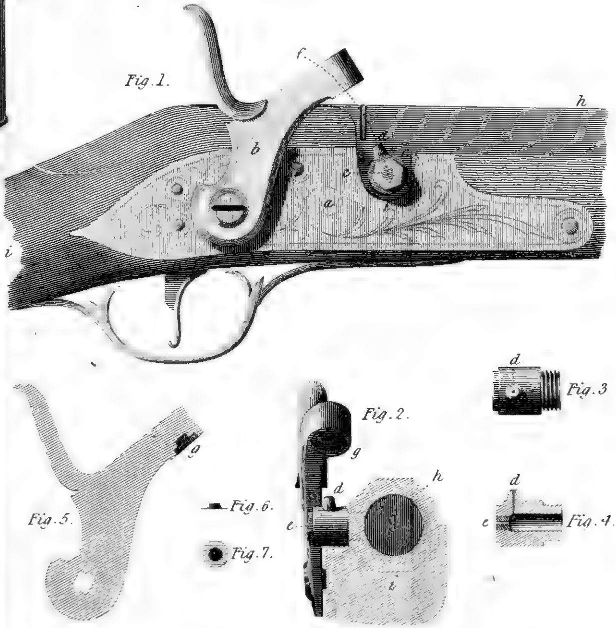
To enter into a detail of the Merits of this valuable performance & explain to the learned Audience whom I have the honor of addressing the Various particulars in which our Author has excell'd his Cotemporaries, is a task, which the limited Bounds of my Talents directed as they have always been to the attainment of a different kind of Knowledge will not enable me to undertake: The Extent of Science is far beyond the grasp of an individual he who is ambitious to enlarge its bounds must to effect his purpose take his seperate department & Finaly confine himself to that subject whatever it be in which fortunate application has enabled him to excell In truth I feel no humiliation when I declare that having dedicated my Youth to the Pursuit of another Science the Superficial knowledge of Mathematic's I have hitherto attaind howsoever it may enable me to distinguish Conspicuous merit will not Empower me to enter into an explanatory detail of a work intended for the perusal of those only who are fully initiated in the deepest Mysteries of Mathematical knowledge by men whose acquirements have gain'd them reputation in that Line our Author is held in the highest esteem & his Works are by learned foreigners universaly deem'd equal at least to Those of his most admir'd Cotemporaries in all parts of Europe as is Plainly evinc'd by the Controversy he in this very Paper maintains

* I hold myself answerable for the authenticity of this curious document. No sooner had Sir Joseph terminated this address than a murmur of *Rigmarol! Rigmarol!* ran through "the faction," as they were termed. Some of the President's less judicious partisans immediately proposed the *publication* of his "admirable speech;" but they were outvoted by such of his friends as were too wise to risk his reputation, and that of the Society, on such a strange production. It was simply determined, therefore, that the President's copy of the *speech* should be lodged in the archives of the Society. On the succeeding day a friend of mine made faithfully and carefully the copy which I now possess. A few days afterwards other fellows of the Society visited the rooms in order to take copies; but the document was removed, by the President or his friends, and has never since been seen.

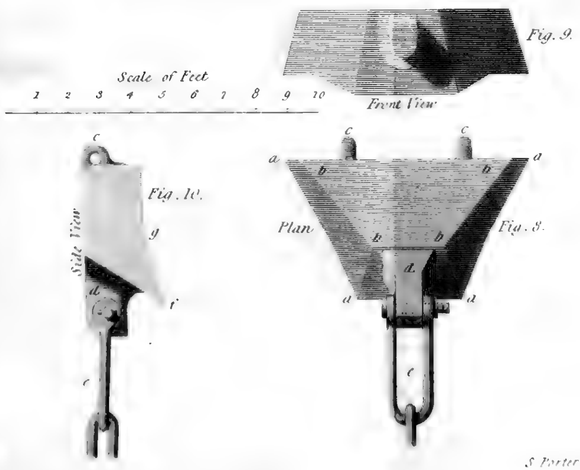
Fig. 11.



Mr. C. Hall's Percussion Gun Lock.



Mr. J. Park's Cast Iron Mooring Block.



S. Porter.

Sir

[Exa

Atho' yo
Annual Bo
Science has
that the Pa
Competitio
cieties appr
tation in Fo
already Pro
matter of hi
all admiring
ject, more
institution
decide with

To Edwa
thematic's i
London & I
to deliver t
approved m
general ter
term of the

To enter
plain to the
Various par
a task, whic
ways been t
able me to
individual h
pose take hi
whatever it
truth I feel
to the Pursu
I have hithe
cuous merit
work intend
deepest My
ments have
highest este
equal at leas
Europe as is

---

* I hold m
No sooner ha
Rigmarol! ra
sident's less
" admirable
too wise to r
production.
of the *speech*
ceeding day
I now posse
the rooms in
President or

tains with some of the most respected literary Characters in Europe for the Priority of Publication of more than one of the Principal discoveries of the age we live in

I consider it as fortunate for the Society & feel on that account no inconsiderable pleasure that we have it in our power to bear testimony to the merits of such an Essay so deeply learned & so ably written on a subject in which the Public had been told we were deficient delivered in to us at a time when an unfortunate dispute among the Members had robb'd our Meetings of the assistance of some of them whose literary abilities we cease not to respect how widely soever many of us may Differ from them in our judgements of the Matters which were then in Dispute among us The Nation whose Eyes are ever intent on the Conduct of the Royal Society will be assur'd by this very Paper that even at the time when we were most Divided Mathematical Knowledge was to be Found among us & that the Society at all times & under all Circumstances are ready to reward it.

From the Appearance of our present Meeting I will venture to Foretell that our dissentions are at an end that the Gentlemen from whom I have had the misfortune to differ in opinion will abide by the decisions of the Society which they have repeatedly taken, agree with me in a Determination to throw a veil of Oblivion over all past animosities and unite once more in sincere Efforts towards the advancement of the Society the honor & reputation of which we have all equaly pledg'd ourselves to support.

But enough of dissention a word never more I sincerely hope to be heard within these Walls dedicated as they are by a generous Monarch to the service of Science Peace & harmony should ever be found within them for under the influence of Peace & harmony among those who Profess to cultivate it Science can only flourish.

Let us unite once more then my Friends to Fulfill the wise purposes of our liberal Patron & Benefactor and resume at the same time the Prudent Conduct of our Predecessors who for more than a Century past supported the honor of this Society unsullied & have bequeath'd it to us pure as they received it they never Fail'd to sacrafice such resentment as arose among them to the good of the general Cause in which they felt themselves equaly embark'd for altho' some individuals among them have heretofore indulg'd their Feelings by appealing to the Public when they imagin'd the welfare of the Body at large was in danger they never once attempted to convert the Meetings instituted for the advancement of Knowledge into Assemblies of debate & Controversy.

[The President hereupon addressing Dr. Shepherd said]

Animated with the pleasing hope of returning peace let me now proceed to the most grateful part of the Office I have the honor to hold under favor of your indulgence That of delivering to Merit the mark of regard which the Society has allotted for it's reward—to you then D^r^ Shepherd as the representative of D^r^ Waring I deliver this Medal requesting you to give it to him on the Earliest opportunity in your power when you present him, Sir with this token of the approbation of his Fellow labourers encourage him to persevere in unravelling the Clue of that difficult but justly admir'd Science in the annals of which he allready holds so distinguish'd a place Assure him that the Royal Society ever anxious to discover & reward merit in whatever line it may be exerted never more fully Feel the pleasing Idea of fulfilling well the purposes of their institution than when they seize an opportunity to reward those who labor to extend the limits of that Science which enabled our Illustrious Newton to penetrate into the deeper mysteries of nature and explain them to his fellow creatures in terms within the reach of their limited Comprehensions

 By

By this time the reader will probably inquire with eagerness, Through what strange train of circumstances could an individual so sadly disqualified be elevated to "the chair" of the Royal Society? This train, intricate and involved as it has usually been deemed, it will not now be difficult to explore.

Some of the most brilliant discoveries in electricity, were, as every one knows, made by the celebrated Dr. FRANKLIN; and, at an age of the world when this country was agitated by all the trying events of a war with America, Dr. Franklin had the misfortune to be *an American*. Among this philosopher's numerous happy applications of his electrical discoveries, was that of *elevated pointed conductors* to secure buildings from injury by lightning; an application which was warmly approved, and eagerly recommended by the most eminent electricians then living. In luckless hour, however, Mr. *Benjamin Wilson* (the father, I believe, of the present Sir Robert Wilson, and at that time, or soon after, contractor for the *painting* under the Honourable Board of Ordnance) *objected* to the use of pointed conductors, recommending instead of them conductors with *knobs* at their superior extremities. "It was by *his* obstinacy and improper conduct (says Dr. Thomson*) that he introduced those unhappy divisions which had so unfortunate an effect upon the Royal Society, and were so disgraceful to science and philosophy." Disgraceful, indeed, they were, both on account of the temper with which they were conducted, and the incessant violation of the principles of true philosophy which occurred in the writings of Mr. Wilson and his adherents. Philosophers in other parts of Europe wondered what strange fatality could have fallen upon English men of science, that they could force this into a topic of controversy; and neither then nor since have they uttered a syllable in favour of blunt conductors†. The truth, however, is, that had it not been for the intermixture of political feeling with the principles of the discussion, it could not have been kept alive for a single month. The American war had been the occasion of scattering the seeds of political animosity far and wide; and, since Franklin was a politician as well as a philosopher, it was by no means difficult to insinuate that they who agreed with him in his philosophical speculations agreed with him, likewise, in his political creed. Thus, with many, the opinions of a philosopher as to the *blunts* and the *points*, were regarded as the index of his opinions as to the American war; and the celebrated dispute among the "*little-*" and the "*big-endians*" recorded

* History of the Royal Society, p. 444.

† See Biot—*Traité de Physique*, tom. ii. pp. 442-450.

by

by Lemuel Gulliver, furnished an apt representation of the folly and the rancour which found their way into this discussion.

Ere long, the Royal Patron of the Society, whose strong feeling in reference to the American war is well known, became interested in the controversy, and often gave unequivocal indications of the manner in which he was anxious to see it decided. This soon reduced it to neither more nor less than a Government question. In 1773, when it was proposed to fix conductors to the powder magazine belonging to the Board of Ordnance at Purfleet, that Board applied to the Royal Society for their opinion as to the most proper kind to be employed. The Society replied by quoting their own annual advertisement from the year 1762 downward, "That it is an established rule of the Society, to which they will always adhere, *never to give their opinion, as a body*, on any subject either of nature or art, that comes before them." The Society were then requested to appoint a Committee for this purpose. After much discussion this was agreed to, and a Committee, consisting of Mr. Cavendish, Dr. Watson, Dr. Franklin, Mr. Robertson, and Mr. Wilson, was appointed. After examining the building, the four gentlemen first named, recommended *pointed* conductors: Mr. Wilson dissented from their judgement, and assigned his reasons in a long paper. His notions were refuted by Nairne, Henley, Swift, and others. Dr. Musgrave, on the other hand, defended his speculations.

In 1777 the Purfleet magazine received damage from lightning, although it had been previously furnished with conductors. The Royal Society, again requested to give an opinion, appointed a Committee of nine of the most distinguished electricians: their deliberate judgement was again in favour of pointed conductors, and again was their judgement opposed by Mr. Wilson. In this stage of the business the Royal Patron of the Society directed Sir John Pringle to employ his official influence in strengthening Mr. Wilson's hands. Sir John replied, that "duty as well as inclination would always induce him to execute His Majesty's wishes to the utmost of his power: but, Sire, (said he) *I cannot reverse the laws and operations of nature.*" "Then," said His Majesty, "*perhaps, Sir John, you had better resign**?" Sir John took the hint, and resigned at the next anniversary, Sir Joseph

* Soon after this occurrence a friend of Franklin wrote an epigram which may not be deemed unworthy of preservation here:

While you, great George, for knowledge hunt,
And sharp conductors change for blunt,
The nation's out of joint:
Franklin a wiser course pursues,
And all your thunder useless views
By keeping to the point.

Banks

Banks being appointed his successor the same evening. Whether *he* had or had not engaged to *reverse* the laws of nature, I am not prepared to say.

Sir Joseph was no sooner seated in the President's chair than he began to manifest his dislike of Americans and American philosophy *, and of all those members who accidentally testified their esteem of his learned predecessor. He also gave the most decisive indications of his philosophical bigotry, of his determination unduly to exalt some branches of inquiry, and as unduly to depreciate others; and of another determination, which he had not sufficient discretion to disguise, to convert a fellowship or brotherhood of philosophers, into a *monarchy*, or rather into a *despotism*, of which *he* alone was to be the focus of power and authority. Such is the force of self-delusion, when a coterie of sycophantic danglers surround an individual of this description, and foster his love of domination, that it would seem as though Sir Joseph actually fancied himself a kind of monarch, and formed his phraseology and expected to be approached accordingly. It was no longer the Council of the Royal Society, or the Secretaries of that learned body, but "My *Council*," "My *Secretaries*," "My *Assessors*," "My *Society*," &c. He held *his court* in Soho Square; and none but those who were introduced into the regal apartments there in due form, and danced attendance with due frequency, could obtain admission into the Royal Society, or continue to attend its meetings with comfort, if they had been elected fellows in better days.

That men of real genius and science should be disgusted with all this, was naturally to be expected; as well as that men of independence should make some efforts to deliver themselves from so disgraceful a thraldom. Hence originated the new class of dissentions which agitated the Royal Society between the years 1781 and 1785, and to which the eulogists of Sir Joseph Banks have now so unwisely recalled the public attention. Of these dissentions it is the more necessary a correct account should here be exhibited; because some of Sir Joseph's partisans, as though the lapse of six-and-thirty years had not been sufficient to cool their resentment, make them the basis of recent and renewed calumnies †.

"The

* This anti-American spirit is scarcely yet extinguished. Seven years ago there were not more than *three* American fellows of the Royal Society; and even at the present moment there are not *six*.

† A biographer of Sir Joseph Banks in the *New Times* of July 14, 1820, whose ignorance of science and of facts is so obvious, that it would be a waste of time to render it more prominent, terminates his misrepresentation of these matters, thus:

"All intellectual propensities have their *merits* [those of lying, slandering and thieving, for example], and the use of practical mathematics is important

"The bitter spirit" (as the writer in the New Times calls it) did not "break out on the dismissal of Dr. Hutton from one of the secretaryships," but much earlier. Some of the causes which fomented it will appear by a few quotations from a pamphlet entitled "An History of the Instances of Exclusion from the Royal Society," published early in 1784.

"The charge we bring against Sir Joseph Banks is, that, though not entrusted with any such power, either by statute or custom, and very unfit, from his acknowledged violence of temper, and from his incapacity to judge of literary qualifications, in which he is himself shamefully deficient, to be entrusted with it, he has repeatedly interposed in a clandestine manner, to procure rejections of proper candidates, with the visible design of taking away the privilege of the body at large, and making himself the sole master of the admissions,—in other words, the *monarch* of the Society."

tant and extensive. We honour the great inventors—the world is debtor to NEWTON. But of a thousand mathematicians, not the human cube root has ever been, or will be, more than the depository of the dusty problems, that the bookmakers of the art, the SIMPSONS, and HUTTONS, and BONNYCASTLES, have transmitted to them. This pride 'that puffeth up,' has had more fatal powers of perversion, and religion has no where found more inveterate prejudice or more morbid repulsion than among those men, rendered incapable of discerning truth unless it came in the whole dignity of an algebraic formula. The bitter spirit broke out in the Royal Society on the dismissal of Dr. HUTTON from one of the secretaryships. How Dr. HUTTON, whose life, till he was mature, was spent in keeping a village school in Westmoreland, [*videlicet,* the *village* of Newcastle upon Tyne,] could have sustained the office without numberless offences against the habits of good society, it is difficult to conjecture; and his merits as a mathematician were common-place.

'Lands he could measure, terms and tides presage;
And even the saying ran, that he could gauge.'

"Sir JOSEPH BANKS, in point of general accomplishment, public utility, and rational and enlarged employment of his understanding, was worth the whole host, of which no single name did honour even to their own narrow pursuit. HORSLEY, afterwards a bishop, was the principal among the disturbers. His Commentary on the *Principia,* the most meagre and inefficient that ever came from the press, is this man's tribute to science. But he was virulent, insolent and intriguing. The Bench restrained him, and he gradually cooled, but in the hostility against Sir JOSEPH BANKS he gave full way to the bitterness of his nature. The President's conduct was put to the vote, and on the 8th of January 1784, the Resolution "that this Society do approve of Sir JOSEPH BANKS for their President, and will support him," was carried by a great majority. Measures of conciliation were now adopted. A vote was passed, that Dr. HUTTON had done nothing to forfeit the confidence of the Society: and, on the other hand, that it would be more convenient to have his office executed by a resident in London. Since that period opposition has slept. The Presidency has been in honour and activity."

In

In proof of this charge, we are told that during the twelve weeks which, according to the statutes, the certificate recommending a candidate hung up in the Society's rooms, it was the habit of Sir Joseph to prejudice the minds of those who attended the Soho Square *levees*, by making known his resolution in phraseology not very courtly, but suited to the purpose and varied to accord with the occasion. "We want no *mathematicians*." "No more *worshippers of old Cardan* for me." "I'll have no *schoolmasters*." "Let us have no *country surgeons*." "He! why he is an *author!* Who could think of proposing him? We want no *authors*;" and so on. If these, and similar remarks, scattered with great activity during the twelve weeks' probation, seemed likely to fail in their effect, then "the President would run about the room on a night of election, out of breath with anger and impatience, seducing the ignorant, awing the timid, and deceiving the wise; cajoling as many as possible to put in black-balls:" and often "inducing the candidate, or his friends from an apprehension of rejection, to avoid the mortification by taking down the certificate."

Among the candidates rejected principally by black-balling, in the years 1781, 1782, and 1783, were, Mr. Henry Clarke, of Manchester; Mr. Meyrick (who was black-balled by the President asking more than 100 persons in the room to vote against him, *an ascertained fact*); Dr. Bates, a physician at Buckingham; Dr. Hallifax; Dr. Enfield (here the cry was, "I'll have no *Dissenters*"); Dr. Beerenbrock and Dr. Blane, two eminent physicians; and Major Desbarres, the friend and maritime tutor of Captain Cook. Shortly after the "black-balling" of this latter named gentleman, the following paragraph appeared in the public papers:

"Yesterday Major Desbarres kissed His Majesty's hand on being appointed Governor of Nova Scotia. This reward, we hear, has been conferred on this able and spirited officer, for great national services, in recompense of much time and much money, for having saved by his *philosophical* labours, many of the king's ships, and the lives of many of our fellow subjects."

The preceding list of exclusions serves to prove, that in the early portions of Sir Joseph's reign, his antipathy was not merely to mathematicians.

[To be continued.]

XXVII. *An*

XXVII. *An Attempt to explain the Phænomenon known by the Name of the Aurora Borealis.* By Mr. William Dobbie.

To Mr. Tilloch.

Glasgow, Sept. 23, 1820.

Sir, — The following Essay was written in December 1816, as an attempt to explain the *aurora borealis* in connexion with a beautiful phænomenon seen at Glasgow and most parts of the country on the evening of the 24th September in the above year, and also on the 11th September 1814. I had for several years before the above periods entertained an opinion as to the cause of the *aurora borealis*, entirely different from that generally held. The phænomenon alluded to was an illumined arch similar to the rainbow, only colourless, and formed in a clear serene sky. This arch I may say demonstrated itself to have the same origin as the common *aurora borealis*; for towards the conclusion it fell to pieces, and assumed the usual appearance of *streamers*. This last circumstance fully confirmed me in my opinion as to the cause of those phænomena, and I wrote at that time the annexed paper, but never published it.

I trust the prevailing hypothesis on this question is fully disproved. The one which I offer will be found, I hope, to contain hints at least, and data that may lead to a demonstration of its truth by some abler observer. An Essay on some properties of Light in your Number for March last, contains opinions on this subject somewhat bordering on mine, the perusal of which induced me to send the present Essay for insertion in the Philosophical Magazine, should you judge it worthy of a place. I hope the way in which I have disposed of the alleged noise produced by streamers, taken notice of by the author of the above-mentioned Essay, will be so convincing that no attempt to account for it is necessary. I have frequently seen these phænomena, but never heard the supposed sound, and indeed think that I have proved the impossibility of its existence even according to their own hypothesis who believe it. But, far from reflecting on the veracity of respectable persons, who assert that they have heard such noise, I am satisfied that it is an illusion produced partly by tradition, and partly by one sense being affected by another, as more fully explained in the Essay.

This sympathy of the senses has, I presume, been experienced by many in peculiar circumstances: for instance, in a large building, when full of people, if any sudden and unaccountable noise produce uproar and confusion, in the first state of alarm the eye is apt to be deceived, and an apprehension induced that the timber is bending, supports moving out of their place, and all ready to fall:

fall: as the eye is deceived in this case, so I presume the ear is in the other.

I may here remark that, independent of every other argument, the failure of all attempts to ascertain the height of the illumined arches, or of the *aurora borealis*, at any time, completely overturns the common hypothesis, and establishes mine. If those phænomena were masses of the electric fluid, or the combustion of any kind of matter, while they remained stationary, their height might be found as readily as that of any other object: but this has never been done; and, according to my account, cannot by the common method, because, as in the case of the rainbow, every spectator sees a different section of the beam of light by which they are produced.

I will take this opportunity of stating an opinion I have also long held, and which is indirectly connected with the present subject. It is, that a sphere of light is not formed around the sun, or any luminous body, by the particles of light being projected in every direction to that distance which they are known to reach. This would be an expense of light millions of times beyond what is necessary, and utterly at variance with the simplicity and œconomy invariably observed in all the works of creation of which man has attained any knowledge. The positive part then of my opinion is, that as light is known to be attractible as well other matter, every planetary or other body will attract its due quantity of light according to its size and distance from the source whence it is supplied. Hence a large planet, such as Saturn, notwithstanding his distance from the sun, may be more bountifully supplied with light than has hitherto been supposed: and it is observable that the planets most remote from the sun are, generally speaking, the largest. That particles so inconceivably minute should be projected from the sun in every direction, to the utmost verge of the system he enlightens, is an operation scarcely conceivable; and considering that this enormous expenditure of light and power would be to no purpose, except the comparatively minute portion falling on a few wandering specks in this immense space, is too absurd to be imagined, since it is so easy to conceive how the process of enlightening may be carried on by the mutual action of the two bodies concerned, without a particle of light being lost. The principles of attraction and repulsion may be the agents employed in this case, as they are known to be in others. What is advanced in the annexed Essay is independent of the result of this inquiry, as the reflection and refraction of light are not thereby necessarily affected. Much might be said on this subject; but having shortly stated my opinion and reasons for adopting it, I leave it for

for the present to the consideration of those who may take an interest in the subject, if by your favour it shall be presented to them. I am, sir,

Your obedient humble servant,

WILLIAM DOBBIE.

On the Aurora Borealis.

It has long been a generally received opinion, that the *aurora borealis* is the exhibition of immense masses of the electric fluid *in vacuo*, or at least at such a height that the atmosphere is in an extremely rarefied state. No circumstance connected with these phænomena seem however to favour that opinion, much less to warrant the unreserved manner in which it has been adopted.

The following questions may be proposed, to show how little is known concerning those phænomena.

Why is their appearance confined to particular times of the year and of the night?

Why are they always seen in a particular quarter of the heavens?

Why do they in general assume the particular form and position observable, rather than any other?

Why are they under all their various appearances different in colour from the electric fluid in other cases?

And, lastly, Why is the motion of the electric fluid so dissimilar to that of streamers, the former being determined by known laws; whereas the latter move to and fro laterally, without even a conjecture as to the cause of such motion?

Streamers are said to be often accompanied with a hissing or rustling noise. This notion probably had its origin at the time when they were supposed to be ominous of disastrous events, or to represent armies in hostile conflict, and might arise from a sympathy of the sense of hearing with that of vision. At least, it would not be easy for our untutored ancestors to conceive how those gigantic aërial warriors could perform their tremendous evolutions altogether without noise: the latter seems to have been the idea concerning those appearances in the time of Ossian, and in some measure till the present time.

This wild notion of the hissing and crackling noise has been acceded to by many who ought to be more guarded in what they admit regarding natural phænomena, as it is completely at variance with the fundamental part of their own hypothesis, which is, that this peculiar appearance of the electric fluid is produced by the total or partial absence of air. This being granted, how are they to account for the production or transmission of sound? Besides, the height generally assigned to streamers is many times greater than the distance which the loudest known sounds ever reach, even where the medium is properly adapted to their production and transmission.

Having thus stated the above objections to the prevalent opinion respecting the cause of the *aurora borealis*, it is the object, in what follows, to endeavour in few words to account for the phænomena in question, so as to remove the objections and furnish answers to the questions above stated.

It is generally at or near the time of the equinoxes that those lights make their appearance in these latitudes, at which times the sun's rays would be tangents to the poles of the earth, were they not disturbed by the refractive power of the atmosphere. By the refraction, it is obvious that the rays will extend to a certain point beyond the pole, on the side opposite to the sun, when they must of course fall on the immense accumulation of ice within the polar circle, and will be reflected with great brilliancy towards the darkened hemisphere, undergoing in their course another refraction, which bends them still more southward; and as the atmosphere possesses also the power of reflecting light, those rays will finally fall back on the earth, and will at a certain angle and within certain limits be visible to its inhabitants.

What is here advanced accounts satisfactorily and with simplicity for those phænomena, and also for the annual and diurnal times of their appearance. Towards midsummer and midwinter the relative position of the earth and sun is unfavourable, or rather does not admit of those appearances in our latitude. But further north they may be and are seen during a greater part of the winter. The fact here agreeing so well with the assigned cause, is a strong evidence that it is the true one. At the seasons above mentioned, several hours after sun-set, when a vertical plane passing from us to the centre of the sun would also fall within the limits of the frozen regions of the pole, then, circumstances permitting, streamers might be seen faintly at first towards the east; and as the sun proceeds nearer to the centre of the polar regions the streamers advance westward, and are more elevated; and if continued till near midnight, his rays falling on a world of unsullied snow and ice, forming angles of every description, shoot forth into our zenith a beautiful though confused assemblage of prismatic colours. Towards midnight is the only time, and near the zenith the only place, that I have ever seen coloured streamers: the fact and the theory agree here also so remarkably, that a doubt concerning the cause can scarcely be entertained. The time of appearing, and situation in the heavens, of those phænomena being thus accounted for, it is easy on the same principle to account for their form and position. The general form of streamers, as this name imports, is that of a long a long stream of light straight or slightly curved according as they are situated with regard to the spectator; and their position is, generally speaking, north and south, deviating oftentimes more or less from that direction, according to circumstances. It appears that streamers vary in their form and position according to the relative position of the sun, earth, and the several surfaces by which they are reflected, and are longer or shorter to the right or left, or in the meridian, according to the angle with which the rays of the sun fall upon the several reflecting planes: in short, they may be considered as an assemblage of lengthened and distorted images of that luminary. The higher or south ends of the streamers point to the zenith, and the others towards the northern horizon, extending over a greater or less space, according to circumstances. They may be aptly compared to the ribs of a dome roof having a portion of the upper end cut off, but sometimes uniting at the zenith, and even running into a confused mass, exhibiting various colours as before described. They are also curved in a similar manner to those ribs, owing no doubt to the varying density of the atmosphere; and perhaps it is increased by the attraction of the earth, in the case both of the streamers and the ribs to which they are here compared: those right over head appear straight, and those seen obliquely show the curve. Although both the form and motion of streamers are very irregular, yet I have witnessed only one other form which is a remarkable exception to their general features just described, and that is the beautiful regular arch afterwards mentioned. There is a kind of luminous clouds sometimes seen in unsettled weather, which I believe have been generally confounded with the *aurora borealis*, but are evidently entirely different in their nature and origin.

It is now requisite, on the same principle, to explain how the motion of streamers is produced. In order to this, it is only necessary to suppose the bodies of ice by, which in all probability they are reflected, to be in motion; and this they may be by floating in detached masses in water, or descending from heights where they had accumulated into the plain, sometimes moving gently, and sometimes vibrating by violent concussions against each other. As the angular motion of the image, or reflected ray, will correspond to that of the body by which it is reflected —if a mass of ice by rolling or falling change its position sixty degrees, it is evident the streamer reflected by it will in the same time move through a space equal to its distance from the surface which reflects it: this distance may be several thousands of miles. A beam of light sweeping through this immense space in an instant, is perhaps the greatest velocity that the eye can witness, and to produce which no other cause than the one here

 assigned

assigned seems adequate. Many of the movements, however, may be the effect of a change from one reflecting surface to another which presents a different angle; for sometimes there seems to be a succession of different streamers, at other times only a lateral motion to and fro of the same streamer.

The illumined arch which appeared on the 24th September last, and that on 11th September 1814, were evidently a modification of the *aurora borealis,* because they proceeded from the same quarter of the heavens, and in both cases were resolved into the ordinary appearance assumed by those phænomena. These facts, besides proving the latter position, go far to prove the general theory here advanced. If every circumstance connected with the enlightened arches is duly considered, a doubt can scarcely be entertained concerning their cause. Their form, position, motion, and time of appearing, all concur in pointing it out to be the light of the sun reflected by the spherical surface of the earth, and again reflected back on a different part of it by the atmosphere. From the regular form of the arches, it is probable that the surface from which they were reflected was that of the ocean, which stretches in the direction in which the sun was during their appearance. But later in the evening, when that uniform surface had passed out of the line of direction by the rotation of the earth, and the icy regions of the north pole had intervened, the sun being reflected from a broken unequal surface, the arch was also broken into streamers of the usual appearance. It will be obvious, that without the refractive power of the atmosphere those phænomena could have no existence, because in that case the reflected rays of the sun could fall nowhere except in that space enlightened by his direct rays; but by refraction those rays falling upon the verge of the enlightened hemisphere, must, when reflected, be bent into the dark hemisphere.

It is only to a certain extent within the latter boundary that streamers can be seen; for beyond that the reflected rays will pass the bounds when the atmosphere has power to reflect them back on the earth: therefore, in our latitude, the streamers generally disappear before midnight; but in higher latitudes they are seen at that time, being nigher the boundary of light; and for the same reason they are seen in the northern regions through a greater part of the year, as before noticed.

If the *aurora borealis* were of an electric or meteoric nature, as is supposed, their height might be ascertained by the common method of measuring heights at any time when they are stationary; but if the true origin is as above explained, the common method of measuring heights will not apply to them. If they are the reflected rays of the sun, the arch or streamer is a section of those rays

rays again reflected on the earth by the atmosphere at a certain angle: therefore they will be seen from different places at nearly the same angle, only affected by the angle which the reflected rays make with the horizon in proceeding from the latter towards the zenith; being with that exception similar to the rainbow, which, however the spectator may change his place, preserves its relative situation to him.

If I am at all right, I should suppose that an approximation to the height of these phænomena might be found by something like the following method, which would apply more particularly to the arch, if such a phænomenon should again make its appearance, because its motion is slow and uniform, and seems only to depend on the motion of the earth relative to the sun. Take the angle of height and the bearing of the middle or highest point of the arch, noting the time; repeat this two or three times at intervals till it disappear, and it would be so much the better if these observations were made at two or three different parts of the country as distant as possible from each other. It could then be found, if a line passing through the centre of the sun and the observer coincided with the different bearings at the times they were taken. Find also the boundary of light and darkness and the above-mentioned lines, or rather vertical planes, at the times noted. A little on the light or north side of this boundary must be the place from which the arch is reflected, and which from the regularity of the figure seems to be the ocean in a liquid state, or with a uniform surface of ice, or the latter covered with snow.

From the two times on which this phænomenon was seen so nearly coinciding, it is probable that it cannot be produced except when the earth and sun are in the same relative position.

The times alluded to, it will be recollected, were near the autumnal equinox, from about 8 till 10 o'clock in the evening; and it is scarcely to be supposed that the ocean could be frozen at that time of the year in the direction of the sun between those hours. But the surface of the water seems quite adequate to reflect the rays of the sun with all the splendour displayed by that beautiful phænomenon, when we consider the great obliquity of the incident rays, and their reflection into the dark serene atmosphere which on those evenings favoured their exhibition. The above observations being made, and making allowance for refraction in both the incident and reflected rays, probably increased by the earth's attraction on the latter, (which I am inclined to think is considerable, and principally causes the curve observable in streamers,) it will be seen at once if the phænomena are produced by the cause I have assigned. The reflected ray being traced as above suggested, and being intersected at the

the different stations of observation by the observed angle of elevation, these intersections will be the height of the arch at such places. The above method would not apply so well to common streamers; but when stationary for a time, circumstances might be determined concerning them by those or similar observations.

It is to be observed, that a circumstance has been noticed in high northern latitudes, which cannot be accounted for otherwise than by supposing an extraordinary degree of refraction to exist in the polar regions. The circumstance is the appearing of the sun above the horizon, many days before that luminary could be expected from the relative position of the earth at the time, with only the quantity of refraction usually allowed. Whatever is the cause of the increased refraction at the north pole, it will greatly affect those phænomena, and must be ascertained at least before their height can be accurately found. I believe the cause commonly, and perhaps truly, assigned for the great refracting power above noticed, is the dense state of the atmosphere produced by extreme cold: there is however no certainty that the singular state which causes mock suns, landscapes, &c. in the air, may not be concerned here.

It may be asked, If the cause of the *aurora borealis* is as above explained, why are they not always visible at the two periods before mentioned? The answer is, So they would, were the atmosphere always in that state of purity which is essential to their exhibition. But the complete absence of clouds in so vast an extent of a northern sky must be very rare.

In a more limited space, the atmosphere must be more frequently in such a state of serenity as to favour the exhibition of these phænomena; which, with other causes before mentioned, is no doubt the reason of the frequency of their appearance in more northern latitudes. A conjecture has been offered concerning the cause of the phænomena in question, which being more absurd than that already I think disproved, it is scarcely necessary to take the trouble of refuting. It is, that those lights are produced by the combustion of hydrogen gas that has escaped from the earth, and accumulated in upper regions of the atmosphere. It is evident that such combustion, were its existence not altogether improbable, could neither be periodical nor local, nor exhibit an appearance at all similar to streamers. Were this inflammable gas collected where the oxygen of the atmosphere had access to it, and there kindled, they would instantly unite with tremendous noise, and the water formed fall to the ground.

But if it ascended above the atmosphere, it would be entirely beyond the means of ignition; neither could combustion there go on, from want of oxygen.

In

In the case of hydrogen gas ascending in the atmosphere, if it were not combined or mixed in its progress, it would continue to ascend till it surmounted all the other ingredients which compose the latter, because it would expand as the pressure diminished: consequently its specific gravity would at any height bear the same proportion to that of the atmosphere as it does at the surface of the earth: therefore its progress upwards would continue till it was beyond the means of either ignition or combustion.

XXVIII. *Description of the Percussion Gun-Lock invented by Mr.* Collinson Hall, *of High-street, Mary-le-bone**.

The cock, or hammer, and the touch-hole are the only parts in which Mr. Hall's gun differs from those in ordinary use; and these parts are so simple that a common lock may be converted into a percussion lock on Mr. Hall's plan, at a very small expense.

The detonating powder which is used for the priming is made into the form of a pellet, and is fixed in the centre of a small round piece of paper covered with wax. In this state it is applied to a cavity countersunk in the head of the hammer, to which it adheres by means of the wax, and is thus preserved from the effect of wet. The touch-hole consists of a cylindrical plug screwed into the side of the barrel, and having a pin or nipple projecting from it at right angles: this pin is perforated in the direction of its axis, and thus forms a communication with the powder in the cavity of the plug. When, by the release of the tumbler, the hammer is let go, the countersunk cavity, containing the patch of detonating paste, strikes on the top of the pin of the touch-hole, the paste explodes, and, communicating its percussion through the perforation of the pin, fires the powder in the cavity of the plug, and thus discharges the gun. The corrosive and deliquescent salt resulting from the decomposition of the detonating paste can act only on the hollow of the hammer, where it does no material injury, instead of soiling and occasioning damp in the touch-hole itself. Hence a lock on this construction hardly ever misses fire, and the discharge is remarkably rapid; both of them circumstances which very materially influence the success, and consequently the satisfaction, of the sportsman.

* From the *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, vol. xxxvi. The Society's silver medal was voted to Mr. Hall for this communication.

The

The detonation is so powerful, that if a card be laid over the pin, or even if its perforation be stopped with tallow, the gun will, notwithstanding, be discharged. If the hammer is let down gently after priming, the spring presses the pellet close into the cavity, and thus considerably increases the effect.

The paste is made of the several ingredients in the following proportions, viz.

	Grains.
Oxymuriate of potash	196
Flour of sulphur	68
Fine powdered charcoal	34
Gum arabic	12

Dissolve the gum in as little water as possible; then grind the oxymuriate of potash fine, in a Wedgwood's mortar, by itself, and also the flour of sulphur and charcoal together, with a pestle of the same material. The mixture of all with the gum must then be effected, either in a wooden mortar with a wooden pestle, or, at any rate, in a Wedgwood's mortar with a wooden pestle, taking care to keep it moist during that operation, lest it should explode.

The paste, being of the consistence of soft clay, is then to be formed into pellets, by means of a mould made of a plate of brass or copper, one-sixteenth of an inch thick, and filled with holes of one-eighth of an inch in diameter: this plate being placed upon a table, or other flat surface, over which a sheet of paper is first to be laid, the paste is to be spread evenly over its surface, and then pressed into the holes, either by passing a roller over it, or by beating upon it with a wooden mallet: the paste is then to be removed from the upper face of the mould, with a thin spatula or palette knife; and the mould is next to be slided, for the length of an inch, along the paper, to separate the paste from it; and it may then be lifted up, and the pellets carefully driven out of the holes in it, by striking upon it with a soft brush; they are then to be dried. The round paper patches being cut by a proper punch are covered on one side with bees-wax mixed with a little tallow, and coloured red to distinguish the adhesive side from the other: the pellet is then gently pressed on the centre of the waxed side of the patch, to which it adheres, and the priming patch is thus completed.

When used, the patch is to be pressed firmly into the counter-sunk cavity of the head of the hammer, to which it easily adheres in consequence of its waxed surface being in contact with the metal.

The following recipe for the composition of the pellets has been communicated from another quarter.

Take

Take oxymuriate of potash 49 grains, flour of sulphur 17 grains, pulverized charcoal $8\frac{1}{2}$ grains. Mix the three ingredients in a wooden mortar, with a tea-spoonfull of weak gum water, making it about the consistence of bookbinders' paste. Have ready a piece of copper or brass plate, pierced with circular holes of one-eighth of an inch diameter, lay it on a board, and spread the composition over it, so as to fill up all the holes. Allow twenty minutes for the paste to harden, push the pellets out with a wooden punch that fits the holes, and spread them to dry more completely, after which they may be fixed with any adhesive composition upon small circular pieces of thin paper for use.

Many testimonials in favour of Mr. C. Hall's invention from persons who had used it for some months, accompanied the original communication, but which it is not thought necessary to insert here. They remain, however, in possession of the Society, as also does a model of the lock.

Explanation of the Figures.—Plate II.

a, fig. 1, the lock-plate of a common gun, with the hammer and feather spring removed, and the screw holes plugged up; the pan also being filed off level with the lock-plate and bevelled to drain the rain off.

b, the hammer placed on the axis of the tumbler in place of the cock.

c, a plug screwed into the breech where the touch-hole formerly was; which plug is perforated through its whole length at right angles to the axis of the barrel.

d, a small pin or nipple left on the plug, through which a hole is bored at right angles to the axis of the plug. The top of the pin is so placed as to strike directly on the centre of the priming patch in the head of the hammer, when the hammer is released, as shown by the dotted arc, *ff*.

e, a bush made of platina screwed into the end of the plug, and perforated by a capillary tube, in order to moderate the effect of the detonation, and thus prevent the powder from being blown out of the plug before it is ignited.

Fig. 2 is a front view, the barrel being cut off close to the plug.

Figs. 3, 4, are a lateral view and section of the plug.

Fig. 5 is a section of the hammer to show the cavity *g*, in which the patch is deposited.

Figs. 6, 7, a plan and elevation of the patch.

XXIX. *Particulars respecting the Pancratic Eye-Tube invented by* William Kitchiner, *M.D., Author of "Practical Observations on Telescopes, Spectacles," &c. &c. made only by* Dollond, *London.*

"It has long been known, that the magnifying powers of telescopes could be augmented by increasing the distance between the two glasses next to the eye, and the two that are next to the object-glass, to *almost* double the power of the eye-tube in its usual form, *i. e.* from 30 to 55. This is the utmost that opticians have at any time accomplished; yet this variation is so desirable, that I think it only requires to be generally known, to be generally desired.

"A few months ago, I saw an eye-tube, made by Mr. Cauchoix, with a scale of magnifying powers from 25 to 73; but, upon trial, I found the vision was good only between 35 and 45.

"My attention was strongly excited by the idea of *one* eye-tube effecting the whole business of magnifying; and after several experiments, I combined lenses of such proportions that they admitted of being separated from each other so as to magnify at one extremity, *more* than double they did at the other, the vision continuing uniformly distinct to the extreme edges of the field of view.

"Having now done more than had been previously effected, I brought it to you. The great approbation you expressed of what I had done, so encouraged me, that I applied unceasingly, determined to perfect the object in view; which I have now accomplished.

"I beg to present to you the following accurate measurement of the powers, and faithful account of the performance of

"The Pancratic Eye-Tube, which gives a neater and better defined image of a fixed star, and shows double stars decidedly more distinct and perfectly separated, than any other eye-tube, and will enable the observer to determine the distances of these very delicate objects from each other in a more perfect manner than has been possible heretofore.

"This Eye-tube applied to the Achromatic Refractor of forty-four inches focus, produces, in the most perfect manner, every intermediate degree of magnifying power between 100 and 400, the vision continuing uniformly distinct to the extreme margin of the field of the telescope.

"The tube is graduated; and the change from one power to another may be made instantaneously, even in the dark, with the utmost facility and certainty (see Pl. II. fig. 11.).

"It is presumed, that the advantage of my Pancratic Eye-tube over

over common magnifiers, in variety of effective magnifying power, convenience, and portability, is as 300 to 1."

"ε *Bootes*, as observed on the 25th of May 1819, by Mr. H. Browne, F.R.S. and myself, with an achromatic telescope of 30 inches focus and 2-$\frac{7}{10}$ths aperture, made by Mr. George Dollond. With 270 the two stars were as perfectly and as distinctly defined as in the diagram, without either rings, or rays, &c. around them. The blue colour of the smaller star remarkably bright.

"To observe this double star to the utmost advantage, (especially the colour of the small star,) the illuminating power of the telescope must be in a high proportion to the magnifying power.

"α *Geminorum*, with 230, as represented in the diagram; *Castor* does not require much illuminating power. I have shown it to several persons who did not know that it was a double star, with one of Mr. Dollond's one foot portable telescopes, to which I applied a *Pancratic* Eye-tube, which gave a power of 70 times, and they described to me its appearance very accurately."

[The above is an extract from Dr. Kitchiner's Letter to Sir Joseph Banks, P.R.S., which was read at the meeting on the 20th April 1820; and if this invention contributes to facilitate astronomical researches, let it be enrolled among the many obligations which science owes to the discernment of that indefatigable patron.]

Another is made, which is adapted for terrestrial purposes, magnifying from 55 to 200 times.

N.B. The apparent diameters, and the distances of double stars from each other, vary very much, according to their distance from the meridian, the different states of the atmosphere, and the distinctness and magnifying power of the telescope.

Eyes also differ in a very surprising manner in the size that these celestial objects appear to them. The same evening that, with a power of 180, the planet Jupiter has appeared to me to be about an inch and a half diameter, a person, who observed it the next minute, said it looked as big as the moon: another, about four inches diameter; and a third thought it did not appear larger to his eye than a small pea.

This Eye-tube is applied to the telescope in the same manner as other eye-tubes, and is adjusted to distinct vision by the same pinion motion.

For the lowest magnifying power, the whole of the tubes must be shut up; and when the magnifying power is to be increased, the smallest of the sliding tubes, A, must be drawn out to either of the numbers engraved upon it; care being taken not to draw out any part of the other sliding tubes, B and C, until the whole of the first, A, is pulled out; the second tube, B, may then be drawn out to either of the numbers engraved thereon; and in like manner the third tube. The numbers denote the magnifying power of the telescope.

To change the power, for any less power than the one to which the tubes have been drawn out, the reverse of the above described mode of proceeding must be observed; and the largest tube must be returned first, and so on, until they have been brought back to the number required. Each alteration of the magnifying power will require a new adjustment of the pinion; and as the magnifying power is increased, the distance between the eye-glass and the object-glass must be diminished.

⁂ It is applicable to achromatic and Newtonian telescopes of all lengths.

XXX. *Description of the Mooring Blocks now used in Portsmouth Harbour. By Mr.* J. Park *of Portsmouth**.

Portsmouth-yard, March 25, 1818.

Gentlemen,—I trust that the communication which I am about to lay before you will not be deemed altogether undeserving your notice.

In October 1795 I was appointed junior master attendant of Portsmouth yard; and as the security of his majesty's ships and all works on float relative thereto are in the master attendant's department exclusively, I applied myself as much as possible to gain a thorough knowledge of the harbour, as well as of the nature of the security and disposition of the moorings; and the more I became acquainted therewith, the less satisfied I was with the method by which the ground-chain was secured, as a national evil attended it, and various other inconveniences to the public service.

The evil alluded to was that of throwing some thousand tons

* From the *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce,* vol. xxxvi. The gold medal of the Society was presented to Mr. Park for this great improvement respecting harbours for king's ships; and a model of the contrivance is preserved in the Society's Repository.

of

of shingle ballast annually on what is called the *claws* of the moorings to render them secure, which ballast was by the wash of the tide carried into the bed of the harbour and lakes where the ships ride.

Having arrived at the head of my department in April 1812, I ventured humbly to recommend to the honourable Navy Board considerable alterations in the arrangement of the moorings, which would not only tend to improve the harbour by giving more space in the lower part, where the same was required for ships to pass and repass, but also afford accommodation to a greater number of them than hitherto could be laid up: the recommendation being favourably received, I was directed to proceed accordingly.

These alterations were effected; but the great and growing evil of filling up with ballast a harbour already too shallow, still continued, and produced an anxious wish for some substitute for the claw, by which the application of shingle ballast might be discontinued. I was accordingly induced to make several experiments, and after various trials, I submitted to the Navy Board a model of a cast-iron Mooring Block which appeared to promise fair to do away every objection arising from the method of securing the ground chain, being at once a substitute both for claws and mooring anchors.

The Board directed two to be cast of such form and weight as I wished, and when received in the yard, trials to be made to ascertain what degree of resistance they possessed.

When received, trials were made under the inspection of several experienced and distinguished naval officers, and the principal officers of the dock-yard; which proving satisfactory, induced me to address the Navy Board on the 2nd of November 1814, detailing my sentiments, &c. relative to Portsmouth harbour, and the moorings, accompanied by accurate statements of the trials made with the blocks, copies of which I have annexed hereto, having first obtained the Board's permission to do so.

A trial being ordered on a lighter block, and proving equally satisfactory, directions were shortly after given for their general adoption, to the exclusion of every thing hitherto used for securing moorings, and a contract immediately entered into for the supply of them.

The superiority of the block in question over both claws and anchors is manifest; it will last for ages without repair, will resist much greater power than either, and will completely obviate the use of shingle ballast to render the mooring secure, (which must hitherto have been extremely injurious to the harbour,) as

on

on applying a strain it has a tendency, arising from its form, to bury itself more and more under the surface until it becomes fixed; it is likewise free from liability to be hooked by ships' anchors, and the moorings thereby rendered insecure; which has been the case hitherto, as represented in my letter to the Board above quoted.

I now beg leave to notice the Mooring Blocks in an economical point of view.

The largest blocks, adapted for first-rates' moorings, are now supplied for less than half the sum required to provide and fix what is termed a claw, and about a quarter of the cost of a mooring anchor.

It must also be considered that both the anchor and claw would require to be replaced in the course of forty or fifty years, (supposing them to remain undisturbed,) besides which the claw would require frequent repair from the effect of the worm during that period.

On the blocks already laid down at this port (although principally as substitutes for claws) there arises a saving to the public of upwards of 3,000*l.*; and where it may be necessary to lay them down instead of anchors, the saving will be infinitely greater.

It may not be amiss to mention, that an opinion prevailed that the block invented by me was only an improvement on one invented by Mr. Hemmans of Chatham Dock-yard some years ago; but on an examination of the two by a Committee of the Navy Board, the same was clearly proved to be erroneous: the Report to the Admiralty on that subject, and recommending the general adoption of my block, was as follows, viz.:

"The Committee has further to remark, that Mr. Park's Block cannot be considered as an improvement on the plan of Mr. Hemmans, being totally dissimilar; but altogether as a new invention, and having the same object in view."

As a model and drawing of the block are forwarded, I decline giving any written description of it here; but should the Society require further particulars, I shall have much pleasure in furnishing them.

I have only now to observe, that having been influenced by a strong sense of public duty, and an ardent desire to be useful to my country by overcoming the serious evils set forth in my narrative, I trust it will not be considered too presuming to request as a mark of your approbation that you will be pleased to give my invention publicity. I am, Gentlemen, &c.

J. Park.

A. Aikin, Esq.
Secretary, &c.

Copy

Copy of a Letter addressed to the Hon. the Navy Board.

Portsmouth-yard, Nov. 2, 2814.

Honourable sirs,—Having from my first appointment to Portsmouth-yard as junior master attendant, dedicated as much time and attention as in my power towards acquiring a thorough knowledge of the harbour, both as to the depth of water and quality of the ground, and also to the method of preparing and laying down moorings, together with any improvements that might be made, either for their security or for increasing their numbers by a more advantageous arrangement, or by laying down additional ones where found practicable:

I have in the course of my practice (which has been now upwards of 19 years) experienced many inconveniences, which I have long conceived might be removed by making some alteration in the manner of securing the ground-chain.

I have likewise been of opinion from an early period after my appointment, that many advantageous alterations might be made among the moorings in various parts of the harbour, as well as that new moorings might be laid down both for ships of the line and frigates in the different lakes; and having submitted the same to your Honourable Board by letters of the 30th April 1812, and 26th July 1814, was directed by your warrants of the 8th May 1812, and 28th July 1814, to carry the propositions into effect: in consequence of which, several alterations have been made, and many new moorings laid down, and much may yet be done when the other duties of the port will admit: but as I am preparing a plan of the harbour, which will show the alterations, &c. much plainer than any written description, I shall decline saying more at present, and endeavour to describe the manner of securing the ground-chain, with the inconveniences alluded to.

The ground-chain of all the swinging moorings in the harbour is secured as follows:

One end is fixed to what is termed a claw, namely, a frame of wood, with an iron ring in the front for shackling the chain to, which claw is buried below the surface from 2 to 3 feet, by digging away the mud or ground as near the low water mark at spring tides as circumstances will admit, with piles driven in the front, and when completed, the mud which has been removed is thrown on the claw so as to cover it.

The other end of the chain is secured by a mooring anchor, namely, two anchors of about 70 cwt. each, in one stock, with their upper hooks either taken off or beaten down on the shank; this is for line-of-battle ships' moorings; frigates' moorings have only one anchor of about 60 cwt.

From this harbour having for some years become a rendezvous for ships in the transport service, and thereby crowded with ships of of that description, together with the liability of the mooring anchors, from their construction, to be hooked by the transports' anchors, much inconvenience, labour and risk have been experienced, and many instances have occurred when it has been necessary to take up a mooring from end to end, in consequence of ships having hooked the mooring anchor, and, regardless of every thing but the recovery of their own anchors, have hove down unobserved in the night-time at low-water, and by the rise of tide forced the mooring anchor out of the ground; nor did I ever find one so displaced, when taken up, entire; but, on the contrary, one anchor has been lying across the other, the stock broken or gone, or the chain foul of the flooks, and I have seen instances when the mooring anchors have been completely upset and found with the flooks uppermost. Having described the swinging moorings, and also what I humbly consider objections to the anchors, and the principal inconveniences arising therefrom (I say principal, because there are others, particularly where the anchors lie in shoal water, the frequency of their being injured by ships grounding on them, &c.), I have now to state that all the head and stern moorings in the different lakes are secured by claws only, the chain being laid from shore to shore, and each end shackled to a claw: this method of securing the chain is not however, in my opinion, without objections, and to which I humbly call the attention of the Board.

Notwithstanding the claws are perfectly buried when laid down, yet in the course of twelve months they appear above ground, and frequently require a supply of shingle ballast to be thrown on them, particularly in the lakes where the stream is narrow; and as the disappearance of this ballast can only be accounted for, by its being washed down by the tide into the bed of the harbour and lakes, I cannot divest myself of the opinion that the same must prove detrimental to the harbour.

These considerations induced me to search for a substitute, free from such objections, to answer the purpose either of the claw or the anchor; and after making various trials I submitted for the inspection of the Committee of your Honourable Board, who visited Portsmouth in September 1813, the model of a cast-iron block; when they were pleased to give directions for two being provided; and your Honourable Board have also directed, by warrant of the 6th July last, the two blocks to be received and tried: they have accordingly been received, and trials made with every possible power, applied to ascertain their stability; and as every one who has witnessed the experiments is fully convinced of the superiority of the blocks, I trust I shall not be considered too presuming in recommending their adoption for claws as well as anchors, as I am given to understand the cost will not much

much exceed the expense of making and fixing a claw, which is liable to injury, by vessels grounding on, or hooking fast to it, nor is its durability beyond 40 or 50 years, even where it remains undisturbed, whereas the cast-iron blocks will last for many centuries.

I am likewise informed that the blocks may be cast at the foundry, in the yard, if your Honourable Board should approve of a furnace being erected for that purpose, which would materially lessen the expense.

I have hereunto annexed a description of the trials, and have forwarded by this night's coach, two drawings.

No. 1, showing the present method of securing the ground chain.

No. 2, showing the manner in which the mooring block was tried.

And by Clark's waggon, a model of the block.

I am, sir, &c.

J. Park.

Description of the Trials made with the Cast Iron Mooring Block, invented by me, and now humbly submitted for the consideration of the Honourable Navy Board.

First, The cast-iron mooring block, weighing 142 cwt. was placed on the shore some distance from low water mark, and an anchor of 85 cwt. (exclusive of the stock, which weighed about 35 cwt.) was also placed the same distance from low water mark, and 65 fathoms from each other, on ground of the same quality; 15 fathoms of mooring chain were attached to each, and to the end of each chain four treble blocks of 22 inches; four three-fold purchases of new 6-inch hawser rove, and two mooring lighters, with 40 men in each, grounded, one abreast of the cast-iron block, and the other abreast of the anchor; the falls were brought to the capstans and windlasses and the strain applied to heave the mooring block and anchor towards each other.

Both drew; the former one inch to one foot of the latter, until the mooring block had drawn about the distance of its own base, when having completely buried itself, it became stationary, but the anchor continued to come home (notwithstanding it was buried to the upper flook) until every one present was satisfied that any further trial with an anchor of that weight was useless.

Second, being willing to make further trial, I caused an anchor of 95 cwt. (namely, the Nelson's best bower) to be laid down as before, and the same purchase to be applied; but the power not being sufficient to move either the block or anchor, 10 additional men were sent into each lighter, when the anchor started,

 and

and continued drawing, notwithstanding it soon buried itself (as the former had done), but the block remained immoveable.

Although this trial was very satisfactory, yet wishing to ascertain the power of resistance which the block possessed, I caused the following one to be made.

Third, an anchor of 41 cwt. was laid down about 60 feet behind the large anchor, and attached to it by cable, and on applying the same purchase as above, the large anchor drew until the cable between the anchors became taught, when it was found necessary to increase the power, which being done, both anchors started, and continued to come home, until the superiority of the mooring block (which still remained firm) was declared to be so manifest, that no further experiment was necessary, it being the opinion of the gentlemen under whose inspection this last trial was made, viz. Admiral Sir Richard Bickerton, bart.; Rear Admiral Foote; Commissioner the Hon. Sir George Grey, bart.; Captain Sir James Athol, Wood Hewitt, and the principal officers of the Dock-yard;— that it was much superior to any thing yet offered for the purpose of securing the ground chain of the moorings, and that its introduction would prove advantageous to the service, particularly in shoal water where ships had to pass over the anchors. J. Park.

Statement of Trials made with a lighter Cast-Iron Mooring Block.

First, the mooring block weighing 115 cwt. was placed on the shore near low-water mark, and also an anchor of 95 cwt. (exclusive of the stock) about 65 fathoms from each other, with 15 fathoms of mooring chain attached to each, and to the end of each chain four treble blocks of 22 inches, four three-fold purchases of new 6-inch hawser rove, and two mooring lighters, with 50 men in each grounded, one abreast of the mooring block, and the other abreast of the anchor; the falls were brought to the capstans and windlasses, and the strain applied to heave the mooring block and anchor towards each other (similar to the trials made with the former block, a statement of which accompanied my letter of the 2nd of November last).

The block and the anchor both drew about the distance of seven feet, when the block became fixed, but the anchor continued to draw as long as the purchase was applied.

Second, an anchor of 48 cwt. was laid down about 10 fathoms behind the large anchor, and attached to it by cables (termed by seamen, "backing an anchor") when the purchase was again applied by 64 men in each lighter: the large anchor drew, taking the small one with it, until the latter had buried itself up to the crown, when the anchors became stationary, and the block

began

began to draw, and continued to do so while the strain was applied.

Third, having removed the anchor of 43 cwt. and laid down one of 23 cwt. instead, at the distance of 15 fathoms behind the large anchor, the same purchase was again applied, when both anchors came home.

The block, after having drawn about seven or eight inches, became fixed, but the anchors had drawn 13 feet, and kept coming home as long as the purchase was continued, and until it was evident that the block was superior to the anchors.

The foregoing trials were made under the inspection of Admiral Sir Edward Thornbrough, K.C.B.; Rear Admiral Halkett, Commissioner the Hon. Sir George Grey, bart.; Captain Hewitt; the Master Shipwright, Master Attendant, Engineer and Mechanist, &c.

J. Park.

Reference to the Engraving of Mr. J. Park's *Cast-Iron Mooring Block,* Plate II.

AAAA, the extent of the lower flat of the block.
BBBB, the extent of the upper flat.
C C, for lowering the block into its place.
D, the neck of the block, to which the chain is attached.
E, the shackle which connects the mooring chain to the block.
Side View.—F G gives the block an inclination to dive into the ground when strain is applied.

XXXI. *Electricity and Galvanism explained on the mechanical Theory of Matter and Motion. By Sir* Richard Phillips.

In no branch of philosophy have superstition and the love of the marvellous revelled in greater luxury of variety and absurdity, than in every existing disquisition, observation, and theory of the classes of phænomena called Electrical.

Theories assuming miraculous principles which never had existence, and which are inconsistent with that supreme power for whose support they were weakly invented, and then a course of reasoning by false analogies, have led to all these absurdities. The *philosophical* electrician talks flippantly of his fluids and his fires—his negatives and his positives—his charges, surcharges, and discharges—his saturations and non-saturations—his attractions and repulsions—and other conjurations—and believes that he can bottle up this fluid *sui generis;* that a cloud can be surcharged with it; that bodies contain more or less than their natural quantity; and a hundred other equal errors. It is therefore to be feared, that he will be as much enraged at the writer

 of

of these Essays, as the devotees of the gravitating effluvia and of the eternal projectile force, on its being proved that there is in truth no such thing as an electrical fluid, and that all the appearances are mere mechanical accidents of passive matter temporarily disturbed by the causes which generate electrical phænomena.

We shall not be long in arriving at this conclusion; but we must look to FACTS, and not to THEORIES; and must avoid false analogies founded on erroneous theories.

Fact 1. Every exhibition of electrical phænomena takes place in and within ELECTRICS only.

Fact 2. The condensation or accumulation of force takes place at the surface of any body, which bounds the electric.

Fact 3. No force appears at one surface of an electric, unless a similar force appears at the opposed surface.

Fact 4. The force at one surface is of a contrary character to that at the opposed surface.

Fact 5. The force at one surface has an oxygenating or acid effect, and that at the opposed surface an azotic or alkaline effect.

Fact 6. In the galvanic excitement a palpable decomposition takes place in the fluid lying between the plates, and the latent elements decomposed appear in the acid and alkali at the opposite ends of the series.

Fact 7. In the excitement of glass and all other electric plates, one side of the plate becomes simultaneously in an opposite state to the other, and must therefore be of suitable thickness and in circumstances permitting its corresponding change of state, and the opposed sides exhibit respectively the acid and alkaline properties.

Fact 8. It makes no difference whether the conducting surface, which bounds the electric, be thick or thin; whether it be a solid metal or gold leaf.

Fact 9. When the electric plate as such is destroyed by the interposition or continuity of any non-electric, or conductor, an equilibrium takes place within the disturbed electric; and the opposed surfaces of the electric cease to exhibit electrical phænomena.

Fact 10. When the opposed surfaces are brought near to each other, an equilibrium takes place by a spark which proceeds from any projecting point of one of the surfaces; and heat and light are elicited.

Fact 11. Unless the parts of each opposed surface are united, or rendered continuous by a conductor, the phænomena are inconsiderable.

Fact 12. Some mechanical action, as friction, variation of volume,

volume, or different power of receiving or radiating heat, or atomic motion, is necessary to the production of electrical phænomena.

Fact 13. The power, when excited in any electric, is capable of being transferred to any other electric, provided the surfaces be coated with a conductor.

Fact 14. Bodies are conductors nearly in the same ratio as that in which they are conductors of heat or atomic motion; and they are electrics by a contrary law.

Fact 15. All electrical phænomena take place, and all successful experiments are made within atmospheric air.

Deductions from these Facts.

Fact 8. Proves, that electricity does not permeate the substance of conductors; for whether a conductor is hollow or solid, or of glass, or baked wood covered with gold leaf, or of solid metal, the effect is equally powerful. It is, therefore, a gross error to speak of conducting bodies as charged or surcharged, or as containing more or less than their natural quantity, &c.

Fact 1. Proves, that the electrical power resides within the adjoining electric, and this fact, and fact 8, prove that it does not reside within the body of the conductor, the best conductors having no conducting substance, but only a conducting surface.

Fact 15. Proves, that air is the universal electric, and that in all cases, a plate of air is the thing affected. But air is composed of 20 or 21 volumes of oxygen, and 80 or 79 volumes of azote, being the very principles which, by facts 5, 6, and 7, are evolved, and extricated on the opposed sides of every electric plate.

It is inferred from facts 5, 6, and 7, that all cases of electrical excitement consist merely of the decomposition or separation of the acid and alkaline principles natural to the substance and constitution of the body, or electric plate, and that the various phænomena attending the partial or general restoration constitute all the appearances called electric and galvanic.

Is the electric power, therefore, any thing more than a mechanical separation, or decomposition of the constituent, or gazeous portions of the electric? Are not the gazeous portions, by some peculiar motions, carried to the positive and negative sides of the plate? Do not all the phænomena proceed, first, from the endeavour of the oxygen and azote to return to their fit combination in air; and, second, from this often taking place suddenly? Is electricity, in fine, any thing more than an accident of the constituent atoms of air, or the similar atoms of other electrics? Or, in other words, as all experiments and phænomena take place in air, are not the phænomena of all other

electrics

electrics merely relative to the powers of air, and governed by the relative powers of each to the other, as partial conductors and partial electrics?

These questions, and the consideration of all the facts, lead to the general conclusion,—that there is no fluid *sui generis* producing electrical phænomena—nor any peculiar fluid, nor any fluid whatever concerned in electrical phænomena—and that all this class of phænomena arises from the mechanical decomposition, or temporary separation of the constituent elements of the atmospheric air, or electric medium or fluid interposed between conducting surfaces, within which electrics all the phænomena take place, as well between them and conductors, as between them and other adjacent electrics, and between them and other electrics and conductors.

Electricity is, therefore, an accident of air, or of the atoms of air, just as wind is an accident of air in mass; and it would be as rational to refer a storm to a peculiar fluid, as it is to refer the phænomena called electrical, to a peculiar fluid.

But at the time when the peculiar fluid was first invented, the constituent parts of air had not been discovered, just as the two-fold motions of the earth were not suspected when the fall of bodies was superstitiously ascribed to the earth's attraction; or just as the rotation of the earth round the fulcrum of the earth and moon was not suspected when the tides were superstitiously ascribed to the attraction of the moon. But new facts and improved reasoning render it highly proper to get rid of all these properties *per se*, fluids *sui generis*, and attractions without mechanical cause! Philosophy must be cleared of them, or the schools of philosophy will soon be as contemptible for their appeals to faith, as any of the temples of any superstition with which ignorant tribes are abused by a selfish priesthood, in any part of the world.

Behold how beautiful and simple electricity rises on the wreck of the superstitions with which it has hitherto been entangled!

The *excitement*, whatever it be, is mechanical, and it produces the mechanical effect of separating the constituent atoms of an affected or electrified plate of air or other electric.

If we excite *glass*, &c. we produce a preponderance of the acid or oxygen atoms on the proximate surface of air, and the withdrawing of these necessarily occasions an apparent preponderance of alkaline or azotic atoms on the opposed surface which it has hitherto been so difficult to understand.

If we *coat* the glass surface with a conductor, or congeries of atoms more capable than glass or air of conducting heat or atomic motion, we then unite or connect the points of the electric plate or plate of air.

If

If we present a similar coated surface in opposition to the first excited plate, we then produce a maximum of effect, *i. e.* two surfaces which unite all the points of the surfaces of the plate of air, one of which is oxygenated, or positive, and the other azotic, or negative, both exerting considerable force to co-mix in that state of fitness which rendered them atmospheric air *.

If then any light body, or body whose inertia is less than the force with which the atoms seek to reunite, be presented between the surfaces, or to one surface (the other being supposed or understood, and existing in the hand, the operator, or the walls), then the said body will be driven or *apparently* attracted, and will assist in restoring the equilibrium of the affected electric plate.

If the surfaces be moved so near, that the excitement which separated the atoms is overcome by the aptitude of their forms to reunite, and if any small point project on either surface, carrying the surfaces nearer by the thickness of the said point, then the reunion of the entire surface takes place through that point, and the concentrated force of the simultaneous rush of the oxygenous atoms in one direction, and the nitrogenous atoms in the opposite, produces the action called *light;* and also mechanical effects on all bodies which contain either oxygen or nitrogen.

The restoration, the double current, the spark (the stream being an optical illusion), and most of the other wonders vanish therefore when examined by a rational mechanical theory.

The great phænomena of nature, which take place when a vast affected plate of the atmosphere is coated by clouds, are easily understood. Some exciting cause, generally the atomic motion of heat, has decomposed the air; but the effects are dissipated in space, till a cloud coats the upper surface, and connects all the points of the affected plate of the atmosphere. Under these circumstances some cloud or point of a cloud, sinking below the general level of the surface, or some projecting point on the earth, narrows the plate in that place, and a concentrated restoration, or partial restoration, takes place at that point, exhibiting lightning, &c. &c. in such imposing grandeur that priestcraft in

* Thirty-two years ago the writer made his prime conductor of a board covered with tin-foil, and adopting the principle that every conductor is, in fact, but a coating to a plate of air, he arranged similar boards above and below, and thereby decomposed a double plate of air. Galvanism was then unknown; but if he had heard of the Voltaic pile, he would certainly have imitated it in a common electrical circle. He conceives that the ACCELERATED POWER gained in this way would be far more splendid than in the galvanic circle, because, in electricity, the power is expanded and results from the energy of natural restoration; but in galvanism the exciting power is limited, and not restored, but dissipated.

all

all ages has seized upon it as means of terrifying the ignorant and superstitious.

One might trace, examine, and easily explain all the details of the phænomena on this simple and natural theory; but enough has been said to show that ELECTRICITY is no exception to the mechanical principles of matter and motion—and in regard to the kindred phænomena of GALVANISM, I will content myself with observing, that it is merely ACCELERATED ELECTRICITY, the interposing fluid being palpably decomposed and evolving the electrical powers, each term in the series of plates being a new impulse or power added to the previous one, till the ultimate effect is accelerated, like that of a body falling by the continuous impulses of the earth's motions, or like a nail heated red-hot by accelerations of atomic motion produced by repeated percussions of a hammer.

July 11, 1820.

XXXII. *The Bakerian Lecture. On the Composition and Analysis of the inflammable gaseous Compounds resulting from the destructive Distillation of Coal and Oil, with some Remarks on their relative heating and illuminating Powers. By* WILLIAM THOMAS BRANDE, *Esq. Sec. R. S. Prof. Chem. R. I.**

THE experiments detailed in the following pages were originally undertaken with a view of ascertaining the relative fitness of the gases obtained by the decomposition of coal and oil for the purposes of illumination, and of elucidating some apparent anomalies in their economical applications. Merely as such, however, I should not have deemed them of sufficient novelty or importance to form the subject of the Bakerian Lecture; but during the progress of the inquiry, some new views relative to the constitution of these gaseous mixtures suggested themselves, and some properties of terrestrial radiant matter became apparent, which I trust will be thought worthy the attention of this Society.

SECTION I.

On the inflammable gases afforded by the destructive distillation of pit coal and of oil.

The gases used in the following experiments, except where it is otherwise expressly stated, were those employed for the common purposes of illumination; the coal gas being that supplied

* From the Philosophical Transactions for 1820, Part I.

from

from the Company's works in Westminster, and the oil gas furnished by the decomposition of common whale oil, in an apparatus erected for that purpose by Messrs. Taylors and Martineau, at Apothecaries' Hall*. These gases have been submitted to analysis by different chemists of eminence; and we are more especially indebted to Dr. Henry for a series of valuable researches respecting their production and composition†. It is therefore with considerable diffidence that I venture to propose views relating to them in many respects different from those of my predecessors in this important branch of chemical inquiry.

It is generally admitted, that there are two definite compounds of carbon and hydrogen; the one, usually termed *olefiant gas*, consisting of *one* proportional of carbon and *one* of hydrogen; and the other called *light hydrocarburet*, composed of *one* proportional of carbon and *two* of hydrogen: the former of these gases appears to have been discovered in 1796, by the associated Dutch chemists, Messrs. Bondt, Dieman, Van Troostwick, and Lawerenbourg‡, and the other first examined by Mr. Dalton§. Assuming hydrogen as 1, the specific gravity of olefiant gas is 13,4; and it contains 1 proportional of carbon =5,7 +1 proportional of hydrogen=1. Light hydrocarburet has generally been considered as consisting of 1 proportional of carbon=5,7+2 proportionals of hydrogen =2, and its specific gravity has been stated as 7,7 compared with hydrogen; or as 57365, assuming atmospheric air as 1.

My first object in the examination of coal gas was to ascertain its specific gravity; and I was surprised to find the first that I examined so low as ,4430. There was some variation in different specimens; and the specific gravity of that prepared in the laboratory of the Royal Institution, and purified in the usual way by condensation in cold vessels, and passing through lime water, was as high as ,4940, which is the heaviest that I have yet met with.

Having been led to consider coal gas as consisting essentially of the two varieties of carburetted hydrogen, I imagined that the specific gravity of the light hydrocarburet must have been estimated too high; I therefore prepared light hydrocarburet from acetate of potash, and having separated its carbonic acid by lime, found its specific gravity ,687; the specific gravity of the gas from stagnant water, according to Mr. Dalton||, is ,600,

* A description and plate of this apparatus are given in the Quarterly Journal of Sciences, &c. Vol. VIII. p. 120.

† Nicholson's Journal, Vol. XI. p. 65. Philos. Trans. 1808. Manchester Memoirs, Vol. III. New Series. Phil. Mag. Vol. XXXII. p. 277.

‡ *Journal de Physique*, XIV. § New System of Chemical Philosophy.

|| New System of Chemical Philosophy.

and that from moistened charcoal when purified is ,480*. It became evident, therefore, that coal gas could not consist principally of the two hydrocarburets; nor could the presence of carbonic oxide be suspected, its specific gravity being ,9834. Hence it occurred to me, that the only mode of explaining these apparent anomalies, was to consider coal gas as a mixture of olefiant and hydrogen gases; and the following experiments were undertaken with a view to determine this point.

1. One hundred volumes of coal gas were detonated by the electric spark over mercury, with 200 of oxygen; the carbonic acid was absorbed by liquid potassa, and 36 volumes of pure oxygen remained in the tube. Whence it appears that 100 volumes of the coal gas under examination required for its perfect combustion 164 parts of oxygen; consequently, as 100 parts of olefiant gas require 300 of oxygen, and 100 of hydrogen 50, for their respective combustion, it might be concluded from the above experiments, supposing no foreign gases present, that the 100 of coal gas consisted of about 55 parts of hydrogen and 48 of olefiant gas; a mixture, of which 100 cubical inches would weigh nearly 15 grains, and which closely corresponds with the specific gravity of the coal gas.

2. One hundred measures of coal gas were introduced into a small bent glas tube containing a little sulphur, and inverted in mercury; a red heat was applied until the inclosed gas underwent no further dilatation; and on examining its volume when cold, it was found to occupy 140 measures. If we consider the increase of bulk as resulting from the decomposition of olefiant gas, this experiment gives the composition of coal gas 60 hydrogen and 40 olefiant by volume.

3. One hundred measures of coal gas were introduced into a mercurial gasometer, connected with a second gasometer by means of a platinum tube, in the manner described by Messrs. Allen and Pepys in their Essay on the Combustion of Carbon*. Some small quartz crystals previously heated red hot were introduced into the platinum tube, which was heated bright red; the gas was then passed through it from one gasometer to the other for about a quarter of an hour. The apparatus having cooled, the gas was found to have sustained an increase of volume =40 parts; it burned with the pale flame of hydrogen; and when detonated over mercury, required scarcely more than half its volume of oxygen, and afforded a very minute portion of carbonic acid. The interior of the platinum tube was lined with charcoal, the crystals were covered with it, and some had assumed a beautiful brown tint.

* Henry's Elements, p. 320.

† Phil. Trans. 1807. Phil. Mag. Vol. XXIX. pp. 216, 315.

4. The

4. The conclusions drawn from the last experiment are founded upon the supposition, that olefiant gas is decomposed by the simple operation of a high temperature, and that one volume is resolved into two volumes of hydrogen, losing at the same time its carbon. The importance of this fact, as connected with these researches, induced me to repeat, with every requisite precaution, the beautiful experiment of M. Berthollet, which consists in decomposing this gas by passing it repeatedly through a red hot earthen tube; instead of which, however, I employed a tube of platinum, arranged as in the last experiment, increasing the heated surface by the introduction of quartz crystals. One hundred measures of olefiant gas*, obtained by distilling alcohol with sulphuric acid, were passed and repassed through the tube heated to high redness, until they ceased to dilate: when the apparatus was cool, the volume of gas was almost exactly doubled; there was a copious deposition of charcoal in the part of the tube that had been ignited, and the evolved hydrogen was so free from carbon, that when detonated with its volume of oxygen, half a volume of the latter remained, which scarcely rendered lime water turbid, and underwent no perceptible diminution by exposure to liquid potassa.

It may be supposed, that in consequence of the dilution of the last portions of olefiant by the hydrogen evolved, the perfect decomposition of the gas is a matter of difficulty; and a trace of carbon will, I believe, always remain in the hydrogen evolved, since the decomposition is progressive. I cannot, however, on this account see reason to believe, with M. Berthollet†, that carbon and hydrogen are capable of forming several definite compounds; the data are, on the contrary, such as to warrant an opposite conclusion.

In making this experiment in the manner just described, and more especially when the tube is only dull red, the first portions of gas that reach the receiving gasometer are obscured by a considerable quantity of vapour, which, however, afterwards disappeared. To examine more particularly the cause of this phænomenon, I passed some pure olefiant gas, very slowly, through a red hot glass tube, about two feet in length, and containing in the heated part some pure and well burned charcoal: the gas was collected in a cold receiver, the sides of which became lined with a brown viscid substance of an agreeably fragrant odour, perfectly soluble in alcohol, and precipitated from this solution

* This gas was washed with solution of potassa to separate a little carbonic acid, and was then ascertained to be pure by the action of chlorine, with the precautions afterwards described.

† Thenard, *Traité de Chimie*, tom. I. p. 293.

lution by water, which rendered it turbid, and of a whitish green hue. This peculiar resinous matter appears to be a compound of hydrogen and carbon: its vapour is perfectly decomposed by passing it through a highly heated platinum tube, hydrogen being evolved, and carbon deposited.

5. Mr. Faraday, whose accuracy as an operator is not inferior to his assiduity as my Assistant in the Laboratory of the Royal Institution, has shown in a paper published in the Quarterly Journal of Science, that the supposed distinction between olefiant and light hydrocarburet, by means of the action of chlorine, has no foundation; and that at common temperature, all varieties of carburetted hydrogen are condensed by, and combined with, chlorine.

To ascertain how far the action of chlorine could be depended upon as a means of analysing mixtures of olefiant and hydrogen gases, I mixed equal volumes of chlorine and hydrogen, over water at the temperature of 55°, in a tube of half an inch diameter, and exposed to ordinary daylight, but carefully excluded from direct sunshine. After twenty-four hours, the whole of the chlorine had been absorbed by the water, and the original volume of hydrogen remained unaltered.

One volume of hydrogen mixed with one of olefiant gas and two of chlorine, was reduced under the same circumstances to very little more than one volume, the whole of the olefiant having been absorbed.

In these cases it is convenient to use considerable excess of chlorine, and in this way the purity of olefiant gas may be ascertained: it will be found, even when obtained with every caution, to afford a small residue of hydrogen; but as this is sometimes as little as one per cent, it may, generally speaking, be disregarded.

6. The analysis of a mixture of hydrogen with carburetted hydrogen, carbonic oxide, and carbonic acid, presents peculiar difficulties in the ordinary mode of proceeding; and as it often requires to be performed in investigations relating to the gases used for illumination, it became an object to facilitate the process, for which I have used the following plan.

A hundred measures of the gas are introduced into a graduated tube, and the carbonic acid absorbed by a solution of potassa; the remaining gas is then transferred to thrice its volume of chlorine of known purity, standing over water in a tube of about half an inch diameter, and exposed to daylight, but carefully excluded from the direct solar rays; after twenty-four hours the carburetted hydrogen and the excess of chlorine will have been absorbed, and the remaining gas, consisting of carbonic

oxide

oxide and hydrogen, may be analysed by detonation with oxygen in excess; the measure of carbonic acid formed being the equivalent of that of the original carbonic oxide.

This proceeding depends upon the non-formation of chlorocarbonic acid in a mixture of carbonic oxide and chlorine in the contact of water, and out of the direct agency of the solar rays. Such mixture I have kept several days, occasionally renewing the chlorine as it became absorbed by the water, and have not observed any diminution in the bulk of the carbonic oxide. In all these cases it is necessary to ascertain the purity of the chlorine by its absorption by water, and to be aware of the evolution of common air from water during that process.

7. I repeated many of the above experiments, substituting for coal gas a mixture of six volumes of hydrogen with five of olefiant gas. The specific gravity of this mixture was ,4700; one hundred cubical inches weighing 14,2 grains. The flame with which this mixture burned was of the same colour and intensity as that of common coal gas; its dilatation by heat was similar, and it underwent an analogous increase of bulk when heated with sulphur.

The readiness with which carburetted hydrogen is decomposed, when passed through red hot tubes, appears to me to offer a solid objection to a mode of purifying coal gas, which has been proposed by Mr. G. H. Palmer*, since it would deposit carbon, and consequently sustain great loss in illuminating power. The object in view was probably to get rid of the sulphuretted hydrogen; but neither is this so to be attained. In examining coal gas, I have often been struck with the formation of sulphurous acid during its combustion; though when passed through solution of acetate of lead, it occasioned no blackening, a circumstance which led me to suspect the presence of some other sulphureous compound; and I have often thought, in passing the open gas pipes in the streets, that I perceived the smell of sulphuret of carbon. When sulphurous acid or sulphuretted hydrogen are passed with carburetted hydrogen through a red hot tube, a portion of carburet of sulphur is always formed, and the vapour of that highly volatile compound may well exist in the gas employed for illumination, which is always hurried through the condensers and gasometer.

8. Most of the above experiments were now repeated upon the gas obtained by the decomposition of whale oil; its specific gravity was ,7690; so that 100 cubical inches weighed rather more than 23 grains. Deducing the composition of this gas, considered as a mixture of hydrogen and olefiant, from its specific gravity, we should conclude that it is composed of 1 volume

* Peckston on the Theory and Practice of Gas-lighting, p. 213.

of

of hydrogen and 3 of olefiant, upon the presumption that 100 cubical inches of hydrogen weigh 2,25 grains, and 100 of olefiant 30,15.

Such a mixture, when submitted to the action of heat, of sulphur, and of chlorine, and when detonated with oxygen, afforded results similar to those obtained by experiments upon the original oil gas, and it burned with the same degree of briliancy.

9. I have also submitted to similar experiments the inflammable gases obtained by the decomposition of acetate of potash, of alcohol, and ether, and by passing water over red hot charcoal. All these contain a considerable portion of carbonic acid, which, when abstracted by potassa, leaves a mixture of carburetted hydrogen, hydrogen, and carbonic oxide, in proportions liable to much variation, according to the materials employed, and to the circumstances under which their decomposition has been effected. The specific gravity of these products is of course liable to corresponding variations.

10. The inference which, I think, may be drawn from the preceding experiments and observations, is, that there exists no definite compound of carbon and hydrogen, except that usually called *olefiant gas;* that the various inflammable compounds employed for the purpose of illumination, and produced by the destructive distillation of coal, oil, &c. consist essentially of a mixture of olefiant gas and hydrogen ; that the gas procured from acetate of potash and from moist charcoal contains the same elements, with carbonic oxide and carbonic acid ; and that no other definite compound of carbon and hydrogen can be recognised in them, except olefiant gas.

Section II.

Comparative experiments on the illuminating and heating powers of olefiant, coal, and oil gases, and on some general properties of radiant matter.

1. In the following experiments I employed a gasometer with counterpoise weights acting over regulating pullies, and capable of containing about 5000 cubical inches, or about 2,89 cubical feet: the different jets were attached to it in the usual way, and the pressure was measured by the difference in the level of the water within and without the bell, to which was attached an accurately graduated scale sliding through the frame of support.

2. Having filled this gasometer with pure olefiant gas, it was allowed to issue from a brass jet having a single perforation of $\frac{1}{60}$ of an inch diameter, under a pressure of a half inch column of water ; it was then inflamed, and regulated by means of a stopcock, so as to produce a light equal to that of a wax candle burning with full brilliancy; the relative intensity of the light of these

these flames was ascertained by a comparison of shadows. Under these circumstances, the consumption of gas was found = 640 cubical inches per hour, or 0,37 cubical feet. When the same burner was used with oil gas, it consumed 800 cubical inches per hour, or =0,47 cubical feet.

3. I now employed an Argand burner, with a cylindrical glass, constructed in the usual way, with 12 holes each of the same dimensions as that of the single jet, and forming a circle 0,7 inch diameter. The pressure being 0,5 inch, the flame was so regulated as to burn with its full intensity without producing smoke, and its light being measured by a comparison of shadows, it was found equal to ten wax candles. The consumption of gas amounted to 2600 cubical inches, or about a cubical foot and a half per hour.

If the result of this experiment be compared with the above, in which a single jet was used, it will appear that the proportion of light from a given quantity of gas is increased in a very high ratio by employing many flames near each other, the consumption of the single jet giving a light of one candle, being =640 cubical inches, whereas the Argand burner gave a light of ten candles, with the consumption not of 640×10 cubical inches, but of 2600 cubical inches. It will be remembered, that in the latter the combustion is perfected by a central current of air, rendered more rapid by the glass tube which surrounds the flame. Count Rumford showed some time ago, "that the quantity of light emitted by a given portion of inflammable matter in combustion, is proportional in some high ratio to the elevation of temperature, and that a lamp having many wicks very near each other, so as to communicate heat, burns with infinitely more brilliancy than the Argand lamps in common use*." The construction of the gas Argand burner is particularly calculated to produce an effect of this kind; and to such a cause the great increase of light relative to the consumption of gas may probably be attributed.

4. The gasometer being filled with oil gas, an Argand burner, giving the light of eight wax candles, was found to consume 3900 cubical inches per hour; and the same intensity of light was produced by the same quantity of artificial oil gas; that is, of a mixture of three parts of olefiant and one of hydrogen.

5. The apertures of burners for coal gas require to be considerably larger than those for olefiant or oil gas. In the burner employed in the following experiments, each hole was $\frac{1}{30}$ inch diameter, and the circle upon the circumference of which they were placed, was 0,9 inch diameter. The light of the flame was

* Davy's Elements of Chemical Philosophy, p. 224.

found

found equal to five wax candles only, and the consumption of gas per hour amounted to 6560 cubical inches.

With a mixture of six parts by measure of hydrogen with five of olefiant gas, the light of the flame was somewhat more intense; and the quantity of gas consumed by the same burner, so adjusted as not to smoke, was 6000 cubical inches.

6. It appears from the above data, that to produce the light of ten wax candles for one hour, there will be required,

2600 cubical inches of olefiant gas.
4875 - - - oil gas
13120 - - - coal gas;

and that the quantity of oxygen consumed

by the olefiant gas will be = 7800 cubical inches.
by the oil gas - =11578.
by the coal gas - =21516.

Olefiant gas cannot of course be employed for any economical purposes, and is only here adverted to for the sake of comparison. The relation of the quantity of oil gas to that of coal gas, furnishes a datum that may be practically useful, especially as indicating the relative sizes of gasometers required for the supply of establishments. It may, I think, be stated with sufficient accuracy for practical purposes, that a gasometer containing 1000 cubical feet of oil gas, is adequate to furnish the same quantity of light as one of 3000 cubical feet of coal gas, provided due attention be paid to the construction of the burners, and to the distribution of the lights.

7. For the ordinary purposes of illumination by oil gas, I consider ten-hole Argand burners, each consuming about a cubical foot and a half per hour, and giving the light of seven wax candles, or nearly two oil Argands, as the most economical and generally useful. Single jet burners, or those in which the flames do not coalesce, consume, as has been above shown, a very much larger quantity of gas for the production of an equal quantity of light; and for the same reason, Argand burners, in which the flames do not coalesce, consume more gas for an equal production of light, than those in which the apertures are more numerous, but sufficiently near each other to allow of the union of the separate flames.

8. To ascertain the relative heating powers of the flames of olefiant oil, and coal gases, I employed the twelve-hole Argand burners mentioned above, and placed over each, as near to the lamp glass as was consistent with a clear flame, a clean copper boiler, 2,5 inches deep and 5 inches diameter, slightly concave at bottom, capable of holding rather more than a quart of water, with an immersed thermometer, and a small vent for steam. It contained two pounds of distilled water, which was raised to the

boiling

boiling point in similar times, namely, 20′ by each of the flames; so that it would appear, that to raise a quart of water from 50° to 212°, at 30 inches barometrical pressure, requires

870	cubical inches of	olefiant gas,
1300	- -	oil gas,
2190	- -	coal gas.

From this experiment it may be inferred, that the air of a room equally lighted by oil and coal gas, will be much less heated by the former than the latter; but that the actual heating power of the flames is in the direct ratio of the quantity of olefiant gas.

9. Having occasion in some of the foregoing experiments to produce light of great brilliancy by the combustion of olefiant gas, and finding it very difficult to measure its intensity by a comparison of shadows, in the manner pointed out by Count Rumford, I endeavoured to avail myself of Mr. Leslie's photometer: for this purpose I concentrated the light by a plano-convex lens, and placed the blackened ball of the instrument in the focus. I found the effect, however, so great as to lead me to believe that I had obtained a focus of considerable heating power, and on substituting a delicate mercurial thermometer, it rose 4°,5 in 5′. In the focus thus obtained from the light of a large Argand burner supplied with olefiant gas, the elevation of temperature was very sensible to the hand; and in depressing and elevating the flame by means of a regulating stopcock, corresponding effects were produced upon the thermometer: the lens itself, which was a thick one, did not become heated.

These experiments coincide in result with those of Dr. Maycock, and of M. Delaroche*, and show that the calorific rays emanating from common combustibles, are capable of passing through transparent media like those of the sun.

10. There are certain substances, the chemical relations of which are singularly affected by the influence of direct solar rays. Among these, the mixture of chlorine and hydrogen is most remarkable: if kept in common daylight, but out of direct sunshine, the gases do not act upon each other; but the moment the mixture is placed in the sunshine, the muriatic acid begins to be formed. I therefore hoped that this property might be applicable in certain photometrical experiments. I exposed a mixture of equal volumes of chlorine and hydrogen, in a tube inverted over water, capable of holding about four cubical inches, and blown into a thin bulb at its upper extremity, to the brilliant focus produced by a large olefiant gas flame; it was exposed for 15′, but underwent no other change than a slight increase of bulk, acting as an air thermometer.

11. It now occurred to me to try how far any effect would be pro-

* Murray's System of Chemistry, vol. i. p. 336. 4th Edition.

produced by the more intense light of the Voltaic battery, and I placed the tube containing the mixed gases in a darkened room, within about an inch of the charcoal points connected with an apparatus of one hundred pairs of plates highly charged: upon making the contact, the effect of the light upon the mixed gases was very remarkable; fumes of muriatic vapour were instantly produced, the water rose in the tube in consequence of the production of muriatic acid, and in about five minutes the absorption was entire; but the most curious circumstance was, that in two instances an explosion of the gases took place the moment they felt the impulse of the electric light.

12. As I have in no case been able to produce an analogous effect by any other terrestrial light, however intense, I cannot but consider the phænomenon as dependent upon some peculiar property belonging to the rays of solar and electric light.

The lunar rays produce no effect upon mixed chlorine and hydrogen, nor upon chloride of silver; neither was the whiteness of the latter in the slightest degree impaired by the most powerful luminous focus that I could obtain from an olefiant gas flame.

13. In some experiments connected with the subjects of this communication, I have availed myself of a photometric thermometer, acting upon the principle of that described by Mr. Leslie, but infinitely more sensible: it is constructed nearly in the same way as the differential thermometer, but instead of containing air, the balls are filled with the vapour of ether, and the stem contains a column of that liquid; it thus forms a very delicate differential thermometer. To convert it into a photometer, the upper bulb is covered with a thin coating of India ink, and the lower one with silver or gold leaf; the whole instrument is then placed in a pellucid glass tube: when taken out of its case the influence of light is perceived at the instant of exposure, by the falling of the liquid from the blackened to the metallic side; it is powerfully influenced by the flame of a candle at the distance of one foot, and proportionally by other luminous bodies.

[To this paper is annexed a drawing of an Argand burner for oil gas upon what Mr. Brande believes to be the most œconomical construction. It differs from the common gas Argands, in having the top of the cylinders joined, not by a flat perforated plate, but by two bevilled rims, ascending from the inner and outer tube respectively, and joining each other at nearly a right angle, the sharp angle being taken off a little on the upper part, so as to make a flat face for the holes. The bevilling of the perforated edge contributes greatly to the perfection of the light, as shown in the section, Fig. 1. The diameter of the circle of holes is 0,7 inch, and the holes should not be more than $\frac{1}{60}$ of an inch in diameter. Consuming at the highest average 4000 cubical inches per hour, it gives the light of between eight and nine wax candles of four to the pound.

What is technically termed a *rose burner* has six holes of the same dimensions as those of the Argand; and when so regulated as to produce a light equal to that of six wax candles, its greatest average consumption of gas amounts to 4800 cubical inches per hour.]

XXXIII. *Re-*

XXXIII. *Remarks on a* Newtonian's "*Observations on the Phænomena of the Universe,*" *published in the Philosophical Magazine for last Month.*

To Mr. Tilloch.

Sir, — Your correspondent who calls himself a Newtonian, erring in his very first deduction from the principles of Sir Richard Phillips, and his subsequent deductions being founded on his first, all his inferences are false, and the whole of his reasonings erroneous.

He says, "that the density of the gaseous medium, the density of the planets, and their velocities in their orbits, decrease from the sun to the confines of the solar system!"

Now, sir, nothing of the kind is to be inferred, or gathered, or assumed from the Essays of Sir Richard Phillips. He generally asserts that all phænomena are effects of motion, as variously imparted to aggregates, or to atoms of aggregates,—that the twofold motions of a planet constitute its power of aggregation, and cause all bodies to fall to the centre; and that as the *common force* which revolves a planet creates equal *momenta* in every stratum and part of the mass, the quantity of matter in every stratum must be, or must have a tendency to be, inversely as its velocity or radius; consequently that any dense body raised to a stratum of disproportionate velocity must be precipitated to others of less velocity, till the *momentum* accords with the *common force*, or is equal to the *momentum* of the other parts of the mass; and hence the fall of bodies to the centre.

In some subsequent *speculations* on the causes of the planetary motions, he ascribes them to the action or motion of the sun on the medium filling space, which, as far as can be collected from his words, he considers homogeneous, and of uniform density; the cause, effect, and law of propagation requiring no variation of density.

Your correspondent must therefore have read with his understanding shut, or have intended to *hoax* your readers with a *double entendre* at the expense of truth.

If he or any Newtonian can show that the aggregate of the heterogenous bodies constituting a planet is not revolved or moved by a *common* force; and if he can show that a *common* force can revolve bodies with unequal *momenta*, then he may be able to prove that Sir Richard Phillips is in error; and that dense bodies will not be impelled towards the centre, or to shorter circles of revolution, whenever they happen to lie in circles, which confer a velocity greater than the common force can confer on their density: in other words, till it can be shown that the same

 force

force will carry a cubic foot of cork and a cubic foot of silver with equal velocity, it must be granted, that the silver cannot be revolved by the same mundane force in the same circle as the cork, and that if placed together (nearly as in water) one must ascend towards its circle of accordant velocity, and the other descend, which is the doctrine of Sir Richard Phillips; and it explains the phænomena of the descent of relatively dense bodies, and the ascent of relatively rare ones, on palpable principles of motion, without having recourse to any power like that of attraction, repulsion, or gravitation.

Brentford, Sept. 5, 1820. PHILO-VERITATIS.

XXXIV. *The Results of Observations made at the Observatory of Trinity College, Dublin, for determining the Obliquity of the Ecliptic, and the Maximum of the Aberration of Light. By the Rev.* J. BRINKLEY, *D.D. F.R.S. and M.R.I.A. and Andrew's Professor of Astronomy in the University of Dublin**.

OBSERVATIONS have been made by the eight feet circle of the Observatory of Trinity College, Dublin, at the respective summer solstices since the year 1809, with the exception of two. The obliquity of the ecliptic thence resulting, has always agreed so nearly with that adopted in the French tables, that I have heretofore thought it useless to make any public communication relative thereto. But some circumstances have now induced me to lay my results before the Royal Society.

The recent publication of Mr. Bessel's valuable labours on the observations of Dr. Bradley, has afforded us a more exact determination of the obliquity of the ecliptic, as deduced from the early observations by the Greenwich quadrant, than we before possessed. The comparison of this with the present obliquity, gives us the diminution for an interval of nearly 60 years, with a considerable degree of accuracy, and almost sufficient to enable us to state with some confidence the mass of Venus.

To obtain this point with a greater degree of certainty, the present obliquity, as deduced from a mean of the observations of different astronomers, should be used.

It has been an opinion almost generally received among astronomers, that observations of the winter solstice have given a less obliquity of the ecliptic than observations of the summer solstice.

The explanation of this seemed very difficult. But in the above-mentioned work of Mr. Bessel, he calls in question this

* From Phil. Trans. Royal Soc. for 1819. Part. II.

opinion,

opinion, and shows that the observations of Dr. Bradley give the same result both in summer and winter. His own observations also tend to the same conclusion. The observations of Dr. Maskelyne, of M. Oriani, of M. Arago, and of Mr. Pond, are in opposition to these; to which my own may be added.

It is not likely that this difference really exists; but it is a question of some importance in astronomy, and the explanation thereof may throw some light on other points.

It is probable the difference arises from some unknown modification of refraction. I find, and I believe other observers have found the same, that at the winter solstice, an irregularity of refraction takes place for the sun greater than for the stars, at the same zenith distance. The zenith distance of the sun at this place is then nearly 77°.

What Mr. Bessel has adduced certainly tends to render the prevalent opinion doubtful. It therefore appears to me of consequence, that astronomers should pay attention to the observations at the winter solstice. My observations at that time have been much fewer than in the summer, because, on account of the uncertainty of refraction, I considered them of less importance.

It has been proposed to make the two results agree, by an increase of the quantity of Bradley's mean refraction; but this could not be done without increasing it by a quantity greater than can be justified by other determinations respecting refraction.

Considering then this uncertainty respecting the observations of the winter solstice, it appears better to compare the results from Dr. Bradley's summer solstices, with the result as deduced from the mean of the observations of different astronomers.

Mean Obliquity, Jan. 1, 1813.

M. Oriani *	4 summer solstices	23°	27′	50″,34
Mr. Pond †	2 summer solstices	23	27	50 ,37
Mr. Arago ‡	2 summer solstices	23	27	50 ,09
Dr. Brinkley	8 summer solstices	23	27	50 ,99
Mean Jan. 1.	1813	23	27	50 ,45
Dr. Bradley, Jan. 1.	1755	23	28	15 ,49
diff.	58 years.			25 ,04

This gives 0,″ 43, for the annual diminution.

* See Mr. Bessel's work, p. 62.

† Phil. Trans. 1813, p. 304. This is corrected for the solar nutation.

‡ *Conn. des Temps*, 1816, The observations were made with a three feet repeating circle.

The

The mean of 18 observations near the winter solstice gives me mean obliquity Jan. 1, 1813, 23° 27′ 48″,14.

The above determination of the obliquity by observations near the summer solstice gives (taking the annual diminution 0″,43),

Mean obliquity Jan. 1, 1800 = 23° 27′ 56″,0, differing only 1″ from that assumed in M. Delambre's tables of the sun. And as far as my own observations are concerned, the difference does not exceed half a second.

In M. Zach's solar tables, there is given a determination of the obliquity of the ecliptic computed by M. Gerstner, from a mean of a great many observations of Dr. Maskelyne's, made at 19 summer solstices. Although the results of the several solstices are rather discordant, more so than was to be expected from a fixed instrument, yet it is likely a mean of 173 observations cannot be far from the truth.

This mean is 23° 28′ 11″,0 for 1769,
when reduced to 1800, is 23 27 57, 7,

which agrees sufficiently near with the present determination, to show that, if the necessary corrections for the sun's latitude, &c. had been used, the result would probably have been very exact.

The mean of 102 observations at 17 winter solstices computed by M. Gerstner, gives for 1769—23° 28′ 3″; a result which, after making all possible allowances for the error of the quadrant, is considerably less than that deduced from the summer solstices.

In using the eight feet circle, two or more observations were made a few minutes before the sun arrived at the meridian, and then the instrument was reversed, and observations made after the passage. The results were carefully reduced to the meridian; the upper and lower limbs being observed, the zenith distance of the centre was deduced from the instrument itself. This facility of reversing the instrument seems more likely to produce exact results, than those obtained by a fixed instrument, although from the necessary effect of the action of the sun on the parts of the instrument, the results must be expected to be more discordant than those obtained by a fixed instrument.

The

The results of the several observations are as follow.

Time of Observation.	Observed Declination.	Corr. for ☉'s Lat.	Mean Obliquity reduced to Jan. 1, 1813.
1809. June 9	22° 56′ 4″,34	+ 0″,24	23° 27′ 51″,43
14	23 16 24,84	+ 0,82	50,85
15	23 19 15,49	+ 0,85	50,76
17	23 23 41,83	+ 0,84	49,56
18	23 25 15,58	+ 0,82	46,67
19	23 26 28,74	+ 0,74	47,87
22	23 27 37,58	+ 0,32	49,58
27	23 21 17,24	− 0,40	52,76
1810. June 1	22 0 37,31	+ 0,49	23 27 50,00
6	22 37 23,04	+ 0,64	47,55
20	23 27 7,65	− 0,55	49,43
22	23 27 43,28	− 0,29	53,43
1811. June 18	23 24 35,59	+ 0,63	23 27 52,67
19	23 25 58,05	+ 0,68	51,07
22	23 27 40,65	+ 0,66	50,78
1813. June 22	23 27 41,28	+ 0,25	23 27 53,58
24	23 26 17,22	+ 0,34	50,07
25	23 24 59,75	+ 0,33	49,97
26	23 23 17,68	+ 0,28	50,06
28	23 18 38,88	+ 0,05	49,36
1814. June 15	23 18 40,32	+ 0,65	23 27 49,01
19	23 26 21,29	+ 0,07	51,22
21	23 27 40,26	− 0,26	49,63
22	23 27 42,88	− 0,42	49,23
23	23 27 21,44	− 0,56	49,63
24	23 26 35,25	− 0,65	50,02
25	23 25 23,89	− 0,69	50,12
1815. June 21	23 27 41,40	+ 0,03	23 27 52,78
22	23 27 48,76	+ 0,16	51,48
27	23 22 24,08	+ 0,73	54,56
28	23 20 1,40	+ 0,76	51,46
29	23 17 16,13	+ 0,76	50,45
1816. June 16	23 22 29,42	+ 1,15	23 27 52,31
21	23 27 50,73	+ 0,88	51,23
28	23 18 3,91	− 0,11	53,61
1818. June 11	23 4 50,08	− 0,76	23 27 49,23
12	23 9 2,50	− 0,64	53,29
18	23 25 20,22	+ 0,33	54,81
20	23 27 26,32	+ 0,67	53,23
22	23 27 55,72	+ 0,51	53,53
24	23 26 44,04	+ 0,35	51,92
30	23 13 20,25	− 0,42	51,53

In

In the paper which I had the honour of presenting to the Royal Society last year, I mentioned my doubts as to the quantity of the maximum of the aberration of light; and that, as far as could be ascertained from Dr. Bradley's Wanstead observations with a zenith sector, we ought rather to adopt 20″,00 than 20″,25. I also mentioned that it would be desirable to investigate this point, and therefore during the last year, I instituted a course of observations for this purpose, and I beg leave to offer the results thereof.

	No. Ob.	Max. Aber.	N. P. D. By Observations in 1818.	N.P.D. Before.
		″	° ′ ″	″
α Cassiopeæ	22	20,72	34 27 43,34	43,59
Polaris	23	20,73	1 39 44,55	44,27
α Ursæ Maj.	23	20,04	27 16 7,50	7,38
γ	27	21,20	35 17 34,83	36,22
ε	30	21,36	33 3 0,26	0,45
ζ	20	20,15	34 7 15,31	17,63
η	21	21,12	39 46 29,15	29,37
	166	20,80		

By these the maximum appears to be 20″,80, which is much greater than I had expected. While these observations were going forward, Mr. Bessel's work above mentioned was published. From several investigations in the Greenwich observations of Dr. Bradley, he also deduced the maximum = 20″,70, nearly. These results certainly appear extraordinary, and are not likely to be acknowledged by astronomers, unless they shall be established by a great number of observations.

My results were computed with great care, allowances being made for the ellipticity of the earth's orbit. It is not likely, supposing the velocity of the light of all the stars to be the same, that the result can err more than ¼ of a second*.

By continuing the observations, I hope to obtain further information on this interesting point. And it appears to be an inquiry deserving of the joint co-operation of astronomers.

* The observations of Mr. Pond with the fixed telescope, may be adduced as contrary to my results; because with this maximum of aberration, his summer and winter differences of N. P. distance of β Aurigæ and α Cygni would differ by 1″ in a direction contrary to parallax. But it also seems to show the necessity of exact determination of the precise quantities of the equations for N. P. D. before any conclusive arguments respecting the non-existence of parallax, from observations of the positions of stars relative to each other can be adduced. In observations by the eight feet circle this is not so necessary, as has been before mentioned.

These

Those instruments which admit of observing each star, without a reference to other stars, seem best adapted thereto. It is not likely that the maximum of aberration differs in different stars; yet this ought not to be taken for granted.

The mean N.P.D. Jan. 1, 1818, deduced from former observations, have been put down as a proof of the consistency of my instrument. ζ Ursæ Majoris is the only star in which the difference is worth notice. Whether this difference is from the error of observation, or from any uncertainty in the proper motion of the star, it is difficult to say. Three results reduced by Bradley's refraction are as follow.

		N. P. D. Jan. 1, 1815.
My observation,	1812	34° 6′ 19″,99
Mr. Pond's observation,	1815	18 ,92
My observation,	1818	17 ,67

A comparison of independent results is for many reasons much to be desired. I offer the above principally with a view of calling the attention of astronomers to such investigations.

It appears to me, that the only method by which an explanation of the difficulties that have occurred, from a comparison of the Greenwich observations and of those made at this Observatory, can be obtained, is from an *extensive* series of observations of many stars, referring each to the apparent zenith point. I am therefore pursuing such a course of observations. Conclusions as to the existence or non-existence of parallax, from comparisons of the *relative* places of stars taken indiscriminately, must be liable to much uncertainty, whether the comparisons be made by polar distances or by right ascensions. The former being affected by the uncertainty of refraction, may, at first view, be thought more subject to error than the latter; but a careful consideration of the circumstances attending the latter method, will show that it has its peculiar difficulties*.

* As Mr. Bessel's determination of the maximum of aberration has been referred to, it may also be right to mention his results respecting the parallax of certain stars. He uses transit observations of stars nearly opposite in right ascension (p. 110, &c.) Thus he finds the sum of the parallaxes of Sirius and α Lyræ insensible, and the sum of the semi-parallaxes of Procyon and α Aquilæ, nearly 1″. This method of using the transit observations is undoubtedly far preferable to that of using them indiscriminately. With respect to the observations Mr. Bessel had to compute from, I think it must be allowed they were not sufficiently exact, to give much weight to his conclusions. The methods of observing with the transit, and of entering the observations, were then far inferior to the present. This objection, however, does not apply to the observations of the pole star, and therefore does not affect the maximum of aberration deduced from the observed right ascension of that star.

XXXV. *Notices respecting New Books.*

The Cyclopædia; or, Universal Dictionary of Arts, Sciences, and Literature, by Abraham Rees, *D.D. F.R.S. F.L.S. S. Amer. Soc.; with the Assistance of eminent professional Gentlemen:* 4to, 39 *volumes, besides* 5 *volumes of Plates, and* 1 *of Atlas.* Longman. 85 parts at 1*l.* in Bds. royal 36*s.*

It would be unpardonable in us to pass without notice the completion of a Work, which has occupied upwards of Eighteen years in its publication; and which, far more than any other single Work which has preceded it, or that perhaps has been contemporary with it, has *extended the bounds of useful knowledge*, by putting upon record, and making accessible to general Readers, the improvements made and making, in nearly every branch of Science and of the Arts, particularly all those of the latter, which have Chemistry or Mechanics for their basis. The numerous Plates (by *Lowry*) of Machines and Apparatus for effecting almost every kind of purpose, which are given in this Work, have a minuteness of detail, and a degree of accuracy in the drawing and Engraving, which are without a parallel in any Work extant: the Articles referring to these Plates*, have in general the merit, of having been written by Persons, either extensively engaged in the Art or Manufacture treated of, or else they have been written by scientific Persons, who have, with few exceptions, qualified themselves for the task, by minute investigations and inquiries, carried on in the most extensive of the Laboratories, Work-shops, Manufactories and public Works, which so distinguish our Country, by consulting original Works, and by researches in the learned Transactions and Scientific Journals, for records of the origin of inventions and improvements, and of the progress and proceedings relating thereto; in the furnishing of which materials, the Writer is glad to perceive, that the "Philosophical Magazine" has held a distinguished place in the estimation of numbers of the *Cyclopædia* writers. With respect to most of the other branches of Art, and the useful or curious applications of Science and Literature, the Articles thereon, have mostly been written by Men, eminent in their several Professions, or paths of Study, as will be perceived by perusing the following list, which we have prepared, from the ac-

* It would be an act of injustice in the Writer, were he to omit mentioning, the large share which Mr. Wilson Lowry has had, in procuring the assistance of able scientific Men, as contributors to this Work; seeing, that Dr. Rees in his Preface, has wholly omitted to mention this distinguished Artist!

knowledge-

knowledgements made by Dr. Rees, in the Preface to the first volume, compared with the announcement of his Contributors' Names, which were printed on the Covers of Parts 8 to 28, inclusive, with a few additions, which have happened to fall within the Writer's knowledge or inquiries.

Abernethy, John	Anatomy, Physiology
Aikin, Arthur	Chemistry, Geology, Mineralogy
Aikin, Edmund	Architecture
Anderson ..	made Drawings
Arrowsmith, Aaron ..	directed Maps
Bacon, John	Sculpture
Bakewell, Robert ..	Geology, Mineralogy, Rock, Strata, Wool, Worsted, &c.
Barlow, Peter	Algebra, Analysis, Geometry, Strength of Materials
Bateman, Dr. Thomas ..	Medicine
Blair, William	Cipher, Surgery
Bland, Dr. Robert ..	Midwifery
Bonnycastle, John ..	Algebra, Analysis, Astronomy
Brande, William Thomas	Chemistry
Britton, John	Topography
Burney, Dr. Charles ..	Musical Biography, Music
Carpenter, Dr. Lant ..	Education, Language, Mental and Moral Philosophy
Cavallo, Tiberius ..	Dynamics, Electricity, Machinery, Magnetism, Mechanics
Clarke, Bracy	comparative Anatomy
Clarkson, ..	various Articles
Cooper, Samuel	Surgery
Cuthbertson, John ..	Electricity
Dalton, John	Chemistry, Meteorology
Daniell, Thomas and Wm.	made Drawings
Davy, Dr. John	Chemistry
Davy, Sir Humphry ..	Chemistry
Dickson, Dr. R. W.	Agriculture, Meteorology
Donovan, Edward ..	Conchology, Entomology, &c.; made Drawings for, and arranged Nat. Hist. Plates
Duncan, John	Manufactures, Weaving
Edwards, Sydenham ..	made Nat. Hist. Drawings
Ellis, Henry	Antiquities, and various Articles
Farey, John, Sen. ..	Canals, Geology*, Measures, Music, Trig. Survey

* See our 45th vol. p. 335, Note.

Farey, John, Jun... ..	Machinery, Manufactures, Mechanics, Mill, Steam-Engine, Water, &c.; made numerous Mechanical Drawings
Farey, Joseph	made many mechanical and miscellaneous Drawings
Flaxman, John	Sculpture
Fletcher, John	Chemistry
Glenie, James	Artillery-Carriages, Cannon, Fortification
Glover, George	Naval Architecture
Haslam, Dr. John ..	Mental Derangement
Henderson, Dr. Alexander	Medicine
Hinckes, Rev. Josiah ..	Geography
Hoare, Prince	Sculpture
Howard, Henry	Drawing, and various Articles
Howard, Luke	Meteorology
Jones, Dr. ..	Grammar, Language
Joyce, Rev. Jeremiah ..	various Articles
Ivory, James	Conic Sections, Curves, Geometry
Kelly, Dr. P. ..	Coinage, Exchanges, Standard, Weight
Kirkman, ..	made Drawings
Köenig, Charles	Gem, Gem-Engraving, Geognosy, Mineralogy
Landseer, John	French, Italian and other Schools of Engraving
Lawrence, William ..	Anatomy, Human and Comparative, Physiology
Lowry, Wilson	made Drawings for some, and Engraved very numerous Plates
Macartney, Dr. James ..	Comparative Anatomy, Physiology
Mackay, Dr. Andrew ..	Navigation
Malkin, Dr. ..	Biography
Marcet, Dr. Alexander	Chemistry
Milner, Dr. John ..	Gothic Architecture
Milton, Thomas	engraved Nat. Hist. Plates
Moor, Major	Indian Mythology
Morgan, William ..	Annuities
Mushett, David	Blast and Blowing Furnaces, Iron-Manufacture
Nayler, Sir George ..	Heraldry
Nicholson, Peter	Architecture, Carpentry, Joinery, Panorama, Perspective, Projections, Proportional Compasses, Shadows, Stereography, Stereotometry, &c.

Opie,

Opie, John	Painting
Ottley, William Young	Painting
Parker, H.	Prosody, Versification
Parkes, Samuel	Manufactures
Pearson, Rev. Dr. Wm.	Astronomical, Chronometrical, Optical, &c. Instruments, Horology, Planetary Machines, Watch, &c.
Phillips, Thomas	Painting
Pond, John	Algebra, Analysis, Astronomy, Degree, Diophantine, Force, &c.
Porden, William	Architecture
Pugh, William Owen ..	English History
Rees, Dr. Thomas ..	Biography, and various Articles; examined and described the Plates
Rees, Rev. Dr. Abraham,	*Editor;* Atmosphere, Hydrostatics, and various Articles
Russell, John	Painting
Sanderson, George* ..	Arch
Scott, John	engraved Nat. Hist. Plates
Smith, Sir James Edward	Botanical Biography, Botany
Sowerby, James	made Nat. Hist. Drawings
Strutt, Joseph	Antiquities
Stubbs, George	made Drawings
Sylvester, Charles ..	Chemistry, Definite Proportions, File-cutting, Galvanism, Pottery, Voltaism, &c.
Taylor, Dr. Charles ..	Bleaching
Taylor, John	Mining
Thompson, James ..	Cotton Spinning and Manufacture
Tooke, Rev. William ..	Geography
Turner, Sharon	English History
Turrell, Edmund	Enamelling
Webster, Thomas ..	Architecture, Aquatinta
Wood, Rev. William ..	Botany
Woodville, Dr. William	Botany

We could have wished to have been able to distinguish, in each case in the above List, whether *various Articles,* appertaining to the Science or Subject mentioned, or only the particular Article bearing the Name of the Science or Subject, are the production of the Individual mentioned; this, however, we are unable to do. Besides the above names, the Covers above mentioned, announced, that

* Of this distinguished self-taught Mathematician, we gave *a Portrait* in our 15th volume: intending to have accompanied the same by a Biographical Memoir, but circumstances prevented the fulfilment of our intentions: we invite some surviving friend of departed worth and talent, to favour us with a sketch of Mr. Sanderson's Life.—Editor.

that the assistance of C. R. Aikin, John Clennel, E. Coleman, Astley Cooper, Rev. W. Crowe, John Leslie, Dr. Richard Pearson, W. Symonds, and William Thomas, were engaged; but whether all, or any of these Gentlemen furnished any Articles, we are uninformed.

We have been sorry to observe the Date 1819 affixed to the Title-page of each of the 39 Volumes, instead of that particular Year, in which each Volume was finished; because of the great number of discoveries and improvements in the useful Arts and the Sciences, which have been, for the first time, submitted to the Public, or at least in so methodized a form, in the Volumes of this Work, by the many able, practical, and scientific Individuals, who have written Articles in them; the want of these Dates to the Volumes, can scarcely fail to be the source of much literary injustice, and of high regret by the future historians of Scientific Improvement. We trust therefore, that our Readers will approve our giving here, a List, containing *the Dates of Publication*, of each of the 85 Parts of this extensive Work; and to which we have affixed the name, of the last Article contained in each of such Parts.

Vol.	Part.	Date of Publication.	Last Article.
I.	1	2nd January 1802, ..	AGOGE.
	2	4th May 1802, ...	AMARANTHOIDES.
II.	3	18th October 1802, ..	pt. ANTIMONY.
	4	7th April 1803, ...	ARTERIOTOMY.
III.	5	22nd September 1803,	pt. BABEL-MANDEB.
	6	17th March 1804, ..	BATTERSEA.
IV.	7	17th August 1804, ..	BIÖRNSTHAL.
	8	13th April 1805, ...	BOOK-BINDING.
V.	9	1st June 1805, ...	pt. BRUNIA.
	10	26th December 1805,	CALVART.
VI.	11	18th February 1806,	pt. CAPE of G. H.
	12	17th June 1806, ...	CASTRA.
VII.	13	1st October 1806, ..	pt. CHALK.
	14	9th February 1807, ..	CHRONOLOGY.
VIII.	15	18th May 1807, ...	pt. CLAVARIA.
	16	10th August 1807, ..	COLLISEUM.
IX.	17	27th November 1807,	pt. CONGREGATION.
	18	8th March 1808, ..	CORNE.
X.	19	2nd May 1808	pt. CROISADE.
	20	2nd July 1808, ...	CZYRCASSY.
XI.	21	23rd September 1808,	pt. DELUGE.
	22	3rd December 1808,	DISSIMILITUDE.
XII.	23	14th February 1809,	pt. DYNAMICS.
	24	22nd May 1809, ..	ELOANÆ.

XIII.	25	18th August 1809, ..	pt. Equation.
	26	25th November 1809,	Extremum.
XIV.	27	3rd February 1810,	Fibro-Cartilage.
	28	13th April 1810, ..	Food.
XV.	29	27th June 1810, ...	pt. Froberger.
	30	8th October 1810, ..	Generation.
XVI.	31	29th November 1810,	Gnieme.
	32	25th January 1811,	Gretna G.
XVII.	33	8th March 1811, ..	Hatfield R.
	34	22nd April 1811, ..	Hibe.
XVIII.	35	3rd June 1811, ...	Huysum.
	36	20th August 1811,	Increment.
XIX.	37	14th September 1811,	pt. Josephus.
	38	16th December 1811,	Kilmes.
XX.	39	27th January 1812,	pt. Lauremberg.
	40	19th March 1812, ..	Light-horse.
XXI.	41	12th May 1812, ..	pt. Longitude.
	42	27th July 1812, ..	pt. Machinery.
	42	A. of Plates	
XXII.	43	27th August 1812, ..	pt. Manganese.
	44	4th November 1812,	Mattheson.
XXIII.	45	11th December 1812,	pt. Metals.
	46	9th February 1813,	Monsoon.
XXIV.	47	30th March 1813,	pt. Muscle.
	48	26th April 1813, ..	Newton.
XXV.	49	15th July 1813, ...	pt. Oleinæ.
	50	15th Sept. 1813,	Ozunicze.
	50	B. of plates	
XXVI.	51	27th Nov. 1813, ..	pt. Passiflora.
	52	18th January 1814,	Perturbation.
XXVII.	53	22nd March 1814,	pt. Picus.
	54	7th May 1814, ...	Poetics.
XXVIII.	55	14th July 1814, ...	pt. Preaching.
	56	16th Sept. 1814, ..	Punjgoor.
	57	C. of Plates	
XXIX.	57	14th Dec. 1814,	pt. Ramists.
	58	26th January 1815,	Repton.
XXX.	59	21st March 1815, ..	pt. Rock.
	60	1st June 1815, ...	Rzemien.
XXXI.	61	11th July 1815, ..	pt. Sarabanda.
	62	21st Sept. 1815,	Scotium.
	62	D. of Plates	
XXXII.	63	22nd Dec. 1815, ..	pt. Shammy.
	64	28th February 1816,	Sindy.
XXXIII.	65	17th May 1816, ..	pt. Sound.
	66	27th July 1816, ..	Starboard.

XXXIV.

XXXIV.	67	26th October 1816,	pt. STUART, J.
	68	11th Dec. 1816, ..	SZYDLOW.
XXXV.	69	19th March 1817,	pt. TESTUDO.
	70	1st May 1817, ...	TOLERATION.
XXXVI.	71	13th August 1817,	pt. TUMOURS.
	72	24th October 1817,	VERMELHO.
XXXVII.	73	20th Dec. 1817, ..	pt. UNION.
	74	23rd March 1818,	WATEEOO.
XXXVIII.*	75	29th May 1818, ..	pt. WHITBY.
	76	30th July 1818, ...	pt. WREN.
XXXIX.	77	E. of Plates, ...	ZYTOMIERS; & pt. BALDWIN, of Adda.
	77*	30th Dec. 1818,	
	78	27th Oct. 1819,	ZOLLIKOFER, do.
	78	F. of Plates	
	78	G., or 79 of Plates, their References and Titles	29th July 1820.

To have expected that a Work so extensive as the present, and so long in course of publication, could have been of equal Merit throughout all its parts and departments, or without several Faults, would perhaps be deemed unreasonable: suffice it to say, that its merits are conspicuous, and well understood, as its very extensive sale and patronage, have already evinced. The printing has been executed by Andrew Strahan, in an elegant stile, but whose omission of *pages*, has been complained of by great numbers, as precluding reference to particular passages in the long Articles.

Recently published.

Green's Botanical Dictionary; or, Universal Herbal. 2 vols. 4to; with Plates, coloured and plain.

The Botanist's Companion; or, an Introduction to the Knowledge of Practical Botany and the useful Plants. 2 vols. 12mo. 12*s*.

Travels in various Countries of the East; being a Continuation of Memoirs relating to European and Asiatic Turkey. By the Rev. R. Walpole, M.A. 2 vols. 4to.

A Compendium of the Ornithology of Great Britain; with a Reference to the Anatomy and Physiology of Birds. By John Atkinson, F.L.S. 8vo. 8*s*.

* Three and half sheets of Vol. XXXVIII., ending with WEETIN, were published in Part 77.

A Voyage

A Voyage to Africa; with some Account of the Manners and Customs of the Dahomian People. By John MacLeod, M.D.

The Italian Schools of Painting. By the Rev. J. T. James.

A Treatise on Domestic Wine-making—from the various Fruits of the United Kingdom. 8vo. 7*s*.

An Essay on the Construction of Wheel-Carriages, as they affect both Roads and Horses; with Suggestions relating to the Principles on which the Tolls ought to be imposed, and a few Remarks on the Formation of Roads. By Joseph Storrs Fry. 8vo. 6*s*.

Rules for Repairing Roads; drawn up from the Evidence of Mr. Telford and Mr. MacAdams. 8vo. 2*s*.

A New Practical Gauger. By M. Iley. 8vo. 10*s*. 6*d*.

The Cottager's Manual, for the Management of his Bees. By Robert Huish, Author of the 'Treatise on the Management of Bees.' 2*s*.

An Essay on Involution and Evolution. By Peter Nicholson. 8vo. 6*s*.

Observations on a general Iron Rail-Way, showing its great Superiority over all the present Methods of Conveyance. 8vo. 1*s*. 6*d*.

A New Method of solving Equations with Ease and Expedition, by which the true Value of the unknown is found without previous Reduction. By T. Holdred. 4to. 7*s*.

Lectures on the Philosophy of History, with Notes and illustrative Engravings. By the late Rev. Ezekiel Blomfield. 4to. 1*l*.

Popular Observations on Regimen and Diet. By J. Tweed. 12mo. 5*s*.

Preparing for Publication.

Travels in Georgia, Persia, Armenia, Ancient Babylonia, &c. in the years 1817, 1818, 1819 and 1820, by Sir Robert Ker Porter.

A Treatise on Domestic Chemistry, containing Instructions for making good and wholesome Bread, Beer, Wine, Vinegar, Pickles, &c. By Mr. Accum.

Professor Leslie has in the Press, Geometrical Analysis, and the

the Geometry of Curve Lines. Also a Treatise on Heat, Theoretical and Practical.

Dr. Renwick has in the Press, A Continuation of the Narrative of Miss Margaret MacAvoy's Case, with general Observations on the Case itself, &c. and with additional Proofs of her Blindness.

A Translation of Travels in England, Wales, and Scotland, in 1816, by Dr. Spiker, Librarian to the King of Prussia.

Lectures on the Philosophy of the Human Mind, by the late Dr. Thomas Brown, in 3 vols. 8vo.

A Synopsis of British Mollusca, being an Arrangement of the Bivalve and Univalve Shells, according to the Animals inhabiting them. By Dr. Leach.

Sketches illustrative of the Manners and Customs of Italy, Switzerland, and France, in a Series of 12 Numbers. The Plates to be coloured. By Mr. Bridgens.

M. Belzoni's interesting Work on the Antiquities of Egypt will soon make its appearance.

Dr. Thomson will soon publish a new Edition of his System of Chemistry. He has also announced his intention to publish a Work on the Practice of Chemistry.

Outlines of Midwifery; with illustrative lithographic Prints. By J. T. Conquest, M.D. F.L.S. &c.

Designs for Private Dwellings, lithographed; by Mr. Hedgeland. 4to.

XXXVI. *Intelligence and Miscellaneous Articles.*

DISCOVERY SHIPS.

Captain Johnston, of the Cambrian whaler, which has recently arrived from Davis's Straits, states that he was further up Lancaster Sound than Captain Ross penetrated, but saw nothing of the Discovery Ships. He went up eighty miles; the Sound was there twenty miles wide, the current strong, and no obstruction appeared from the mast head. From all that he saw, Captain J. is in the firm belief that Lieut. Parry must have succeeded in effecting a passage. The Friendship and True-Love were proceeding

ceeding up the Sound when the Cambrian was returning; but whether they would go further up or not, is uncertain. Some ships have this season been as far north in Baffin's Bay as 80 degrees. The general opinion among the whalers is, that Parry has discovered an inland sea; but whether he will be enabled to get through, or not, is problematical. Captain Fleming, of the Lady Jane whaler, just arrived at North Shields, was told by Captain MacWilliam, of the British Queen, whom he spoke on the 15th of August, that he had discovered what he took to be a new race of people; but whether the same as was seen by Captain Ross, he could not ascertain.

MURIATE OF POTASH IN ROCK SALT.

Dr. Wollaston's discovery of the existence of muriate of potash in sea water, induced M. Vogel to examine whether this salt might not be detected in common salt obtained from springs, or dug solid out of salt mines. He subjected salt from Hallein and from Berchtesgaden to experiment. Nitromuriate of platinum produced no precipitate in the simple solutions; but when they were concentrated till a large portion of the common salt was extracted, they gave a yellow precipitate with this nitromuriate, indicating the presence of potash. Brine from Rosenheim treated in the same manner gave a similar result.—(*Gilbert's Annalen.*)

WODAN PYRITES.

Some time ago it was announced that M. Lampadius, of Freiberg, had discovered 20 per cent. of a new metal in this ore, differing as much from nickel as tellurium from antimony, and to which he had given the name of *wodanium.*

The same mineral has since been analysed by M. Stromeyer, but without detecting in it any new metal. 100 parts contain

Nickel	16·2390
Cobalt, with a little manganese ..	4·2557
Iron	11·1238
Copper	0·7375
Lead	0·5267
Antimony—a trace of.	
Arsenic	56·2015
Sulphur	10·7137
	99·7979

ANALYSIS OF THE PIPER CUBEBA.

The seeds of this plant, according to a late analysis by M. Vauquelin, contain:—1. A volatile oil, almost concrete.—2. A resin resembling that of the balsam copaiva.—3. Another resin, but in small quantity, and coloured.—4. Extractive principle similar to that found in leguminous plants.—6. Saline substances.

FIGURE OF THE EARTH—MINERALOGY.

Dr. MacCulloch is now in the island of Balta, engaged in verifying the experiments of Col. Mudge, M. Biot, Dr. Gregory, and Captain Kater, on the figure of the earth, and in correcting the errors arising from local attraction. We are also informed, that he is occupied, under the direction of the Right Hon. Board of Ordnance, in adding to the mineralogical map of Scotland, which is now nearly completed, a survey of these islands, and that the whole will shortly be published under their auspices.

LITHOTOMY.

Two very considerable improvements have been lately made in the severe operation of cutting for the stone.—The high operation, as it is called, in such repute in France, will probably be revived, in consequence of Mr. Carpue's meritorious exertions to introduce it into this country, after making himself master of the evidence for the practice by several visits purposely to Paris, as set forth in his publication, as well as by actual practice. Further, Sir Everard Home, with great candour, has performed the operation several times at St. George's Hospital, with success, and has made an improvement, which will probably be decisive in favour of the high operation as recorded in the next coming volume of the Philosophical Transactions. On the other hand, Mr. Earl has made considerable improvements in the instrument for breaking the stone in the lateral operation, in those cases in which it is too large for any opening for extraction to be made with safety. By these improvements, the surgical world must feel highly gratified, and they will now have the option of determining by experience the advantages and disadvantages of the two modes in question.

SPONTANEOUS SEPARATION OF WARTS.

In the New (French) Journal of Medicine, Dr. Cheneau relates the following singular case:

" Numerous warty excrescences had long occupied the hands of a hysterical, highly susceptible lady aged forty-four. On the night following the decease of her husband, an event by which she was deeply affected, they all separated, leaving the spots which they had occupied wrinkled, but without induration."

This fact reminds me of a case that came to my own knowledge many years ago in Scotland. Some silver spoons having been mislaid, were supposed to have been stolen, and some expression

pression fell from one of the family, which was either meant, or was so understood by a young lady who acted as governess to the female children, that she had taken them. When the young lady got up next morning, her hair, which before was dark, was found to have changed to a pure white during the night.—The spoons were found afterwards where the mistress of the family had herself deposited them.—A. T.

MACHINE FOR RAISING WATER.

A simple machine has, it is said, been perfected by a gentleman of Shropshire, for raising water from the holds of ships and for supplying reservoirs, which, by means of a small weight, will raise a column of water at the rate of 15 quarts per minute, to the height of 100 feet, and so on, in proportions, double, triple, or quadruple columns of water, to double, triple, and quadruple heights.

LESLIE'S HYGROMETER EMPLOYED TO ASCERTAIN THE STRENGTH OF SPIRITS.

Mr. W. Ritchie, of Perth, has proved by some late experiments that there exists a uniform ratio between the cold induced by evaporation (from the bulb of Leslie's hygrometer) and the strength of the evaporating spirits.

The bulbs of three very delicate hygrometers were moistened —one with strong whisky; another with a mixture of the same whisky and water in equal quantities; and the third with water. The lowest degree of cold induced by evaporation was carefully watched: that of the water was 40, that of the dilute spirits 64, and of the strong 88.

"Hence the following proportion : 24 : 48 : : strength of the dilute : strength of the strong spirit."

This he tried with different proportions of spirits and water, in different states of the atmosphere, and found the same property uniformly obtain.—(*Thomson's Annals.*)

THE WARWICK VASE.

Mr. Thomason, of Birmingham, has lately finished a fac-simile of this vase (of which an engraving was given in a former volume) entirely of metal. The late Earl of Warwick permitted him and his artists to have free access to the original, to model it in wax, which occupied several months. These models were cast in lead to serve as patterns for the bronze vase. This undertaking was commenced in the 54th year of the late King, and the vase was raised by the efforts of about fifty workmen, and put upon its base in celebration of the accession of his present Majesty to the Throne. Two hundred and eleven medals, including one of George IV., all struck at Mr. Thomason's manufactory,

factory, were sealed up in an antique urn, and deposited in the centre of the pedestal on which the vase was placed. The vase is 21 feet in diameter, and weighs several tons. The field was oxidated by means of a combination of the sulphates and nitrates urged by a strong heat, which has given it the desired appearance of the rouge antique marble: the masks, handles, panther skins and leaves are oxidated by the acetates, and resemble verd antique bronze. The whole is a noble performance, and highly creditable to Mr. Thomason.

SINGULAR PHÆNOMENON.

There is at present to be seen, at Arbroath, a beautiful phænomenon of nature, arising from stagnate water by the late hot weather. In a bason belonging to a salt-work, stopt some time ago from working, the combination of gases occasioned by the decomposition of the water, has become so powerful that, after dark, its surface appears as if sparkling with fire; and when a stone, or other weighty substance, is thrown in to disturb the fluid, a brilliant blueish flame immediately takes place.—(*Caledonian Mercury*, 18*th Sept.*)

CLEOPATRA'S NEEDLE.

This celebrated monument of antiquity may be shortly expected to arrive from Alexandria—a present from the Pasha of Egypt to His Majesty George IV. It is, we understand, to be set up in Waterloo Place, opposite to Carlton House, where it will, for ages we hope, serve to keep alive the recollection of the exploits of our naval and military heroes in that country. The weight of the column is about 200 tons—the diameter at the pedestal 7 feet.—We understand that we are indebted to the influence of S. Briggs, Esq. British Resident at Grand Cairo, with the Pasha of Egypt, for this magnificent monument.

ARCTIC LAND EXPEDITION.

Accounts have been received in Edinburgh from a gentleman attached to the Arctic land expedition, dated in January last, at which period the party were in comfortable winter quarters at Cumberland house. The cold was very severe, the thermometer standing at 30 deg. below zero, but owing to the dryness of the atmosphere it was not so unpleasant as the cold wet weather in England. The rivers and lakes abounded with fish of various kinds, particularly trout of a very large size, and the hunters brought moose deer and buffaloes from the woods, so that there was no scarcity of provisions at their present station. It was intended to proceed to the northward as soon as the season would permit, and, having the whole summer before them, they expected

pected to make great progress in their journey; but owing to the great distance to the supposed northern shores, it is probable that it would take them the greatest part of next summer to make any very extensive survey of the coast; and that they would have to retire to the southward during the ensuing winter; but it was uncertain where they would take up their quarters, as they could gain no intelligence of the country beyond the limits of the fur traders. The officers of the Hudson's Bay and North-west Companies had paid every attention to the party.

INDIAN ANTIQUITIES.

Extract of a Letter from an Officer who accompanied General Sir Charles Colville in his tour and inspection of the Deckan, containing a description of the memorable Hindu Caves at Ellore, 1st March 1820:

"These caves are 18 miles from Arungabad, and consist of more than 20 excavations in a rocky mountain, which forms a semi-circle of about 2000 yards. The largest of the caves is called Khylass, or Paradise. It is cut through the solid rock, and no other material is used. The chisel seems to have been the only tool employed. A most beautiful stone temple is formed, adorned, both inside and outside, with figures in *basso relievo*, and separate figures of the most exact symmetry, representing all the Hindu gods, their conquest of Ceylon, &c. There is a space between the scarped rock and temple with galleries, and a veranda under the former, in which there are 50 gigantic figures, with symbols of their history, &c., forming the whole Hindu mythology. The dimensions of this cave are 240 feet in length, 140 in breadth, and the scarp 90 feet in height. The temple has a movable appearance, from elephants, tigers, &c. being cut underneath the floor, which appear to support the whole building; the heads and part of their bodies only being exposed on the outside. Many of the other caves are equally extraordinary. There are flying figures, women, and all the fanciful tales of the Hindus, admirably depicted in stone. There is a miser, about ten feet in height, with his mother, wife and children clinging to his legs, whilst a thief is taking off his treasure. It is a group that might be placed near the Laocoon, and our sculptors might take lessons by a visit to these wonderful caves. There are no natives now in existence equal to any thing of the kind. Some thousands must have been employed; their origin is involved in obscurity. The general report is, that they were made about 1000 years ago, when the Boodh or the Brahmin religion was in the greatest splendour, and that they were used for schools, religious rites, &c., and the residence of their priests. There is a profusion and minuteness, elegance and lightness in the figures

beyond

beyond description. The whole of the orders are displayed on the pillars, which are cut out as if to support the rooms inside. No chuman (lime) is used. There is some account of these caves in Colonel FitzClarence's Travels, and some beautiful and correct views of them by Daniell. They are thought by some superior in magnificence, though in another way, to the Pyramids of Egypt."

SOLAR ECLIPSE, SEPT. 7, 1820.

The day proved very favourable to the inhabitants of the Metropolis and its environs, for the observation of this interesting event; the light fleecy clouds that occasionally passed over the sun by no means obstructed the view of it, and, with the exception of a very few minutes, the progress of the eclipse was visible from the beginning to the end. The moon, seen through a telescope of considerable power, exhibited her inequalities in a most distinct manner, insomuch that the heights of the mountainous parts might have been measured with great accuracy. Although ten and a quarter out of twelve parts, into which the solar orb is astronomically divided, were obscured, the decrease of light was not so great as was generally expected; and we much doubt whether the diminution would have been remarked, under the ordinary circumstance of a dense cloud passing over the sun's face. The thermometer at the Royal Observatory at Greenwich, fell three degrees during the time of the greatest obscuration; while in London, at the Royal Exchange, the mercury fell from 69¾ to 64, and the barometer rose. This is the greatest solar eclipse that has taken place for fifty-six years, and we believe that few persons now living will ever witness another of the same extent.

At 9 o'clock A.M. the thermometer stood at 58, the barometer 29·925. (Cornhill level); the standard barometer at the Exchange, at the same period, at 30·031.—thermometer at 60. The first impression upon the sun's disc I observed at 23 min. 30 sec. past twelve. Greenwich mean time (or, astronomically, 0 deg. 23 min. 30 sec.) being 15 sec. previous to the time laid down in the Ephemeris; the thermometer at 68.

At 45 min. past 12 at 69¾ | 15 min. past 1 at 68¼.

The barometer at this period had risen, and assumed a much more convex surface.

At 30 min. past 1 therm.	67¾	At 15 min. past 2 therm.	64
45 ditto ditto	67	25 ditto ditto	65
50 ditto ditto	66¾	30 ditto ditto	66
Two o'clock ditto	65¼	Three o'clock ditto	68

At 14 min. 24 sec. past 3 the impression left the sun's disc—the thermometer at 71—the barometer as at the commencement;

ment; at two o'clock I saw Venus, but no other planet or star. A small telescope was used.—Place of observation 21·2 in time west of Greenwich.

To Mr. Tilloch. Sept. 8.

Sir,—For the greater advantage of seeing the eclipse of the sun on the 7th of September, I walked into Hyde Park. Entering by Cumberland Gate at half after twelve o'clock, and proceeding across the open area within the circular drive towards the Powder Magazine Guard-house, the following remarkable appearances occurred, and which may be worthy of record: I observed several luminous yellow patches upon the grass, spreading from a distance of twenty yards to the spot on which I stood; they were not like the partial illuminations of sun-beams from between scattered clouds, but arose from a semi-opaque yellow mist in defined patches of about a foot diameter each; they did not glide along the ground like the shadows and gleams of moving clouds, but were stationary for several seconds, and disappeared without changing their places. The bare footpaths, which were dry at this time, exhibited a yellow hue, as if covered by a yellow dust of a turmeric tint. On the spot where this yellow mist fell, the shadows under the blades of grass were of a deep indigo hue, and beneath the foliage of white-Dutch clover the shadows had the effect of dark violet-coloured flowers interspersed among the stems of the clover.

These strange appearances were not owing to any individual optical delusion in myself, because they were equally distinct to two children, the one of them nine and the other eight years of age, and also to a lady of about thirty. They continued during more than half an hour, while we leisurely advanced to Kensington Gardens, by the gate next the Uxbridge road.

A little after one o'clock, an extensive yellow mist appeared in the horizon, occupying many places, and in all directions of the compass; it invariably arose from the *ground*, and ascended above the houses and trees, filling spaces equal to about 1-30th part of the field of view, with free intervals. This appearance did not glide along, but appeared and disappeared at the same places. It was of fine gallstone colour, and gave a beautiful cloud effect to the sky, and sometimes it changed to orange. These phænomena lasted near an hour, the sky was interspersed with thin clouds, and two strata of them were crossing, one from south-west, another from east. A. C.

Leighton, Sept. 21, 1820.

Dear Sir,—Having made a few observations on the late eclipse, and wishing to call the attention of some of your scientific readers to a subject in some way connected with astronomy, I beg you will, if other matter of greater importance has not filled your pages, give room for the following lines.

The latitude of the place where I observed the eclipse is 51° 54′ 59″, and longitude 0° 39′ 39″ west of Greenwich; altitude above the sea 311 feet.

The telescope used at the commencement was an achromatic of 2·75 inches, object-glass with a micrometer eye-piece, magnifying about 25 times, having proper smoked glass to defend the eye. The telescope was mounted on an equatorial, and the *time* read off by my son, from a chronometer made by Arnold; the rate of going having been for some days previous to the eclipse well ascertained by transits of *Sirius* in the morning, and η *Ophiuchi* in the evening. I consider it proper to state the above circumstances, to show what credit may be placed upon the observation as to time; and although I was at the telescope a few minutes before the eclipse began, I will not be positive that I saw it for the first second or two; but from my habits of observing, I think I may say that the eclipse could not have commenced three seconds before it was sufficiently visible; and as the conclusion was gradual and steadily watched, I think *one* second for uncertainty will be sufficient for that part of the observation. The visible beginning was .. $0^h\ 21^m\ 25^s$

end 3 13 7

H. M. S. *Mean Time at this Place.*

At 1 47 31, I observed the quantity of the sun's disc covered to be 363 parts out of 2860, or about 10½ digits. No distinct spots could be observed of sufficient magnitude to note the time of obscuration; but I could very plainly see two projecting tumuli on the preceding edge of the moon's disc. The angles of intersection appeared a little rounded both internal and external, in consequence of the refraction of the moon's atmosphere.

The state of the weather was attended to during the eclipse by my son; but little variation was observable either in the barometer or thermometer, or state of the clouds; the wind being small, had a little veering between the S. and W. and may be called S. W. on the average.

The barometer for the whole period was 29.868; thermometer attached 63½°, detached 63°; the detached thermometer sunk about 3° towards the conclusion, but soon recovered its former height.

I have given the above particulars of the barometer and thermometer, with the hope of inducing some others of your readers to do the same, as an excellent mode of determining the relative height of the stations of observation; and I beg leave to suggest, that if persons in possession of good barometers would take the trouble

trouble to observe and note the height *precisely at the commencement of each hour, from eight in the morning to noon on the tenth day of every month remaining of the present year*, and communicate the results to your Magazine and other Philosophical publications, there would soon be constructed a table of *Altitudes* of every important situation, to supply that great defect in all our topographical publications: considering this as a public invitation, I shall commence on the 10th of October.

Yours truly, B. BEVAN.

Gosport Observatory, Sept. 7. The eclipse of to-day excited great interest in this neighbourhood, and was viewed, under favourable circumstances of the weather, with admiration. The beginning of the eclipse, or the appulse of the moon on the sun's northern limb, took place at* .... 0h. 16m. 37s.

Visible conjunction, or time of new moon ..	1	43	53
Greatest obscuration of the sun's disc	1	46	23
End of the eclipse, or separation of the limbs of the sun and moon	3	10	6

The portion of the sun eclipsed at the greatest obscuration was digits 10¼ deg. nearly out of 128. This was the greatest solar eclipse that has happened in this part of Europe since the year 1764; and indeed, of all those that will again happen here before the year 1847. In certain places, as in the Shetland islands, Hanover, Frankfort, Munich, &c. it was annular, or showed the appearance of a ring round the body of the moon. In latitude 81. 39. 29. north, and longitude 32. 55. west, at 59. 3. (our time) P. M. the sun and moon rose together; the sun with a beautiful ring of light round the moon. In latitude 27. 10. 30. north, and longitude 46. 2. 4. east, at 3h. 12m. 35s. (our time) P. M. the sun set with the same ring of light round the body of the moon. The total duration of this eclipse to the inhabitants of the earth, was 5h. 17m.; but at no one place in particular was the duration much more than half that time. At 20m. past one P. M. Venus was seen with the naked eye, shining with a white light in the W. by S. point of the compass, and by a sextant, 40. 55. distant from the centre of the sun—viewed through an inverting achromatic telescope, she represented an illuminated crescent, only equal to what is shown by the moon at her entering her second quarter; and it was full an hour before she was hidden by a cloud. At 50 minutes past one P. M. the planet Mars presented himself to the naked eye: he shone with a full orb of a bright gold colour, was 36° to the east of and above the path of the sun, and continued in sight about ten minutes. At the greatest obscuration, the sun only presented to our view a small red crescent, similar to

* Mean or clock time.

that of the moon two or three days old. The moon's edge was well defined on the sun's disc, and her body appeared like a spherical mass of cooling iron. The nearest comparison we could draw on the existing light at the greatest obscuration is, that it was only equal to that of sunset, or an early crepusculum, when the sun has verged 2 deg. or 3 deg. under the horizon, with this difference, that the light was stronger, and the shade considerably darker, but the clouds not tinged with prismatic colours, as they are generally by the horizontal radiation at sunset. At 2 P. M. the difference in the increment of light was scarcely distinguishable. The sky was then free from clouds, and of a dark blue colour; and the distant clouds near the horizon lost part of their light, and descended in the lower atmosphere, as is frequently observed at or soon after sunset, when the dew is falling. The birds, too, both small and great, flew over, as if hastening to their nocturnal places of abode. In an hour and a half after the commencement of the eclipse, Fahrenheit's thermometer sunk from 70 to 60; nor would a burning-glass at that time set tinder on fire.—A similar thermometer that was exposed more to the fresh S. E. breeze, sunk to 58 deg.; so that a diminution of more than 1-6th took place in the diurnal temperature by the influence of the eclipse. By 4 P. M. the thermometer had again risen to 66 deg. The barometer rose 1-100th, and sunk 3-100ths of an inch; and De Luc's whalebone hygrometer ranged from 51d. to 57d. during the eclipse.

Edinburgh.—The cultivators of astronomy in this place were greatly disappointed in having only a partial opportunity of observing the most remarkable eclipse of the sun that has happened for many years.—At about a quarter past two, a distinct view of the phænomenon was obtained for a few minutes, in some situations, through flying clouds: the end of the eclipse, although invisible in the city, was distinctly observed at the distance of a few miles in the country, towards the south. About the middle of the eclipse, the darkness which pervaded this quarter was about equal to the gloom of twilight.

At Perth and its neighbourhood, it was only partially observed. No change of temperature was perceptible by the most delicate thermometers, and the diminution of light was not very remarkable.

At Stirling also the weather was not favourable for observing the eclipse.

At Ayr, the eclipse was not observed at all; nor was it visible at Glasgow, but was seen very well in some places further west. Between Rothsay and Greenock, the view of it was particularly favourable, as the light clouds (*cumulo-strati*) served to mitigate the brightness of the sun and render the advance of the moon perfectly

perfectly seen with the naked eye. The ring was complete, except at the north-east quarter. The appearance at this time was very beautiful. No change of temperature was perceptible by the thermometer, and the diminution of light was not at all remarkable.

Paris, 8th Sept.—The weather yesterday was extremely favourable for the observation of the eclipse of the sun. This phænomenon could add nothing to the precision of astronomical authorities, but it will furnish the means of calculating the comparative longitudes of all the points of the globe in which the beginning and end of the eclipse may happen to be exactly determined. We subjoin these two elements in sideral time as marked at the royal observatory of Paris :—

Commencement	..	..	11h. 45′ 15″
End	..	..	14 34 57

A thermometer, exposed to the shade and towards the north, fell in the interval between the commencement and middle of the eclipse 2° centigrades; another thermometer, inclosed in a metallic case and exposed to the sun, fell during the same period 12° centigrades.

On the Effect of the late Eclipse of Sept. 7th, on the Heat of the Atmosphere. Communicated by Doctor T. Forster.

Sir,—I was desirous of ascertaining the precise degree in which the late solar eclipse would depress the temperature, and with this view made observations on two thermometers, one placed in the sun, and the other in the shade. The day was clear, and, except during the passage of a thin veil of *cirrocumulus*, mixed with *wane-cloud* before the sun, (which was quite transient,) no circumstance occurred to render the experiment at all doubtful. The thermometer in the sun was placed on a wall with a southern aspect. The instrument in the shade was under a cool wall of the porch of the house, facing the north.

In the sun, the thermometer at half past 11 o'clock stood at 84° of Fahrenheit's scale, and it continued rising till the eclipse produced a depression, which I perceived to take place gradually as the shadow of the moon intercepted the sun's rays. It must be observed too, that after the eclipse was over, the thermometer rose again, and that on ordinary occasions a perpendicular thermometer rises to its greatest maximum at about two o'clock in the afternoon.

The following is the result of the experiment:

At 11 hours, 45 min.	Thermom.	..	92°
Noon	..	..	94
12h 15′	..	..	$94\frac{1}{2}$
12 30	..	..	$92\frac{1}{2}$

12h

12^h 45′	Thermom.	91°
12 50	.. .. ..	89
1 5	.. ..	87
1 30	.. .. ..	74
1 35	.. .. ..	73
1 40	.. .. ..	72
1 45	.. ..	71
2 0	.. .. ..	69

Thus, at two o'clock happened the minimum of the thermometrical depression, following closely the time of total eclipse: it continued for some at the same degree, and then gradually rose again as follows :

At 2^h 45′ it was	.. ..	72°
3 0	.. . ..	82

In the shade, where the thermometer is affected more by reflected than by direct heat, the only sensible effect was a depression of two degrees of the scale: when the eclipse began, the thermometer stood at 60°, and at 2 o'clock (when on ordinary occasions it would have risen one or two degrees) it had sunk to 58°. By three o'clock it had risen again two or three degrees.

The barometer remained stationary at 30·05 ; wind westerly, and very calm.

The effect produced by an apparent close of the day in the middle of it was very curious : the singularity of effect was produced by the mind's contemplating at once two phænomena which do not occur together at the ordinary time of night-fall—namely, short shadows and diminished light ; the opaque body of the intervening moon having reduced the light to the gloom of five o'clock in the evening, while the short shadows cast from objects by an elevated sun proclaimed midday. A remarkable crowing of cocks occurred just at the total of the eclipse ; and this circumstance (though I believe quite accidental) heightened the curious effect of the whole phænomenon.

I am, Sir, yours, &c.

Hartwell, Sussex, T. FORSTER.
Sept. 12, 1820.

EXTRAORDINARY CIRCUMSTANCE.

As Mr. John Cole, formerly a schoolmaster at Fingringhoe in Essex, was sitting with others in a field belonging to Mr. Elijah Clarke, farmer, of that parish, while viewing the late eclipse of the sun with his *right* eye, he being totally blind of the *left*, partially shaded by his hand, his left eye was instantly restored to sight, and he can now see with it as perfectly as he did thirty years ago.

METEREO-

METEOROLOGICAL JOURNAL KEPT AT BOSTON, LINCOLNSHIRE.

[The time of observation, unless otherwise stated, is at 1 P.M.]

1820.	Age of the Moon.	Thermometer.	Barometer.	State of the Weather and Modification of the Clouds.
	DAYS.			
Aug. 15	7	72·	29·36	Cloudy—rain A.M.
16	8	74·	29·30	Fine
17	9	77·	29·25	Stormy
18	10	70·	29·35	Fine
19	11	64·	29·35	Ditto
20	12	64·	29·50	Ditto
21	13	64·	29·54	Ditto
22	14	60·	29·65	Ditto
23	full	59·	29·90	Ditto
24	16	67·	29·80	Ditto
25	17	67·	29·40	Cloudy—rain morning and after-[noon
26	18	66·	29·20	Ditto
27	19	64·	29·35	Stormy—heavy rain at night.
28	20	56·5	29·10	Cloudy—rain A.M.
29	21	61·	29·40	Ditto
30	22	65·	29·64	Ditto
31	23	61·	29·80	Ditto
Sept. 1	24	62·5	29·80	Fine
2	25	61·5	29·80	Ditto
3	26	61·	29·87	Cloudy
4	27	65·5	29·85	Fine
5	28	66·	29·76	Ditto
6	29	64·	29·70	Ditto
7	new	65·5	29·90	Ditto
8	1	66·	29·90	Ditto
9	2	70·5	29·98	Ditto
10	3	72·	29·85	Ditto
11	4	72·	29·76	Ditto
12	5	71·5	29·83	Ditto
13	6	72·	29·68	Ditto
14	7	75·	29·40	Cloudy

METEORO-

METEOROLOGICAL TABLE,

By Mr. Cary, of the Strand,

For September 1820.

Days of Month. 1820.	Thermometer. 8 o'Clock Morning.	Noon.	11 o'Clock Night.	Height of the Barom. Inches.	Weather.
August 27	51	64	54	29·78	Cloudy
28	54	60	53	·58	Rain
29	52	64	54	·78	Fair
30	51	61	53	30·10	Fair
31	53	61	52	·15	Fair
Sept. 1	53	64	54	·15	Fair
2	54	63	55	·14	Fair
3	57	63	52	·22	Fair
4	50	65	51	·25	Fair
5	52	65	52	·18	Fair
6	53	63	54	·14	Fair
7	54	62	55	·18	Fair
8	57	68	55	·36	Fair
9	57	69	56	·48	Fair
10	56	70	59	·40	Fair
11	57	73	62	·45	Fair
12	60	72	60	·36	Fair
13	59	72	59	·25	Fair
14	55	73	62	·01	Fair
15	62	62	54	29·80	Small rain
16	55	64	55	30·08	Fair
17	54	64	52	·02	Cloudy
18	52	56	47	29·65	Fair, rain at night
19	45	54	45	30·05	Fair
20	43	57	52	29·94	Cloudy
21	47	53	47	·54	Showery
22	46	56	50	·95	Fair
23	55	67	58	30·08	Fair
24	57	64	50	29·82	Fair
25	52	55	47	·78	Showery
26	46	52	45	30·08	Cloudy

N.B. The Barometer's height is taken at one o'clock.

XXXVII. *A Review of some leading Points in the Official Character and Proceedings of the late President of the Royal Society. By* A CORRESPONDENT.

[Concluded from p. 174.]

I WILL now quote again from the "History of the Instances of Exclusion," its author is speaking of

"The formation of every Council since Sir Joseph's presidency, but particularly of the last Council. The Council of the Royal Society is, at the same time, as is well known, its committee of papers, that part of the body who is to decide upon the merit of discoveries, either foreign or domestic, and to hold the equal balance between its own laborious and ingenious members. The nomination of this body is in the Society at large, who, however, in a very evil hour, have of late in fact left it to their President, evidently under an implied though not expressed covenant, that he would take care there should always be in it a proper number of men of science in each branch qualified to do the work for which they are deputed. * * * But what lists are there put into the balloting-boxes this year? * * * Where are the mechanics? Where are the professed chemists? Where are the mathematicians? Where are the practical astronomers? What! not a single astronomer in the Council of the Royal Society of London, instituted for the promotion of natural knowledge, at a time when the heavens, almost shut up since the creation, have been unfolded by Herschel to the curiosity of mankind? Is it possible? and do we affect (for affect it we must) to be seriously uneasy, because we suspect that some foreigners may not have had answers in form to their letters of form, while this is our shame and this our disgrace? * * * * What then is to become of the papers, and by whom are they to be tried? Formerly there was some kind of established order in the Society; the learned man gave his papers to the Secretary, the Secretary in due time produced them to a body of men that was known, and each of whom was responsible for the sentence he gave. The *President* now takes them, the President changes the order of reading them (not in particular cases, as alone he is permitted by exception in the statutes, but every Thursday); the President may if he pleases hand them about to a junto (he must hand them about to somebody) for an opinion, who may be the enemies or the rivals of the writer. Whoever sees not in this as well as in the imperial ludi-magisterial knock with the hammer, in the dictatorial rebuff; in the nomination of Dr. Dryander to take the catalogue of the books when there was a Librarian in the house, and in the attempt to *dismiss* the said clerk and librarian unheard and unadmonished,—sees not a fixed and settled plan of despotism, not less violent in the means than trifling in the object, must have been born blind, or have made himself so."

"The President is incurably sick with the lust of domination*; he imagines himself born to rule (Good God! how little do men know themselves!); and cannot perceive that he has neither the intellectual nor the moral qualities of a ruler. Honesty he possesses—the honesty of a private man. Of the honesty of a governor, for which modern languages have no name, the Greeks called it ἐπιείκεια, he is destitute."

"We have not written thus far to dissemble what we think. Sir Joseph Banks *might* make a very good clerk, a very good attorney, or even a very good treasurer to the Society; but the man who is to fill the place of President should be something more. We hear much of his hospitality, and of his public breakfasts; but surely the papers of Messrs. Cavendish, Kirwan, and Herschel; of Dr. Maskelyne, Dr. Hutton, and Mr. Wales; of Mr. Vince, Dr. Waring, Mr. Hunter and Mr. Maseres (and take these away, what so great remains?) would have been produced, though there had been no breakfasts in Soho Square; and *who knows* after all (we speak upon *more* than conjecture) how many papers have been stifled, and how many *subjects* of science have been discouraged, by the same caprice and love of dominion, which has dictated so many other innovations? * * * * The Royal Society *was* a *Society;* we do not wish to see it a *monarchy:* it *did* conduct itself according to the rules of justice and equity; we desire that it may not violate those rules; its principles *were*, that the first distinction of men is virtue, and the second learning; we cannot bear that birth (merely *as* such) should take rank with either of these. Now, the President does think that it ought (and forces his noble friends upon us accordingly), and *therefore* it is proper to look out for one who with Sir Joseph Banks's merits, be those merits what they may, does not think so."

Such, according to the representation of those who were active

* As an evidence of the manner in which the President dictated to the fellows in the choice of officers, I here insert a verbatim copy of an engraved card circulated to recommend Dr. Blagden.

"In consequence of Mr. Maty's resignation of the Secretaryship at the last meeting of the Royal Society, the President takes this method of acquainting you, that, *at his desire*, Dr. Blagden has declared himself a candidate for that office. From Dr. Blagden's known abilities and habits of diligence, the President does not doubt but he will, if elected, fulfil the duties of the station with advantage to the Society.

"Soho Square, March 29, 1784."

The card, of which the above is a copy, is now in my possession.

members

members of the Royal Society, nearly forty years ago, were the causes of the dissensions by which it was then agitated. In the course of these disputes Sir Joseph and his friends formed the plan of removing Dr. HUTTON, then Professor of Mathematics in the Royal Military Academy at Woolwich, from the office of Foreign Secretary, which he had discharged with great honour to himself, and perfectly to the satisfaction of a majority of the members.

Here, again, that I may not, however involuntarily, slide into any discoloration of circumstances, I shall quote a pamphlet published expressly on the subject, and entitled "An Appeal to the Fellows of the Royal Society, concerning the Measures taken by Sir Joseph Banks, their President, to compel Dr. Hutton to resign, &c."

"Dr. Hutton is known to be one of the best mathematicians in England: and he is likewise a very good writer upon the mathematics, which is far from being the case with every person who understands them, or is well read in them. He is also remarkably industrious, and has furnished the Philosophical Transactions with more papers (and those full of ingenuity as well as learning) upon mathematical subjects, than, I believe, any other member of the Society. He is also Professor of Mathematics at the Royal Military Academy at Woolwich, where he some years ago tried a variety of most curious and useful experiments upon the force of fired gunpowder, and the initial velocity of cannon-balls, similar to those which had formerly been tried upon the like subjects with respect to musket-balls, by the late very eminent mathematician and engineer Mr. Benjamin Robins. And he afterwards drew up an account of these experiments upon cannon-balls, which was presented to the Royal Society and printed in the Philosophical Transactions; the Society rewarding its learned author by giving him Sir Godfrey Copley's medal."

It was on account of Dr. Hutton's eminent abilities and his extraordinary activity* in devoting them not to purposes of mere theory, but to momentous practical objects connected with philosophy, that the Royal Society elected him Foreign Secretary in January 1779; it being regarded as an office of honour and not of emolument. He had the misfortune, however, to be honoured with the friendship of Sir John Pringle, to appreciate too highly

* Such is the ignorance of the writer in the *New Times,* that he speaks of *Simpson, Hutton,* &c. as mere elementary writers for school-boys. Were he acquainted with the writings of practical French mathematicians (as *Montucla, Dupin, Hachette,* &c.) he would find them describing these very men, and their successors at Woolwich, as the persons who have mainly contributed to prevent the extinction of mathematical science in England.

 the

the value of time to waste much of it at the Soho Square breakfasts; and lastly, to be really fond of his own profession (without attempting to depreciate those of other men, whatever they might be): these, it was generally understood at the time, were the reasons why Sir Joseph Banks wished to deprive him of the secretaryship. But, knowing that the Doctor's character and reputation had made him many friends, he determined to "let him down easy" by a *ruse de guerre*. The manner in which this was to be accomplished will appear by another quotation from the pamphlet last cited.

From the preceding inquiry, "it appears that, notwithstanding Dr. Hutton's diligence in discharging the duties of the said office, Sir Joseph Banks proposed to the Council, in a meeting held November 20, 1783, to remove Dr. Hutton from his said office of Foreign Secretary, alleging in general terms, that he had neglected the duties of it, but without specifying any instances of such neglect, though requested to do so by Dr. Maskelyne, who was then a member of the Council: and that, when Dr. Maskelyne further desired that Dr. Hutton might be sent for to appear before the Council, and be heard in his own defence against any charges of neglect of duty which might be brought against him, the President refused to do so, and *still expressed a wish that he should be removed from his office immediately*. And that, when he found the Council unwilling to concur with him in removing Dr. Hutton from his said office immediately *in a direct manner*, he proposed to them a resolution concerning the expediency of the Foreign Secretary's residing in London, which was calculated to produce Dr. Hutton's removal from it *in an indirect manner*, viz. by *obliging him* to resign it; and that in this resolution he obtained the concurrence of the Council.

"That, in consequence of this resolution of the Council, Dr. Hutton soon after, viz. November 27, 1783, resigned his office of Foreign Secretary, as the President had foreseen, and intended he should do; but that, as Dr. Hutton conceived himself to have been injured by the President and Council, in being thus driven to the necessity of resigning his said office, he made the resignation *publicly* to the Society at large, at one of their weekly meetings."

The whole of Dr. Hutton's conduct in this affair was marked by his usual mildness and gentleness; and furnished a singular contrast to the ungentlemanly and obstreperous exultation evinced by Sir Joseph, on having carried his point. But so gross a piece of maltreatment of one of the most amiable as well as eminent members of the Society, kindled a flame among the other members which was not easily extinguished. Warm discussions took

place

place on the question of the treatment experienced by Dr. Hutton. Governor Pownall made a motion, which was seconded by Mr. Glenie, "That if Dr. Hutton hath been, in the opinion of any member of the Society, criminated, it is the opinion of the Society that he hath fully justified himself." This motion was carried by 49 against 15. In subsequent meetings the great room of the Society became the arena for regular debate: *Cavendish, Anguish, Horsley, Maskelyne, Maseres, Poore, Glenie, Watson, Maty, Lord Mulgrave,* and others, took their parts in the several debates; some with considerable talent, eloquence, and calmness; others with talent, but with unbecoming impetuosity. As the discussions proceeded, it was found that Sir Joseph was daily losing strength; so that there would have been no difficulty in removing him from his office. But just at this crisis of affairs, it was perceived that Dr. Horsley began to aspire to the Presidency. He was a man of real and varied talent; and in some respects of profound knowledge; but in violence of temper he was nearly, if not quite, on a par with Sir Joseph: hence it was thought better to let Sir Joseph remain in his place, than to remove one despot to make way for another. Dr. Hutton, therefore, and several of his friends, retired from the Society, leaving " the President with his train of feeble amateurs, and the toy upon the table," to maintain the honour of the Institution as well as they might be able, after the secession of the bulk of their most celebrated members.

Hutton, Maskelyne, Horsley, and others who retired on that occasion, did not, therefore, discontinue to devote themselves to science. Horsley, being soon after (*i. e.* in 1788) made a bishop, directed his attention more exclusively to theology, having passed, indeed, from his controversial proceedings in the Royal Society, to those in which he engaged with Dr. Priestley. But Hutton and Maskelyne continued with unabated ardour to promote science and philosophy in the departments which they had respectively chosen; Hutton as an active conductor of experiments and a most sedulous and successful author on mathematical subjects in all their variety, carrying on at the same time a more extensive correspondence with mathematicians at home and abroad than any other man in England; Maskelyne as an unwearied observer of the heavens, and as the superintendent and director of the *Nautical Almanac,* an important work, to which he gave a correctness altogether unequalled in any similar publication, or even in that, since it has fallen into other hands.

Although, however, these distinguished individuals quitted the Society for the sake of *peace,* they were not permitted to remain in peace. The President continued for years to annoy them with a petty but inextinguishable malignity. His opposition to

Dr.

Dr. Maskelyne evinced itself most frequently in the *Board of Longitude*, of which he was, *ex officio*, a member. Sir Joseph was altogether ignorant of nautical astronomy, of the construction of nautical instruments, and the principles of mechanics employed in the construction of new apparatus: but, notwithstanding these disqualifications, he was incessantly setting up his judgement against that of the Astronomer Royal. If the Astronomer Royal brought forward any new plan of nautical improvement, the President of the Royal Society was sure to oppose it. If the Astronomer Royal recommended a new instrument, the President's opposition followed as naturally as night succeeds day. This habitual opposition by degrees brought the Oxford and Cambridge Professors (who were also *ex officio* members of the Board) to be uniform supporters of Dr. Maskelyne; and this soon led Sir Joseph to regard them as *his* enemies. Determined to maintain his ascendency, notwithstanding the opposition of this powerful phalanx of men of science, he laid a plan for remodelling the Board. This he could not carry during Dr. Maskelyne's life-time; but by dint of perseverance and intrigue he at length succeeded, and in 1818 had influence enough to effect such an entire change in the constitution of the Board, as brings it under the management of a little committee in London, and, whenever it is necessary, throws the Oxford and Cambridge professors, certainly *the most useful members of the Board*, into a complete and decided minority. Thus, to adopt the language of the *New Times*' eulogist, has "the Presidency been *in honour and activity*."

Often, again, has the dislike of Sir Joseph to this eminent astronomer been manifested by causing to be "black-balled" candidates whose certificates Dr. Maskelyne had signed. From twenty instances of this kind which I could specify, I shall only select one. Mr. *Stephen Groombridge*, residing at Blackheath, in the immediate vicinity of the Royal Observatory, maintained a friendly intercourse with Dr. Maskelyne, and became himself a most sedulous astronomical observer, having at considerable expense provided excellent instruments for that purpose. About two years before Dr. Maskelyne's death, he (with others) signed the usual certificate recommending Mr. Groombridge as a fit person to be a fellow of the Society. The signature of Dr. Maskelyne was fatal. But Sir Joseph put the rejection of Mr. Groombridge upon another pretext. Mr. Groombridge, it seems, has a mercantile occupation in London. Sir Joseph, therefore, actively directed his appropriate observations to the danglers at his levees during the twelve weeks' probation. "*O! ho! we are to have London tradesmen thrust upon us, are we? I am astonished at Dr. Maskelyne. But we will not degrade the Royal Society by the*

the admission of London tradesmen!" A fine illustration, truly, of the avowed principles of the Society in 1693, quoted at the beginning of this review*.

The sequel of this affair should not be omitted. In two or three years afterwards Mr. Groombridge was much extolled by French and German astronomers on account of the accuracy and utility of his researches. A new attempt was made (Maskelyne being dead) to get him elected; and the Royal Society was actually "*degraded* by the admission of a London tradesman." Poor Sir Joseph! "O consistent spirit of inconsistency, how harmonious are all thy blessed operations!"

On the death of Dr. Maskelyne in 1811, (twenty-seven years after the dissensions,) some of his friends informed Mrs. Maskelyne that his library, which contained a judicious selection of the best books connected with astronomy in all languages, would be a valuable acquisition to the Doctor's successor, whoever he might be. She therefore offered the whole library to Government on a fair valuation. The members of administration to whom this proposal was made were at first disposed to accede to it: but, on consulting Sir Joseph Banks on the subject, who, as President of the Royal Society, was one of the *visitors* of the Observatory, he depreciated the value of the library, and persuaded them to decline the offer. The consequence was, that the library was sold by auction, and agents employed by Sir Joseph selected during the sale those books which they thought most valuable.

Similar to this, both in kind and in operation, was the hosti-

* It would be easy to fill a volume with miscellaneous examples of the capricious exercise of the President's power with regard to exclusion. A single example shall be placed in this note. A distinguished physiologist was proposed as a candidate; his certificate being signed by two noblemen, by a member whom, to avoid circumlocution, I will call Mr. A. C., and by three other members. On the evening of election Mr. A. C. observed Dr. *Dryander* (who, though not a fellow, was usually very busy on these occasions) trotting about from fellow to fellow, and whispering to each. Ere long he came to him: "The President's compliments, and he will thank you to *black-ball* this candidate." "Give my compliments to the President (rejoined Mr. A. C.), and say, that though I might be happy to oblige him on ordinary occasions, it would not be *decent* now; as my name is on the certificate." By and by, on examining the balloting-box, the President exultingly exclaimed "*All black-balls but one!*" It seems the candidate had no other friend than Mr. A. C. present. But what, the reader will inquire, was the reason of his exclusion? Simply this: the names of *two noblemen* were on his certificate! Had only one nobleman signed, it would have added weight to the testimonial: but TWO *noblemen* were usually interpreted to indicate a wish to overpower the President; and then it was "*We'll show them who's who: no undue aristocratical authority here!*"

lity

lity manifested by Sir Joseph to Dr. *Hutton*. *His* friends, as well as Maskelyne's, if they wished to become fellows of the Royal Society, were regularly excluded; or, sometimes, with the utmost *civility*, informed beforehand, that they "had better not expose themselves to the risque and mortification of rejection." If any of them presented papers to the Society, they had the honour of being carefully lodged in the archives of the Society, where the world in general, or even the members of the Society, would derive no more benefit from them than if they were deposited at the centre of the earth. This was the case with memoirs presented by *Wildbore*, *Vince*, *Lax*, *Mudge*, &c.

About the year 1816, Dr. Hutton having, by reason of his advanced age, formed a determination to relinquish the habits of a student and the active pursuits of an author, resolved, in consequence, to dispose of his library. He was strongly induced to form this resolution, on being informed by some of his scientific friends, that there were scarcely any mathematical books in the British Museum, and that it was exceedingly probable the governors would be glad to enrich it with so valuable and complete a library as his, if they were properly applied to. The views and wishes of several of the governors of that national establishment were hereupon ascertained; and they were found to be generally favourable to the suggestion of Dr. Hutton's friends. The Doctor announced that it was not his wish to make money by the sale of his books, but simply to have them all deposited permanently in some suitable place; and that, therefore, he would most cheerfully abide by the valuation affixed by two persons, one to be appointed by each party. To this proposal many of the governors were well inclined, and they actually appointed one of their officers to take an inventory of the books, and report upon them. The report was favourable. In this state of things, Sir Joseph Banks being then in Lincolnshire, Dr. Hutton, fearing he might take offence if not apprized of what was going on, wrote to communicate the requisite information, and to express his hopes that the proposal would be approved by Sir Joseph. To this letter the Doctor received no reply; but, in less than a fortnight after he had dispatched it, he was informed that Sir Joseph was in London, and busily employed among the other Governors of the British Museum in dissuading them from the purchase! From that moment all negotiation ceased. Thus, it seems, does malignity sleep in the breast of a "genuine philosopher," for more than 30 years; when, on a suitable occasion, it starts from its slumber, and proceeds to exert itself with all its primitive virulence.

It would be curious to contrast this proceeding with the grateful

ful eagerness with which Sir Joseph promoted the "job" (as it is universally designated) of transplanting the late Dr. Burney's library to the British Museum. But I forbear.

The Trigonometrical Survey of England and Wales was placed by the Duke of Richmond under the direction of Colonel *Williams*, and Lieutenant (afterwards General) *Mudge*, on the recommendation of Dr. Hutton. Here was a double cause of offence to Sir Joseph: 1st, In not confiding the superintendence of the Survey to him (for which, however, one of his grooms was just as competent as himself): 2dly, In acting upon the opinion of Dr. Hutton, to whom *he* had long evinced an inveterate hostility. The result, alas! too natural in a man of his disposition, was, that for a series of years he continued to oppose the Trigonometrical Survey, and to traduce the character of its conductors. The accounts of the Trigonometrical Survey had been regularly published in the Philosophical Transactions; but at length, through the instrumentality of Sir Joseph, further accounts were excluded. The conductors then laid them before the world in a separate volume; but this was a new occasion of offence. A few years afterwards, a foreigner, *Don Joseph Rodriguez*, was employed to deteriorate the reputation of Colonel Mudge's operations, and to detect, or pretend to detect, mistakes. This foreigner was received by Sir Joseph with open arms, and his memoir was inserted in the Philosophical Transactions; although the paper on which Rodriguez animadverted had not been admitted, and although Sir Joseph *knew* that at the time when he and "his Council" admitted the strictures of this foreigner Colonel Mudge was too ill to *read* them, much less to reply to them. In that exigency, however, Dr. *Gregory*, of the Royal Military Academy, undertook to expose the fallacy, inaccuracy, and illiberality, of Don Joseph's animadversions; and such was the success of his efforts, that from that moment the President of the Royal Society was glad to slink out of his opposition to the Survey, and to lay the blame of the encouragement given to Rodriguez upon one or other of the coterie of danglers who then surrounded him. From that period he began to smile upon the man whom he had previously so deeply injured, and Colonel Mudge was found among the visitors at Soho Square! But ingenious men can account for the strangest phænomena; and such have affirmed that Sir Joseph's recent behaviour to the conductor of the Trigonometrical Survey, was only a temporary cloak assumed for awhile, to be laid aside as soon as a particular purpose was accomplished. Sir Joseph had large estates in Lincolnshire, of which he wished to possess an accurate map. None could execute this work so well as the Ordnance Surveyors; and when it was finished, a few guineas would purchase the map of the whole county which included Sir Joseph's estates. How much better than to employ a surveyor at his own expense! A fine project, truly. But, alas! death has defeated it; and ere now both the great man, and the placable individual whom he endeavoured to cajole, have learnt the vanity of every pursuit except those which were consistent with man's ultimate end, and conducted upon principles which will be recognised at the final day of account.

Much should I rejoice if I could, consistently with justice, omit to record any other instance of this lamentable implacability. The task, however, is so repugnant to all the better feelings of one's nature, that a single additional instance is all I shall adduce.

Six or seven years ago, a gentleman named *Marrat*, who had attained a very respectable reputation as a man of literature and science, and who was then, I believe, a bookseller at Lincoln, undertook a History of the County of Lincoln, under the auspices of Sir Joseph Banks. The work was to be published in periodical numbers, or parts; Sir Joseph engaging to give it his warmest recommendation, as well as to furnish documents, from his private library, in illustration of the history, &c. of those portions of the county in which his own estates lay. Relying upon these engagements, Mr. Marrat pursued his labours. The work did not obtain a sufficient sale, as it proceeded, to defray its own expenses; but its author, urged by Sir Joseph to persevere, relaxed not. Pleased with the attentions of Sir Joseph, he presented to him a copy of a "Treatise on Mechanics," which he had published in 1810; who, much to the astonishment of Mr. Marrat, *immediately withdrew his patronage*. Again and again the historian of Lincoln wrote to Sir Joseph, humbly reminding him of his promises, hinting at the expenses in which he had been involved in consequence of those promises, entreating Sir Joseph to furnish the documents which he had engaged to supply, and without which the work could not proceed, and urgently explaining how ruinous to himself the whole transaction must be, unless, by being enabled to *complete* the publication, he might have some probability of remuneration. But his letters, his expostulations, and his arguments were all in vain. No answer could he obtain; and though he, at length, employed a common friend, who had been present in Sir Joseph's library when the promises were made to Mr. Marrat, still nothing could overcome the great man's inflexible silence. What will the reader conjecture was the occasion of this extraordinary behaviour? I blush for human nature, while I tell him, that this unfortunate book of mechanics, in so luckless an hour presented to Sir Joseph Banks, was *dedicated to Dr. Hutton!*, to the man who, *between*

30 *and* 40 *years before*, had offended the President of the Royal Society!!

Poor Mr. Marrat's circumstances became so embarrassed by reason of Sir Joseph's hard treatment, that he was obliged to quit England. He went over to New York, carrying with him letters of recommendation from Dr. *Hutton* and Dr. *Gregory;* and he is now a Professor of Mathematics in one of the colleges of that State.

Tired as I now am of recording examples of Sir Joseph's vexatious, or indecorous, or malignant treatment of *individuals;* let me proceed to alleviate my own fatigue, and probably that of the reader, by adverting, as briefly as possible, to his illiberal treatment of different *Societies;* after which I shall terminate these remarks.

About the year 1792 or 1793 was established the "*Society for improving Naval Architecture.*" The very title of this Society declares the momentous nature of its objects, especially in a country like ours, which owes so much to its commercial and naval preeminence. The members of this Society were very numerous, and highly respectable in character, consisting principally of public-spirited noblemen, practical engineers, mathematicians, naval officers, merchants, and ship-builders. Their attention was directed to the variety of topics included in the theory and practice of ship-building; such as the strength and strain of materials, their preservation, the resistance given by water to bodies of different shapes moving in it, the structure of masts, the shape and position of the sails, the form and operation of the rudder, &c. They made many experiments, and some of them most useful in their tendency: every thing went on well, till their operations began to be impeded by the jealousies of Sir Joseph Banks. Not satisfied with being at the head of the Royal Society, he was anxious to be at the head of this Society also. Sir Joseph was Vice-President; but the President was the late Earl Stanhope, a man of extraordinary talent (whatever his peculiarities might be), and too inflexible to yield to the ambition of one for whose abilities he entertained a most sovereign contempt. Sir Joseph, however, uniformly thwarted the plans proposed by his lordship and the bulk of the Society, and soon formed a party of his own for the purpose of systematic annoyance. This led to a determination on the part of the main body to free themselves from this source of vexation. A series of resolutions was framed, proposed by the late Mr. *William Nicholson* (Editor of the Philosophical Journal), and carried by a large majority. In these the Society firmly declared their determination to support their President, so long as he continued to aid and sanction the legitimate objects of the Society. Sir Joseph shortly after retired from the institution; *but not to remain in inactivity.* At that period a most virulent spirit of political animosty, engendered by the acts of the French revolution, was in constant operation. Sir Joseph availing himself of this, and of the political character of Lord Stanhope, most diligently insinuated among different members of His Majesty's Government, that the Society, under colour of an association for better purposes, was a jacobinical confederacy with *Citizen Stanhope* at their head. This calumny soon produced its designed effect; so that by a series of rapid steps, which I need not here detail, this useful institution became extinct.

Mr. Nicholson afterwards became a neighbour of Sir Joseph's, in Soho Square, and a certain degree of intimacy, in consequence, subsisted between them; Mr. Nicholson occasionally conducting experiments on voltaism, &c. at the President's house. Still, his crime in opposing Sir Joseph in the Society for improving Naval Architecture was never cordially forgiven; nor was he ever admitted a fellow of the Royal Society. No, no: "*To be sure Nicholson is a clever fellow. But you know he is only a sailor-boy turned schoolmaster; and we cannot, with any sort of propriety, admit such people among* us."

When the "*Royal Institution*" in Albemarle Street was established, it commenced under too powerful auspices for Sir Joseph to think it expedient to attempt any formal opposition. He therefore became its friend; and favoured the managers with his advice. But his conduct soon proved that he was actuated by the puerile jealousies of a little mind. The influence of the President of the Royal Society might naturally have been employed in recommending to the Institution Lecturers of eminence in different departments, or in lending his mature and comprehensive judgement in the formation of a library. But, instead of these, Sir Joseph exerted the energies of his mighty mind—how? *in taking care that the Journals of the Royal Institution should not be printed in quarto!* Why not in *quarto?* Truly for this cogent reason, that the *Philosophical Transactions* are published in quarto; and to print those journals in the same sized page might excite an unfavourable comparison!

In 1813, when several distinguished mineralogists and geologists established the "*Geological Society,*" the members invited the President of the Royal Society to join them, and he accepted the invitation. He had not long, however, joined this new association before he began to show, as on all similar occasions, that he regarded the Royal Society as the "Aaron's rod" of scientific institutions which was to swallow up all the rest. When

the

the papers read in the Geological Society had so increased in magnitude and interest, that it became a question whether the Society should not issue a volume, Sir Joseph proposed that they should be inserted in the Transactions of the Royal Society. This might perhaps have been acceded to; but it was accompanied with the further extraordinary condition, that *after the Council of the Geological Society had determined what papers should be printed and what laid aside,* "HIS *Council,*" *that is, the Council of the Royal Society, should have the further power of adopting or rejecting those which were thus selected for their use.* This strange condition naturally caused the rejection of Sir Joseph's proposal. Immediately he seceded from the Geological Society, with many of his friends. The Society, however, continued to flourish notwithstanding; and in the course of three or four years, several of the seceding members begged to be re-admitted.

In 1818, it was attempted, under the auspices of the British Government, to carry into effect a plan for determining with considerable accuracy the relative values of the weights and measures of all trading countries. This plan originated with Dr. *Kelly*, of Finsbury Square, who was about to prepare a new edition of "The Universal Cambist," a comprehensive work on the monies, weights and measures of all countries, which had been liberally patronized by Government. The Doctor pointed out to "the Board of Trade" the advantages that would accrue to the commercial world, if Government would avail themselves of this season of universal peace, and obtain accurate standards of the principal measures of all countries. In consequence of this suggestion, Lord Castlereagh, by the recommendation of the Board of Trade, issued a circular in March 1818, directing all the British Consuls abroad to send home copies of the principal standards of weight and measure, employed within their respective consulates, verified by the proper authorities, and accompanied by explanatory papers. This order was executed in the course of the year, in a very complete and satisfactory manner; and the standards thus transmitted were deposited in our Royal Mint, where the comparisons were to be made by *Robert Bingley*, Esq. the King's Assay-master, in conjunction with Dr. Kelly; the latter of whom was to publish the results in the new edition of his Cambist.

The business, it would seem, had proceeded thus far unknown to Sir Joseph Banks, although he was a member of the Board of Trade. No sooner did he learn what had been going on, than he expressed great displeasure that the plan was not under *his* direction: and he had sufficient influence to obtain an order compelling the officers at the Mint to desist from all further proceedings

ceedings in reference to these foreign standards. Thus he occasioned a delay of more than a year. At length, different members of the Board of Trade, who were apprized of this delay, called upon Sir Joseph to assign his reasons, which appeared so frivolous that he was immediately outvoted upon the question, and the inquiry ordered to proceed, agreeably to the original directions. Sir Joseph's plea for his opposition to so natural a plan, was, that as he had recently got Lord Stanhope's scheme overthrown, and a commission appointed to revise British weights and measures, a commission at the head of which *he* was placed, it would be highly unbecoming and indecorous to allow any experiments on *foreign* weights and measures to be carried on at the Royal Mint independently of him and his colleagues in the said commission. This childish pretext was altogether disapproved by most of the members of the Board, and subjected Sir Joseph to the mortification of defeat; a mortification which he did not very long survive.

At the commencement of the present year 1820, several promoters of astronomy in theory and practice instituted an "*Astronomical Society.*" An interesting address explanatory of the objects of the Society, was drawn up and actively circulated, not merely among the friends to astronomical science in Britain, but among the principal encouragers of astronomy on the continent. Stimulated by this address, nearly all the distinguished observers, and other promoters of astronomy in theory and practice in Britain, became members, and several of the most eminent astronomers abroad have testified their approbation of the Society, and requested to be admitted as associates. Among the officers for conducting the affairs of the Institution during the first year, we observe the following well-known names: Sir *W. Herschel, the Astronomer Royal,* Drs. *Pearson* and *Gregory,* Col. *Beaufoy,* Capt. *Colby,* Messrs. *Babbage, Baily, Colebrooke, Groombridge, J. F. W. Herschel, Harrison, Moore, Stokes* and *Troughton.* Thus far the Society has proceeded with unpredicted success; and there is every probability that it will long and extensively tend to the diffusion of astronomical knowledge. It has already operated as an incentive to other learned bodies; of which a most gratifying evidence presents itself, in the resolution of the University of Cambridge to erect a new Observatory upon a grand and noble scale.

Copies of this address, so well received in every other quarter, were presented to Sir Joseph Banks: it will be natural to inquire, How did *he* receive them? I really regret to say, that their appearance called forth the most puerile and pitiable jealousy. Several of the members of the new Society were fellows of the Royal Society, and personal friends of Sir Joseph. These

he

he subsequently treated with coolness and incivility; and some he even affected *not to know*. Shortly afterwards he summoned the Council of the Royal Society ("*his* Council," as they were still denominated), laid before them this address, and with a countenance half tinged with melancholy, half with anger, asked what was to be done? They recommended him to let the new Society alone, unless he wished to establish it on a firm and durable basis by his opposition: but this was advice too judicious and sensible to be followed. He then expostulated with the Astronomer Royal upon his grossly reprehensible conduct, in sanctioning the new Society: but the Astronomer Royal was inflexible, and so stupidly blind as not to be convinced by Sir Joseph's arguments, that to sanction a British Astronomical Society was altogether irreconcileable with the duties of Astronomer Royal of Britain. Sir Joseph next expostulated with the *Duke of Somerset*, who had consented to be President of the Astronomical Society, and who, if I am correctly informed, had actually attended one of the meetings, on the incompatibility of this procedure with the duty of a faithful member of the Royal Society: His Grace, in consequence, withdrew from the new Society.

An active member of the Astronomical Society, whose name I need not specify, had received a promise from Sir Joseph Banks, that whenever there was a vacancy among the Royal Society members of the Board of Longitude, he would recommend him as an admirably qualified person. On the death of Gen. Mudge, this gentleman called upon Sir Joseph Banks and reminded him of his promise. Sir Joseph replied, that *by becoming a member of the Astronomical Society he had forfeited all claims upon his recommendation for the Board of Longitude!*

How utterly repugnant all this is to the character of an English gentleman, to say nothing of a philosopher, must be evident to every one. Nothing, it seems, that had a tendency to promote British science in *any* department, could be tolerated by Sir Joseph Banks, unless it were in league with, or rather in subserviency to, the Royal Society: nothing was to be encouraged *by* that Society unless it met his full approbation: and scarcely any person could obtain admission for his papers into the Philosophical Transactions (however indisputable their merit), or for himself as a *fellow* (however established his reputation), unless either by dancing attendance with assiduous frequency, or, by getting some approved friend to sue for his excuse from this degrading process, he caught the smiles and the sanction of the great man. If genuine science and philosophy have gained ground in England, during the last 40 years, notwithstanding the tendency of these things to impede their progress, it must have

have been from the operation of circumstances over which Sir Joseph, his habits and propensities, had no controul.

After the preceding enumeration of particulars, I may safely ask, If the knowledge of pure mathematics have declined in England during the last 40 years, who can help ascribing it to Sir Joseph Banks? If mixed mathematics, if practical mechanics, if geology and mineralogy, if astronomy, nay, if chemistry, have made any considerable advances in England; or if any of them have been enriched with noble inventions and brilliant discoveries, who will venture to impute the least portion of those advances, or the least valuable of those discoveries, to the fostering influence of that celebrated individual? The flatterers of Sir Joseph have termed him the *Solon*, the *Nestor*, the *Mecænas*, of British science; and he must doubtless have laughed in his sleeve at their simplicity or their folly, whenever he knew them so to speak. The MECÆNAS truly! What tragedies did he compose? What memoirs of distinguished men? What classifications of precious stones? What was the name of the learned man whose estates he redeemed, as Mecænas did those of Virgil? What poet or philosopher owed deliverance from Royal disgrace to his unsought intervention? What real promoter of science did he on his death-bed recommend to the especial patronage of his Prince, as Mecænas did Horace to Augustus? The MECÆNAS! Into what will flattery precipitate men! Why not the NEWTON, at once? and why not propose for his epitaph—

Sibi gratulentur mortales,
Tale tantumque extitisse
Humani generis decus!

One remark more, and I have done. Much has been said of Sir Joseph's hospitality; and there has been inferred from it the necessity that his successor in the chair of the Royal Society should be a man of opulence. This is very fallacious, and easily exposed. Had Sir Joseph, instead of aspiring to honour among philosophers, contented himself with moving in the sphere of a country gentleman, he would doubtless have given as many dinner parties to the neighbouring gentry, and placed before them as splendid repasts, as he did to his philosophical associates. And as to his *tea-parties*, I know of nothing peculiar about them, except it be that in order to show a philosophic indifference to the Christian sabbath, they were for many years held on *Sunday evenings*. Several persons who have attended them frequently, and who were, on the whole, pleased with the society they there met with, have always found it difficult to suppress a smile when they have heard of the *opulence* necessary to continue the practice, and affirm that they would engage to defray the whole expense for much less than 150*l.* per annum.

After

After all, it does not appear quite *axiomatic*, that genuine science and philosophy are essentially, if at all, promoted by this kind of parties. They tend wonderfully to the formation of distinct coteries. When from 50 to 100 persons, especially men of talent, meet frequently, talk much about their own concerns, or speculations, or discoveries, or supposed discoveries, and little about those of other persons, it requires much more watchfulness, and much more freedom from vanity, than usually falls to the lot of mortals, to preserve these individuals from thinking themselves "THE WISE, *and that wisdom will die with them.*"

Doubtless the researches and discoveries of *Hutton*, *Maskelyne*, *Landen*, *Waring*, *Herschel*, *Young*, *Davy*, *Wollaston*, *MacCulloch*, *Brewster*, *Ivory*, and very many others, the glory of British science, would have had all their intrinsic excellency and all their distinguished celebrity, although Sir Joseph Banks had never gratuitously dispensed a single cup of tea.

XXXVIII. *Remarks on the Succession of Rocks in the District of the Lakes*.*

SIR, — IT is a question not fully determined among Geologists, whether the mountainous district of Cumberland, Westmorland, and Lancashire, ought to be considered as a stratified or an unstratified country. This may arise partly from a want of sufficient observation, and partly for want of a precise definition of the term stratification. It is true, these rocks present little of that regularity of appearance observable in many other districts; yet they can hardly be said to be devoid of all traces of stratification; and, if it be allowable to adopt an intermediate term, they may be said to be *imperfectly stratified.*

Granite is understood to occupy the lowest place in the series of rocks which have hitherto been exposed to human observation; it may be called the foundation rock upon which all the others rest: there are, however, rocks of granite found in other situations; these may be considered as of a later formation. The only granite which I think entitled to the name primary appearing in this district, is of a grey kind, composed of quartz, white felspar, and black mica; it may be seen denudated in the bed of the river Caldew, near its source on the north-east side

* From the "Lonsdale Magazine," an interesting monthly work, printed at Kirkby Lonsdale. In our 51st vol. p.389, we announced a Map of the District of the Lakes, by the ingenious Writer of this Paper: upon Copies of this Map presented by Mr. Otley to some of his Friends, he has laid down the Strata, corresponding to the description here given.—EDITOR.

 of

of Skiddaw; and in a branch of the river Greta between Skiddaw and Saddleback, about 400 yards above the level of the sea. This appears to be the highest elevation to which the primary granite, or foundation rock, has attained in this district; whence its surface may be presumed to have an inclination or dip each way; but probably more rapid on the north than on the south side. It is intersected by veins of quartz, in which, among other minerals, molybdena, tungsten and wolfram have been found.

The rocks which succeed, and have been confounded together under the general name of slaty rocks, may be classed in three principal divisions. The first of which, or lowest in the series, forms the mountains Skiddaw, Saddleback, Grisdale Pike, and Grasmoor, with most of the Newland's mountains; extending across Cromack lake, and by the foot of Ennerdale, as far as Dent hill. That which reposes immediately upon the granite is a slaty rock, containing a considerable portion of mica, but perhaps scarcely sufficient to entitle it to the character of mica-slate; as it recedes from the granite the quantity of mica decreases, and it appears marked with dark spots; this is quarried for flooring flags. Encircling the granite, this rock occupies a limited space upon the surface; it may be imagined to pass under the more simple clay slate which forms the bulk of the before-named mountains.

All the rocks of this division are of a dark colour, inclining to black, and generally of a slaty structure; some of them admit of being manufactured into roofing slate, which being most easily procured, has formerly been the general covering of houses in Keswick and its vicinity; but being subject to be shivered by the weather in thin flakes, it has been superseded by the pale blue slate of the next division. These rocks do not effervesce with acids, they contain little or no calcareous spar: imbedded crystals of a mineral called chyastolite are found in some parts of Skiddaw and Saddleback; veins of quartz and lead ore occur in Thornthwaite, Newlands, Loweswater, and other places; a copper mine in Newlands, called Gold-scalp, has formerly been worked to a considerable extent, and is said to have been very rich; the salt springs of Borrowdale (deserving the attention of naturalists) issue from veins in this rock; and in some places its resemblance to the shale accompanying coal has induced trial to be made for that mineral as in Mungrisdale, &c. with scarcely the most remote probability of success, its geological position being considered.

The second division consists of rocks more varied in their composition; they have been included under the general name of slate rocks: but as those rocks which exhibit the slaty cleavage form but a small portion of this division, it does not ac-

cord

cord with my ideas to apply the term slate to the rocks not possessing the laminar or slaty structure. Leaving the terms trap, basalt, grey-wacke, greenstone, whinstone, ragstone, &c. to those more conversant in their application; I shall for the present content myself with such distinctive characters as first arrest the attention of an untutored observer, and these are the colour and fracture. With the exception of some reddish granite, or sienitic rocks, at Muncaster, Irton, Eskdale, Buttermere, Shap Fells, &c. a porphyritic rock near Keswick, and some others, they are generally of a pale bluish-grey colour. The mountains of Eskdale, Wasdale, Borrowdale, Langdale, Grasmere, Patterdale, Martindale, Mardale, &c. including the highest mountains Scawfell and Helvellyn, as well as the Old Man at Coniston, are in this division. The fine pale-blue roofing slate occurs in beds (called by the workmen veins); the most natural position of the folia or leavage of the slate seems to be vertical; but it is found in various degrees of inclination, both with respect to the horizon, and the planes of stratification. In Borrowdale the upper part of the slate inclines to the north, in Langdale to the south; as though the mountain ridge, dividing the counties of Cumberland and Westmorland, had acted as a wedge in separating them.

Most of the rocks of this division effervesce in some degree with acids, but more especially those possessing the slaty structure; they contain some calcareous spar in veins and nodules; some lead ore at Patterdale; a copper mine at Dalehead in Newlands near the northern extremity, produces some rare varieties of ore; copper is also got at Coniston, near the southern boundary of the division; several small veins of iron-ore appear, but none thought worth the expense of working; the famous plumbago or black-lead mine of Borrowdale, is also contained in this division: it occurs not in a regular vein, but in isolated sops, or pipes, which appear to be formed by the intersection of cross veins.

The third division, forming only inferior elevations, commences with a bed (erroneously called a vein) of a dark-blue limestone, (the transition limestone of some geologists,) intermixed with a slaty rock of the same colour: this is the first stratum in which I have recognised any organic remains of shells, &c. It crosses the river Duddon near Broughton, stretches in a north-east direction by the foot of the Old Man mountain, crosses the head of Windermere Lake, near the Low Wood Inn, and proceeds through the valleys of Troutbeck, Kentmere, &c. It is succeeded on the south-east by a series of rocks of the same dark-blue colour; from some of which, as at Brathay, excellent flags for flooring, as well as for tombstones, &c. are procured. Large quantities of dark coloured roofing slate (called black slate, to distinguish it from the paler blue slate of the last division) are manufactured in the district between Ulverston and Broughton; which is well situated for shipping, either by the river Duddon, or by the canal at Ulverston. Most of these rocks exhibit a slaty structure, and it has been stated that some of them had two distinct cleavages, meeting and crossing each other under a certain angle; but a person accustomed to the manufacture of roofing slates would smile on being told that he might cleave them in any other than one direction. Although little difference has hitherto been made by writers, between the roofing slate of these three divisions, yet a workman of moderate experience will readily distinguish them. A preference is given to the slate from some quarries, as requiring less weight for the covering of a roof of given dimensions; this does not depend so much on the specific gravity of the different slates, (which varies from about 2750 to 2800,) as upon the fineness of grain, which enables it to bear splitting thinner. All these rocks effervesce more or less with acids; they contain some calcareous spar, and pyrites, but little metallic ore of any kind; lead ore has been found near Stavely, but in very small quantity. In those districts where the rocks are of a slaty structure, the roads are generally smooth, the fragments naturally adapting themselves to a flat surface, not rolling about like rounded stones, nor presenting angles like rough broken ones: but in low situations, or, where roads are much used, they are too soon converted into a clayey matter.

A stratum of dark blue rock, which bassets out near Cartmel, on Benson Knot, and Tenter Fell near Kendal, and other places, breaks equally in all directions, and appears to be the parent rock, from which have been produced a great portion of the rounded stones found in the beds of the rivers Kent and Lune, with those turned up by the plough in the district between these two rivers, and in the parish of Cartmel; and furnishes materials for paving the streets and repairing the roads in those places.

Rounded stones of various sizes, from the smallest gravel to the weight of several pounds, held together by a ferruginous calcareous cement, form a conglomerate rock, extending from Mell-fell, to the foot of Ullswater.

A bed of limestone forms an irregular circle round this mountainous or slaty district, intervening between that and what are called the coal measures. It bassets out near Egremont, Lamplugh, Pardshaw, Papcastle, Bothel, Ireby, Caldbeck, Berrier, Dacre, Lowther, and, after a circuitous course through Westmorland, appears near Kendal, Witherslack, Cartmel, Dalton, and Millum, whence for some distance its place is occupied by the sea. The most considerable mineral production of this limestone is iron ore, which is raised in great quantities in Low Furness;

as

as it was also formerly near Egremont. This limestone does not conform to the direction of the strata beneath it in a regular order of succession; but may be supposed to overlay and conceal the basseting out of many of the lower rocks. It dips each way from the mountains, but with different degrees of inclination, the declivity being generally least on the southern side; on which account it is seen upon the surface to a greater extent, as from Witherslack and Kendal, to Warton and Farlton Craggs, and even as far as Kellet, before the commencement of the superincumbent sandstone belonging to the coal measures; (a remarkable exception occurs at the foot of Holker Park, where the blue rock is succeeded by limestone, and that by sandstone and shale, indicating the beginning of coal measures; all within a very short distance;) while on the north and west of the mountains, from the greater dip, and thinness of the strata, the slaty rock of the first division is succeeded by limestone, freestone, and coal, all within the distance of three or four miles.

Keswick, Aug. 1, 1820. J. OTLEY.

XXXIX. *Tables of the Planet Venus, including the Perturbations, originally computed by* REBOUL, *according to the Theory of* LAPLACE, *and the Elements of* LINDENAU. *Now arranged in a more convenient Form, and adapted to the Meridian of Greenwich. By* A CORRESPONDENT.

It is of greater importance to astronomy and navigation, that we should possess correct Tables of Venus, than of any other planet. Her motion is sufficiently rapid for the purpose of ascertaining the longitude at sea, by lunar distances; and although this had been remarked several years ago, by Professor Reboul, it is but recently that one or two continental astronomers have begun to put this method into practice, by giving in their Ephemerides, the lunar distances from Venus, in like manner as from the sun and stars. The fulfilment of this end, obviously requires the Tables of Venus to be of equal accuracy with those of the Moon, which cannot be accomplished unless we apply the corrections arising from the attractions of the other planets.

The scarce and valuable Tables now first presented to the British public, are, it is believed, the only ones *in print*, which supply this desideratum: they were published at Marseilles in 1811, and the form given to them is nearly that of Mayer's Solar Tables; extending to 30 pages in quarto. Some modification was of course necessary, to adapt these to an octavo impression; and, as considerable improvements have lately been made in the arrangement

arrangement of astronomical Tables, it was resolved to remodel these entirely, and to present them in the form which, it is probable, the author himself would have chosen, had their construction been deferred to the present time.

Daussy's Tables of Vesta were adopted as the model, which has been deviated from only in two instances. The first regards the mode of compensating for the intercalary day in Leap Year: the one here employed, the writer believes to be new, and flatters himself it may be considered an improvement, since the precept usually subjoined to the table of daily motions, is liable to escape notice. In the other instance, he has chosen to retain in its original form the Table of Heliocentric Latitude, instead of giving the Polar distances as is now commonly done.

The chief variations from the original Tables are as follow: In Table II. the epochs for 1750, 1770, 1801—1809, and 1890, are omitted, and those for 1740, 1821—1839, and 1900 introduced; the whole being adapted for the meridian of Greenwich, in lieu of that of Paris. And in order that the new Table might not be less accurate than the old one (even by the tenth of a second), the computations for the mean longitude were made from the original elements, and were carried to two decimal places further than are retained. The place of the perihelion is substituted for that of the aphelion; and the longitude both of that, and of the planet, is diminished by one degree, which is the sum of the constant quantities employed to render always additive, the equation of the centre, the perturbations in longitude, and the reduction to the ecliptic. The longitude of the node is only diminished by four minutes, which is the constant quantity for the reduction. In Table III. double quantities are given for January and February, and those for the other months are increased by one day's motion; the numbers in Table IV. being diminished by the like quantity. The differences in Tables VI. VIII. and X. are for 10 minutes instead of one degree. The equations of perturbation are all put into one Table, whereby room is saved, and reference facilitated. Lastly, the numbers in Table VIII. are diminished by 0·0000401, sum of the constant quantities for the perturbation of the radius vector.

Although to persons accustomed to the use of astronomical Tables, the preceding explanations will suffice, yet as short precepts, and an example of their application, may be acceptable to many of the readers of the Philosophical Magazine, it is proposed to supply these in a future Number.

TABLE

TABLE I. *Mean Motions for Years.*

Years.	Longitude.				Perihelion.			Node.			Arg. I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
1	7ˢ	14°	47′	29″·7	0°	0′	47″·0	0°	0′	29″·9	375	460	100	749	499	345	084	123	969	176
2	2	29	34	59·4	0	1	34·0	0	0	59·8	750	920	199	498	998	690	169	247	939	353
3	10	14	22	29·1	0	2	20·9	0	1	29·8	125	380	299	248	497	036	253	370	908	529
4 B	6	0	46	6·6	0	3	8·0	0	1	59·8	498	835	396	996	992	376	337	404	878	706
5	1	15	33	36·2	0	3	55·0	0	2	29·7	873	295	496	745	491	721	422	617	848	882
6	9	0	21	5·9	0	4	42·0	0	2	59·6	248	755	595	494	990	066	506	741	817	059
7	4	15	8	35·6	0	5	29·0	0	3	29·5	623	215	695	244	489	412	590	864	787	235
8 B	0	1	32	13·1	0	6	16·1	0	3	59·5	996	670	792	992	984	752	675	988	757	412
9	7	16	19	42·8	0	7	3·1	0	4	29·4	371	130	892	741	483	097	759	111	727	588
10	3	1	7	12·5	0	7	50·1	0	4	59·4	746	590	991	490	982	442	843	235	696	765
11	10	15	54	42·2	0	8	37·0	0	5	29·3	121	051	091	240	481	788	927	358	666	941
12 B	6	2	18	19·7	0	9	24·1	0	5	59·3	494	506	188	988	976	129	012	483	635	117
13	1	17	5	49·4	0	10	11·1	0	6	29·2	869	966	288	737	475	474	096	606	605	293
14	9	1	53	19·1	0	10	58·1	0	6	59·1	244	426	387	486	974	819	180	730	574	470
15	4	16	40	48·7	0	11	45·1	0	7	29·0	619	886	487	236	473	165	265	853	544	646
16 B	0	3	4	26·2	0	12	32·2	0	7	59·0	992	341	584	984	968	505	349	977	514	823
17	7	17	51	55·9	0	13	19·2	0	8	29·0	367	801	684	733	467	850	433	100	484	999
18	3	2	39	25·6	0	14	6·2	0	8	58·9	742	261	783	482	966	195	518	224	453	176
19	10	17	26	55·3	0	14	53·1	0	9	28·8	117	721	883	232	465	541	602	347	423	352
20 B	6	3	50	32·8	0	15	40·2	0	9	58·8	490	176	980	980	960	881	687	471	392	529
40 B	0	7	41	5·6	0	31	20·5	0	19	57·6	979	352	960	960	919	763	374	941	784	058
60 B	6	11	31	38·4	0	47	0·7	0	29	56·4	469	528	940	940	879	644	061	412	176	587
80 B	0	15	22	11·2	1	2	41·0	0	39	55·2	959	704	920	920	838	526	748	882	568	116
100 B	6	19	12	44·0	1	18	21·2	0	49	54·0	448	880	900	900	798	407	435	352	960	645
200 B	1	8	25	28·0	2	36	42·4	1	39	48·0	398	762	802	799	594	815	868	702	922	289
300 B	7	27	38	12·0	3	55	3·7	2	29	42·0	346	642	703	699	391	222	302	052	882	934
400 B	2	16	50	55·9	5	13	24·9	3	19	36·0	795	523	604	599	189	630	737	402	843	579
500 B	9	6	3	39·9	6	31	46·1	4	9	30·0	244	404	505	498	985	037	171	752	804	223
600 B	3	25	16	23·9	7	50	7·3	4	59	24·0	693	285	406	398	783	445	605	103	765	868
700 B	10	14	29	7·9	9	8	28·5	5	49	18·0	141	165	307	298	580	852	039	454	726	513
800 B	5	3	41	51·9	10	26	49·7	6	39	12·0	590	047	206	198	377	261	473	804	687	167
900 B	11	22	54	35·9	11	45	11·0	7	29	6·0	039	927	109	097	175	667	907	155	647	802
1000 B	6	12	7	19·9	13	3	32·2	8	19	0·0	487	808	010	997	972	075	341	505	608	447

TABLE II. *Epochs of the mean Longitudes of the Planet, the Perihelion, and the Node; with the Epochs of the Arguments which regulate the Perturbations. (Merid. Greenwich.)*

Years.	Mean Longit.				Long. Perihel.			Long. Node			Arg. I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
					4 signs.			2 signs.												
1740 B	10s	14°	13′	54″ 6	6°	56′	5″·5	14°	22′	42″·3	403	291	563	085	892	483	167	768	358	998
1760 B	4	18	4	27·4	7	11	45 8	14	28	41·1	893	467	543	065	851	364	854	238	750	527
1780 B	10	21	55	0·2	7	27	26·0	14	38	39·9	383	644	523	046	811	246	541	708	143	057
1790	1	23	2	12·7	7	35	16·1	14	43	39·3	128	234	514	534	790	689	384	940	839	821
1800 C	4	24	9	25·2	7	43	6·2	14	48	38·6	874	824	506	026	774	132	227	177	535	585
1810	7	25	16	37·7	7	50	56 2	14	53	38·0	620	415	497	516	756	574	070	412	231	350
1811	3	10	4	7·4	7	51	43·2	14	54	7·9	995	874	596	266	257	920	155	536	201	526
1812 B	10	26	27	44·9	7	52	30·3	14	54	37·9	368	330	694	014	749	261	239	659	170	702
1813	6	11	15	14·6	7	53	17·3	14	55	7·8	743	790	793	763	249	601	324	783	140	878
1814	1	26	2	44·2	7	54	4·3	14	55	37·8	118	250	893	512	748	951	408	907	109	055
1815	9	10	50	13·9	7	54	51·3	14	56	7·7	493	709	993	262	247	297	492	030	079	231
1816 B	4	27	13	51·4	7	55	38·3	14	56	37·7	866	165	091	010	742	637	576	154	049	408
1817	0	12	1	21·1	7	56	25·3	14	57	7·6	241	625	190	759	241	982	661	277	019	584
1818	7	26	48	50·8	7	57	12·3	14	57	37·5	616	085	289	508	740	327	745	401	988	761
1819	3	11	36	20·5	7	57	59·3	14	58	7·4	991	545	389	258	239	673	830	524	957	937
1820 B	10	27	59	58·0	7	58	46·4	14	58	37·5	364	000	486	006	734	014	914	648	927	114
1821	6	12	47	27·7	7	59	33·4	14	59	7·4	739	460	586	755	233	359	998	771	896	290
1822	1	27	34	57 4	8	0	20·4	14	59	37·3	114	920	685	504	732	704	083	895	866	467
1823	9	12	22	27·0	8	1	7·4	15	0	7·3	489.	380	785	254	231	050	167	018	835	643
1824 B	4	28	46	4·5	8	1	54·5	15	0	37·3	862	835	882	002	726	390	251	142	805	820
1825	0	13	33	34·2	8	2	41·5	15	1	7·2	237	295	982	751	225	735	336	265	775	996
1826	7	28	21	3·9	8	3	28·5	15	1	37·1	612	755	081	500	724	080	420	389	744	173
1827	3	13	8	33 6	8	4	15·5	15	2	7·0	987	215	181	250	223	426	504	512	714	349
1828 B	10	29	32	11·1	8	5	2·6	15	2	37·0	360	670	278	998	718	766	589	636	684	526
1829	6	14	19	40·8	8	5	49·6	15	3	6·9	735	130	378	747	217	111	673	759	654	702
1830	1	29	7	10·5	8	6	36·5	15	3	36·9	110	590	477	496	716	456	757	883	623	879
1831	9	13	54	40·2	8	7	23·5	15	4	6·8	485	051	577	246	215	802	841	006	593	055

TABLE II. *continued.*

1832 B	5	0	18	17·7	8	8	10·6	15	4	36·8	858	506	674	994	710	143	926	131	562	231
1833	0	15	5	47·3	8	8	57·6	15	5	6·7	233	966	774	743	209	488	010	254	532	407
1834	7	29	53	17·0	8	9	44·6	15	5	36·6	608	426	873	492	708	833	094	378	501	584
1835	3	14	40	46·7	8	10	31·6	15	6	6·5	983	886	973	242	207	179	179	501	471	760
1836 B	11	1	4	24·2	8	11	18·7	15	6	36·5	356	341	070	990	702	519	263	625	441	937
1837	6	15	51	53·9	8	12	5·7	15	7	6·5	731	801	170	739	101	864	347	748	411	113
1838	2	0	39	23·6	8	12	52·6	15	7	36·4	106	261	269	488	700	209	432	872	380	290
1839	9	15	26	53·3	8	13	39·6	15	8	6·3	481	721	369	238	199	555	516	995	350	466
1840 B	5	1	50	30·8	8	14	26·7	15	8	36·3	854	176	466	986	693	895	601	118	319	643
1860 B	11	5	41	3·6	8	30	6·9	15	18	35·1	344	353	446	966	653	776	288	588	711	172
1880 B	5	9	31	36·4	8	45	47·1	15	28	33·9	833	529	426	947	612	659	975	060	104	703
1900 C	11	11	46	1·4	9	1	27·2	15	38	32·7	325	709	409	928	576	545	662	530	496	231

TABLE III. *Mean Motions for Months.*

Months.	Longitude				Perih	Node.	I.	II.	III.	IV	V.	VI.	VII.	VIII.	IX.	X.
Janu^y Bissext.	0^s	0°	0′	0″·0	0″·0	0″·0	000	000	000	000	000	000	000	000	000	000
Janu^y Common.	0	1	36	7·8	0·1	0·1	998	996	998	999	996	995	000	000	000	000
Febr^y Bissext.	1	19	40	2·0	4·0	2·6	947	869	924	979	873	859	007	010	997	015
Febr^y Common.	1	21	16	9·8	4·1	2·6	945	865	921	978	869	855	007	010	997	015
March	3	6	7	48·4	7·7	4·9	897	747	852	959	753	728	014	020	995	029
April	4	25	47	50·5	11·7	7·5	844	616	776	937	626	587	021	030	993	044
May...	6	13	51	44·7	15·6	9·9	793	490	702	917	502	451	028	041	990	058
June	8	3	31	46·7	19·6	12·5	740	359	625	896	375	311	035	051	988	073
July	9	21	35	40·9	23·4	14·9	688	232	551	875	251	175	042	061	985	088
August	11	11	15	43·0	27·4	17·5	635	102	475	854	124	034	049	072	982	103
September	1	0	55	45·0	31·4	20·0	582	970	398	832	997	894	056	082	980	118
October...	2	18	59	39·2	35·3	22·5	531	844	324	812	873	758	063	092	977	132
November	4	8	39	41·3	39·3	25·0	478	713	248	790	746	617	070	103	975	147
December	5	26	43	35·5	43·1	27·5	426	586	174	770	622	481	077	113	972	162

TABLE IV. *Mean Motions for Days of the Month.*

Days.	Longitude.				Perih.	Node.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
1	0s	0°	0′	0″·0	0″·0	0″·0	000	000	000	000	000	000	000	000	000	000
2	0	1	36	7·8	0·1	0·1	998	996	998	999	996	995	000	000	000	000
3	0	3	12	15·6	0·2	0·2	997	992	995	999	992	991	000	001	000	001
4	0	4	48	23·4	0·3	0·3	995	987	993	998	988	986	001	001	000	001
5	0	6	24	31·2	0·5	0·3	993	983	990	997	984	982	001	001	000	002
6	0	8	0	39·0	0·6	0·4	991	979	988	997	980	977	001	002	000	002
7	0	9	36	46·8	0·8	0·5	990	975	985	996	975	973	001	002	000	003
8	0	11	12	54·7	0·9	0·6	988	970	983	995	971	968	002	002	000	003
9	0	12	49	2·5	1·0	0·7	986	966	980	994	967	964	002	003	999	004
10	0	14	25	10·3	1·2	0·8	985	962	978	994	953	959	002	003	999	004
11	0	16	1	18·1	1·3	0·9	983	958	975	993	959	955	002	003	999	005
12	0	17	37	25·9	1·4	0·9	981	954	973	992	955	950	003	004	999	005
13	0	19	13	33·7	1·5	1·0	980	950	970	992	951	946	003	004	999	006
14	0	20	49	41·5	1·7	1·1	978	945	968	991	947	941	003	004	999	006
15	0	22	25	49·3	1·8	1·2	976	941	965	990	943	937	003	005	999	007
16	0	24	1	57·1	1·9	1·2	974	937	963	990	939	932	003	005	999	007
17	0	25	38	4·9	2·0	1·3	973	933	960	989	934	927	004	005	999	008
18	0	27	14	12·7	2·2	1·4	971	928	957	988	930	923	004	006	999	008
19	0	28	50	20·5	2·3	1·5	969	924	955	987	926	918	004	006	998	009
20	1	0	26	28·3	2·5	1·6	968	920	953	987	922	914	004	006	998	009
21	1	2	2	36·1	2·6	1·7	966	916	951	986	918	909	005	007	998	010
22	1	3	38	44·0	2·7	1·7	964	912	949	985	914	905	005	007	998	010
23	1	5	14	51·8	2·8	1·8	963	908	946	985	910	900	005	007	998	011
24	1	6	50	59·6	3·0	1·9	961	903	944	984	906	896	005	008	998	011
25	1	8	27	7·4	3·1	2·0	959	899	941	983	902	891	006	008	998	012
26	1	10	3	15·2	3·2	2·1	957	895	939	983	898	887	006	008	998	012
27	1	11	39	23·0	3·4	2·1	956	891	936	982	893	882	006	009	998	012
28	1	13	15	30·8	3·5	2·2	954	886	934	981	889	878	006	009	998	013
29	1	14	51	38·6	3·6	2·3	952	882	931	980	885	873	006	009	998	013
30	1	16	27	46·4	3·7	2·4	951	878	929	980	881	869	007	010	998	014
31	1	18	3	54·2	3·9	2·5	949	873	926	979	877	864	007	010	997	014

TABLE V. *Mean Motions for Hours, Minutes, and Seconds.*

Hou.	Longit.	I.	II.	III.	IV.	V.	VI.
1	0° 4′ 0″·3	0	0	0	0	0	0
2	0 8 0·7	0	0	0	0	0	0
3	0 12 1·0	0	0	0	0	0	999
4	0 16 1·3	0	999	0	0	999	999
5	0 20 1·6	0	999	0	0	999	999
6	0 24 2·0	0	999	999	0	999	999
7	0 28 2·3	0	999	999	0	999	999
8	0 32 2·6	999	999	999	0	999	999
9	0 36 2·9	999	998	999	0	999	998
10	0 40 3·3	999	998	999	0	998	998
11	0 44 3·6	999	998	999	0	998	998
12	0 48 3·9	999	998	999	0	998	998
13	0 52 4·2	999	998	999	0	998	998
14	0 56 4·6	999	998	999	0	998	997
15	1 0 4·9	999	997	999	0	997	997
16	1 4 5·2	999	997	998	0	997	997
17	1 8 5·5	999	997	998	0	997	997
18	1 12 5·9	999	997	998	0	997	997
19	1 16 6·2	999	997	998	999	997	996
20	1 20 6·5	999	995	998	999	997	996
21	1 24 6·8	999	996	998	999	996	996
22	1 28 7·2	999	996	998	999	996	996
23	1 32 7·5	998	996	998	999	996	996

Sec.	Lon.	Sec.	Lon.	Sec.	Lon.	Sec.	Lon.	Sec.	Lon.
3	0″·2	15	1″·0	27	1″·8	39	2″·6	51	3″·4
6	0·4	18	1·2	30	2·0	42	2·8	54	3·6
9	0·6	21	1·4	33	2·2	45	3·0	57	3·8
12	0·8	24	1·6	36	2·4	48	3·2	60	4·0

Min.	Longit.	Min.	Longit.
1	0′ 4″·0	31	2′ 4″·2
2	0 8·0	32	2 8·2
3	0 12·0	33	2 12·2
4	0 16·0	34	2 16·2
5	0 20·0	35	2 20·2
6	0 24·0	36	2 24·2
7	0 28·0	37	2 28·2
8	0 32·0	38	2 32·2
9	0 36·0	39	2 36·2
10	0 40·1	40	2 40·2
11	0 44·1	41	2 44·2
12	0 48·1	42	2 48·2
13	0 52·1	43	2 52·2
14	0 56·1	44	2 56·2
15	1 0·1	45	3 0·2
16	1 4·1	46	3 4·2
17	1 8·1	47	3 8·3
18	1 12·1	48	3 12·3
19	1 16·1	49	3 16·3
20	1 20·1	50	3 20·3
21	1 24·1	51	3 24·3
22	1 28·1	52	3 28·3
23	1 32·1	53	3 32·3
24	1 36·1	54	3 36·3
25	1 40·1	55	3 40·3
26	1 44·1	56	3 44.3
27	1 48·1	57	3 48·3
28	1 52·2	58	3 52·3
29	1 56·2	59	3 56·3
30	2 0·2	60	4 0·3

Table VI. *Equation of the Centre, for* 1820.

Argument, Mean Anomaly, reckoned from the Perihelion.

	0 sign.	Diff. for 10′.	I sign.	Diff. for 10′.	II signs.	Diff. for 10′.	III signs.	Diff. for 10′.
0°	55′ 0″·0	8″·30	78′ 45″·9	7″·13	96′ 2″·0	4″·02	102′ 10″·6	0″·13
1	55 49·8	8·31	79 28·7	7·05	96 26·1	3·88	102 9·8	0·28
2	56 39·7	8·30	80 11·0	6·98	96 49·4	3·77	102 8·1	0·43
3	57 29·4	8·30	80 52·9	6·89	97 12·0	3·63	102 5·5	0·58
4	58 19·2	8.28	81 34·2	6·82	97 33·8	3·50	102 2·0	0·72
5	59 8·8	8·27	82 15·1	6·73	97 54·8	3·37	101 57·7	0·85
6	59 58·4	8·25	82 55·5	6·64	98 15·0	3·23	101 52·6	1·00
7	60 47·9	8·23	83 35·3	6·55	98 34·4	3·10	101 46·6	1·15
8	61 37·3	8·21	84 14·6	6·47	98 53·0	2·97	101 39·7	1·28
9	62 26·6	8·18	84 53·4	6·37	99 10·8	2·82	101 32·0	1·42
10	63 15·7	8·16	85 31·6	6·27	99 27·7	2·70	101 23·5	1·57
11	64 4·7	8·13	86 9·2	6·17	99 43·9	2·55	101 14·1	1·72
12	64 53·5	8·10	86 46·2	6·08	99 59·2	2·42	101 3·8	1·83
13	65 42·1	8·07	87 22·7	5·98	100 13·7	2·28	100 52·8	1·98
14	66 30·6	8·03	87 58·6	5·87	100 27·4	2·15	100 40·9	2·13
15	67 18·8	7·98	88 33·8	5·78	100 40·3	2·00	100 28·1	2·25
16	68 6·7	7·95	89 8·5	5·65	100 52·3	1·85	100 14·6	2·40
17	68 54·5	7·90	89 42·4	5·55	101 3·4	1·72	100 0·2	2·53
18	69 41·9	7·86	90 15·7	5·45	101 13·7	1·58	99 45·0	2·67
19	70 29·1	7·82	90 48·4	5·34	101 23·2	1·43	99 29·0	2·82
20	71 16·0	7·77	91 20·4	5·23	101 31·8	1·28	99 12·1	2·94
21	72 2·6	7·72	91 51·8	5·11	101 39·5	1·15	98 54·5	3·07
22	72 48·9	7·65	92 22·4	5·00	101 46·4	1·02	98 36·1	3·20
23	73 34·8	7·60	92 52·4	4·87	101 52·5	0·85	98 16·9	3·33
24	74 20·4	7·55	93 21·6	4·77	101 57·6	0·73	97 56·9	3·45
25	75 5·7	7·47	93 50·2	4·64	102 2·0	0·57	97 36·2	3·60
26	75 50·5	7·42	94 18·0	4·52	102 5·4	0·43	97 14·6	3·72
27	76 35·0	7·35	94 45·1	4·40	102 8·0	0·28	96 52·3	3·83
28	77 19·1	7·27	95 11·5	4·27	102 9·7	0·17	96 29·3	3·97
29	78 2·7	7·20	95 37·1	4·15	102 10·7	0·02	96 5·5	4·10
30	78 45·9		96 2·0		102 10·6		95 40·9	

Secular Variation of the Equation of the Centre, for (1800+*t*).

	0ˢ —	Iˢ —	IIˢ —	IIIˢ —		0ˢ —	Iˢ —	IIˢ —	IIIˢ —
0°	0″·0	22″·7	39″·2	44″·9	15°	11″·8	32″·1	43″·5	43″·1
1	0·8	23·4	39·6	44·8	16	12·6	32·6	43·7	42·9
2	1·6	24·1	39·9	44·8	17	13·3	33·2	43·8	42·6
3	2·4	24·7	40·3	44·7	18	14·1	33·7	44·0	42·4
4	3·2	25·4	40·6	44·7	19	14·8	34·3	44·1	42·1
5	4·0	26·1	41·0	44·6	20	15·6	34·8	44·3	41·9
6	4·8	26·7	41·3	44·5	21	16·3	35·3	44·4	41·6
7	5·6	27·3	41·6	44·4	22	17·0	35·7	44·5	41·3
8	6·3	28·0	41·8	44·2	23	17·8	36·2	44·6	41·0
9	7·1	28·6	42·1	44·1	24	18·5	36·6	44·7	40·7
10	7·9	29·2	42·4	44·0	25	19·2	37·1	44·8	40·4
11	8·7	29·8	42·6	43·8	26	19·9	37·5	44·8	40·0
12	9·5	30·4	42·8	43·6	27	20·6	37·9	44·9	39·6
13	10·2	30·9	43·1	43·5	28	21·3	38·4	44·9	39·3
14	11·0	31·5	43·3	43·3	29	22·0	38·8	44·9	38·9

TABLE VI. *continued.* *Equation of the Centre.*

Arg. Mean Anomaly.

	IV signs.	Diff. for 10′.	V signs.	Diff. for 10′.	VI signs.	Diff. for 10′.	VII signs.	Diff. for 10′.
0°	95′ 40″·9	4″·20	78′ 24″·9	7″·13	55′ 0″·0	8″·17	31′ 35″·1	7″·07
1	95 15·7	4·33	77 42·1	7·20	54 11·0	8·17	30 52·7	6·98
2	94 49·7	4·47	76 58·9	7·25	53 22·0	8·16	30 10·8	6·92
3	94 22·9	4·57	76 15·4	7·33	52 33·1	8·15	29 29·3	6·83
4	93 55·5	4·68	75 31·4	7·38	51 44·2	8·14	28 48·3	6·77
5	93 27·4	4·80	74 47·1	7·45	50 55·4	8·13	28 7·7	6·68
6	92 58·6	4·93	74 2·4	7·50	50 6·6	8·12	27 27·6	6·60
7	92 29·0	5·02	73 17·4	7·57	49 17·9	8·10	26 48·0	6·50
8	91 58·9	5·15	72 32·0	7·61	48 29·4	8·08	26 9·0	6·43
9	91 28·0	5·25	71 46·4	7·67	47 40·9	8·05	25 30·4	6·33
10	90 56·5	5·35	71 0·4	7·70	46 52·6	8·03	24 52·4	6·25
11	90 24·4	5·47	70 14·2	7·75	46 4·4	8·00	24 14·9	6·17
12	89 51·6	5·57	69 27·7	7·79	45 16·4	7·98	23 37·9	6·07
13	89 18·2	5·67	68 40·9	7·83	44 28·5	7·95	23 1·5	5·97
14	88 44·2	5·78	67 53·9	7·88	43 40·8	7·91	22 25·7	5·87
15	88 9·5	5·87	67 6·6	7·91	42 53·4	7·88	21 50·5	5·78
16	87 34·3	5·97	66 19·2	7·95	42 6·1	7·83	21 15·8	5·67
17	86 58·5	6·07	65 31·5	7·98	41 19·1	7·79	20 41·8	5·57
18	86 22·1	6·17	64 43·6	8·00	40 32·3	7·75	20 8·4	5·47
19	85 45·1	6·25	63 55·6	8·03	39 45·8	7·70	19 35·6	5·35
20	85 7·6	6·33	63 7·4	8·05	38 59·6	7·67	19 3·5	5·22
21	84 29·6	6·43	62 19·1	8·08	38 13·6	7·61	18 32·0	5·15
22	83 51·0	6·50	61 30·6	8·10	37 28·0	7·57	18 1·1	5·02
23	83 12·0	6·60	60 42·1	8·12	36 42·6	7·50	17 31·0	4·93
24	82 32·4	6·68	59 53·4	8·13	35 57·6	7·45	17 1·4	4·80
25	81 52·3	6·77	59 4·6	8·14	35 12·9	7·38	16 32·6	4·68
26	81 11·7	6·83	58 15·8	8·15	34 28·6	7·33	16 4·5	4·57
27	80 30·7	6·92	57 26·9	8·16	33 44·6	7·25	15 37·1	4·47
28	79 49·2	6·98	56 38·0	8·17	33 1·1	7·20	15 10·3	4·33
29	79 7·3	7·07	55 49·0	8·17	32 17·9	7·13	14 44·3	4·20
30	78 24·9		55 0·0		31 35·1		14 19·1	

Secular Variation.

	IVˢ —	Vˢ —	VIˢ +	VIIˢ +		IVˢ —	Vˢ —	VIˢ +	VIIˢ +
0°	38″·5	22″·1	0″·0	22″·1	15°	31″·3	11″·4	11″·4	31″·3
1	38·1	21·4	0·8	22·7	16	30·7	10·7	12·1	31·8
2	37·7	20·7	1·6	23·4	17	30·1	9·9	12·8	32·4
3	37·2	20·0	2·3	24·0	18	29·6	9·2	13·6	32·9
4	36·8	19·3	3·1	24·7	19	29·0	8·4	14·3	33·5
5	36·4	18·6	3·9	25·3	20	28·4	7·7	15·0	34·0
6	35·9	17·9	4·7	25·9	21	27·8	6·9	15·7	34·5
7	35·4	17·2	5·4	26·5	22	27·2	6·2	16·4	35·0
8	35·0	16·4	6·2	27·2	23	26·5	5·4	17·2	35·4
9	34·5	15·7	6·9	27·8	24	25·9	4·7	17·9	35·9
10	34·0	15·0	7·7	28·4	25	25·3	3·9	18·6	36·4
11	33·5	14·3	8·4	29·0	26	24·7	3·1	19·3	36·8
12	32·9	13·6	9·2	29·6	27	24·0	2·3	20·0	37·2
13	32·4	12·8	9·9	30·1	28	23·4	1·6	20·7	37·7
14	31·8	12·1	10·7	30·7	29	22·7	0·8	21·4	38·1

Table VI. *continued. Equation of the Centre.*

Arg. Mean Anomaly.

	VIII signs.	Diff. for 10′.	IX signs.	Diff. for 10′.	X signs.	Diff. for 10′.	XI signs.	Diff. for 10′.
0°	14′ 19″·1	4″·10	7′ 49″·4	0″·02	13′ 58″·0	4″·15	31′ 14″·1	7″·20
1	13 54·5	3·97	7 49·3	0·17	14 22·9	4·27	31 57·3	7·27
2	13 30·7	3·83	7 50·3	0·28	14 48·5	4·40	32 40·9	7·35
3	13 7·7	3·72	7 52·0	0·43	15 14·9	4·52	33 25·0	7·42
4	12 45·4	3·60	7 54·6	0·57	15 42·0	4·64	34 9·5	7·47
5	12 23·8	3·45	7 58·0	0·73	16 9·8	4·77	34 54·3	7·55
6	12 3·1	3·33	8 2·4	0·85	16 38·4	4·87	35 39·6	7·60
7	11 43·1	3·20	8 7·5	1·02	17 7·6	5·00	36 25·2	7·65
8	11 23·9	3·07	8 13·6	1·15	17 37·6	5·11	37 11·1	7·72
9	11 5·5	2·93	8 20·5	1·28	18 8·2	5·23	37 57·4	7·77
10	10 47·9	2·82	8 28·2	1·43	18 39·6	5·34	38 44·0	7·82
11	10 31·0	2·67	8 36·8	1·58	19 11·6	5·45	39 30·9	7·86
12	10 15·0	2·53	8 46·3	1·72	19 44·3	5·55	40 18·1	7·90
13	9 59·8	2·40	8 56·6	1·85	20 17·6	5·65	41 5·5	7·95
14	9 45·4	2·25	9 7·7	2·00	20 51·5	5·78	41 53·3	7·98
15	9 31·9	2·13	9 19·7	2·15	21 26·2	5·87	42 41·2	8·03
16	9 19·1	1·98	9 32·6	2·28	22 1·4	5·98	43 29·4	8·07
17	9 7·2	1·83	9 46·3	2·42	22 37·8	6·08	44 17·9	8·10
18	8 56·2	1·72	10 0·8	2·55	23 13·8	6·17	45 6·5	8·13
19	8 45·9	1·57	10 16·1	2·70	23 50·8	6·27	45 55·3	8·16
20	8 36·5	1·42	10 32·3	2·82	24 28·4	6·37	46 44·3	8·18
21	8 28·0	1·28	10 49·2	2·97	25 6·6	6·47	47 33·4	8·21
22	8 20·3	1·15	11 7·0	3·10	25 45·4	6·55	48 22·7	8·23
23	8 13·4	1·00	11 25·6	3·23	26 24·7	6·64	49 12·1	8·25
24	8 7·4	0·85	11 45·0	3·37	27 4·5	6·73	50 1·6	8·27
25	8 2·3	0·72	12 5·2	3·50	27 44·9	6·82	50 51·2	8·28
26	7 58·0	0·58	12 26·2	3·63	28 25·8	6·89	51 40·8	8·30
27	7 54·5	0·43	12 48·0	3·77	29 7·1	6·98	52 30·6	8·30
28	7 51·9	0·28	13 10·6	3·88	29 49·0	7·05	53 20·3	8·31
29	7 50·2	0·13	13 33·9	4·02	30 31·3	7·13	54 10·2	8·30
30	7 49·4		13 58·0		31 14·1		55 0·0	

Secular Variation.

	VIIIˢ +	IXˢ +	Xˢ +	XIˢ +		VIIIˢ +	IXˢ +	Xˢ +	XIˢ +
0°	38″·5	44″·9	39″·2	22″·7	15°	43″·1	43″·5	32″·1	11″·8
1	38·9	44·9	38·8	22·0	16	43·3	43·3	31·5	11·0
2	39·3	44·9	38·4	21·3	17	43·5	43·1	30·9	10·2
3	39·6	44·9	37·9	20·6	18	43·6	42·8	30·4	9·5
4	40·0	44·8	37·5	19·9	19	43·8	42·6	29·8	8·7
5	40·4	44·8	37·1	19·2	20	44·0	42·4	29·2	7·9
6	40·7	44·7	36·6	18·5	21	44·1	42·1	28·6	7·1
7	41·0	44·6	36·2	17·8	22	44·2	41·8	28·0	6·3
8	41·3	44·5	35·7	17·0	23	44·4	41·6	27·3	5·6
9	41·6	44·4	35·3	16·3	24	44·5	41·3	26·7	4·8
10	41·9	44·3	34·8	15·6	25	44·6	41·0	26·1	4·0
11	42·1	44·1	34·3	14·8	26	44·7	40·6	25·4	3·2
12	42·4	44·0	33·7	14·1	27	44·7	40·3	24·7	2·4
13	42·6	43·8	33·2	13·3	28	44·8	39·9	24·1	1·6
14	42·9	43·7	32·6	12·6	29	44·8	39·6	23·4	0·8

Table VII. *Perturbations in Longitude.*

Equations I to V, to be taken out with their respective Arguments.

Arg.	I.	II.	III.	IV.	V.	Arg.	I.	II.	III.	IV.	V.
	″	″	″	″	″		″	″	″	″	″
000	40·0	4·0	0·3	0·4	0·4	500	40·0	4·0	2·0	7·6	3·6
010	40·0	4·1	0·3	0·5	0·4	510	42·2	3·7	1·9	7·6	3·6
020	40·1	4·1	0·3	0·5	0·4	520	44·4	3·4	1·8	7·6	3·6
030	40·2	4·2	0·3	0·5	0·4	530	46·6	3·1	1·8	7·6	3·6
040	40·4	4·3	0·3	0·6	0·5	540	48·5	2·9	1·7	7·5	3·6
050	40·9	4·4	0·3	0·7	0·5	550	50·2	2·6	1·6	7·5	3·5
060	41·6	4·4	0·4	0·7	0·5	560	51·7	2·4	1·6	7·4	3·5
070	42·5	4·5	0·4	0·8	0·6	570	52·9	2·1	1·5	7·3	3·5
080	43·6	4·6	0·4	1·0	0·6	580	53·7	1·9	1·4	7·2	3·4
090	44·9	4·7	0·5	1·1	0·7	590	54·1	1·7	1·3	7·1	3·4
100	46·4	4·8	0·5	1·2	0·7	600	54·2	1·5	1·3	7·0	3·3
110	47·9	4·9	0·5	1·4	0·8	610	54·0	1·3	1·2	6·9	3·3
120	49·5	5·1	0·5	1·5	0·9	620	53·4	1·2	1·1	6·7	3·2
130	51·0	5·2	0·5	1·7	1·0	630	52·4	1·0	1·1	6·6	3·1
140	52·4	5·3	0·6	1·9	1·0	640	51·0	0·9	1·0	6·4	3·1
150	53·7	5·5	0·6	2·0	1·1	650	49·4	0·8	1·0	6·3	3·0
160	54·8	5·6	0·7	2·2	1·2	660	47·6	0·8	0·9	6·1	2·9
170	55·7	5·7	0·7	2·4	1·3	670	45·5	0·7	0·8	5·9	2·8
180	56·3	5·9	0·7	2·6	1·4	680	43·2	0·7	0·8	5·7	2·7
190	56·6	6·1	0·7	2·9	1·5	690	40·9	0·7	0·8	5·5	2·7
200	56·6	6·2	0·7	3·1	1·6	700	38·5	0·7	0·7	5·3	2·6
210	56·3	6·4	0·8	3·4	1·7	710	36·1	0·7	0·6	5·1	2·5
220	55·6	6·5	0·9	3·5	1·8	720	33·8	0·8	0·6	4·8	2·4
230	54·7	6·7	1·0	3·7	1·9	730	31·8	0·9	0·5	4·6	2·3
240	53·5	6·8	1·1	4·0	2·0	740	29·9	1·0	0·5	4·4	2·2
250	51·9	6·9	1·1	4·2	2·1	750	28·1	1·1	0·5	4·2	2·1
260	50·1	7·0	1·2	4·4	2·2	760	26·5	1·2	0·5	4·0	2·0
270	48·2	7·1	1·3	4·6	2·3	770	25·3	1·3	0·5	3.7	1·9
280	46·2	7·2	1·3	4·8	2·4	780	24·4	1·5	0·5	3·5	1·8
290	43·9	7·3	1·3	5·1	2·5	790	23·7	1·6	0·5	3·4	1·7
300	41·5	7·3	1·4	5·3	2·6	800	23·4	1·8	0·5	3·1	1·6
310	39·1	7·3	1·5	5·5	2·7	810	23·4	1·9	0·5	2·9	1·5
320	36·8	7·3	1·6	5·7	2·7	820	23·7	2·1	0·5	2·6	1·4
330	34·5	7·3	1·6	5·9	2·8	830	24·3	2·3	0·5	2·4	1·3
340	32·4	7·2	1·7	6·1	2·9	840	25·2	2·4	0·5	2·2	1·2
350	30·6	7·2	1·7	6·3	3·0	850	26·3	2·5	0·5	2·0	1·1
360	29·0	7·1	1·8	6·4	3·1	860	27·6	2·7	0·5	1·9	1·0
370	27·6	7·0	1·8	6·6	3·1	870	29·0	2·8	0·5	1·7	1·0
380	26·6	6·8	1·9	6·7	3·2	880	30·5	2·9	0·5	1·5	0·9
390	26·0	6·7	2·0	6·9	3·3	890	32·1	3·1	0·5	1·4	0·8
400	25·8	6·5	2·0	7·0	3·3	900	33·6	3·2	0·5	1·2	0·7
410	25·9	6·3	2·1	7·1	3·4	910	35·1	3·3	0·5	1·1	0·7
420	26·3	6·1	2·1	7·2	3·4	920	36·4	3·4	0·5	1·0	0·6
430	27·1	5·9	2·2	7·3	3·5	930	37·5	3·5	0·5	0·8	0·6
440	28·3	5·6	2·2	7·4	3·5	940	38·4	3·6	0·4	0·7	0·5
450	29·8	5·4	2·2	7·5	3·5	950	39·1	3·6	0·4	0·7	0·5
460	31·5	5·1	2·2	7·5	3·6	960	39·6	3·7	0·4	0·6	0·5
470	33·4	4·9	2·1	7·6	3·6	970	39·8	3·8	0·4	0·5	0·4
480	35·6	4·6	2·1	7·6	3·6	980	39·9	3·9	0·3	0·5	0·4
490	37·8	4·3	2·0	7·6	3·6	990	40·0	3·9	0·3	0·5	0·4

TABLE VII *continued. Perturbations in Longitude.*

Equations VI to X, to be taken out with their respective Arguments.

Arg.	VI.	VII.	VIII.	IX.	X.	Arg.	VI.	VII.	VIII.	IX.	X.
	″	″	″	″	″		″	″	″	″	″
000	0·6	2·3	1·4	3·3	2·6	500	1·4	1·7	2·5	0·7	1·4
010	0·6	2·3	1·3	3·4	2·7	510	1·4	1·8	2·6	0·7	1·4
020	0·5	2·2	1·2	3·4	2·7	520	1·5	1.9	2·7	0·6	1·3
030	0·5	2·1	1·1	3·4	2·8	530	1·5	2·0	2·8	0·6	1·3
040	0·5	2·0	1·1	3·4	2·8	540	1·5	2·1	2·9	0·6	1·2
050	0·4	1·9	1·1	3·4	2·9	550	1·5	2·1	2·9	0·5	1·2
060	0·4	1·8	1·0	3·5	2·9	560	1·6	2·2	3·0	0·5	1·1
070	0·4	1·7	0·9	3·5	3·0	570	1·6	2·3	3·1	0·5	1·1
080	0·3	1·6	0·9	3·5	3·0	580	1·7	2·4	3·1	0·5	1·0
090	0·3	1·6	0·8	3·4	3·1	590	1·7	2·5	3·2	0·5	1·0
100	0·3	1·5	0·7	3·4	3·1	600	1·7	2·6	3·3	0·5	0·9
110	0·3	1·5	0·7	3·4	3·1	610	1·7	2·7	3·3	0·6	0·9
120	0·3	1·4	0·6	3·4	3·1	620	1·7	2·8	3·4	0·6	0·9
130	0·2	1·3	0·6	3·3	3·2	630	1·7	2·8	3·4	0·6	0·8
140	0·2	1·2	0·6	3·3	3·2	640	1·8	2·9	3·4	0·7	0.8
150	0·2	1·1	0·5	3·3	3·2	650	1·8	2·9	3·5	0·7	0·8
160	0·2	1·0	0·5	3·2	3·2	660	1·8	3·0	3·5	0·8	0·8
170	0·2	1·0	0·5	3·2	3·2	670	1·8	3·0	3·5	0·8	0·8
180	0·2	0·9	0·5	3·1	3·2	680	1·8	3·1	3·5	0·9	0·8
190	0·2	0·9	0·4	3·0	3·2	690	1·8	3·1	3·5	0·9	0·8
200	0·2	0·8	0·5	3·0	3·2	700	1·8	3·2	3·5	1·0	0·9
210	0·2	0·8	0·5	2·9	3·1	710	1·7	3·2	3·5	1·1	0·9
220	0·2	0·7	0·5	2·8	3·1	720	1·7	3·3	3·5	1·2	0·9
230	0·3	0·7	0·5	2·8	3·1	730	1·7	3·3	3·5	1·2	0·9
240	0·3	0·7	0·6	2·7	3·1	740	1·7	3·4	3·4	1·3	0·9
250	0·3	0·6	0·6	2·6	3·0	750	1·7	3·4	3·4	1·4	1·0
260	0·3	0·6	0·6	2·5	3·0	760	1·7	3·4	3·4	1·5	1·0
270	0·3	0·6	0·7	2·3	2·9	770	1·6	3·4	3·3	1·6	1·1
280	0·4	0·6	0·7	2·3.	2·9	780	1·6	3·4	3·3	1·7	1·1
290	0·4	0·6	0·8	2·2	2·8	790	1·6	3·4	3·2	1·7	1·2
300	0·4	0·6	0·9	2·2	2·8	800	1·6	3·3	3·2	1·8	1·2
310	0·5	0·6	1·0	2·1	2·7	810	1·5	3·3	3·1	1·9	1·3
320	0·5	0·6	1·1	2·0	2·7	820	1·5	3·3	3·0	2·0	1·3
330	0·6	0·6	1·1	1·9	2·6	830	1·5	3·3	3·0	2·1	1·4
340	0·6	0·7	1·2	1·8	2·5	840	1·4	3·3	2·9	2·2	1·5
350	0·6	0·7	1·3	1·7	2·5	850	1·4	3.3	2·8	2·3	1·5
360	0·7	0·7	1·3	1·6	2·4	860	1·3	3·2	2·7	2·4	1·6
370	0·7	0·8	1·4	1·5	2·3	870	1·3	3·2	2·6	2·5	1·6
380	0·8	0·8	1·5	1·4	2·3	880	1·2	3·1	2·6	2·6	1·7
390	0·8	0·9	1·6	1·4	2·2	890	1·2	3·1	2·5	2·6	1·8
400	0·9	0·9	1·6	1·3	2·1	900	1·1	3·0	2·4	2·7	1·9
410	0·9	1·0	1·7	1·2	2·0	910	1·1	2·9	2·3	2·8	1·9
420	1·0	1·0	1·8	1·1	2·0	920	1·0	2·9	2·2	2·9	2·0
430	1·0	1·1	1·9	1·0	1·9	930	0·9	2·8	2·1	2·9	2·1
440	1·1	1·2	2·0	1·0	1·8	940	0·9	2·7	2·0	3·0	2·2
450	1·1	1·2	2·1	0·9	1·7	950	0·8	2·7	1·9	3·0	2·2
460	1·2	1·3	2·2	0·9	1·7	960	0·8	2·6	1·8	3·1	2·3
470	1·2	1·4	2·3	0·8	1·6	970	0·7	2·5	1·7	3·2	2·4
480	1·3	1·5	2·4	0·8	1·5	980	0·7	2·4	1·6	3·2	2·5
490	1·3	1·6	2·4	0·7	1·5	990	0·7	2·3	1·5	3·3	2·5

TABLE VIII. *Radius Vector for 1800, with the Sec^r Var^n.*

Argument, Mean Anomaly, reckoned from the Perihelion.

	0 sign.	Diff. for 10′.	I sign.	Diff. for 10′.	II signs.	Diff. for 10′.	
0°	0·7183284	1,2	0·7190017	74,2	0·7208354	127,0	30°
1	0·7183291	4,2	0·7190462	76,3	0·7209116	127,5	29
2	0·7183316	6,2	0·7190920	78,5	0·7209881	128,5	28
3	0·7183353	9,0	0·7191391	80,5	0·7210652	130,3	27
4	0·7183407	11,3	0·7191874	83,0	0·7211434	130,8	26
5	0·7183475	14,2	0·7192372	84,8	0·7212219	132,3	25
6	0·7183560	16,5	0·7192881	86,2	0·7213013	133,0	24
7	0·7183659	19,0	0·7193398	89,2	0·7213811	134,0	23
8	0·7183773	21,7	0·7193933	91,0	0·7214615	135,0	22
9	0·7183903	24,0	·07194479	93,2	0·7215425	135,8	21
10	0·7184047	26,8	0·7195038	94,0	0·7216240	136,8	20
11	0·7184208	29,2	0·7195602	97,0	0·7217061	137,5	19
12	0·7184383	31,7	0·7196184	98,3	0·7217886	138,2	18
13	0·7184573	34,0	0·7196774	100,7	0·7218715	139,0	17
14	0·7184777	36,7	0·7197378	102,3	0·7219549	139,5	16
15	0·7184997	39,0	0·7197992	103,5	0·7220386	140,3	15
16	0·7185231	41,7	0·7198613	106,0	0·7221228	140,8	14
17	0·7185481	44,2	0·7199249	107,2	0·7222073	141,3	13
18	0·7185746	46,3	0·7199892	109,2	0·7222921	142,2	12
19	0·7186024	48,7	0·7200547	110,8	0·7223774	142,4	11
20	0·7186316	51,3	0·7201212	112,3	0·7224628	142,6	10
21	0·7186624	53,8	0·7201886	113,8	0·7225485	142,8	9
22	0·7186947	55,5	0·7202569	115,3	0·7226341	143,0	8
23	0·7187280	58,3	0·7203261	117,3	0·7227199	143,8	7
24	0·7187630	60,8	0·7203965	118,5	0·7228062	144,0	6
25	0·7187995	62,7	0·7204676	119,8	0·7228927	144,2	5
26	0·7188371	65,3	0·7205395	121,5	0·7229791	144,2	4
27	0·7188763	67,3	0·7206124	122,5	0·7230656	144,3	3
28	0·7189167	70,0	0·7206859	123,8	0·7231522	144,5	2
29	0·7189587	71,7	0·7207602	125,3	0·7232389	144,4	1
30	0·7190017		0·7208354		0·7233255		0
	XI signs.		X signs.		IX signs.		

	0^s +	I^s +	II^s +			0^s +	I^s +	II^s +	
0°	787	678	385	30	15	759	551	193	15°
1	786	671	373	29	16	755	541	180	14
2	786	664	361	28	17	751	531	166	13
3	785	656	348	27	18	747	520	153	12
4	785	649	336	26	19	742	510	139	11
5	783	641	323	25	20	738	499	126	10
6	782	633	311	24	21	733	488	112	9
7	781	624	298	23	22	728	477	99	8
8	779	616	285	22	23	722	466	85	7
9	777	607	272	21	24	717	455	71	6
10	774	598	259	20	25	711	444	58	5
11	772	589	246	19	26	705	432	44	4
12	769	580	233	18	27	699	421	30	3
13	766	570	220	17	28	692	409	16	2
14	763	560	207	16	29	685	397	3	1
	XI^s +	X^s +	IX^s +			XI^s +	X^s +	IX^s +	

TABLE VIII. *continued. Radius Vector, with the Sec^r Var^n.*							
Argument, Mean Anomaly.							
	III signs.	Diff. for 10′.	IV signs.	Diff. for 10′.	V signs.	Diff. for 10′.	′
0°	0·7233255	144,3	0·7257985	123,5	0·7275982	70,3	30°
1	0·7234120	144,2	0·7258726	122,2	0·7276404	68,0	29
2	0·7234986	144,1	0·7259459	121,0	0·7276812	65,7	28
3	0·7235851	143,9	0·7260185	119,8	0·7277206	63,8	27
4	0·7236714	143,8	0·7260904	117,8	0·7277589	61,2	26
5	0·7237577	143,5	0·7261611	116,7	0·7277956	59,2	25
6	0·7238439	143,2	0·7262311	114,8	0·7278311	56,8	24
7	0·7239298	142,8	0·7263000	113,7	0·7278652	54,8	23
8	0·7240155	142,5	0·7263682	112,2	0·7278981	52,0	22
9	0·7241011	142,0	0·7264355	110,2	0·7279293	49,8	21
10	0·7241863	141,5	0·7265016	108,8	0·7279592	47,7	20
11	0·7242712	141,2	0·7265669	107,2	0·7279878	45,5	19
12	0·7243559	140,5	0·7266312	105,5	0·7280151	42,5	18
13	0·7244402	139,8	0·7266945	104,0	0·7280406	40,8	17
14	0·7245241	139,3	0·7267569	102,0	0·7280651	37,7	16
15	0·7246077	138,9	0·7268181	100,0	0·7280877	35,8	15
16	0·7246911	137,8	0·7268781	98,3	0·7281092	33,2	14
17	0·7247738	137,2	0·7269371	96,7	0·7281291	31,0	13
18	0·7248561	135,9	0·7269951	94,5	0·7281477	28,3	12
19	0·7249376	135,4	0·7270518	92,7	0·7281647	25,7	11
20	0·7250189	134,5	0·7271074	91,0	0·7281801	23,7	10
21	0·7250996	133,5	0·7271620	89,2	0·7281943	21,3	9
22	0·7251797	132,8	0·7272155	87,0	0·7282071	18,5	8
23	0·7252594	131,7	0·7272677	84,8	0·7282182	15,8	7
24	0·7253384	130,8	0·7273186	82,7	0·7282277	13,7	6
25	0·7254169	129,5	0·7273682	80,8	0·7282359	11,3	5
26	0·7254946	128,5	0·7274167	79,0	0·7282427	8,7	4
27	0·7255717	127,0	0·7274641	76,7	0·7282479	6,7	3
28	0·7256479	126,2	0·7275101	74,3	0·7282519	3,7	2
29	0·7257236	124,8	0·7275547	72,5	0·7282541	1,2	1
30	0·7257985		0·7275982		0·7282548		0
	VIII signs.		VII signs.		VI signs.		

	III^s –	IV^s –	V^s –			III^s –	IV^s –	V^s –	
0°	11	401	684	30°	15°	214	562	760	15°
1	25	413	691	29	16	227	571	764	14
2	38	425	697	28	17	240	580	767	13
3	52	436	703	27	18	253	589	770	12
4	66	447	709	26	19	266	598	772	11
5	79	459	714	25	20	279	607	776	10
6	93	470	720	24	21	291	616	778	9
7	107	480	726	23	22	304	624	780	8
8	120	491	731	22	23	317	632	781	7
9	134	502	736	21	24	329	640	783	6
10	147	512	740	20	25	341	648	784	5
11	161	522	745	19	26	354	656	785	4
12	174	532	749	18	27	366	663	785	3
13	187	542	753	17	28	378	670	786	2
14	201	552	757	16	29	390	677	786	1
	VIII^s –	VII^s –	VI^s –			VIII^s –	VII^s –	VI^s –	

Table IX. *Perturbations of the Radius Vector.*

The six Equations to be taken out with their respective Arguments.

Arg.	I.	II.	III.	IV.	V.	VI.	Arg.	I.	II.	III.	IV.	V.	VI.
000	288	98	7	19	27	2	500	509	0	11	13	27	26
010	290	98	6	20	29	2	510	506	0	12	12	25	26
020	297	98	6	21	31	2	520	496	1	12	11	23	26
030	308	99	5	22	33	3	530	479	2	13	10	21	25
040	322	99	5	23	35	4	540	457	4	13	9	19	24
050	338	100	4	24	36	4	550	430	7	14	8	18	24
060	355	101	4	24	38	5	560	398	9	14	8	16	23
070	373	101	3	25	39	6	570	362	13	15	7	15	22
080	389	102	3	26	41	6	580	324	16	15	6	13	22
090	402	103	2	27	42	7	590	285	20	16	5	12	21
100	412	104	2	28	43	8	600	245	24	16	4	11	20
110	417	105	2	29	44	9	610	206	29	16	3	10	19
120	417	105	1	29	46	9	620	168	34	17	3	8	19
130	411	106	1	30	47	10	630	128	39	17	2	7	18
140	399	106	1	30	49	11	640	96	44	17	2	5	17
150	382	107	1	31	50	12	650	68	49	17	1	4	16
160	360	107	0	31	51	13	660	45	54	18	1	3	15
170	333	106	0	32	51	14	670	26	59	18	0	3	14
180	302	106	0	32	52	14	680	12	64	18	0	2	14
190	268	105	0	32	52	15	690	3	69	18	0	2	13
200	233	104	0	32	53	16	700	0	74	18	0	1	12
210	197	103	0	32	53	17	710	3	78	18	0	1	11
220	162	101	0	32	54	18	720	12	82	18	0	0	10
230	128	99	0	32	54	19	730	26	86	18	0	0	9
240	96	96	0	32	54	20	740	45	90	18	0	0	8
250	68	93	1	32	54	20	750	68	93	17	0	0	8
260	45	90	1	32	53	21	760	96	96	17	0	1	7
270	26	86	1	31	53	22	770	128	99	17	1	1	6
280	12	82	1	31	53	23	780	162	101	17	1	1	5
290	3	78	2	31	52	23	790	197	103	16	1	2	5
300	0	74	2	30	52	24	800	233	104	16	2	2	4
310	3	69	2	30	52	25	810	268	105	16	2	2	3
320	12	64	3	29	51	25	820	302	106	15	3	3	3
330	26	59	3	29	50	26	830	333	106	15	3	4	2
340	45	54	3	28	49	26	840	360	107	15	4	5	2
350	68	49	4	28	48	27	850	382	107	14	4	6	1
360	96	44	4	27	47	27	860	399	106	14	5	7	1
370	128	39	4	26	46	27	870	411	106	14	6	8	1
380	168	34	5	25	45	28	880	417	105	13	7	9	0
390	206	29	5	24	44	28	890	417	105	13	8	10	0
400	245	24	6	23	42	28	900	412	104	12	9	12	0
410	285	20	6	22	41	28	910	402	103	12	10	13	0
420	324	16	7	21	39	28	920	389	102	11	11	15	0
430	362	13	7	20	38	28	930	373	101	11	12	16	0
440	398	9	8	19	36	28	940	355	101	10	13	18	0
450	430	7	8	18	35	28	950	338	100	10	14	19	0
460	457	4	9	17	33	28	960	322	99	9	15	21	0
470	479	2	9	16	32	27	970	308	99	9	16	22	1
480	496	1	10	15	30	27	980	297	98	8	17	24	1
490	506	0	10	14	28	27	990	290	98	8	18	26	1

Table X. *Reduction to the Ecliptic.*

Argument, True Longitude in Orbit, — Longitude of Node.

°	0s. VIs.	Is. VIIs.	IIs. VIIIs.	IIIs. IXs.	IVs. Xs.	Vs. XIs.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
0	4 0·0	1 23·6	1 23·6	4 0·0	6 36·4	6 36·4
1	3 53·7	1 20·6	1 26·9	4 6·3	6 39·4	6 33·1
2	3 47·4	1 17·7	1 30·3	4 12·6	6 42·3	6 29·7
3	3 41·1	1 15·0	1 33·9	4 18·9	6 45·0	6 26·1
4	3 34·9	1 12·5	1 37·7	4 25·1	6 47·5	6 22·3
5	3 28·6	1 10·2	1 41·7	4 31·4	6 49·8	6 18·3
6	3 22·5	1 8·2	1 45·8	4 37·5	6 51·8	6 14·2
7	3 16·3	1 6·4	1 50·1	4 43·7	6 53·6	6 9·9
8	3 10·2	1 4·7	1 54·6	4 49·8	6 55·3	6 5·4
9	3 4·2	1 3·4	1 59·2	4 55·8	6 56·6	6 0·8
10	2 58·3	1 2·1	2 3·9	5 1·7	6 57·9	5 56·1
11	2 52·4	1 1·1	2 8·8	5 7·6	6 58·9	5 51·2
12	2 46·6	1 0·3	2 13·9	5 13·4	6 59·7	5 46·1
13	2 40·9	0 59·8	2 19·0	5 19·1	7 0·2	5 41·0
14	2 35·5	0 59·4	2 23·3	5 24·8	7 0·6	5 35·7
15	2 29·7	0 59·3	2 29·7	5 30·3	7 0·7	5 30·3
16	2 23·3	0 59·4	2 35·5	5 36·7	7 0·6	5 24·8
17	2 19·0	0 59·8	2 40·9	5 41·0	7 0·2	5 19·1
18	2 13·9	1 0·3	2 46·6	5 46·1	6 59·7	5 13·4
19	2 8·8	1 1·1	2 52·4	5 51·2	6 58·9	5 7·6
20	2 3·9	1 2·1	2 58·3	5 56·1	6 57·9	5 1·7
21	1 59·2	1 3·4	3 4·2	6 0·8	6 56·7	4 55·8
22	1 54·6	1 4·7	3 10·2	6 5·4	6 55·3	4 49·8
23	1 50·1	1 6·4	3 16·3	6 9·9	6 53·6	4 43·7
24	1 45·8	1 8·2	3 22·5	6 14·2	6 51·8	4 37·5
25	1 41·7	1 10·2	3 28·6	6 18·3	6 49·8	4 31·4
26	1 37·7	1 12·5	3 34·9	6 22·3	6 47·5	4 25·1
27	1 33·9	1 15·0	3 41·1	6 26·1	6 45·0	4 18·9
28	1 30·3	1 17·7	3 47·4	6 29·7	6 42·3	4 12·6
29	1 26·9	1 20·6	3 53·7	6 33·1	6 39·5	4 6·3

Table XI. *Logarithmic Cosine Heliocentric Latitude, or*

Factor for the Curtate Distance.——Argument, same as Tab. 10 and 12.

	0s. VIs.	Is. VIIs.	IIs. VIIIs.			0s. VIs.	Is. VIIs.	IIs. VIIIs.	
0°	0·0000000	8106	4294	30°	15°	9·9999491	6198	2900	15°
1	9·9999998	7984	4180	29	16	9423	6064	2835	14
2	9991	7866	4068	28	17	9350	5932	2774	13
3	9979	7745	3959	27	18	9275	5800	2718	12
4	9963	7623	3853	26	19	9195	5668	2665	11
5	9943	7499	3750	25	20	9111	5536	2618	10
6	9924	7374	3650	24	21	9024	5406	2574	9
7	9887	7246	3553	23	22	8934	5277	2535	8
8	9852	7118	3457	22	23	8840	5148	2502	7
9	9814	6989	3367	21	24	8743	5021	2472	6
10	9771	6858	3280	20	25	8642	4895	2446	5
11	9723	6726	3196	19	26	8539	4771	2424	4
12	9671	6596	3117	18	27	8433	4649	2409	3
13	9616	6463	3040	17	28	8324	4528	2398	2
14	9556	6331	2968	16	29	8213	4410	2392	1
	XIs. Vs.	Xs. IVs.	IXs. IIIs.			XIs. Vs.	Xs. IVs.	IXs. IIIs.	

TABLE XII. *Heliocentric Latitude for* 1800.

Argument, True Longitude in Orbit, — Longitude of Node.

	0s. North. VIs. South.	Diff. for 10′.	Is. North. VIIs. South.	Diff. for 10′.	IIs. North. VIIIs. South.	Diff. for 10′.	
°	° ′ ″	″	° ′ ″	″	° ′ ″	″	°
0	0 0 0·0	35·48	1 41 41·6	30·58	2 56 11·3	17·50	30
1	0 3 32·9	35·47	1 44 45·1	30·28	2 57 56·3	16·97	29
2	0 7 5·7	35·45	1 47 46·8	29·95	2 59 38·1	16·40	28
3	0 10 38·4	35·43	1 50 46·5	29·62	3 1 16·5	15·87	27
4	0 14 11·0	35·40	1 53 44·2	29·27	3 2 51·7	15·30	26
5	0 17 43·4	35·33	1 56 39·8	28·90	3 4 23·5	14·75	25
6	0 21 15·4	35·25	1 59 33·2	28·55	3 5 52·0	14·17	24
7	0 24 46·9	35·17	2 2 24·5	28·18	3 7 17·0	13·60	23
8	0 28 17·9	35·08	2 5 13·6	27·80	3 8 38·6	13·03	22
9	0 31 48·4	35·00	2 8 0·4	27·40	3 9 56·8	12·45	21
10	0 35 18·4	34·90	2 10 44·8	27·00	3 11 11·5	11·85	20
11	0 38 47·8	34·80	2 13 26·8	26·60	3 12 22·6	11·28	19
12	0 42 16·6	34·68	2 16 6·4	26·20	3 13 30·3	10·68	18
13	0 45 44·7	34·55	2 18 43·9	25·77	3 14 34·4	10·10	17
14	0 49 12·0	34·37	2 21 18·2	25·33	3 15 35·0	9·50	16
15	0 52 38·2	34·20	2 23 50·2	24·90	3 16 32·0	8·90	15
16	0 56 3·4	34·03	2 26 19·6	24·45	3 17 25·4	8·30	14
17	0 59 27·5	33·85	2 28 46·3	24·00	3 18 15·2	7·70	13
18	1 2 50·6	33·67	2 31 10·3	23·55	3 19 1·4	7·10	12
19	1 6 12·6	33·47	2 33 31·6	23·07	3 19 44·0	6·47	11
20	1 9 33·4	33·25	2 35 50·0	22·60	3 20 22·8	5·87	10
21	1 12 52·9	33·03	2 38 5·6	22·12	3 20 58·0	5·27	9
22	1 16 11·1	32·80	2 40 18·3	21·63	3 21 29·6	4·63	8
23	1 19 27·9	32·55	2 42 28·1	21·13	3 21 57·4	4·03	7
24	1 22 43·2	32·30	2 44 34·9	20·63	3 22 21·6	3·40	6
25	1 25 57·0	32·05	2 46 38·7	20·12	3 22 42·0	2·78	5
26	1 29 9·3	31·78	2 48 39·5	19·62	3 22 58·7	2·18	4
27	1 32 20·0	31·50	2 50 37·2	19·08	3 23 11·8	1·53	3
28	1 35 29·0	31·20	2 52 31·7	18·57	3 23 21·0	0·93	2
29	1 38 35·2	30·90	2 54 23·1	18·03	3 23 26·6	0·32	1
30	1 41 41·6		2 56 11·3		3 23 28·5		0
	XIs. South. Vs. North.		Xs. South. IVs. North.		IXs. South. IIIs. North.		

TABLE XIII. *Horizontal Parallax, and Semidiameter.*

Argt. Elongation	In superior part of Orbit.				In inferior part of Orbit.			
	Parallax; Sun being in			Semidia. Sun being in M. Dist.	Parallax; Sun being in			Semidia. Sun being in M. Dist.
	Apogee.	M. Dist.	Perigee.		Apogee.	M. Dist.	Perigee.	
	″	″	″	″	″	″	″	″
Conjunct. or 0° 0′	5·0	5·1	5·1	4·6	29·7	31.8	33.5	29·3
10 0	5·1	5·2	5·2	4·7	29·0	30·8	32·8	28·3
20 0	5·5	5·5	5·6	5·0	27·1	28·8	30·7	26·5
30 0	6·2	6·3	6·3	5·7	23·8	25·3	27·1	23·3
40 0	8·0	7·9	7·9	7·3	18·6	20·0	21·7	18·4
42 30	8·9	8·7	8·6	8·0	16·8	18·4	20·0	16·9
45 0	10·9	10·1	9·7	9·3	13·6	15·7	17·6	14·4
45 21	...	...	...	...	...	...	13·1	...
46 20	...	...	...	...	...	12·6	...	11·6
47 22	...	...	...	...	12·2	...	...	...

XL. *Catalogue of corresponding Eclipses at one Period Distance.* *By Mr.* Thomas Yeates.

[Continued from vol. 55, p. 247.]

A.D.		Where observed.		D.	H.	M.	A.D.			D.	H.	
1	⊙	Pekin	June	10	1	10	913	⊙	June	7	9	M.
5	⊙	Rome	March	28	4	13	917	⊙	Sept.	5	0	M.
14	☽	Pannonia	Sept.	26	17	15	926	☽	Sept.	24	9½	M.
27	⊙	Canton	July	22	8	56	939	⊙	July	19	8½	M.
							Paris		July	18	19	45
30	⊙	Canton	Nov.	13	19	20	942	⊙	Nov.	11	6½	M.
40	⊙	Pekin	April	30	5	50	952	⊙	April	26	10½	N.
45	⊙	Rome	July	31	22	1	957	⊙	July	29	4	N.
46	⊙	Pekin	July	21	22	25	958	⊙	July	19	8	M.
	☽	Rome	Dec.	31	9	52		☽	Dec.	28	10½	N.
49	⊙	Pekin	May	20	7	16	961	⊙	May	17	8½	M.
							Rheims		May	16	20	13
53	⊙	Canton	March	8	20	42	965	⊙	March	6	3½	M.
55	⊙	Pekin	July	12	21	50	967	⊙	July	10	6½	M.
56	⊙	Canton	Dec.	25	0	28	968	⊙	Dec.	22	9	M.
59	⊙	Rome	April	30	3	8	971	⊙	April	27	5½	N.
60	⊙	Canton	Oct.	13	3	31	972	⊙	Oct.	10	3½	M.
65	⊙	Canton	Dec.	15	21	50	977	⊙	Dec.	13	8½	M.
69	☽	Rome	Oct.	18	10	43	981	☽	Oct.	16	3	M.
70	⊙	Canton	Sept.	22	21	13	982	⊙	Sept.	20	3	M.
71	☽	Rome	March	4	8	32	983	☽	March	1	11½	N.
95	⊙	Ephesus	May	21			1007	⊙	May	19	8	M.
125	☽	Alexand.	April	5	9	16	1037	☽	April	2	11½	N.
							Paris	⊙	April	17	20	45
133	☽	Alexand.	May	6	11	44	1045	☽	May	3	9½	N.
134	☽	Alexand.	Oct.	20	11	5	1046	☽	Oct.	17	7½	N.
136	☽	Alexand.	March	5	15	56	1048	☽	March	3	6½	M.
237	⊙	Bologna	April	12			1149	⊙	April	12	9½	N.
238	⊙	Rome	April	1	20	20	1150	⊙	March			
290	⊙	Carthage	May	15	3	20	1202	⊙	May	13	3½	M.
304	☽	Rome	Aug.	31	9	36	1216	☽	Aug.	28	9½	N.
316	⊙	Constan.	Dec.	30	19	53	1228	⊙	Dec.	28	8	M.
							Naples		Dec.	27	9	55
334	⊙	Toledo	July	17	Noon		1246	⊙	July	14	1	N.
348	⊙	Constan.	Oct.	8	19	24	1260	⊙	Oct.	6	12	N.
360	⊙	Ispahan	Aug.	27	18	0	1272	⊙	Aug.	25	1½	M.
							Vienna	☽	Aug.	10	7	27
364	☽	Alexand.	Nov.	25	15	24	1276	☽	Nov.	22	2½	M.
							Vienna		Nov.	22	15	0

401

A.D.		Where observed.		D.	H.	M.	A.D.			D.	H.	
401	☽	Rome	June	11			1313	☽	June	9	9	M.
	☽	Rome	Dec.	6	12	15		☽	Dec.	3	8½	N.
							Torcello		Dec.	3	8	58
402	☽	Rome	June	1	8	43	1314	☽	May	30	2½	M.
	⊙	Rome	Nov.	10	20	33		⊙	Nov.	8	2	N.
447	⊙	Compos^{la}	Dec.	23	0	46	1359	☽	Dec.	5	7½	M.
451	☽	Compos^{la}	April	1	16	34	1363	☽	March	30	5	M.
	☽	Compos^{la}	Sept.	26	6	30		☽	Sept.	23	8½	N.
458	⊙	Chaves	May	27	23	16	1370	⊙	May	25	4½	N.
462	☽	Compos^{la}	March	1	13	2	1374	☽	Feb.	27	7½	M.
464	⊙	Chaves	July	19	19	1	1376	⊙	July	17	8½	M.
484	⊙	Constan.	Jan.	13	19	53	1396	⊙	Jan.	11	11	M.
							Augsburg		Jan.	11	0	16
486	⊙	Constan.	May	19	1	10	1398	⊙	May	16	5	N.
497	⊙	Constan.	April	18	6	5	1409	⊙	April	15	1½	N.
							Constantinople		April	15	3	1
512	⊙	Constan.	June	28	23	8	1424	⊙	June	26	2½	N.
							Wittemburg		June	26	3	57
538	⊙	England	Feb.	14	19	0	1450	⊙	Feb.	12	1	N.
540	⊙	London	June	19	20	15	1452	⊙	June	17	3	N.
577	☽	Tours	Dec.	10	17	28	1489	☽	Dec.	8	5	M.
							R. C.*		Dec.	7	17	41
581	☽	Paris	April	4	13	33	1493	☽	April	2	1	M.
							R. C.		April	1	14	0
582	☽	Paris	Sept.	17	12	41	1494	☽	Sept.	15	6½	M.
							R. C.		Sept.	14	19	45
590	☽	Paris	Oct.	18	6	30	1502	☽	Oct.	15	11	N.
							R. C.		Oct.	15	12	20
592	⊙	Constan.	Mar.	18	22	6	1504	⊙	March	16	1½	N.
603	⊙	Paris	Aug.	12	3	3	1515	⊙	Aug.	9	9	N.
622	☽	Constan.	Feb.	1	11	28	1534	☽	Jan.	30	1½	M.
							R. C.		Jan.	29	14	25
644	⊙	Paris	Nov.	5	0	30	1556	⊙	Nov.	2	8	M.
									NEW STYLE.			
680	☽	Paris	June	17	12	30	1592	☽	June	24	10	13
683	☽	Paris	April	16	11	30	1595	☽	April	24	4	12
693	⊙	Constan.	Oct.	4	23	54	1605	⊙	Oct.	12	2	32
716	☽	Constan.	Jan.	13	7	0	1628	☽	Jan.	20	10	11
718	⊙	Constan.	June	3	1	15	1630	⊙	June	10	7	47
733	⊙	England	Aug.	13	20	0	1645	⊙	Aug.	21	0	35
734	☽	England	Jan.	23	14	0	1646	☽	Jan.	30	18	11
752	☽	England	July	30	13	0	1664	☽	Aug.	6	11	45
753	⊙	England	June	8	22	0	1665	☽	July	26	11	A.
	☽	England	Jan.	23	13	0		☽	Jan.	30	18	47

* Ricciolus's Catalogue.

760

A.D.		Where observed.		D.	H.	M.	A.D.		N. S.	D.	H.	
760	☉	England	Aug.	15	4	0	1672	☉	Aug.	22	6	43
	☽	London	Aug.	30	5	50		☽	Sept.	6	18	54
764	☉	England	June	4	noon.		1676	☉	June	10	21	26
770	☽	London	Feb.	14	7	12	1682	☽	Feb.	21	11	N.
774	☽	Rome	Nov.	22	14	37	1686	☽	Nov.	29	12	22
784	☽	London	Nov.	1	14	2	1696	☽	Nov.	9	12	22
787	☉	Constan.	Sept.	14	20	43	1699	☉	Sept.	23	22	38
796	☽	Constan.	March	27	16	22	1708	☽	April	5	6	M.
800	☽	Rome	Jan.	15	9	0	1712	☽	Jan.	23	8	A.
807	☉	Angoul^{me}	Feb.	10	21	24	1719	☉	Feb.	19	7	M.
	☽	Paris	Feb.	25	13	43		☽	March	6	8	M.
	☽	Paris	Aug.	21	10	20		☽	Aug.	29	9	A.
809	☉	Paris	July	15	21	33	1721	☉	July	24	9	M.
	☽	Paris	Dec.	25	8	0		☉	Dec.	19	1	M.
810	☽	Paris	June	20	8	0	1722	☽	June	29	3	M.
	☉	Paris	Nov.	30	0	12		☉	Dec.	8	3	A.
	☽	Paris	Dec.	14	8	0		☽	Dec.	22	4	A.
812	☉	Constan.	May	14	2	13	1724	☉	May	22	7	A.
813	☉	Cappad^{a}	May	3	17	15	1725	☉	May	12	10½	M.
817	☽	Paris	Feb.	5	5	42	1729	☽	Feb.	13	6	A.
818	☉	Paris	July	6	18	0	1730	☉	July	15	5	M.
820	☽	Paris	Nov.	23	6	26	1732	☽	Dec.	1	10	N.
824	☽	Paris	March	18	7	55	1736	☽	March	26	12	N.
828	☽	Paris	Dec.	24	13	45	1740	☽	—	—		—
831	☽	Paris	April	30	6	19	1743	☽	May	8	3½	A.
	☉	Paris	May	15	23	0		☉	May	23	6	A.
	☽	Paris	Oct.	24	11	18		☽	Nov.	2	3	M.
832	☽	Paris	April	18	9	0	1744	☽	April	26	9	A.
840	☉	Paris	May	4	23	22	1752	☉	May	13	8	A.
841	☉	Paris	Oct.	17	18	58	1753	☉	Oct.	26	10	M.
842	☽	Paris	March	29	14	38	1754	☽	April	7	8½	M.
843	☽	Paris	March	19	7	1	1755	☽	March	28	1	M.
861	☽	Paris	March	29	15	7	1773	☽	April	7	9	M.
878	☽	Paris	Oct.	14	16	0	1790	☽	Oct.	23	1	M.
883	☽	Arracta	July	23	7	14	1795	☽	July	31	8	A.
889	☉	Constan.	April	3	17	52	1801	☉	April	13	4	M.
891	☉	Constan.	Aug.	7	23	48	1803	☉	Aug.	17	8	M.
901	☽	Arracta	Aug.	2	15	7	1813	☽	Aug.	12	3	M.
904	☽	London	May	31	11	47	1816	☽	June	10	1	M.
	☽	London	Nov.	25	9	0		☽	Dec.	4	9½	Af.
912	☽	London	Jan.	6	15	12	1824	☽	Jan.	16	9	M.

Note. All the historical eclipses in the above Catalogue are taken from Mr. Ferguson's Tables, and their corresponding ones from *L'Art de vérifier les Dates.* Paris 1785.

Series

Series of corresponding Eclipses in a Lunar Cycle at one Period Distance.

[Appendix to page 445, vol. 55.]

A.D.	O. Style.		D.	H.	M.	
889	●	March	21	2	30	M.
	⊙	April	4	4	30	M.
	⊙	——	—	—	—	
	●	Sept.	13	4	30	M.
890	●	March	10	Noon.		
	⊙	Aug.	19	10	0	M.
	●	Sept.	2	5	0	Af.
891	⊙	Feb.	12	4	0	Af.
	⊙	Aug.	8	10	30	M.
	☽	Aug.	23	9	30	M.
892	☽	——	—	—	—	
	⊙	Feb.	2	8	0	M.
	☽	July	13	3	30	Af.
893	●	Jan.	6	5	30	M.
	⊙	June	17	5	0	Af.
	●	July	2	10	45	Af.
	●	Dec.	26	7	30	Af.
894	☽	——	—	—	—	
	⊙	June	7	10	0	M.
	☽	June	22	0	30	
	⊙	——	—	—	—	
	☽	Dec.	16	11	30	M.
895	☽	——	—	—	—	
	⊙	May	28	2	0	M.
	☽	——	—	—	—	
	⊙	Nov.	20	9	30	M.
896	☽	May	1	2	30	M.
	☽	Oct.	25	0	30	M.
	⊙	——	—	—	—	
897	⊙	April	5	11	0	Af.
	●	April	20	7	0	Af.
	●	Oct.	14	11	45	M.
898	⊙	Mar.	26	1	0	M.
	☽	April	10	11	0	M.
	☽	Oct.	3	3	0	Af.
899	⊙	Mar.	15	10	30	M.
	☽	Aug.	24	5	0	Af.
900	●	Feb.	18	9	30	M.
	●	Aug.	13	9	30	M.
901	⊙	Jan.	23	6	30	M.
	●	Feb.	6	10	0	M.

A.D.	N. Style.		D.	H.	M.	
1801	●	Mar.	30	5	30	M.
	⊙	April	13	4	30	M.
	⊙	Sept.	8	6	0	M.
	●	Sept.	22	7	30	M.
1802	☽	March	19	11	30	M.
	⊙	Aug.	28	7	30	M.
	☽	Sept.	11	11	0	N.
1803	⊙	Feb.	21			
	⊙	Aug.	17	8	30	M.
	☽	——	—	—	—	
1804	☽	Jan.	26	9	30	Af.
	⊙	Feb.	11	11	30	M.
	☽	July	22	5	30	Af.
1805	●	Jan.	15	9	0	M.
	⊙	June	26	11	0	Af.
	●	July	11	9	0	Af.
	●	Jan.	4			
1806	☽	Jan.	5	0	0	M.
	⊙	June	16	4	0	Af.
	☽	June	30	10	0	Af.
	⊙	Dec.	10	2	30	M.
	☽	——	—	—	—	
1807	☽	May	21	5	30	Af.
	⊙	June	6	5	30	M.
	☽	Nov.	15	8	30	M.
	⊙	Nov.	29	Noon.		
1808	●	May	10	8	0	M.
	●	Nov.	3	9	0	M.
	⊙	Nov.	18	3	0	M.
1809	⊙	April	14			
	☽	April	30	1	0	M.
	☽	Oct.	23	9	30	M.
1810	⊙	April	4	2	0	M.
	☽	——	—	—	—	
	☽	——	—	—	—	
1811	⊙	March	24	10	0	M.
	☽	Sept.	2	11	0	Af.
1812	●	Feb.	27	6	0	M.
	●	Aug.	22	3	0	Af.
1813	⊙	Feb.	1	9	0	M.
	☽	Feb.	15	9	0	M.

A.D.	O. Style.		D.	H.	M.		A.D.	N. Style.		D.	H.	M.	
901	●	Aug.	3	0	30	M.		☽	Aug.	12	3	15	M.
902	⊙	Jan.	12	4	0	Af.	1814	⊙	Jan.	21	2	30	Af.
	☽	Jan.	26	4	30	Af.		☽	——	—	—	—	
	⊙	July	8	1	0	M.		⊙	July	17	7	0	M.
	☽	Dec.	17	6	30	Af.		☽	Dec.	26	11	30	Af.
903	☽	June	12	8	0	Af.	1815	●	June	21	6	30	Af.
	⊙	June	27	5	30	Af.		⊙	July	7	0	0	M.
	⊙	Dec.	7	10	0	M.		●	Dec.	16	1	15	Af.
904	●	May	31	11	30	Af.	1816	●	June	10	1	30	M.
	⊙	June	16	10	0	M.		⊙	——	—	—	—	
	⊙	Nov.	10	7	0	M.		⊙	Nov.	19	10	30	M.
	●	Nov.	25	9	30	Af.		●	Dec.	4	9	0	Af.
905	⊙	——	—	—	—		1817	⊙	May	16	7	0	M.
	☽	May	21	10	30	M.		☽	May	30	3	30	Af.
	⊙	——	—	—	—			⊙	Nov.	9	2	30	M.
906	☽	——	—	—	—		1818	☽	April	21	0	30	M.
	⊙	April	26	10	0	M.		⊙	May	5	7	30	M.
	☽	——	—	—	—			☽	Oct.	14	6	0	M.
907	●	April	1	10	30	M.	1819	●	April	10	1	30	Af.
	⊙	April	15	11	30	M.		⊙	April	24	Noon.		
	⊙	——	—	—	—			⊙	Sept.	19	1	0	Af.
	☽	Sept.	24	Noon.				☽	Oct.	3	3	30	Af.
908	●	March	20	8	0	Af.	1820	☽	Mar.	29	7	0	Af.
	⊙	Aug.	29	5	0	Af.		⊙	Sept.	7	2	0	Af.
	●	Sept.	13	1	15	M.		☽	Sept.	22	7	0	M.

Note. All the eclipses in this list are computed by the author of *L'Art de vérifier les Dates*. Paris 1785.

XLI. *On Lithography**.

MR. HULLMANDELL ON LITHOGRAPHY.

The drawings I have the honour to present to the Society for promoting the Arts, Manufactures, and Commerce, are the fruits of an art invented some years ago in Germany, and but lately introduced into this country, at least in its present state of perfection. Its great advantage is that of enabling the artist to

* From the *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, vol. xxxvii. The silver medal of the Society was voted to the author of the first of the subjoined papers, Mr. Hullmandell, of Great Marlborough-street, London, for the communication, and the specimens remain in the Society's Repository. The silver Isis medal was voted to Mr. Redman, of Maiden-lane, for another communication on the same subject, which we also subjoin.

offer

offer to the public the original production of his pencil, without having recourse to engravers. The repeated failures I met with when I first began the work entitled "Twenty-four Views of Italy," determined me to have a press and materials of my own; and after several failures and renewed attempts, during the space of fourteen months, I am at last enabled to offer some drawings, which show, I hope, a decided progress in the art. I must beg leave to observe, that the twelve last of the twenty-four views of Italy, and the five drawings marked 1, 2, 3, 4, and 5, are printed entirely under my direction, and that the preparation of the stones, the chalk, the ink, &c. is entirely done by myself. With regard to the drawings marked 6, 7, 8, 9, the whole process, from the first preparation of the stones, as well as the *printing*, is done also by myself.

It is much to be regretted, that no good stones have hitherto been found in England. The only sort which answers tolerably well the purposes of lithography, is the white lias of Bath; but it is of too soft and porous a nature, and gives but few impressions compared with what one can obtain from German stones. The Bath stones, however, answer very well for transfers, and other inferior productions. The decided superiority of German stones over any other, added to the difficulties I met with in obtaining a *pure* Bath stone of sufficient dimensions, has hindered me from producing a drawing done upon an English stone. All these I have the honour of offering, are printed from German stones, from the quarries of Solnhofen in Bavaria.

The art of lithography admits of many different styles; such as ink drawings, either by lines or dots, etchings or engravings, chalk, and imitations of wood-cuts, and of aqua-tinta. The only style, however, which has a decided superiority is that of chalk, as I think no style of copper-plate engravings can give so perfect an imitation of original pencil drawings; whereas, from the natural tendency the stone has to imbibe the lithographic ink, it is impossible to obtain very fine lines, or any drawings which might not be executed with more ease by etching on copper. Very fine lines, and good imitations of copper-plate engraving, may be produced by engraving upon stone; but as it requires almost as much practice as engraving upon copper, the chief advantage of lithography, viz. enabling an artist to execute his own drawings, is lost; to which must be added, the disadvantage of the great bulk and weight of the stones, which must always hinder a person from laying by engravings already executed, as can be done with copper-plates. Transfers upon stones, however, with regard to writing, are extremely useful; it has also been attempted with copper-plate prints, but they are but poor imitations of the original. The art of transferring writing

 upon

upon stone is so very easy and simple, that I have thought it useless to offer any specimen of it. These considerations have led me to turn all my thoughts towards chalk-drawings; and it appears lithography has been considered chiefly in that light, both in Paris and Munich.

The stones proper for lithography must be of a calcareous nature, pure, hard, and of a fine grain. They must imbibe both moisture and grease with equal avidity: on this is founded the whole art of lithography.

The chalk is a composition of grease, wax, shell-lac, soap and black. The lithographic ink is composed of the same materials, but rather softer.

The stone must be rubbed down with fine sand to a perfect level, after which it is ready to receive the drawing: when the latter is executed, a weak solution of nitric acid is thrown over the stone: this operation slightly corrodes its surface, and disposes it to imbibe moisture with more facility. While the stone is still wet, a cylinder, of about three inches in diameter, and covered with common printers' ink, is rolled over the whole surface of the stone; the wet part, of course, refuses to take the ink, while the chalk, being greasy, takes a portion of it from the roller. The stone is now ready for printing. The press consists of a box, drawn by a wheel under a wooden scraper, pressing on it with great power: after the first impression the stone is wetted afresh, again rolled over with the cylinder, drawn under the scraper, and so on. The same process is employed for ink drawings, except that the solution of aqua-fortis must be stronger, and the printing-ink stiffer.

Transfers are made either with chalk or ink, or with both together, on a prepared paper, which is then put damp in the press, on the surface of a stone, and thrown off on it; the stone is then treated as a chalk or ink drawing. The tints of the prints marked 6, 7, 8, 9, are produced by a second stone, covered over with grease; the lights are scraped out in the places where they are intended to be; and the print being brought on the stone in its exact place, produces the effect of a drawing on coloured paper touched in with white. The drawings marked 7, 8, 9, are printed with a third stone, to give more effect to the fore-ground.

Imitations of wood-cuts are produced by covering the stone with lithographic ink, and scraping out the intended lights; and as the finer touches may be added with a hair pencil, prints far superior to wood-cuts may be obtained; but the chief advantage of wood-cuts, viz. printing them at the same time with the text of the book, is lost.

Engraving upon stone is performed by polishing the stone, and

and covering it with a thin coating of gum and black; the part intended for the drawing must be scraped out, and when finished, of course appears white instead of black; the thicker lines, as in copper, must be cut deeper; and when the whole is finished the stone is rubbed with linseed oil, which not being able to penetrate the coating of gum, only touches the stone where it is scraped away. The gum is then washed off, and the print obtained as in the other styles of printing.

The imitations of aqua-tinta are produced by several stones coinciding with each other, and producing a succession of flat tints, as in the drawings 6, 7, 8, 9. Drawings may also be done by mixing ink with chalk, and adding flat tints.

MR. REDMAN ON LITHOGRAPHY.

The stone on which the accompanying specimen is executed, was taken from a quarry the property of William James, Esq. of Warwick, a member of the Society for promoting the Arts, Manufactures, and Commerce. It is situated at Wilmcots, near Stratford-upon-Avon, and the stone may be there procured in any quantity, and of a very large size. I can say from experience (having been some years in practice as a lithographic printer, in which time I have tried various English stones,) that it is equal to the German stones in texture and hardness, and is capable of receiving any kind of drawings intended for lithographic purposes.

XLII. *Observations on the Phænomena of the Universe by a* NEWTONIAN, *in Answer to the Remarks of* PHILO-VERITATIS, *published in the Philosophical Magazine for last Month.*

To Mr. Tilloch.

SIR, — YOUR correspondent PHILO-VERITATIS, in his remarks (Phil. Mag. No. 269) on my observations relative to the Theory of *Sir Richard Phillips*, insinuates my having intended to *hoax* your readers at the expense of *truth*. I therefore solicit your indulgence to insert a few remarks.

In art. I. page 102, vol. 56. The velocity of the planets in their orbits, was by mistake inserted with the density of the gaseous medium, and the density of the planets, as will appear by referring to art. 6, page 103, *i. e.* The motions of the planets in superior orbits are quicker than those which are situated nearer the sun.

But had I erred in the three first deductions, as erroneously stated by *Veritatis*, there would still have been left objections to to confute, sufficient to have exercised the *superior* talents of this gentleman, even with his *understanding open.*

I shall now proceed to substantiate these deductions.

FIRST. As to the density of the gaseous medium. We are told by Sir Richard in his Treatise, page 21, " that the densities are supposed such, that, multiplied by the distances, the products are equal*: consequently, as the distances increase, the densities must of course decrease."

Again: page 25, " The density of each stratum is inversely as the cubes of the radii."

SECONDLY. As to the density of the planets.

Page 19. " We know from the diurnal phænomena that the earth and atmosphere have such a common rotatory motion, without which the common orbicular force must confer on the masses unequal momenta. It is however a necessary mechanical effect of such common rotatory motion, to equalize the momenta of masses of various density, and to force them to range themselves, or to seek to range themselves, in concentric circles or radii of rotation, inversely as their respective densities. By their mutual collisions the *lighter bodies* must, by the mechanism of equal momenta and equilibria, *ascend from the centre towards the circumference, and the heavy ones be forced towards the centre.*"

Whence the same effects must evidently obtain in the planetary system; for the rotatory motion of the gaseous medium and the rotatory motion of the earth's atmosphere, on this principle of mechanics, must undoubtedly produce similar results.

We are also told at page 36, " that if the density of the projectile were equal to the density of the medium, then the projectile would float in the medium, and be carried round the earth in the circular vortex of the earth like the medium itself."

On the same theory, the planets would fall to the sun, unless supported by a medium of equal density with the respective planets—as it is evident they *must swim* in a medium of the same density and velocity—otherwise resistance would be generated till this effect was obtained.

Whence the density of the medium and the density of the planets in the same circle of rotation must of necessity be equal, and, on the principles of *Sir Richard's* Theory, their densities undeniably decrease from the sun to the confines of the solar system, as I before asserted; or, from the centre of any revolving medium or system of bodies, to the extent of their circumference.

Veritatis admits as granted, that a cubic foot of silver cannot be

* This law involves the absurdity, that the sun and planets, and all rotatory bodies, are infinitely dense at their centres!!. *Sublime results, and not unworthy of further speculation!*

be revolved by the same mundane force in the same circle as a cubic foot of cork, and that if placed together (nearly as in water) one must ascend towards its circle of *accordant velocity*, and the other descend. But here *Veritatis* is under a mistake, for it ought to be *accordant density*, as the velocities of rotation when the bodies were first projected, or submitted to the action of the medium, are supposed to be equal. And agreeable to the difference of their respective densities, resistance would be generated, till they ascended or descended in the medium, to circles of *accordant density*.

THIRDLY. In respect to the velocities of the planets in their orbits increasing from the sun to the confines of the solar system.

We are told, page 24, "That is to say, a body SUDDENLY ELEVATED from an *inferior* circle of rotation into one where a more RAPID MOTION exists, or where a motion exists which does not accord with the density of the *elevated body*, is necessarily repelled from *superior* strata to *inferior* strata, till it finds its due level or balance of motion and density."

Of course the laws, which apply to the earth, apply to the same classes of phænomena in all planets, resulting from their two-fold motions around their own axis, and around their primaries: *vide* page 27. Moreover, as these phænomena of motion apply to the planets, the law is universal, and applies likewise to the solar system, and also generally, to other systems. My application of Sir Richard's Theory, as it respects the earth, to that of the solar system, may probably be objected to; but I beg to remark, that in this particular I have followed the steps of the author who at page 26, has applied *Kepler's law* (in relation to the distances and periodic times of the planets) to the physical cause of the fall of projectiles, or to the centripetal force on the earth's surface, &c. Another absurdity also presents itself, *i. e.* The rotatory motion of the earth can have little or no effect in producing gravity in bodies situated at the poles: as they have no rotatory motion in space, but only revolve round their centres once in the space of twenty-four hours, their absolute motion is orbicular: consequently the rotatory motion of the earth can have no effect in producing gravity in bodies so situated; whereas we know from actual observations, that the diminution of gravity in this case, is infinitely less than what it ought to be by this *elegant* theory.

My motive, sir, for intruding my observations on your notice, and that of your readers, was to *elicit truth*. The *inconsistencies* and *errors* contained in Sir Richard's *visionary* theory render it necessary to its investigation. Should *Philo-Veritatis*, or any other *Phillipian*, attempt to vindicate their master's cause, it is solicited that each objection be answered respectively, and not

evaded

evaded by annihilating my objections to the *Phillipian Theory*, with one grand sweep, on an erroneous principle, with an intent to impose on the ignorant. Its remains *particularly* for *Veritatis* to prove the falsity of the three first deductions, as he says my subsequent deductions are founded on my first: otherwise, by the rules of *logic*, all my inferences are true, and the whole of my reasoning correct!!

That the readers of the Philosophical Magazine may not again be told that they are *hoaxed* at the expense of *truth*, under an anonymous signature, I subscribe myself,

Sir, yours truly,

Lynn Regis, Oct. 12, 1820. JAMES UTTING.

P.S.—Vossius too, and many others give partly into the Cartesian notion, and suppose gravity to arise from the diurnal rotation of the earth round its axis.—Vide *Hutton's Dict.* vol. i. p. 548.

XLIII. *Tables by the Board of Longitude.*

To Mr. Tilloch.

Oct. 20, 1820.

SIR,—I HAVE just seen a six-penny pamphlet published, during the course of last year, by order of the Commissioners of Longitude relative to *A rule for correcting observations of meridian altitudes made with the repeating circle:* and I must confess that I am somewhat surprised that that learned body should have considered it necessary to *order* the printing of so useless and inaccurate a performance. I consider it useless, because the tables already given by Delambre, under the title of *Tables for the reduction to the meridian*, are in the hands of every person who has an opportunity of using the repeating circle: and such tables are more convenient and more accurate than those which are the subject of this letter; although founded on precisely the same principles. M. Delambre's formula for the correction of the meridional zenith distance, as given by himself in the *Base du systême métrique*, and repeated by every writer on the subject since that time, is as follows, viz.

$$-\frac{2\sin^2\frac{1}{2}P}{\sin 1''}\times\frac{\cos L.\cos D}{\sin(L-D)}+\frac{2\sin^4\frac{1}{2}P}{\sin 1''}\times\left(\frac{\cos L\ \cos D}{\sin(L-D)}\right)^2\times$$

cot (L—D): where L denotes the latitude of the place, D the declination of the star, and P the horary angle. And, in order to render this formula applicable to practical purposes, he has thrown into two tables for general use, all the *constant* parts, viz. $\frac{2\sin^2\frac{1}{2}P}{\sin 1''}$ and $\frac{2\sin^4\frac{1}{2}P}{\sin 1''}$; but, the *variable* part (depending on the

the latitude of the place and the declination of the star) he has necessarily left to be calculated according to the circumstances of the case. This is the proper and only correct mode of proceeding on such occasions: and the world is much indebted to M. Delambre for the great labour which he has bestowed on this and other branches of practical astronomy. But what has the English computer done, under the sanction of our Board of Longitude?—He has garbled this very formula, and under the disguise of a new dress and a new title, has given us the same thing, or rather *a part* of the same thing, in a more clumsy and inconvenient form. The rule given by this writer is expressed by the following formula: viz. $\frac{\cos L. \cos D. \sec A}{\sin 1''.} \times$ ver-sin P, where A denotes the altitude of the star, and L, D, P, the same as in Delambre's formula above mentioned. And it is a table of the value of the versed sine of P only, for the first $7\frac{1}{2}$ degrees, which constitutes the whole two leaves (for there are literally no more) of this six-penny publication. The other part of the formula, including the constant quantity $\frac{1}{\sin 1''}$, he has left for calculation, according to the particular circumstances of the case. But let us analyse this formula, and reduce it to a more modern appearance by getting rid of those antiquated terms *secant* and *versed sine* (terms which are now necessarily discarded from *practical* astronomy, since there are no tables by which their adoption can be rendered of any use to the computer), and we shall then see that this formula is precisely the same as the first term of Delambre's. For, ver-sin P $= 2 \sin^2 \frac{1}{2}$ P, and sec A $=$ $\frac{1}{\sin (L-D)}$: consequently the English formula, translated into French notation, becomes $\frac{2 \sin^2 \frac{1}{2} P}{\sin 1''} \times \frac{\cos L. \cos D}{\sin (L-D)}$, as above mentioned. But, since the value of $\frac{2 \sin^2 \frac{1}{2} P}{\sin 1''}$ for every second has been already given, in several publications, and to a much greater extent than the table of versed sines here alluded to, there can be no hesitation which is the most convenient formula to adopt: and the Board of Longitude would have chosen a better part, to have reprinted those tables with an English introduction; if indeed an English edition were called for. This however is not the whole of the correction necessary; for there is the other term, viz. $\frac{2 \sin^4 \frac{1}{2} P}{\sin 1''} \times \left(\frac{\cos L. \cos D}{\sin (L-D)}\right)^2 \times \cot (L-D)$ which must be applied where great exactness is required: so that the

the author of the English formula is wrong in stating that it wil give the value of the correction with *perfect accuracy;* and the Commissioners of Longitude ought not to have sanctioned such an assertion. In the present state of astronomy, and when a new impulse seems to be given to the science, every one must hail with satisfaction any attempt to expedite and facilitate the laborious calculations which too frequently arise in practice: and no one is more sensible than I am of the ability and disposition of the members of the Board to encourage such attempts. Let us not however *retrograde* in the science, but endeavour to *improve* on what has gone before: so that we may eventually hope to regain that proud pre-eminence from which we have been driven by our more industrious neighbours.

I am, sir, your obedient servant,

PHILASTER.

XLIV. *An Account of some Experiments on the Flexibility and Strength of Stones. By Mr.* THOMAS TREDGOLD.

To Mr. Tilloch.

SIR, — IN these experiments the piece under trial was supported at each end upon iron supports; the scale for the weights was suspended from the middle between these supports; and a silken line, attached to the middle, moved a lever index; which multiplied the depression so as to render a very small quantity visible.

The scale and its apparatus weigh ten pounds; and the weights I use are cubical pieces of iron, cast for the purpose, of 10 lbs. each. Weights of this kind pack neatly together upon the scale, and there is less risk of error in counting them than common weights.

The weight in the scale was increased by 10 lbs. at a time, laid on as softly as possible, and the index was always allowed to become stationary before another addition was made to the weight. The time which elapsed before the index became stationary was not observed, but it always increased sensibly towards the end of the experiment. I had the advantage of my brother's assistance in making the experiments where the flexure was measured.

Detail of Experiments.

1. A piece of white statuary marble, of a very regular texture, free from veins, or other apparent defects, was tried at three different lengths; the short specimens were the fragments of the long one. The piece was not perfectly uniform in breadth and depth, but the dimensions at the places of fracture are given.

Distance

Distance between the Supports 30 Inches.		Distance between the Supports 15 Inches.		Distance between the Supports 14 Inches.	
Depth . . . 1·075 —		Depth . . . 1·08 —		Depth . . . 1·075 —	
Breadth . . 1·075 —		Breadth . . 1·05 —		Breadth . . 1·075 —	
Weight.	**Depression.**	**Weight.**	**Depression.**	**Weight.**	**Depression.**
10 lbs.	·02 inch.	10 lbs.	·005 inch.	10 lbs.	not sensible.
20 —	·045 —	20 —	·01 —	20 —	·005 inch.
30 —	·06 —	30 —	·012 —	30 —	·01 —
40 —	·08 —	40 —	·015 —	40 —	·012 —
50 —	Broke —	50 —	·017 —	60 —	·015 —
		60 —	·02 —	70 —	·02 —
		70 —	·021 —	90 —	·025 —
		80 —	·025 —	100 —	·027 —
		90 —	·03 —	110 —	·03 —
		100 —	·035 —	120 —	·034 —
		110 —	Broke.	130 —	·037 and broke.

The first trial, that with the 30-inch distance, will give the most accurate measure of the elastic force; but it is not a fair measure of the cohesive force, because it was evidently broke by the momentum, the weight acquired by the addition of the last 10 lbs. The 14-inch length bore the weight some time before it broke.

The specific gravity was found to be 2·706; and it absorbs $\frac{1}{1300}$ of its weight of water.

I observed that the fractures bore a close resemblance to one another, and found that the plane of fracture made always nearly the same angle with the axis of the piece. This angle is about 83°. I have not observed a similar regularity in any other kind of stone, and it is either a remarkable coincidence, or the effect of the structure of this kind.

2. There is some difference in the quality of the Portland stone used in London; the best and strongest kind is of a browner colour than the others. The specimen with which our experiment was made was of the brown variety, and of a regular texture, without apparent defect. The length between the supports was 24 inches, the breadth 2 inch, and the depth 1·45 inch.

Weight	10 lbs.	..	Depression	·01 inch.
——	20 —	..	——	·015 —
——	30 —	..	——	·02 —
——	40 —	..	——	·022 —
——	50 —	..	——	·025 —
——	60 —	..	——	·0275 —
——	70 —	..	——	·03 —
——	80 —	..	——	·032 —
——	90 —	..	——	·035 —
——	100 —	..	——	·037 and broke.

This

This was a very good experiment, as we knew from previous trials very nearly the weight it would bear, and therefore added the weights with more care towards the last.

The specific gravity of the specimen was found to be 2·113, and it absorbs $\frac{1}{16}$ of its weight of water.

3. Our next trial was made with a piece of white siliceous sandstone from Lord Keith's quarries at Long-annet, near Kincardine Tullyallan, on the north side of the Forth. The specific gravity of this stone is 2·212, and it absorbs $\frac{1}{267}$ of its weight of water. The texture regular, with small scales of mica distributed through it. The distance between the supports was 18 inches, the breadth 1·45 inch., and the depth 1·525 inch.

Weight	20 lbs.	..	Depression	·015 inch.
——	30 —	..	——	·02 —
——	40 —	..	——	·022 —
——	50 —	..	——	·025 —
——	60 —	..	——	·03 —
——	70 —	..	——	·038 —
——	80 —	..	——	·045 —
——	90 —	..	——	·05 —
——	92 —	..	——	broke.

This stone is of a more flexible nature than either of the preceding; though from its appearance I expected a different result.

4. The following table contains the results of some experiments in which the flexure was not ascertained; they were made for obtaining data for calculating the lateral strength of stone.

These specimens, with the exception of one of the Long-annet ones, were laid with their natural beds horizontally.

Table of Experiments on the lateral Strength of Stones.

Kind of Stone.	Distance between the Supports.	Breadth. Inches.	Depth. Inch.	Weight that broke the Piece.	Weight of a cubic Foot.
Dundee stone	14 inches.	1·45	1·5	414 lbs.	163 8 lbs.
Craigleith stone . .	14 —	1·55	1·55	137 —	147·6 —
Hailes stone	14 —	1·55	1·5	123 —	134·8 —
Long-annet stone . .	9 —	1·525	1·45	160 —	138·25—
Do. another specimen	7 —	1·55	1·55	233 —	
Portland stone	12 —	2·07	1·55	270 —	132 —
Bath stone . .	5·5 —	1·0	1·0	58 —	123·4 —

The

The Dundee stone is from the Mylne-field quarry, near Dundee; the specimen tried is superior to the kind usually raised from that quarry both in fineness of texture and density. Its specific gravity is 2·621, and it absorbs only $\frac{1}{311}$ of its weight of water.

The Craigleith stone is a fine specimen from the quarries of that name near Edinburgh. Specific gravity 2·362, and absorbs $\frac{1}{63}$ of its weight of water.

The Hailes quarry stone is also from near Edinburgh, and from the same stratum as the Craigleith, but differs from it in being more laminated.

Long-annet stone is also about of the same kind as Craigleith; the 7-inch length was a variety of a coarser texture; the other was a fragment of the piece of which the flexure was measured.

The specimens of Bath and Portland stone were good of their respective kinds, and such as are usually employed about London.

5. In order to compare the results of these experiments, I will use the following formulæ; in which w is the weight that produces a deflexion δ; and W the weight that broke the piece; Δ being the depression at the time of fracture; l = half the length; b = the breadth; and d = the depth.

$\frac{2 l^3 w}{b d^3 \delta}$ = The weight of the modulus of elasticity, or measure of the elastic force*.

$\frac{3 d \Delta}{2 l^2}$ = The extension at the time of fracture.

$\frac{3 l W}{b d^2}$ = The cohesive force of the material, on the supposition that the resistance to tension is equal to the resistance to compression.

As the elastic force of a substance appears to decrease when the strain much exceeds about half the cohesive force, in calculating the elastic force the weight w will be taken, which is nearest to half the weight that broke the piece.

The hardness was compared by scratching a piece of each stone with the same piece of steel, applied in the same manner, and, as nearly as I could judge, with the same force. I had not an apparatus fit for the purpose, or I would have used Perronet's method of determining the hardness. The last column of the table shows the order of hardness, making the softest 1.

* Dr. Young's Nat. Phil. vol. ii. art. 326.

Table

Table of the Properties of some Species of Stone.

Kind of Stone.	Cohesive Force of a square Inch.	Weight of the Modulus of Elasticity of a square Inch.	Height of the Modulus of Elasticity in Feet.	Extensibility.	Specific Gravity.	Weight of Water absorbed, Stone Unity.	Order of Hardness.
Statuary marble	1,811 lbs.	2,513,000 lbs.	2,109,000	$\frac{1}{1394}$	2·706	$\frac{1}{1300}$	3
	2,020 —	1,910,000 —	1,591,000	$\frac{1}{869}$			
	2,197 —	1,800,000 —	1,500,000	$\frac{1}{822}$			
Portland stone . .	857 —	1,152,000 —	1,256,000	$\frac{1}{1789}$	2·113	$\frac{1}{16}$	2
	976 —	. . . .	. . . .	. .	. .		
Long-annet stone . .	734 —	569,000 —	593,000	$\frac{1}{708}$	2·212	$\frac{1}{26 \cdot 7}$	5
	675 —	. . . .	. . . .	. .			
	656 —	. . . .	. . . .	. .	. .		
Dundee stone	2,661 —	. . . .	. . . .	. .	2·621	$\frac{1}{511}$	4
Craigleith stone . .	772 —	. . . .	. . . .	. .	2·362	$\frac{1}{63}$	5
Hailes quarry stone . .	740 —	. . . .	. . . .	. .	2·155	. .	5
Bath stone	478 —	. . . .	. . . .	. .	1·975	$\frac{1}{13}$	1

In theory it is considered that bodies are perfectly homogeneous; but in our trials we found that the magnitude of the facet of a crystal, or the position of a scale of mica, produced a sensible effect on the result in a small specimen: therefore, to determine the strength, the specimen should not exceed about 18 inches in length, with a section of an inch and half square. When a specimen is long, it is not easy to add to the weight without giving it a sensible degree of momentum. To determine the elastic force, the specimen should be long in proportion to its depth, and it is better when the breadth is not less than twice the depth; then both the flexure, and the weight producing it, being greater, the elastic force will be more correctly obtained. In short specimens there is a sensible degree of indentation at the supported ends.

I have observed, that of late stone-stairs, balconies, landings, &c. are executed with a less and less quantity of material, and that there is no prospect of a stop being put to this species of misplaced œconomy till some dreadful accident happens. What a scene of horror the failure of a crowded balcony would create! and who can say what balcony may not be loaded to the utmost the

the space will allow of? They should be calculated to bear the greatest possible load, with safety. My experiments furnish the necessary data as far as regards the strength of the stone. They also show which stone is best adapted for the purpose. The Dundee stone is decidedly the strongest of the specimens I have tried. I am, sir, yours, &c.

Oct. 17, 1820. THOMAS TREDGOLD.

2, Grove Terrace, Lisson Grove.

XLV. *Analysis of Arsenical Nickel, and the Arseniate of Nickel of Allemont (Department of the Isere). By M.* BERTHIER*.

THE arsenical nickel of Allemont has not hitherto been completely analysed. Its colour is reddish brown, approaching that of copper, but paler; it has a metallic lustre both in pieces and in powder; its fracture even, or covered with small asperities, and a little shining; it soon tarnishes in the air; it is brittle, and easily reduced to powder:— specific gravity 7·29. It emits a garlic smell when struck with steel; before the blow-pipe it gives a dense arsenical smoke; melts readily a little above a red heat. Heated for an hour at 150° of Wedgwood, in a crucible lined with charcoal, it loses only about 0·12 to 0·15 of its weight, and does not change its appearance. This loss appears to be almost entirely arsenic.

This mineral consists principally of arsenieuret of nickel, but contains also a small quantity of arsenieuret of cobalt and sulphuret of antimony. It was analysed in the manner following:

To the mineral was added nitric acid at intervals; and it was boiled during two days, which dissolved the whole. The arsenic and sulphur were acidified, and the nickel, cobalt and antimony oxidated. Water being added to the solution, a white powder fell down, weighing when dry 0·276 parts, which was proved to consist almost entirely of arseniate of antimony, by the following experiments: It was first heated in a silver crucible, with four times its weight of caustic potash; and then treated with boiling water, which dissolved all but a small residue of oxide of nickel, weighing 0·008, arising from a small portion of arseniate of nickel which had fallen down along with the arseniate of antimony. The above-mentioned solution in boiling water was then boiled with nitric acid, which produced a white sediment, composed of oxide of antimony and arsenic acid, weighing 0·16 parts. Its component parts were separated by solution in muriatic acid, slow evaporation to dryness, and subsequent addition of water, which caused a copious deposit of in-

* From the *Journ. des Mines*, iv. 467.

soluble

soluble oxide of antimony. A second evaporation to dryness of the soluble part, and re-solution in water, gave a further small deposit of oxide of antimony, after which the solution was no longer troubled by sulphuretted hydrogen. The whole of the oxide of antimony weighed after calcination 0·11 parts, which, subtracted from the weight of the arseniate of antimony, leaves 0·158 for the arsenic acid.

The nitric solution, which had parted with the arseniate of antimony by dilution with water, was then decomposed by sub-carbonate of soda added in slight excess; a pale apple-green precipitate fell down, weighing after drying 1·030 parts; and consisted of arseniated nickel with a small proportion of arseniated cobalt. As a proof that this solution had parted with all its arseniate of antimony, a portion of the apple-green precipitate was calcined, re-dissolved in nitric acid, evaporated slowly to dryness, and again dissolved in water, without leaving any residue; which would have been the case had any antimony been present.

The 1·030 parts of arseniate of nickel were decomposed in a silver crucible by potash; and yielded nearly equal parts of oxide of nickel and arsenic acid. To separate from the latter the minute quantity of oxide of cobalt, it was dissolved in muriatic acid, precipitated by carbonate of soda, changed to an oxalate by digestion with oxalic acid, and then dissolved in ammonia, according to the process described by M. Laugier in the 9th volume of *Annales de Chimie et de Physique*. In this way about 0·002 of oxide of cobalt was detected.

As the liquid whence the arseniate of nickel had been precipitated by the carbonate of soda might retain some arsenic acid, a known weight of peroxide of iron dissolved in muriatic acid was dropped in, and again precipitated by carbonate of soda, and dried. This precipitate weighed 0·054 more than the peroxide of iron first used, which increase was therefore arsenic acid. Lastly, all the clear solution was supersaturated with nitric acid, and treated with nitrate of barytes, which threw down 0·14 parts of sulphate of barytes, equal to 0 02 of sulphur.

The above analysis therefore yielded the following products:

Protoxide of nickel	0·512
Protoxide of cobalt	0 002
Arsenic acid	0·747
Sulphuric acid	0·048
Oxide of antimony	0·110
	1·419

with a trace of oxide of iron and manganese.

But

But as the process of analysis oxidates the several bases which in the mineral in its natural state exist free from oxygen, the component parts of this ore must be stated as follows:

Nickel ..	0·3994	or	Arseniuret of nickel	0·8855
Cobalt ..	0·0016		Arseniuret of cobalt	0·0035
Arsenic ..	0·4880		Sulphuret of antimony	0·1000
Antimony	0·0800			
Sulphur	0·0200			0·9890
	0·9890			

The pure arseniuret of nickel therefore contains 0·451 per cent. of nickel, and 0·549 of arsenic, numbers differing but little from ·44 and ·56, which are given by calculation.

The arseniate of nickel, which is always found at Allemont adhering to arsenical nickel, appears to be derived from the spontaneous decomposition of the latter. It is sometimes compact, and of a very fine apple-green, sometimes friable and greenish white. The latter variety was analysed by fusion in a silver crucible with one and a half its weight of potash, and assayed for cobalt by the process of M. Laugier mentioned above. It gave the following component parts:

Protoxide of nickel	0·362	or	Arseniate of nickel	0·706
Protoxide of cobalt	0·025		Arseniate of cobalt	0·049
Arsenic acid ..	0·368			
Water	0·245		.. ..	0·245
	1·000			1·000

The pure arseniate of nickel therefore will consist of 0·512 per cent. of oxide of nickel, and 0·488 of arsenic acid, which is nearly the composition of the artificial sub-arseniate, that would be formed by three atoms of oxide and two atoms of acid, or, exactly, of 0·496 of oxide of nickel and 0·504 of arsenic acid.

Preparation of Nickel, and Examination of some of its Salts.

The ore of Allemont, after being roasted till all arsenical vapour ceased, was dissolved in nitro-muriatic acid, and evaporated to dryness at a gentle heat. On adding water to the residue, there remained much arseniate of antimony: the solution was then decomposed by common subcarbonate of soda, till the white precipitate of arseniate of antimony began to be coloured, and then filtered. The liquor contained all the nickel, with a little cobalt and arsenic acid. To separate the latter, a solution of muriated peroxide of iron was added, followed by subcarbonate of soda, till the precipitate began to show either a green or a rose-colour, and the liquor was again filtered. The subcarbonate of soda

soda throws down at first the arseniate of iron, and then any simple peroxide that may remain, if more muriate of iron was added than was necessary to afford sufficient peroxide of iron to saturate the arsenic acid. The arseniate of iron is yellowish white, the simple peroxide brown-red, showing that no arsenic acid remains in the solution, if the ferrugineous precipitate, after being yellowish white, appears red in the last portions; and indeed if this does not happen at first, more of the muriate of iron should be added, till the brown-red precipitate shows itself. All the arsenic acid and oxide of iron being thus got rid of, nothing but nickel and cobalt remains in the solution, which must then be separated. The process of M. Laugier answers this purpose completely; but, as M. Tuputi observes, where it is only desired to procure a quantity of pure oxide of nickel, without regard to accuracy of analysis, it is a much cheaper and simpler method to add an alkaline subcarbonate to the solution of the two metals; which first throws down the pure rose-coloured oxide of cobalt, then a mixture of the two metals, and lastly pure oxide of nickel. When only the latter is left in the solution, it is to be boiled with an alkaline subcarbonate, and the precipitated oxide well washed.

Arseniate of Nickel.

To prepare this salt, 1·96 gramme of oxide of nickel was dissolved in muriatic acid, three grammes of arsenic acid in water were added, and then precipitated by a subcarbonate of alkali, and the whole was filtered and the liquor boiled, to throw down the small quantity of arseniate held in solution by the carbonic acid. The arseniate of nickel thus obtained, weighed after calcination 3·91 gr. being exactly double the weight of the oxide of nickel. To recover the remainder of the arsenic acid, one gramme of peroxide of iron in muriatic acid was poured in, and the arseniate of iron was precipitated by an alkali; it weighed 1·97 gr. of which consequently 0·97 gr. was arsenic acid. A loss of 0·08 gr. appears in this operation: nevertheless it may be concluded that arseniate of nickel contains nearly equal parts of acid and oxide—a result confirmed in various ways.

From the known composition of protoxide of nickel and of arsenic acid, it is obvious that the arseniate of nickel, separated by the carbonates from its solution in acids, is a sub-salt, containing one and a half as much base as the neutral arseniates. The same takes place with the arseniates of cobalt, copper, and peroxide of iron obtained in the same way, but not with the arseniate of lime precipitated from its acid solutions by a great excess of ammonia.

Ten grammes of arseniate of nickel heated in a crucible lined with

with charcoal, as in iron assays, gave a well-melted button of arseniuret of nickel weighing 6·15 gr. It was grey without any tint of red, brittle, the fracture granulated, almost even, and somewhat approaching to lamellar; in its centre it contained a cavity lined with brilliant needles; it was not at all magnetic. This compound contained nearly a half part less of arsenic than the native arseniuret of nickel, and consequently one atom of arsenic to two of nickel.

The *Sulphate of Nickel* crystallizes in long oblique prisms with rhomboid bases, and changes into hexaëdral prisms by a facet on each obtuse angle. These crystals are perfectly transparent, and of a beautiful emerald green. By exposure to air and solar light they gradually effloresce, and become opake without losing their form. When calcined, this sulphate was composed of 0·478 per cent. of protoxide of nickel, and 0·522 of sulphuric acid. Ten grains of this sulphate reduced in a charcoal crucible at the heat of an iron assay, gave a well-melted button of sulphuret, which was grey with a shade of yellow, brittle, with a fracture lamellar in one direction, and granulated in the other, and strongly magnetical. It appears to consist of 1 atom of sulphur and 2 of nickel.

The *Carbonate of Nickel* obtained by precipitating a solution of this metal with a subcarbonated alkali, is of a fine apple-green verging to yellow, and retains this colour after exposure to the sun. If it contains ever so little cobalt its tint is sensibly altered, and passes to a dirty greyish violet.

It is composed of

Protoxide of nickel	0·475	
Carbonic acid	0·140	
Water	0·385	1·000

This salt appears to contain 1 atom of acid to 1 atom of oxide.

When a saturated carbonate instead of a subcarbonate is employed, the precipitate is of a very pale green, and becomes light and pulverulent when dried in the sun.

It consists of

Protoxide of nickel	0·483	
Carbonic acid	0·210	
Water	0·307	1·000

It appears to contain 3 atoms of acid to 2 of base.

These carbonates of nickel are readily decomposed by heat. When they are calcined in a dull red heat with exposure to air, they produce a fine black peroxide of nickel, but in a stronger heat this changes to a pure olive-coloured protoxide.

XLVI. *Notices respecting New Books.*

An Analytical Calculation of the Solar Eclipse for the 7th Day of September 1820. *By* D. MacGregor. 8vo. pp. 46. 3*s*.

There is scarcely any circumstance so well adapted to excite in the minds of the unscientific an exalted opinion of Astronomy, as the power which its professors enjoy, of predicting to the greatest nicety the various phænomena of an eclipse. And even among those who have in some degree studied this sublime science, there is no doubt a considerable number, whose attainments will not enable them to go through the various calculations which are required upon such an occasion.

We have been led to this remark, by the examination of a pamphlet recently published, entitled "An Analytical Calculation of the Solar Eclipse for the 7th of September 1820. By D. MacGregor." 8vo. pp. 46. The Author professes to have printed this work "not with the view of instructing mathematicians or astronomers; but of assisting those who are not yet sufficiently conversant in these subjects, and who are desirous of being better acquainted with them." And certainly we have not observed in any elementary work, or Cyclopædia, a more clear elucidation of the calculus of a Solar Eclipse than is here presented to the reader.

The first step taken, is, to ascertain, nearly, the time of New Moon, which is done by Burckhardt's formula given at the end of his Lunar Tables; and consisting of twelve terms. For the epoch thus found, are calculated (from the last-mentioned tables) the moon's true longitude, latitude, horary motion, horizontal parallax, and semi-diameter; and from Delambre's solar tables, the sun's longitude, horary motion, horizontal parallax, and semi-diameter. The computed longitudes of the two luminaries being then compared together, the difference is no more than 2″; and the correction of the time of conjunction found by the formula, only +44 seconds of time.

The next step is to compute, by spherical trigonometry, the Right Ascensions and N. Polar distances of the two luminaries; and the first portion of the process is concluded by the formation of a "Table of data for the general eclipse," in which the principal quantities already enumerated are set down for every 30 minutes of the duration of that phænomenon.

The Author proceeds, in the second part, to give formulæ for the solution of eight problems relating to the eclipse, as affecting the earth generally, but without numerical examples; and then passes to the third portion, which occupies 25 pages, and contains five general analytical solutions, which have for their object

ect the determination of the phænomena of the Eclipse *at any particular place.* These are followed by an actual logarithmic computation of every particular, so as to render the application of the formulæ clear to every one possessing but a moderate knowledge of analysis.

Upon the whole, we think that every lover of the science, who does not possess the original works from whence the formulæ are extracted, will be anxions to procure this interesting pamphlet, which, from the transient form in which it appears, will probably soon become scarce.

Recent Publications.

The Characters of the Classes, Orders, Genera, and Species, or the Characteristics of the Natural History System of Mineralogy. By Fred. Mohs. 8vo. 6*s*. 6*d*.

A new and improved Map of India, on one large sheet; compiled from the latest documents, and engraved by John Walker. 16*s*. or on rollers 1*l*. 1*s*.

Picturesque Scenery on the River Meuse and its Banks, from drawings made on the spot in the summer of 1818. By G. Arnold, A.R.A. No. II. 1*l*. 1*s*.

Medical Tracts, published by the College of Physicians, with coloured Plates, Vol. VIII. 12*s*.

Researches into the Nature and Causes of Epilepsy, as connected with the Physiology of animal Life and muscular Motion. By T. G. Mansford. 7*s*.

Pomarium Britannicum: an Historical and Botanical Account of Fruits known in Great Britain; with three coloured Plates relating to the parts of Fructification. By Henry Phillips. Royal 8vo. 1*l*. 1*s*.

The Theory and Practice of Gas Lighting: in which is exhibited an Historical Sketch of the Rise and Progress of the Science, &c. By T. S. Peckston. With 14 appropriate Plates. 8vo.

An Essay on Mercury; wherein are presented Formulæ for some preparations of this metal, including practical remarks on the safest and most effectual methods of administering them. By David Davies, M.D. 2*s*. 6*d*.

A History of the High Operation for the Stone. By T. Carpue, F.R.S. 8*s*. 6*d*.

Sketches, representing the Native Tribes, Animals and Scenery of Southern Africa, from Drawings made by the late S. Daniell, engraved

engraved by W. Daniell. Royal 4to. 3*l*. 3*s*. boards, or 4*l*. 4*s*. with the plates on India paper.

Preparing for Publication.

An Appendix to Dr. Gilchrist's Guide to the Hindostanee, in which every word in that valuable work will be explained, and its derivation pointed out. By Alexander Nivison, Teacher of the Oriental Languages, Edinburgh.

Illustration of Phrenology. By Sir George S. Mackenzie, Bart. F.R.S. L. & E., in one volume 8vo., with 16 engravings. This work is undertaken for the purpose of giving a succinct, and, as far as possible, a popular view of the new system of philosophy, and of furnishing the student with the means of satisfying himself of its truth, by instructing him in the art of observing.

A Treatise on the Plague, designed to prove it contagious, from facts, founded on the author's experience, during the visitation of Malta in 1813; with observations on its prevention, character, and treatment. By Sir A. B. Faulkner, M.D. &c.

Mr. Godwin's Work on *Population*, being an answer to Malthus, will appear in a short time.

Travels in Syria and Mount Sinai. By J. L. Burckhardt.

Practical Observations on Midwifery, with a selection of Cases. By Dr. Ramsbotham.

The Works of the late Professor Playfair, of Edinburgh, in 4 vols.

The Conchology of Great Britain and Ireland. By Thomas Brown, Esq. F.R.S.E.

An Appendix to the Midland Flora. By T. Purton: embellished with numerous coloured plates. By James Sowerby, F.L.S.

Rome in the Nineteenth Century, containing a complete Account of the Ruins of the ancient City; the remains of the middle Ages, and the Monuments of modern Times, &c. in a Series of Letters written in 1817 and 1818.

A select Cabinet of Natural History, with an Account of the Silkworm, and an elegant Method of obtaining very exact and pleasing Representations of Plants. By the late Dr. Shaw, F.R.S.

Ariconensia: or, Archæological Sketches of Ross and its Vicinity. By the Rev. T. Fosbrooke.

Illustrations of the Geology, Antiquities and Scenery of the Shetland Islands. By S. Hibbert, M.D. F.R.S.E.

Mr. Ackerman has announced for publication by subscription a Picturesque Tour of the Seine from Paris to the Sea, to be comprised in 6 monthly Parts, containing 24 highly coloured engravings.

Views of the Remains of ancient Buildings in Rome and its Vicinity, with letter-press Descriptions. By M. Dubourg. Atlas 4to. The plates to be coloured in imitation of drawings.

The Book of Nature laid open, in a popular Survey of the Phænomena and Constitution of the Universe, and the Appearances of Nature during each Month of the Year. By the Rev. W. Hutton. 12mo.

XLVII. *Proceedings of Learned Societies.*

ROYAL GEOLOGICAL SOCIETY OF CORNWALL.

The anniversary meeting of this Society was held in the Museum, Penzance, on Tuesday, October 3, and was, as usual, numerously attended by most of the gentlemen in the western part of Cornwall. Owing to the inconvenience of frequent sittings, to members residing at great distances from each other and from the apartments of the Society, as must happen in all associations in the country, the monthly and quarterly meetings have in a great measure given way to the general annual meeting in autumn. At least, for the last few years all the principal memoirs presented have been reserved for the anniversary meeting.

On the present occasion this was well attended, and many interesting and valuable papers were read. The following is a brief notice of some of the more interesting of these: 1. The Secretary, Dr. Forbes, read a very elaborate memoir On the Temperature of Mines; a subject which of late years has attracted much attention, but which had received little or no notice in Cornwall previously to the institution of this Society. In this paper the author in the first place detailed the result of thermometrical observations, made by himself and others, in numerous mines, as well in Cornwall as in other countries; from all of which it resulted that the temperature of the air, water, and earth in mines, as shown by the thermometer, progressively but irregularly increased from a few hundred feet beneath the surface to the greatest depths yet attained by the miner: the maximum temperature in the deepest mines of Cornwall (1300 to 1400 feet) being about 80 degrees of Fahrenheit, or 28 degrees above the mean of of the climate. As the existence of so great a temperature as this so near the surface, and still more the seemingly progressive and most rapid increase of it in descending, are at first sight circumstances very startling to our pre-conceived notions, and still more so when traced to the conclusions to which they necessarily lead; the author of the memoir, previously to coming to any opinion as to the site or source of this high temperature, discussed the many hypothetical objections that can be advanced against the existence of an internal source of heat in the body of the earth. We have not space to notice all these, nor to notice any of them fully. The following, among others, were particularly adduced and insisted on: 1. The fact that the degree of elevation above the sea does not affect the temperature of mines; mountain-mines, at equal depths below the surface, being as warm as those at the sea level. 2. The difference of temperaturs in mines of the same depth under the surface. 3. If so high a temperature existed at so comparatively small depths, ought not the law of the equilibrium of caloric to render this perceptible at the *very surface* of the earth? Ought not the temperature of our deep wells and copious springs to be the mean of *this internal temperature and the external or atmospheric temperature conjoined*, and not of the latter only, as is the fact? 4. Besides noticing the fact of the very low temperature of deep seas and lakes, as bearing on the same point, Dr. Forbes brought proofs that the temperature of several abandoned mines filled with water for years, to the depth at least of several hundred feet, is not greater than the mean temperature of Cornwall. These and many other considerations naturally led the author to inquire into the various possible sources of extraneous temperature that are found in mines, and to the examination of how far these will go in accounting for their high temperature: an inquiry, moreover, rendered more natural and necessary by the fact, fully proved by the author of the memoir, of the presence or absence of miners occasioning a difference often of 6, 8, or 10 degrees of temperature in the same mine, or in different mines similarly circumstanced in other respects. The various sources of extraneous temperature noticed by Dr. Forbes were: 1. candles; 2. gunpowder; 3. friction and percussion; 4. the bodies of the miners; 5. the diminished capacity of air for caloric, in deep mines, in consequence of the condensation caused by the increased height of the atmospheric column. In estimating the effect of the four first sources, the author entered into minute calculations, founded on the experiments of various philosophers, and illustrated the whole by application to the case of a single mine. The mine chosen for this purpose was the magnificent copper mine of Dolcoath, which employs (under-ground) 750 persons,

persons, consumes monthly 3000 *lbs.* of gunpowder, and 5000 *lbs.* of candles; is 1400 feet deep, and contains within it upwards of seven millions of cubic feet of excavated space.

By Dr. F.'s calculations it appeared probable that a quantity of *air* might be heated daily in Dolcoath by the various extraneous causes mentioned, from the temperature of 52 to 60 deg. (which was considered the mean temperature of all the air contained in the mine) sufficient to fill it thrice, or about 21 millions of cubic feet. Applied to *water*, the same quantity of caloric will raise, from the temperature of 52 to 77 deg. (the mean temperature of the water in the mine) only 2,300 cubic feet per day; but the pumps of Dolcoath bring up daily upwards of 120,000 cubic feet of water of this temperature! From this, therefore, it is evident that the extraneous sources of caloric in mines, although very important and more considerable than has usually been allowed, entirely fail in accounting for the temperature found in them. An additional, and hitherto unnoticed source of increased temperature in mines, is that arising from the elongation of the atmospheric column and consequent condensation of the air;—a cause constantly operating in every mine where there is a circulation of the contained atmospheric fluid, as is, indeed, the case in all mines. But this, even in the deepest mines in Cornwall, will only cause an increase of four degrees; which, even when added to the other adventitious causes, entirely fails to meet the degree of the actual temperature. In the mines of Cornwall no decomposition of pyrites, or other mineral matter, seems to take place in any degree sufficient to cause any perceptible augmentation of caloric. Whence, then, we may ask with Dr. Forbes, is derived the high temperature of mines? Notwithstanding the strong arguments that can be adduced against it, must we admit the existence of a constant and natural temperature of from 70 to 80 degrees in the body of the earth at the depth of little more than a thousand feet? Or are there other adventitious causes, not yet suspected, that can explain this very striking and singular phenomenon? Dr. Forbes considered the mean temperature of the whole atmosphere at the surface of the earth to be about 66 degrees of Fahrenheit, and stated that *this* is the temperature which he would have expected, *à priori*, to be found in the earth at very great depths, that is, on the supposition that there is no internal source of heat. He concluded by promising some communication on the health of miners as affected by the *tropical* temperature of their subterranean climate.

2. Another paper on the same subject by Mr. R. W. Fox, of Falmouth, was also read, being the second on this interesting topic presented by this gentleman to the Society. Mr. Fox's paper was chiefly occupied in detailing observations on the tempera-

 ture

ture made in upwards of ten mines, and exhibited the results in tables. From these Mr. Fox drew the conclusion, that the temperature of the earth in Cornwall, progressively increases as we descend, nearly in the ratio of one degree of Fahrenheit for every sixty or seventy feet. Mr. Fox has an idea that the ascent of vapour through the lodes, and its condensation in the mine, may be an important agent in the production of heat in these recesses. A very singular fact was detailed in this paper. An accident having happened to a steam-engine in the United Mines mine, the water increased in the bottom of the mine, at the depth of 200 fathoms, so as to fill the two lowest galleries, and continued two days. Immediately after this water had been pumped out, and before the men returned to work, the temperature of these galleries was $87\frac{1}{2}$ and 88 degrees, and this rather diminished than increased for some days after the miners returned to their labour there. Will this fact afford any additional clue to the explanation of the temperature of mines?

3. Two papers by Mr. John Hawkins were then read, which, like all the communications of that gentleman, were marked by acute and judicious observation. One was On the Alternation of Primitive Strata in Cornwall; the other, On the Intersection of Lodes, and the inferences to be deduced therefrom. Both these are unsusceptible of abridgement.

4. Two papers were read by Mr. Joseph Carne, one On some singular Lead Veins lately discovered in Cornwall; the other, On Cornish Petroleum. The former paper referred principally to the very productive mine of Sir Christopher Hawkins in the parish of Newlyn, which is said to yield more than 1000*l.* monthly in silver alone. Naphtha or maltha has never been found in Cornwall. Petroleum has been found in the copper mine of Wheal Unity, at a considerable depth, contained in small cavities in quartz.

Short notices were also read by Mr. Carne, On the mode of blasting rocks, and on the account of tin and copper produced in Great Britain and Ireland during last year.

5. A paper by Mr. Boase, Treasurer of the Society, On the Cultivation of Geological Science in Cornwall, was in the usual clear, eloquent, and forcible manner of that gentleman. After pointing out the difficulties thrown in the way of the cultivation of geology in the commencement of the study, and explaining away all the objections that have been made to its cultivation by well-designing but ignorant persons, the author proceeded to detail the vast importance of the science generally, and especially to Cornwall, which, while it can derive more benefit from the study than any other country, offers greater facilities to the student than any other spot of equal extent on the surface of the globe. The

writer

writer proceeded to demonstrate how very nearly the inhabitants of Cornwall, and especially the proprietors of land, are interested in the prosecution of the study of geology; and, on these grounds, he demanded of them, as their own peculiar affair, to continue to this Society, and every other having similar objects, that patronage and protection which they have so liberally extended hitherto; and he appealed to those Cornishmen who were distinguished for their learning and science (and there are many such) to consecrate some portion of their immortal labours to the welfare and renown of their native county. The discourse thus concluded: "Stimulated by motives so powerful as the fair fame of our country, the diffusion of useful knowledge, and the increasing prosperity of the community at large, much may be expected, and we should not forget that much *is* expected—from the matured labours of this Institution. Let it not then be forgotten that success is the prize of exertion—not of the few, but by a general concurrence in the spirit of our comprehensive Cornish motto "One and All." Then will the memorial of these our days go down to posterity adorned with the imperishable trophies of Science. But if we supinely neglect the auspicious opportunity, instead of living in the grateful recollection of future times, posterity will mourn over our apathy, over the unimproved talents thus buried,

> "And heap the pile with each inglorious name,
> On the fall'n altar of their country's fame."

At this meeting, being the first general one since the accession of his present Majesty to the throne, an address of congratulation was voted to the King as Patron of the Society.

THE ACADEMY OF SCIENCES, PARIS.

This body has proposed the following

Prize Question:

"To follow the development of the triton, or aquatic salamander, through its different stages, from the egg to the perfect animal, and to describe the change which it undergoes interiorly, principally in respect to its osteology and the distribution of its vessels."

The prize, of the value of 300 francs, will be awarded in the public sitting of 1822. The answers must be sent in by the 1st of January 1822.

ROYAL ACADEMY OF SCIENCES, PRUSSIA.

The class of mathematics of this academy has proposed the following

Prize Question:

"To give a mathematical explanation of the luminous and coloured

coloured crowns which are sometimes observed round the sun and moon, agreeing with experiments on light and the constitution of the atmosphere; and with observations of the phænomena made with all the precision possible."

The memoirs to be sent in on or before the expiration of March 1822. The prize, which is fifty ducats, will be adjudged at the public sitting, on the anniversary of Leibnitz, on the 3d of July following.

XLVIII. *Intelligence and Miscellaneous Articles.*

VOLTAIC ELECTRICITY.

To Mr. Tilloch.

Paris, 17th October 1820.

Sir,—The most important of the facts just discovered by M. Ampere are the attraction and repulsion of two conductors, or of two portions of the same conductor joining the two extremities of a Voltaic pile, and placed in a direction parallel to each other: there is attraction or repulsion according to the respective directions of the electric streams, which, in these conductors, are supposed flowing from the extremity which disengages oxygen in the decomposition of water, to that which develops hydrogen. Attraction, when the two currents move parallel in the same direction. Repulsion, when they flow in contrary directions. These attractions, and repulsions, are totally and absolutely different from those which take place between electrized bodies in the ordinary way.

First. Because they take place only when the Voltaic circuit '*est fermé*,' that is, when the two ends touch.

Secondly. It is when the extremities, of the same nature, are the nearest to each other, that there is attraction, and there is repulsion when they are further removed; while, on the contrary, electricity of the same nature repels, and of opposite natures attracts.

Thirdly. These attractions, and repulsions, take place in vacuo as well as in air.

Fourthly. When there is attraction, and it is sufficiently strong to make the two conductors approach each other so as to touch (the wires which formed these conductors were nearly of the diameter of knitting needles), they remain adhering to each other like two magnets, instead of separating instantly, as would two conducting bodies electrified in the ordinary way.

M. Ampere showed that the actions between one Voltaic conductor and a magnet, as well as those between two magnets, are the same as those he has discovered between two electric currents, if if it be admitted that a magnet is an assemblage of electric currents which are produced by an action of the particles of steel upon each other, analogous to those of the elements of a Voltaic pile, and that they move in planes perpendicular to the line which joins the poles of the magnet.

This part of his theory he demonstrates, by showing that a magnet may be substituted for the electrical conductor, and then two magnets instead of the two conductors, without any different result, except in the intensity of the effects, which depend on the force of the magnets in all the cases where two currents act one upon the other in attracting and repelling, or in mutually making each other change directions, by virtue of the attractions and repulsions which exist between them, and which vary in proportion to the cosine of the angle of their directions; so that the attraction of each is changed to repulsion, when this angle becomes obtuse, because the cosines become negative when the angle becomes obtuse.

BENZOIC ACID.

This acid (which has hitherto been found only in benzoin, storax, balsam of Peru and Tolu, vanilla, cinnamon, and the urine of several graminivorous animals, as cows, horses, camels, rhinoceros) has lately been found, by M. Vogel, crystallized in the *Tonquin bean* (employed to give an agreeable flavour to snuff) between the skin and the kernel. These crystals melt at a moderate heat into a transparent liquid, which suddenly shoots out into stars on cooling, and then becomes a crystallized mass. In a higher temperature it sublimes, and deposits itself in fine brilliant needles, which have a smell similar to that of the bean. A concentrated solution of these needles in alcohol reddens litmus paper, and becomes milky when mixed with water. These needles when saturated with ammonia form a salt which precipitates iron with a brown colour. In a word, they possess all the characters of benzoic acid.

M. Vogel has also found benzoic acid in the *trifolium melilotus officinalis* by digesting them in alcohol raised to the boiling temperature. On cooling, it precipitated a fatty substance, and in a few days long crystals of benzoic acid appeared in the liquid. To get rid of the fatty matter, the whole was digested in boiling water, and then filtered. The liquid with the acid passed the filter, and, on being slightly evaporated, yielded the acid in crystals. According to M. Vogel, the quantity of benzoic acid in these flowers is so abundant that it may be extracted from them with profit for sale.—(*Gilbert's Annalen.*)

THE

THE DIAMOND.

Dr. Brewster, while examining the optical structure of amber, was led to compare it with the diamond. Some singular analogies were found in the two substances, and one diamond examined presented a new and unexpected phænomenon, which promises to throw light on its origin and formation. The phænomenon occurs also in amber. It is "the existence of small portions of air within both substances, the expansive force of which has communicated a polarizing structure to the parts in immediate contact with the air. This structure is displayed by four sectors of polarized light encircling the globule of air, and can be produced artificially, either in glass or in gelatinous masses, by a compressing force propagated circularly from a point. It is obvious that such an effect cannot arise from any mode of crystallization; and if any proof of this were necessary, it might be sufficient to state, that I have never observed the slightest trace of it in more than 200 mineral substances which I have examined, nor in any of the artificial salts formed from aqueous solutions. It can therefore arise only from the expansive force exerted by the included air on the *diamond* and the *amber*, when *they were in such a soft state as to be susceptible of compression from so small a force.* That this compressible state of the diamond could not arise from the action of heat, is manifest from the nature and the recent formation of the soil in which it is found; that it could not exist in a mass formed by aqueous deposition, is still more obvious; and hence we are led to the conclusion, rendered probable by other analogies, that the *diamond* originates, like amber, from the consolidation of, perhaps, vegetable matter, which gradually acquires the crystalline form by the influence of time, and the slow action of corpuscular forces." This polarizing structure was found in flat diamonds regularly crystallized, and also in one of a perfectly octoëdral form.—*Edin. Phil. Journal.*

DOUBLE REFRACTION.

M. Soret has, in the *Journal de Physique* (xc. p. 353), given two simple methods of ascertaining the double refraction of mineral substances. The apparatus for the first method is simply two plates of tourmaline, cut parallel to the axes of the crystal, and placed crossways, so as to absorb all the light. The substance to be examined is to be placed between these plates: if it be doubly refractive, the light re-appears through the tourmalines: if not, all remains dark. The second method consists in placing the mineral to be examined over a hole in a card, and examining the light transmitted through it by an achromatic prism of Iceland spar. If the two images produced are coloured differently, it indicates double refraction.

BRITISH

BRITISH SILVER.

Tuesday the 10th October, a block of silver of the value of 1,500*l.* was smelted at Wheal Rose Mine, in Newlyn, the sole property of Sir C. Hawkins, Bart.

GEOLOGY.

Mr. Brongniart has discovered in the recent geological tour in Italy, that great part of the limestone of the Alps is of a much more modern formation than has been hitherto supposed.

M. Cuvier is preparing a new edition of his Fossil Animals, with many additions.

AGRICULTURE, &c.

M. Cadet de Vaux has lately recommended, as an important and useful innovation, the reaping of corn before it is perfectly ripe. This practice originated with M. Salles of the Agricultural Society of Beziers: grain thus reaped (say eight days before it is ripe) is fuller, larger, finer, and is never attacked by the weevil. This was proved by reaping one half of a piece of corn-field, as recommended, and leaving the other till the usual time. The early reaped portion gave a hectolitre of corn more, for half a hectar of land, than the later reaped. An equal quantity of flour from each was made into bread: that made from the corn reaped green gave seven pounds of bread more than the other, in six decalitres. The weevil attacked the ripe corn, but not the green. The proper time for reaping is when the grain, pressed between the fingers, has a doughy appearance, like crumb of bread just hot from the oven, when pressed in the same way.

Major General Beatson has proved, on a farm of 300 acres, at Knowle, Tunbridge Wells, since the year 1813, that by light or *shallow* ploughing, on a *stiff* soil, with *one* horse, without lime or dung, and without *fallow*, he can raise crops of wheat and other grain at the expense of 5*l.* an acre, equal or superior to the crops of his neighbours at an expense of 16*l.* an acre in lime, and labour of cattle.

It has long been believed that leaves of the elder-tree put into the subterraneous paths of moles, drive them away; but it is not so generally known, that if fruit-trees, flowering shrubs, corn or vegetables, be wiped with the green leaves of elder branches, insects will not attach to them. An infusion of elder leaves in water is good for sprinkling over rose-buds, and flowers subject to blights and the devastations of caterpillars.

If pieces of woollen rags be placed in currant-bushes or other shrubs, &c. it is found that the caterpillars uniformly take shelter under

under them in the night. By this means thousands of these leaf-devouring insects may be destroyed every morning, by removing these traps, with their tenants, at an early hour, and replacing the rags for the destruction of others.

Horse-dung, clay, sand, and pitch-tar form a composition, which, when applied to the trunks and stems of fruit-trees, after they are properly cleaned, prevents that spontaneous exudation called gumming, which is very injurious to the growth of trees.

Mr. Knight is of opinion, founded on actual experiment, that oak timber would be much improved, if the tree, after being barked in the spring, was permitted to stand till the following winter.

TO RESTORE THE WHITE IN PAINTINGS.

M. Thenard has applied his oxygenated water with great effect for this purpose. The whites are often rendered brown, or even black, where paintings are acted on by sulphurous vapours, especially by sulphurized hydrogen, which is very abundant in some situations. Recollecting that the oxygenated water converted black sulphuret of lead into a white sulphate, he furnished an artist, who wished to restore a design of Raphael's, with some of it. By applying it with a pencil the spots were instantly removed. *Annales de Chimie*, xiv.

THE DISCOVERY SHIPS.

Extract of a letter dated North-Shields, Oct. 2.

"Having had an interview with Captain Warham, of the British Queen whaler of this port, I am enabled to add his testimony to that of Mr. Fleming, in believing that if the discovery ships, under Captain Parry, are well, they must have effected a passage through what is termed the Hyperborean Ocean into the Pacific, and through Sir James Lancaster's-sound, Baffin's-bay, lat. 74½ N., long. 84½ W., or thereabouts. Mr. Warham has reason to believe Baffin's-bay is imperfectly known, and that Captain Ross's account is much too brief, he not having had time to explore it. After the British Queen had found her way through the ice in Davis's-straits, and found Disco Island, lat. 70½ N., long. 49 W., she went on to Woman's Isles, 73½ N., and nearly the same longitude; found a clear sea; sailed across Baffin's-bay for Lancaster-sound, and doubts the existence of James Island, at least it must be of inconsiderable size to that laid down on maps. He found Lancaster-sound, and sailed up it 20 miles, meeting a strong swell and wind from the N.W. The sound is about 20 miles broad, widening to the W.: bold high land. Not meeting with whales, and his voyage being to catch fish,

fish, he returned, and went to the southward, where he was more successful. On Sunday morning, the 6th of August, going under easy sail, about 60 miles to the S. of Lancaster-sound, he saw a considerable inlet, and a ship higher up in it: turning up the inlet, he was struck with sounds from the shore, which proved to be inhabitants making strange gestures and screams. He and part of the crew landed, and by courteous signs overcame their timidity, and were conducted by a male who had lost both feet, probably by the frost, and a female about 13 years of age, to their huts made of the skins of seal and deer. It was found that most of the population were absent on the hills hunting; only a few males, and some women, but a great number of children, being left. They seemed docile and hospitable, exchanging their skin jackets for those of the sailors, and stripping naked without the least hesitation, to put on the new dress. They seemed to pay some adoration to the Sun.

"The ship's company here caught some fish, and found reason to believe that the inlet communicated with Lancaster-sound. Captain Warham found the variation of the compass to be W. of the true N. about 100 degrees, and thinks the magnetic pole is somewhere there, as the dip is prodigious. The ships then stretched N.E. for Sir Thomas Smith's sound, in lat. 78½, long. 64., leaving Alderman Jones's sound on the larboard side: he made Hackluyt's Island 77½, long. 60., and completed his fishing near Cape Dudley Digges. Coming down Davis's-straits, and even to Cape Farewell, he fell in with ice, and many icebergs, having in snow-showers to thread his way through them; and finally passed the latter cape on the 3d Sept.

"Captain Warham is cautious of speaking of any thing but what he saw, is a good mathematician and astronomer, and quite fitted for active and intelligent observation."

ARCTIC EXPEDITION.

Lieutenant Frankland and his companions were left all well on the 30th June last, 700 miles up the country from Hudson's Bay. By the beginning of September they would, no doubt, arrive at the Copper-Mine River.

IRON BRIDGE OVER THE RIVER CHALMER.

This bridge, which does great credit to the architect Mr. Dodd, was opened for the public on Friday the 15th of Sept. 1820. It crosses the Chalmer in the county of Essex at Springfield, in the great east road leading from Chelmsford to Colchester, Harwich, to the counties of Suffolk and Norfolk. It is a beautiful structure, and differs from all the iron bridges hitherto erected, by requiring no buttresses, but resting on iron columns or standards driven into the banks of the river, having no lateral pressure, but merely resting on its supports.

 The

The method adopted in the erection of this bridge holds out great promise of economy in future bridge-building. No excavation required; no coffer dams; but merely the iron columns driven as far into the earth as they could be by a pile engine: they were then made the fulcrum of a lever loaded with three times the calculated weight of the bridge. The bridge is also so constructed as to require no spandrils—thus leaving the same altitude for the passage of vessels under every part of the span.

The principal strength and stability of this bridge is obtained by elliptical arcs and chords, kept so flat that the purposes of the truss girder are fully obtained, but with superior elegance and greater strength, and may be extended to an indefinite length.—Two of those cross the river, their extreme ends resting on the iron pillars driven in the river banks, and not projecting higher than the hand rail of the balustrades—with an extended chord from the two points of the basement, holding them together, and preventing their extending by pressure; to which elliptical arc-piece are attached or hung chords of suspension for supporting the bridge-flooring—these chords of suspension being flat, form stiles between pannels of tasteful Gothic work; the whole forming balustrades on each side the bridge. It being on the principles of tenacity, the chief part of the iron acts longitudinally by tension. There are grooves in the top of those iron columns, on which the whole bridge has room to contract or expand, so necessary in this climate from the various changes of the atmosphere from heat and cold, as the other previous iron bridges have suffered materially from the want of this precaution, and evidence has been given before the Parliament, that the Southwark bridge rises from 2 to $2\frac{1}{4}$ inches in the middle of the day, and settles again in the evening. By those iron columns in the river, instead of piers or buttresses, if they resist the floating ice, of which from their strength and stability there can be no doubt, Mr. Dodd, the engineer, has certainly introduced an economical plan in bridge-building, as in this there is no occasion for battred'eaux, coffer-dams, &c.; a saving most desirable in the expensive work of bridge-building—particularly so, as they are executed with such facility, and without the expense of centering, and upon this principle can be built to any order, instead of the fillagree patterns hitherto adopted.

CHAIN BRIDGE.

Capt. S. Brown, R.N., has completed the chain bridge over the Tweed. The breadth of the river is 437 feet; and the bridge crosses the whole in one stretch, without any middle support.

THE REGENT'S CANAL.

The magnitude of London, and the vastness of its population, might

might be inferred—were there no other means of calculating the extent of both—from the little communication that appears to exist between the remote extremities of it, and from the mutual ignorance which generally prevails, of whatever not immediately interesting is passing in its distant quarters.—Thus, numbers who live east of the Royal Exchange have never witnessed, and are almost unconscious of, the many extensive improvements that have within the last few years been made, and are daily making, in the vicinity of the two houses of parliament, in the neighbourhood of Pall Mall, and thence northward to the New Road and Regent's Park; while, among those who dwell in the more polite district of this widely-spread town, may be found thousands who have never seen the Mint, the New Custom House, and those useful and splendid monuments of national grandeur and wealth, the West and East India Docks.

We are led to these remarks by the recent opening of the Regent's Canal, which, occurring at a moment when the public mind was much agitated, was not noticed in a manner proportionate to either the enterprising spirit of the design, or the probable importance of its consequences. Here we have an instance of a great work going on for years upon the whole northern border of the Metropolis, but almost unknown, both in its origin and progress, to the majority of the people living in the southern division of the same town, which—supposing a line of separation to be drawn from Tyburn to Mile End—comprehends a full moiety of its inhabitants.

This Canal commences at Paddington, where it joins that branch of the Grand Junction which is called the Paddington Canal, and thus communicates with all the navigable rivers, &c. in England. From this point it proceeds in a N.E. direction, and passes, by means of a tunnel of 372 yards, under Maida-hill; then round the Regent's Park, through Camden-town (where it takes an easterly course) and Somers-town, near which it enters a second tunnel of 970 yards, and penetrates Islington-hill, burrowing below the bed of the New River. It emerges again near Brick-lane, and continues nearly in the same direction through the parishes of St. Leonard Shoreditch, and St. John's Hackney, traversing in these districts the Kingsland and Hackney-roads, and Cambridge-heath. Then entering the parish of Bethnal-green, it bends to the south, passing through the fields adjoining Mile-end and Stepney; and crossing both the latter places, as also the Commercial-road, it opens into a spacious dock formed at Limehouse, which completes the navigation by a direct communication with the Thames. The line of canal is nine miles, running chiefly from west to east, over which are thrown thirty-six substantial brick bridges; and it descends

 eighty-

eighty-six feet to the river by means of twelve double locks, besides a tide lock. Its average breadth is forty-eight feet, and the towing-path is twelve feet, which together occupy about eighty acres of ground; independently of the dock of six acres at Limehouse, and the City-road basin. The latter is a capital work, 110 feet wide, 1600 feet long, and with its commodious wharfs covers twenty-five acres. The Tunnel, of more than half a mile in length, which carries the canal *under a part of the town of Islington*, and also *beneath the New River*, is seventeen feet and a half in width, and nineteen and a half in height. Of the latter space, seven feet and a half are the depth of the water, and eleven feet and a half remain between the surface of the canal and the roof of the tunnel. It is passed, without any aid from towing-lines or poles, in from fifteen to seventeen minutes, and is well worth the notice of those whose laudable curiosity and desire of knowledge have never been gratified by an opportunity of seeing so striking a proof of the powers with which science has invested the civil engineer.

The Regent's Canal is one of the works for which the public are indebted to Mr. Nash, by whom it was originally projected, and under whose direction it has been carried on,—through a multitude of difficulties which could have been surmounted only by great ability, activity, and perseverance,—to its final completion. It was begun in 1813, and opened on the 1st of August last. The expense, which amounts to about 600,000*l.*, has been exceedingly swelled by the extravagant price at which the land required has been obliged to be purchased, and by the many litigious actions which the company of subscribers were called upon, during the progress of the work, to defend.

Upon the utility of the Canal system in general, it is needless now to expatiate: of the advantages that will flow from this in particular, time alone can enable us to judge with any degree of accuracy. When the enormous expense of carting heavy articles from the wharfs on the banks of the river to the northern side of the town, including the adjacent villages, is considered, it appears quite reasonable to believe that much must be gained by water carriage; for it is known that the power of one horse applied to a floating weight, is equal to the strength of thirty drawing the same on wheels. The average charge, as an example, for conveying manure by this Canal is tenpence per ton; gravel, chalk, lime, bricks, and iron, about one shilling; coals, lead, and copper, sixteen pence. To the inhabitants, therefore, of Hampstead, Kentish Town, Highgate, Hornsey, Tottenham, Hackney, &c. and also of the parishes of Marylebone and Paddington, this mode of communication with the Thames must prove highly beneficial. But the good effects that are likely to arise

arise from this navigation are not merely local :—The Messrs. Pickfords lately sent boats from Manchester, and instead of their passing from the Grand Junction to Brentford, and there being unloaded, and the goods re-embarked in other vessels for Deptford, they went direct by the canal to Limehouse, and crossed over without any delay; whereby not only time but a heavy expense, with probable loss and damage, were saved to the proprietors. The dock too at Limehouse, being calculated to receive ships of considerable burthen, admits colliers, which discharge their cargoes upon the wharfs, or into canal barges : and thus the plunder and waste of coal, which so notoriously take place in the Pool, are avoided, and many of those criminal acts, the list of which heretofore has been frightful, are prevented.

LIST OF PATENTS FOR NEW INVENTIONS.

To Robert Frith, of Salford, in the county of Lancaster, dyer, for improvements in the method of dyeing and printing various colours, so as to fix or make the same permanent or fast on cottons, linens, silks, mohair, worsted and woollens, straw, chip and Leghorn.—9th October 1820.—Six months allowed to enroll specification.

To William Harvey Belper, in the county of Derby, ropemaker, for certain improvements in the manufacture of ropes and belts, by machinery, and also improvements in the said machinery.—12th Oct.—2 months.

To Richard Witty, of the parish of Sculcoates, in the county of York, engineer, for certain improvements in pumps of various constructions for raising and conveying water and other liquids; and also methods of applying a certain principle or certain principles to ships' pumps, and for other useful purposes.—16th Oct. —6 months.

To William Acraman the younger, and Daniel Wade Acraman, both of the city of Bristol, iron manufacturers, for certain improvements in the process of forming the materials for the manufacturing chains and chain cables.—16th Oct.—6 months.

To James Richard Gilmour, of King-street, Borough of Southwark, and John Bold of Mill-Pond Bridge, both in the county of Surrey, printers, for certain improvements on printing presses.—20th Oct.—6 months.

To Thomas Prest, of Chigwell in the county of Essex, watch and time-piece maker, for a new and additional movement applied to a watch, to enable it to be wound up by the pendant knob without a detached key or winder.—20th Oct.—2 months.

To Joseph Main, of Bagnio-court, Newgate-street, in the city of London, esq. for certain improvements on wheeled carriages.—20th Oct.—6 months.

BARO-

BAROMETRIC OBSERVATIONS.

Leighton, 17 Oct. 1820.

DEAR SIR,—I send you the observations made at this place with a barometer on the principle of Sir H. Englefield's (No. 391), with the hope of inducing others of your correspondents to do the same, for the purpose of making out a table of the altitudes of different parts of the country. They are as follow:

1820. Oct. 10.	Bar.	Ther. attached.	Ther. detached.	Wind.
8^h A.M.	29·935	53	43	N.N.E.
9 —	29·928	$52\frac{1}{2}$	45	N.N.E.
10 —	29·925	53	$46\frac{1}{4}$	N.N.E.
11 —	29·918	$53\frac{1}{2}$	48	N.
12 —	29·910	$53\frac{3}{4}$	$48\frac{1}{4}$	N.N.E.

The height of the mercury in the basin of my barometer I consider (until corrected) to be $311\frac{1}{2}$ feet above the level of the sea: those persons who have made simultaneous observations will be able to calculate the height of their stations: and by a few repetitions of similar observations on the 10th of November and on the 11th of December next, an additional number of altitudes may be found. I beg leave to say, that when I sent you the general invitation to persons in possession of a good barometer, to make a course of hourly observations from 8 A.M. to 12, on the 10th day of each month, for the remainder of this year, (vide last No. p. 234,) I was not aware, until the paper was sent off, that the 10th of December would fall on a Sunday. I have therefore proposed Monday the 11th in its place; and if it should be thought worth the trouble of continuing the same kind of observations in the ensuing year, it may not be amiss to agree upon the *second Monday* in each month, for the day of making them, always observing the barometer at the commencement of each hour, from 8 to 12 inclusive.

By comparing the observations made at the same minute in different parts of the country for a few months, it may bring to light some new properties of the atmosphere not in general understood; it will afford some satisfactory information of the extent to which the equal pressure may in future be relied upon for distant barometrical measurements.

It will always be desirable to state the estimated or measured height of the barometer in relation to some fixed natural point in the neighbourhood, such as the surface of a meadow near a river, or the summit of some well defined hill, &c.

I am, dear sir, yours truly,

B. BEVAN.

METEORO-

METEOROLOGICAL JOURNAL KEPT AT BOSTON, LINCOLNSHIRE.

[The time of observation, unless otherwise stated, is at 1 P.M.]

1820.	Age of the Moon.	Thermometer.	Barometer.	State of the Weather and Modification of the Clouds.
	DAYS.			
Sept. 15	8	63·5	29·30	Cloudy—rain A.M.
16	9	60·5	29·60	Ditto
17	10	59·5	29·63	Ditto
18	11	54·	29·33	Ditto—rain all the morning
19	12	53·	29·70	Fine
20	13	53·	29·50	Cloudy
21	14	58·5	29·10	Rain
22	full	54·	29·60	Cloudy—rain P.M.
23	16	69·	29·60	Fine
24	17	67·5	29·30	Ditto
25	18	58·5	29·33	Ditto
26	19	53·	29·84	Cloudy
27	20	52·	29·84	Rain
28	21	58·5	29·80	Fine
29	22	58·	29·80	Ditto—rain A.M.
30	23	56·	29·83	Rain
Oct. 1	24	58·	29·90	Fine
2	25	58·	30·16	Ditto
3	26	56·	30·34	Ditto
4	27	56·	30·34	Cloudy
5	28	57·	30·10	Ditto
6	29	55·	30·	Ditto
7	new	58·	29·93	Ditto
8	1	56·	30·03	Fine
9	2	52·	30·04	Cloudy
10	3	52·	29·97	Ditto
11	4	51·5	29·76	Ditto
12	5	51·5	29·80	Fine
13	6	48·5	29·80	Cloudy
14	7	52·	29·40	Ditto

METEORO-

METEOROLOGICAL TABLE,

By Mr. Cary, of the Strand,

For October 1820.

Days of Month. 1820.	Thermometer. 8 o'Clock Morning.	Noon.	11 o'Clock Night.	Height of the Barom. Inches.	Weather.
Sept. 27	42	53	50	30·15	Showery
28	52	61	52	·16	Fair
29	51	58	50	·20	Fair
30	51	63	56	·15	Fair
Oct. 1	49	58	47	·30	Fair
2	48	57	49	·54	Fair
3	50	56	46	·68	Fair
4	45	55	49	·61	Fair
5	50	58	50	·40	Fair
6	50	58	49	·30	Fair
7	48	59	50	·28	Fair
8	50	57	49	·28	Cloudy
9	49	55	49	·33	Cloudy
10	47	51	48	·16	Cloudy
11	46	51	46	·09	Cloudy
12	43	51	43	·14	Fair
13	40	51	47	·05	Fair
14	46	52	53	29·65	Fair
15	60	62	51	·01	Stormy
16	47	52	50	·22	Showery
17	48	54	46	28·92	Fair
18	45	52	46	29·08	Fair
19	46	50	47	·44	Cloudy
20	44	52	46	28·99	Stormy
21	40	53	44	29·55	Fair
22	47	51	47	28·78	Stormy
23	46	53	45	29·24	Fair
24	46	47	46	28·73	Rain
25	47	52	44	29·23	Fair
26	42	52	49	·07	Rain

N.B. The Barometer's height is taken at one o'clock.

XLIX. *A Letter from Dr.* Hutton; *with Communications from the Marquis* De Laplace.

To Mr. Tilloch.

Sir, — In the Philosophical Magazine of February last, you were so obliging as to insert a note from me on the subject of my Calculations on the Density of the Earth; for I then apprehended that the credit of that operation had been transferred to others: and I scarcely need observe, that as honour is the chief reward of scientific labours, it was natural that I should feel some uneasiness on being unjustly deprived of what I conceived my right.

You also had the goodness at the same time to insert the copy of a letter on the same subject, which I had addressed to the *Marquis De Laplace*, under an idea that his Lordship had forgotten to acknowledge the receipt of that little communication. In this apprehension, however, I am happy to find that I was mistaken, as the delay arose, not from any neglect on his part, but rather from his attention to the subject, in preparing a profound and interesting paper on the earth's density, a copy of which he has transmitted to me, with the following very kind and obliging letter.

" *To Dr.* Hutton.

" Paris, Sept. 11, 1820.

" Sir,—I hope you will have the goodness to accept my excuse for not replying sooner to the letter with which you honoured me. I expected every day that the Tracts I am printing in the volumes of the *Connoissance des Tems* would give me an opportunity of inserting what you seemed to wish. But as this opportunity has not yet occurred, I have resolved to publish, for the express purpose, a Memoir on the Density of the Earth, in the volume of the *Connoissance des Tems* for 1823, which will soon appear. I have the honour to send you a copy of this paper. It is my wish that it may satisfy you; being very desirous to prove to you how much I esteem your talents, and honour your person. I thank you for the present you have been so good as to send me of the collection of your Tracts. I have been long acquainted with your profound researches, which secure to you a distinguished rank among geometricians, and which have long inspired me with a high esteem for you, the expression of which I beg you will accept.

" M. De Laplace."

 Although

Although it appears by the foregoing letter from the *Marquis De Laplace,* that his Memoir on the earth's density will shortly appear in the *Connoissance des Tems*, yet the learned world must be gratified with an earlier publication of it, especially in your valuable Magazine, which has so extensive a circulation; I therefore send you the following translation.

Your readers will observe, in the Memoir, that elegant simplicity and perspicuity for which all the other works of the learned author are distinguished. The tribute which he pays to our immortal countryman is as eloquent as it is true, and must be read with the deepest interest. No man more highly appreciates the discoveries of Sir Isaac Newton than the Marquis De Laplace, and no philosopher has better illustrated them. Thus the fame of Newton increases with the progress of science and of time, verifying the apposite quotation from *Cicero*, at the conclusion of the Memoir, which may be thus freely translated, "*Time, which obliterates fanciful theories, confirms decisions founded on nature.*"

On the Mean Density of the Earth. By M. De Laplace.

One of the most curious questions in geology, is the ratio of the mean density of the terrestrial spheroid to that of a known substance. Newton, in his Mathematical Principles of Natural Philosophy, gave the first idea ever published on this subject. This admirable work contains the elements of all the great discoveries that have been since made in the system of the universe. The history of their development by the successors of this great geometrician, would be at once the most useful commentary on his works, and the best guide to new discoveries. The following passage of his work, which relates to the subject in question, will be found in the different editions of that work:

"I thus assume; that the terrestrial globe is more dense than water; if it were entirely formed of it, all rarer bodies would rise and float on the surface,—their specific gravity being less. Thus, supposing the globe of the earth to be entirely covered by water; if it were more rare than the water, some part would discover itself, and the waters of the parts uncovered would collect in the opposite region. The same thing must take place as to our earth, which is in a great part covered by the ocean. If it were less dense than the water, it would rise on account of its lightness;—the waters flowing towards the opposite regions. For the same reason, the spots on the sun are lighter than the luminous matter in which they float; and in the formation of the planets, whatever it may have been, the most dense matter was carried towards the centre, when the whole mass was fluid.

Thus,

Thus, the super-stratum of the earth being about twice as dense as the water, and the sub-strata becoming, in proportion to their depth, three, four, and even five times more dense, it is probable that the whole mass of the earth is five or six times more dense than if it were formed of water."

The theories of the figure of the planets, and of the oscillations of the fluids that cover them, which have been considerably improved since the time of Newton, have confirmed the supposition. By this theory it appears that, for the stability of the equilibrium of the sea, its density must be less than the mean density of the earth, as I have shown in the fourth book of the *Mécanique Céleste.* Notwithstanding the irregularities of measured degrees of meridians, they indicate a less flattening at the poles, than that which agrees with the homogeneity of the earth; and the theory proves that this flattening requires, in the terrestrial strata, a density that increases from the surface to the centre. In like manner, the experiments of the pendulum, more exact and which agree better than the measurement of degrees, indicate an increase of gravity, from the equator to the poles, greater than in the case of its being homogeneous. A remarkable theorem at which I have arrived (tome ii. des *Nouveaux Mémoires de l' Académie des Sciences*) renders this result, independently of the continuous or discontinous figure of the terrestrial spheroid, of the irregularities of its surface, of the manner in which a great portion of it is covered by the sea, and of the density of this fluid.

If we imagine a very rare fluid to rise to a moderate height, and envelope the whole earth and its mountains, this fluid will assume a state of equilibrium; and I have shown in the volume above quoted, that the points of its exterior surface will be all equally raised above the sea. The interior points of the continents, lowered as much as those of the surface of the sea below the upper surfaces of the supposed fluid, form, by their continuity, what I call the *prolonged or extended level of the sea.* The height of a point of the continents, above this level, will be determined by the difference of the pressure of this fluid, at this point and at the level of the sea,—a difference that will be apparent by observations on the barometer;—for our atmosphere, if supposed to be reduced every where to its mean density, becomes the fluid we have just imagined.

This being admitted, let us conceive the earth to be some kind of an homogeneous spheroid, partly covered by the sea; and taking for unity, the length of the seconds pendulum, at the equator and at the level of the sea. If to the length of this pendulum, observed on any point of the surface of the spheroid, be added one-half of the height of this point above the level of the

 ocean,

ocean, divided by the semi-axis of the earth, the increase of this length thus corrected, from the equator to the poles, will be equal to the product of the square of the sine of the latitude by five-fourths of the ratio of the centrifugal force, to the gravity at the equator, or by forty-three ten-thousandths. The multiplied experiments of the pendulum, made in both hemispheres, and reduced to the level of the sea, agree in giving to the square of the sine of the latitude, a coefficient of more than forty-three ten-thousandths, and very nearly equal to fifty-four ten-thousandths. It is therefore fully proved by these experiments, that the earth is not homogeneous, and that the densities of its strata increase from the surface to the centre.

I have shown in the volume before quoted, that the lunar inequalities, owing to the flattening of the earth, and the phænomena of precession and nutation, lead to the same result, which can therefore admit of no doubt.

But all these phænomena, indicating a mean density of the earth, greater than that of water, yet they do not give the proportion of their densities; experiments on the attraction of bodies on the surface of the earth, can alone determine this proportion. In order to ascertain it, it was first attempted to measure the attraction of high mountains. This object particularly excited the attention of the French academicians who were sent to Peru to measure a degree of the meridian. This attraction may be observed either by the pendulum, the rate of which it increases, or by the deviation that it occasions in the direction of the plumb-line of astronomical instruments. Both these methods were employed at Peru. The result of the comparisons of the experiments made on the pendulum at Quito, and on the sea-shore, is that, by the action of the Cordilleras, the gravity at Quito is greater than it would be if only the elevation of Quito were considered; and this indicates a density in these mountains nearly equal to one-fifth of the mean density of the earth. The deviations of the plumb-line have given a result that differs a little. But our ignorance of the interior constitution of these mountains, the certainty that they are volcanic, joined to the uncertainty of the observations, do not admit of a positive decision on the true specific density of the earth. A mountain was therefore to be sought, of considerable size, and well known as to its interior constitution. Schihallien in Scotland seemed to unite these advantages. Dr. Maskelyne observed the deviation of the plumb-line by an astronomical instrument, on two opposite sides of the mountain, and found their sum equal to 11″6. But it was then necessary to ascertain the sum of the attractions of all the parts of the mountain, on the plumb-line, which required a delicate, long and troublesome calculation, and the

invention

invention of particular contrivances to simplify it, and to render it very correct. All this was executed in the most satisfactory manner by Dr. Hutton, an illustrious geometrician, to whom the mathematical sciences are indebted for numerous other important researches. His labours on the subject in question were rewarded by the Royal Society of London, who had appointed him to the undertaking. The result is, that the density of the earth is to that of the mountain, in the ratio of 9 to 5. In order to obtain the proportion between the density of the mountain and that of water, Mr. Playfair made a lithological examination of this mountain, and found it to be composed of rocks, the specific or relative density of which to that of water, varies from 2·5 to 3·2; and he judged that of the mountain to be between 2·7 and 2·8, which gives 5 very nearly as the mean specific density of the earth.

Mr. Michell, of the Royal Society of London, planned an apparatus calculated to measure the attraction of very small bodies, such as leaden spheres of one or two decimetres' radius; but he did not live long enough to put it in practice. This apparatus was transmitted to Mr. Cavendish, who made considerable alterations in it, to obviate all causes of error in the measurement of such slight attractions. The fundamental piece of the apparatus is the *balance detorsion*, which my learned colleague Coulomb invented and was the first to publish, and which he has so successfully applied to the measurement of electric and magnetic forces. Having examined with scrupulous attention the apparatus of Mr. Cavendish, and all his experiments, which are made with that precision and sagacity which distinguish this excellent philosopher, I see no objection to his result, which gives 5·48 for the mean density of the earth: it is the mean of 29 experiments, the extremes of which are 4·88 and 5·79. If to this result we apply the formulæ of my *Théorie Analytique des Probabilités*, it will be found that there is a very great probability that the error is very inconsiderable. Thus, according to these experiments, which are confirmed by the observations made on Mount Schihallien, we may consider the mean specific density of the earth as well known, and very nearly equal to 5·48, which confirms the supposition of Newton.

These experiments and observations evince the reciprocal attraction of the smallest particles of matter, in the ratio of their masses divided by the square of the distances. Newton had concluded it from the principle of the equality of action to reaction, and from his experiments on the weight of bodies, which he found, by the oscillations of the pendulum, to be in proportion to their mass. Notwithstanding this proof, Huyghens, who was better able than any other contemporary of Newton properly

to

to appreciate his merit, rejected this attraction of matter, of particles to particles, and admitted it only between the heavenly bodies; but under this latter view he rendered to the discoveries of Newton that justice which was due to them. In short, universal gravitation had not attained, for the contemporaries of Newton, or for Newton himself, all the certainty which the progress of the mathematical sciences, which are chiefly due to him, and the subsequent observations, have produced; and we may truly apply to this discovery, which is the greatest ever effected by the human mind, these words of Cicero: *Opinionum commenta delet dies, naturæ judicia confirmat.*

L. *On the Dry-Rot in Timber.* *By* T. H. Pasley, *Esq.**

The following principles, it is presumable, will elucidate wherein the cause and possible preventive of dry-rot in timber exist, in a more rational point of view than has hitherto appeared on this highly interesting subject. The millions which this species of expenditure draws from the public purse annually, make it an object of serious concern to all ranks in society, to assist in undermining the common enemy; and there is every prospect that much may yet be effected: the inquiry as hitherto, not being confined to mechanics, who have done but little towards removing the evil (the best constructed ships not being impervious to dry-rot), and less in discovering wherein the cause of the evil consists; as the subject, although not the most inviting of philosophy, is now acknowledged to be worthy the attention of the most enlightened chemists of the day.

First then, as respects the physical constitution of timber, it is the fact, that timber and all other ponderable bodies contain the element of flame in them, in quantity equal to the weight of each. Hence it is, that flame is obtained from all kinds of fuel. Chemical elements which are imponderable, and flame, which constitutes their ponderable base, are the only constituents of which all manner of terrestrial bodies are formed. As bodies part with the former, they suffer no change of weight; but flame is never evolved but what the body parting with it becomes lighter. As then the ponderable base of bodies consists of flame, all bodies without exception contain it, although it is not obtained from all with equal facility. As the ponderable base of wood, flame exists in that species of compound matter in as harmless a state as in inflammable gas, which may have been obtained from ice, or, which amounts to the same as thing, from the decomposed water of melted ice. In consequence of the *attractive powers of flame*

* Communicated by the Author.

it

it is, that flame is never naturally uncombined; that it recombines immediately when set free by art; and that it is always surrounded by one species of chemical elements or other, as is the case with a piece of wood or stone:—from a piece of wood take the chemical elements away, and flame only remains*.

These things being premised, dry-rotted wood manifestly presents the phænomenon of wood which has somehow been deprived of its gravitating base; or of so much internal flame, as equals the loss in weight which the wood has suffered. The strength only of the wood with the weight is gone; whereas what relates to form, bulk and grain, are in all other respects perfectly unaltered. The remaining timber, although it may be immense in volume, is comparatively devoid of all weight: and there is no kind of fuel whatever, it is well known, which yields less flame than dry-rotted wood. It may be concluded therefore, that the loss of the element of flame, which is the ponderable base, is the cause of the wood losing its strength and weight; *which constitutes the dry-rot.* The same thing happens also with other than woody substances. The human body, upon opening sepulchres, is found to consist of an impalpable powder only, which retains the original form of the body, but drops upon the admission of air, or on the slightest touch, and might with ease be compressed into a nut-shell.

The PROCESS which brings this state of the wood or timber about, is connected with principles which show, *that a species of galvanic circulation takes place* between the wood and the medium of air by which it is surrounded; or between the wood and the solid body with which the wood may be in contact.

It is the admitted fact, that without humidity in the wood, there is no dry-rot to be apprehended; neither is there any circulation in the galvanic pile, when dryness prevails. Two pieces of wood in the closest contact, induce no circulation through them, if both or either of them remain perfectly dry: nor does a dry piece of wood give out its gravitating base, when in contact with a humid piece, unless it receives humidity from the latter. Hence it is, that sound and rotted wood are found united; and that wood which has been considered impervious to dry-rot, has fallen a sudden martyr to it, by being in contact with wood of a different kind, or in a different state.

Different kinds of wood in close contact, and containing moisture, are more likely to act on each other, and with greater energy, after the manner of the galvanic plates, than pieces of the same species: still, as no two pieces of wood are perfectly alike, where there are moisture and contact, galvanic, or, in this

* See Treatise on Heat, Flame, and Combustion: by T. H. P. Sold by Baldwin, Cradock, and Joy.

case

case it may be said, *dry-rot circulation* inevitably takes place between them. Humidity or moisture acts, by assimilating the particles of its *gravitating* base, with those of the gravitating base of the wood; so that when the external air is of such a nature as to attract any of these particles, or to attract any element to which they may be united, the wood and water together part with their common gravitating element. The consequence of which is, that the water being decomposed disappears, and the wood has lost its ponderable base. Hence it is obvious, how it is that water is indispensable to promote dry-rot; why its decomposition is to be guarded against; and why wood, when dry-rotted, is always perfectly free from water, and also devoid of weight.

The medium of air, which surrounds wood wholly or in part, is as much accessary to dry-rot circulation, as it is to that of the galvanic pile. In the latter case, chemical elements are alone given off, and oxygen gas promotes the circulation: whereas with wood, the air in which oxygen is deficient favours circulation best; and it likewise is the contrary or ponderable base only which escapes. The medium of air which makes *fungi* shoot, cannot but be the means of exciting dry-rot circulation: sometimes, (as the formation of *fungi* depends on the nature of the juices of the wood,) these formations may contribute to the rot by assisting circulation at its commencement: but without *fungus* appearing at all times or being any way indispensable, dry-rot circulation may take place.

The PREVENTIVE to dry-rot circulation, it follows, consists in *insulating every piece of timber*, or surrounding it like a gate-post, with a medium similar to atmospheric air; or by both applications, according to the situation of the piece. In general, those parts only of the surfaces of the wood which are in contact, and those which are in contact with confined air, are such as have the rot, and for limited distances; which show the mutual action which prevails, where it originates, and the direction it takes; also the medium which favours the circulation, and that which does not excite it. Every piece of timber should be insulated from another, by means of *some non-attracting* disc being fixed between. No single or insulated piece will ever be found capable of galvanising itself. The insulating matter should be such as cannot be readily removed or rubbed away, as is the case with unctuous substances. Wherever confined air may have opportunity to remain, it should be kept out; as we find light wainscots rot on the wall side, having confined air or air deficient of oxygen between: whereas in buildings, all kinds of wood-work are preserved, that are deprived of this deleterious medium by being imbedded in mortar. For which reason, the recent

Mr. J. Malam's Improved Gas Meter.

Fig 2

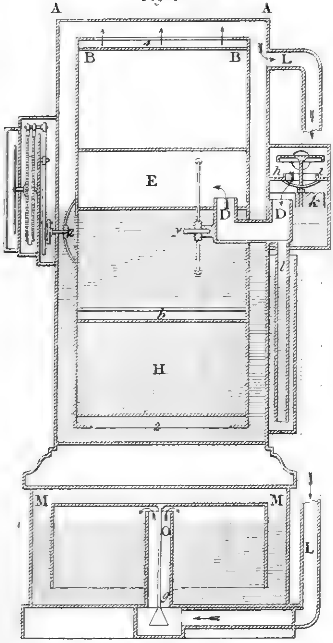


Fig 3.

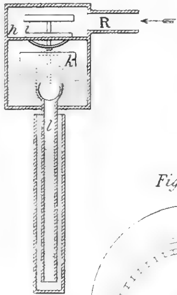


Fig. 7.

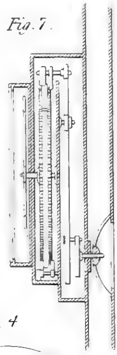


Fig. 4

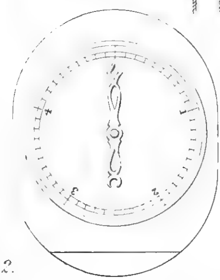


Fig. 2.

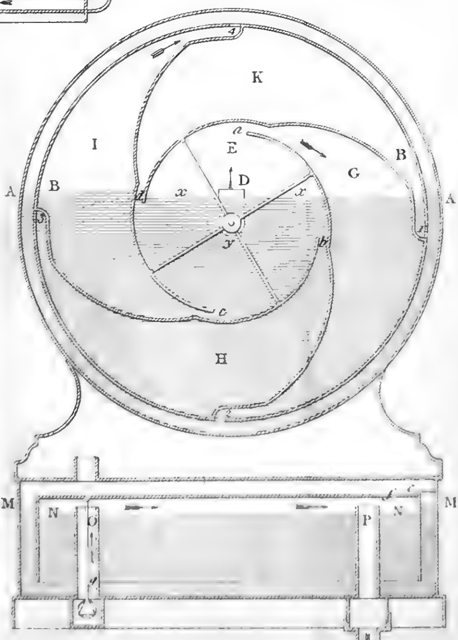


Fig. 5.

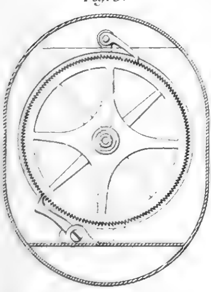
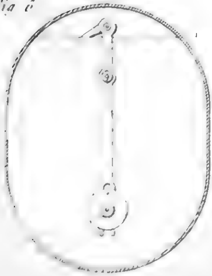


Fig. 6



case it
between
particles
of the
as to at
which t
with th
which i
wood h
is that
compos
rotted,
weight.

The
is as m
galvani
given
with w
tion bes
which
cannot
times,
juices o
by assi
fungus
dry-rot

The
insulat
post, w
plicatio
those p
and the
have th
action
takes;
which
sulated
ing fixe
found c
be such
case w
have op
light w
deficien
wood-w
medium

recent experiment of applying solidifying substances in openings will doubtless be found highly beneficial. These regulations it is manifest are unnecessary, if water can be kept out of wood, or preserved when in it, in the compound state. The cause and preventive in the *dry way* having been pointed out, it may be possible also to arrive at the same object, the retention of the gravitating base, by the *humid way*, and upon principles which are common to both.

Cheap acids might be injected into wood, for the purpose of keeping all internal juices proof against being decomposed. The manner is simply this:—As *fire attracts*, boiled wood is necessarily rendered in a minus or deficient state, by the act of boiling. In that deficient or spongy state, it should be thrown *from the hot boiling kiln into the cold preserving mixture*, in order to absorb *indecomposable* moisture; which in time, by combining with the wood, would contribute to its strength, so far as to prevent the premature loss of the gravitating base, which is always at the expense of the strength of that which it parts from.

Lastly, to preserve a proper medium next the timbers, between the lower decks, and to keep away one which is conducive to dry-rot circulation, there can be nothing better done, than to introduce as a permanent fixture, a condensing pump into each ship's hold, for the purpose of getting rid of heavy foul air downwards, through the ship's bottom. Air in this situation is to atmospheric air, as 1·5 to 1 in weight: therefore pure air, introduced by wind-sails and the like, may dilute, but cannot remove this species of deleterious air out of a ship. To pump it downwards, and after the manner a double levered fire-engine is worked, must necessarily get rid of all impure air, from every hole and opening in the orlop, as well as from every sick birth, to which the suction hose, which may be of any length, may be introduced; and pure air must instantly occupy the place of that which has been pumped out. The resistance to be overcome, in all cases, will be precisely that of a column of water, equal in height to the ship's draught at the time, which can never be more than equal to one-fourth the resistance which a fire-engine surmounts, when it throws water only one hundred feet in the air. So that there is nothing more practicable; and as conducing to the health of the crew, and the ship's durability, the benefit may be infinite, and the expense saved annually of the most serious amount.

Dry-rot and combustion appear to be precisely the converse of each other. In the former, it is the flame or ponderable base which is attracted, and what is chemical alone is left: whereas in combustion, flame only is left, every thing chemical being attracted from it. That which attracts flame from wood, combines with it at the time, which is the reason of its escape in the dry-rot process being unattended with luminousness.

From the opinions in circulation on this subject, which puzzle rather than improve, I feel the more anxious to give publicity to the foregoing, being persuaded that they have a more direct tendency to prevent the dry-rot, than any which have hitherto been advanced or acted on. Besides, it is no more than laudable to maintain one's own right of originality to what may prove highly correct and useful, at a time when honours and medals are awarded those, who, after all, have done nothing for the public, but overload them with expensive and voluminous accounts transcribed from official records. What I now advance is in strict conformity with the theory I published in February, 1815, wherein the dry-rot is attributed to the decomposition of water in wood: at which time it was the general opinion, at least here, that it arose from a *fungus*, and that *fungus* from a seed.

Chatham Dock-Yard, Sept. 15, 1820. T. H. Pasley.

LI. *On some Combinations of Platinum. By* Edmund Davy, *Esq. Professor of Chemistry, and Secretary to the Cork Institution. Communicated by* F. Babington, *M.D. F.R.S.**

In my communication to Sir H. Davy, Bart., "On a new fulminating platinum," which has been honoured with a place in the Transactions of the Royal Society†, I stated, that I had obtained some other new compounds of this metal: these have since occupied no inconsiderable portion of my leisure hours, and I now beg leave to lay the results of my inquiry before the Royal Society. A constant attention to other necessary duties, has not allowed me sufficient time to render this investigation so complete as I could have wished; but as I presume the facts are novel, I shall venture to bring them forward in a form, which, though imperfect, may not be wholly destitute of interest.

I. *On a peculiar Compound of Platinum obtained from Sulphate of Platinum by the Agency of Alcohol.*

Sulphate of platinum, unlike the other metallic sulphates in general, is, to a considerable extent, soluble in alcohol and in ether: as these fluids are capable, in certain circumstances, of partially or wholly reviving some metallic oxides from their solutions in acids, I wished to try their effects on the sulphate of platinum. Accordingly, I put into a small phial about equal

* From the Philosophical Transactions for 1820, Part I.

† Phil. Trans. 1817.—Phil. Mag. for Feb. 1817, p. 146.

volumes

volumes of a strong aqueous solution of the sulphate, and alcohol; and, after agitating the mixed fluids, the phial was put aside. Some weeks afterwards, I found the dark colour of the sulphate had entirely disappeared, a dense black substance had subsided, and the supernatant fluid remained colourless and transparent. On opening the phial, an odour similar to that of ether was perceived, the fluid had a strong acid taste, and afforded a copious precipitate with nitrate of barytes. After the black substance had been well washed and dried, a few preliminary experiments served to show that it was a peculiar compound which had not been noticed. To confirm these results, and procure more of the substance, I repeated the experiment with the sulphate and alcohol. In about two days the fluid assumed a darker tint, the black substance began to precipitate in a finely divided state, and in about a week it had all subsided, leaving the fluid colourless and transparent. I afterwards found that the substance in question may be readily obtained by boiling the sulphate and alcohol * together for a few minutes; it separates in small particles, leaving the supernatant fluid colourless, or with only a slight tinge of yellow. In cases when it is thus procured, a little volatile inflammable fluid, having a peculiar ethereal smell, is also obtained. The substance, after being washed till the water is tasteless and does not affect litmus paper, and dried at a temperature of about 250° Fahrenheit, exhibits the following properties.

2. *Properties of the peculiar Compound.*

The substance is of a black colour, and in small lumps, which are soft to the touch, and easily reduced to an impalpable powder. It readily soils the fingers, or paper. It is destitute of lustre. It is tasteless, and apparently unaffected either by cold or hot water. It has a peculiar ethereal smell that is not easily removed, and probably arises from the presence of a little inflammable matter occasioned by the action of the alcohol. It seems to undergo no change by exposure to the air for some time. When it is gently heated, on a slip of platinum or paper, a hissing noise or a feeble explosion is produced, and this effect is accompanied by a flash of red light, and the platinum is reduced. It is insoluble in nitrous, sulphuric, and phosphoric acids; but it dissolves slowly in muriatic acid. It is scarcely affected by chlorine, except moisture be present, when a little muriate is gradually formed. When the powder is put into liquid ammonia, minute globules of air are evolved from it, and

* The alcohol used in this experiment may vary considerably in its strength and quantity, without materially affecting the results. Ether may also be employed as a substitute for alcohol.

after some time it acquires fulminating properties. The quantity of air I have hitherto obtained in this way, has been too small to allow me to ascertain its nature with precision. When the powder is brought in contact with ammoniacal gas, a crackling noise is produced, and it becomes red hot and scintillates; but by this treatment its external appearance is scarcely altered, though it undergoes a partial decomposition. The powder is immediately decomposed by the agency of alcohol. This fact is shown in an interesting manner by moistening different substances, such as paper, sand, cork, &c. with alcohol, and placing the smallest particle of the powder on them; it hisses, a sufficient degree of heat is produced to reduce and ignite the platinum, and it remains in a state of ignition until the alcohol is consumed. During the agency of alcohol on the powder, acetic acid is produced. This is shown by putting a little of the powder on a paper filter and moistening it with alcohol; a moderate action takes place, and in a few minutes the odour of acetic acid is very perceptible. In some experiments of this kind, the action, though comparatively feeble at first, has presently increased, the powder has become red hot, and the bottom of the filter completely charred. If two or three grains of the powder are placed in a glass, and a few drops of alcohol added, in about half an hour acetic acid will be produced; and as it evaporates and disappears, it may be successively renewed, at longer or shorter intervals, for some weeks, by occasionally adding a little alcohol.

When the powder is boiled in alcohol, it is partially decomposed, and assumes a lighter colour; if it be then thrown on a filter, the odour of acetic acid is soon perceived, and in a few hours the platinum is found reduced and the paper charred. When the powder is mixed with flowers of sulphur, and heated, a sulphuret of platinum is formed of a blue colour. When the powder is heated with phosphorus, there is a brilliant combustion, and a dark-grey phosphoret is formed. Oxygen gas does not affect the powder at the common temperature of the air; but by a moderate heat there is a slight combustion, which seems to indicate the presence of a little inflammable matter.

3. *Composition of the peculiar Compound.*

In my first attempts to ascertain the nature of the black powder, I was limited to very minute quantities of it; and I made several trials before I gained any satisfactory evidences of its constitution. I decomposed the powder in long green glass tubes filled with mercury; in such cases, by a gentle heat, the powder became ignited, the reduced platinum amalgamated with the mercury, a little fluid appeared, and some gas was evolved. The

fluid

fluid reddened litmus, and had an acid taste. The gas rendered lime-water turbid, and was in part absorbed by water and by ammonia; and the unabsorbed portion exhibited properties similar to those of nitrogen. These results seemed to prove, that the powder contained acid and inflammable matter; but they were not sufficiently uniform to enable me to place much reliance on them. I then used very small glass retorts, varying in capacity from $\frac{4}{10}$ to $\frac{7}{10}$ of a cubic inch, and decomposed the powder over pure water and over mercury; but the results were most satisfactory when I operated over mercury. From two experiments of this kind, which I beg briefly to detail, as they very nearly agree, I think I may venture to state the composition of the powder under examination.

Experiment 1. Ten grains of the powder were decomposed in a little retort, over dry mercury, by the heat of a spirit lamp. On the first impression of the heat, gas was disengaged, and shortly after, the interior of the retort assumed a reddish yellow colour (like that exhibited by the vapour of fuming nitrous acid), and small drops of a colourless fluid condensed in the neck of the retort. After the utmost heat of the lamp had been given to the retort, it was suffered to cool, and the results were immediately examined.

(*a*) *Examination of the Gas.*

The gas remaining in the retort made an ignited piece of wood glow brighter; that which came over (deducting the common air) was $\frac{34}{100}$ of a cubic inch, which diminished to $\frac{25}{100}$ on being transferred to water and agitated. $\frac{20}{100}$ of the unabsorbed gas, on being mixed with an equal volume of pure hydrogen, and fired by an electric spark, diminished to $\frac{26}{100}$. Hence, the unabsorbed portion of gas contained more oxygen than could have been furnished from the common air of the retort.

From other experiments, the gas absorbed by water was found to be carbonic acid; it rendered lime-water turbid, was absorbed by ammonia, and again disengaged by muriatic acid.

(*b*) *Examination of the Fluid.*

The fluid which rose in the neck of the retort reddened litmus paper, and resembled the nitrous acid in odour, colour, and taste. It acted upon the mercury in contact with the retort, and when washed out by pure water, the solution did not affect the nitrate of barytes, or silver.

(*c*) The platinum was perfectly reduced, and its particles formed a loosely coherent mass, which could not be removed until the bulb of the retort was broken. It weighed $9\frac{5}{8}$ grains, and suffered no diminution on being again heated to redness in a platinum cup.

Experi-

Experiment 2. Ten grains of the same powder as that used in the first experiment, afforded by its decomposition $9\frac{5}{8}$ grains of platinum, a little fluid agreeing in its properties with that noticed in the former experiment, and $\frac{34}{100}$ of gas, which was examined in a different manner from that of Experiment 1. The gas remaining in the retort was treated with pure nitrous gas; red fumes were produced, and the absorption was so great that the mercury presently rose near the bulb of the retort, and was still rising, when its neck was intentionally broken to secure the platinum. Hence it seems the gas in the retort was oxygen.

The gas that came over was first treated with lime-water; an immediate turbidness was produced, and increased by agitation, and $\frac{9}{100}$ of the gas were absorbed. To the residual gas nitrous gas was added, which occasioned a considerable absorption; and the remaining gas, which exhibited the properties of nitrogen, was principally derived from the common air of the retort. By adding a little diluted muriatic acid to the turbid fluid, it immediately became transparent, and the absorbed carbonic acid was slowly disengaged, and the mercury was studded with innumerable little globules of it.

From these experiments, 100 grains of the black powder appear to contain 96·25 platinum.

96·25	platinum.
3·75	nitrous acid, a little oxygen, and a minute portion of carbon.
100·00	

Though the powder was dried at a heat considerably above 212°, it may contain water; and if this is the case, its composition may be differently stated, as deduced from the foregoing experiments:

96·2500	platinum.
0·1200	oxygen.
0·0106	carbon.
3·6194	nitrous acid and water.
100·0000	

4. *Observations, &c. on the peculiar Compound.*

From the preceding experiments, the black powder obtained by the agency of alcohol on the sulphate of platinum, appears to consist almost solely of platinum, with a little oxygen, and the elements of the nitrous acid. The very minute portion of carbonaceous matter it contains is probably accidental. If the constitution of the powder is such as I have stated, a doubt may arise whether it can be considered as a definite compound; but its solubility in the muriatic acid, the facility with which it combines with sulphur, and resists the action of a strong solution of potash at a boiling heat, and its acquiring fulminating properties in liquid ammonia, are all circumstances which favour the notion of of its being a true chemical compound. It seems rather doubtful, whether the powder can be regarded as a sub-nitrate of platinum, or a combination of platinum with oxygen and nitrogen, in a different state from that in which they co-exist in the nitrous acid. On the idea that the powder is a compound of the metal with a little oxygen and nitrous acid, something may be said on the mode of its formation, and on the more remarkable properties it exhibits.

From the manner in which the sulphate of platinum is formed (namely, by the agency of nitrous acid on the hydro-sulphuret of platinum), there can be no difficulty in accounting for the presence of a small portion of nitrous acid in it; and my experiments incline me to the opinion, that it is scarcely possible to separate the last portions of nitrous acid from the sulphate, without entirely decomposing it. That the quantity of nitrous acid in the sulphate must, however, be very limited, appears from this circumstance, that the addition of a little nitrous acid to the sulphate, entirely prevents the formation of the black powder, though successive portions of alcohol be added, and the whole boiled for a considerable time.

When sulphate of platinum, containing a little nitrous acid, is treated with alcohol, a mutual action takes place; slowly at the common temperature of the air; but rapidly by the assistance of heat: the sulphuric acid being united to the oxide of platinum by a weak affinity, seems to form a new combination with the alcohol, whilst the oxide combines with the portion of nitrous acid present, to form the black powder. In certain cases, as is well known, alcohol separates salts from their aqueous solutions, in consequence of a stronger affinity for the water in which they are dissolved; but in this instance, the agencies of alcohol and of nitrous acid are probably concerned in separating the sulphuric acid from the sulphate.

The vivid action of ammoniacal gas on the powder may be referred to the mutual energy with which the alkaline gas, and loosely combined nitrous acid in the powder, act upon each other. I found by experiment, that ammoniacal gas is absorbed in this instance: thus, three grains of the powder were placed in a graduated glass receiver, and filled with dry mercury. 2·3 cubic inches of ammoniacal gas, containing only $\frac{1}{100}$ impurity, were let up into the receiver: an immediate action took place, the powder became ignited, and after two hours $\frac{3}{10}$ of a cubic inch of the gas were absorbed: recently boiled pure water, whilst yet hot, was let up into the receiver, and the residual gas was all absorbed, except a small globule, which did not exceed the original impurity in the ammonia.

The action of alcohol on the powder is curious, and is connected

nected with the decomposition of both substances. When the powder is brought in contact with the vapour of alcohol, at the common temperature of the air, there is an immediate chemical action; the heat generated is sufficient to reduce and ignite the metal, and to continue it in a state of ignition, until the alcohol is consumed. In this case, the acid first noticed by Sir H. Davy (in his beautiful experiment of the ignited platinum wire, and since, more fully examined by Mr. Daniell) is produced. In other instances, the acetic acid, as has been mentioned, is formed. It would be premature to speculate on the uses to which this powder may be applied; but, from its peculiar properties, there is reason to think it will admit of some useful applications. I have already employed it as an easy means of affording heat and light. To produce heat, it is only necessary to moisten any porous substance, such as sponge, cork, cotton, asbestos, sand, &c. with alcohol or whiskey, and to let a particle of the powder fall on the substance so moistened; it instantly becomes red hot, and remains so until the spirit is consumed; nor is the ignited metal extinguished by exposure to the atmosphere, or by blowing the breath on it; on the contrary, partial currents of air only make it glow brighter. The heat produced in this way may be accumulated to a considerable extent, by increasing the quantity of the materials employed. I have also constructed a tinder-box, to procure immediate light by means of the powder. It consists of two small phials placed in a japanned box, and some sulphur matches tipped with phosphorus. One of the phials contains the powder; the other, alcohol. The stopper of the phial containing the alcohol, has a bit of sponge inserted in a small aperture at the bottom of it. When a light is wanted, it is only necessary to shake the bottle so as to moisten the sponge with the alcohol, take out the stopper, and put the smallest particle of the powder on the moistened sponge; it instantly becomes red hot, and will readily kindle one of the matches. This mode of igniting a metal seems to be quite a new fact in the history of chemistry; but the means of keeping it in a state of ignition is only another illustration of the facts previously pointed out by Sir H. Davy in his late valuable researches, which have thrown so much light on the philosophy of flame, and led to such very interesting, important, and unexpected results.

5. *On the Effects of Sulphate of Platinum upon Gelatine.*

When an aqueous solution of sulphate of platinum is added to any solution of gelatine, such as isinglass, size, or glue, a precipitate occurs, and all the sulphate is separated in union with the gelatine; or, if a minute portion remain, it is precipitated on boiling the fluid. This precipitate, whilst in a moist state, is of a brown a brown colour, and has some degree of tenacity; but when well washed and dried at a temperature a little above the boiling point of water, its colour changes to a jet black; it becomes hard and brittle, and has a resinous lustre. It is not decomposed by being boiled in water or in weak alkaline solutions. When it is gently heated by a spirit-lamp on a slip of platinum, a violent action is produced, and a dense white vapour is exhaled, in which the odour of sulphureous acid is pêrceptible, the substance becomes ignited, and is presently decomposed, leaving the reduced platinum in small grains.

When this compound is decomposed by heat in close vessels over water or mercury, it yields a gray sulphuret of platinum *, nitrogen, sulphureous, carburetted hydrogen and carbonic acid gases, carbonate of ammonia, and an oily-like fluid. This compound of sulphate of platinum and gelatine, when dried at a heat just above that of boiling water, afforded, by its decomposition in two experiments, half its weight of platinum; and if my former statement of the composition of sulphate of platinum is correct, 100 grains of the above compound will consist of about

56·11	oxide of platinum,
20·02	sulphuric acid,
23·87	gelatine and water.
100·00	

6. *On the Sulphate of Platinum, as a Test for Gelatine.*

As I found that minute quantities of gelatine in solution were readily detected by the sulphate of platinum, I made some experiments to ascertain the efficacy of this substance as a test for gelatine, and I am inclined to think it merits a decided preference over the reagents at present used by chemists for this purpose. The best known substances for detecting the presence of gelatine are, I presume, those which contain the tanning principle, as the infusions of oak-bark, nutgalls, catechu, &c. And a variety of gelatine, isinglass, (as is well known,) is employed to ascertain the quantity of tanning principle in different astringent substances; but for this purpose, as Sir H. Davy has shown †, many precautions are necessary; and from his experiments it appears that tannin may exist in a state of combination, in which its presence cannot be made evident by means of a solution of gelatine. I have made several comparative experiments on the efficacy of those astringent infusions, and of the sulphate of platinum,

* In the *Annales de Chimie*, &c. tome v., M. Vauquelin treats of the sulphuret of platinum as a new compound which he had formed; but I published an account of it in the Philosophical Magazine in the year 1812.

† Phil. Trans. 1803.—Phil. Mag. vol. xvi. No. 61. p. 82.

tinum, as tests for gelatine; and I think I may venture to conclude, that the sulphate is a test of superior delicacy, and more certain in its operation. Thus, in cases where the gelatine was in very minute quantity, or in a very diluted state, when no effect was produced by strong infusions of oak-bark, nutgalls, or catechu, there was an immediate precipitate on adding sulphate of platinum. In instances also, when the quantity of gelatine was too minute to be readily detected by simply adding the sulphate, the effect was immediately produced on boiling the fluid.

The effects of sulphate of platinum on solutions of the different varieties of gelatine, as isinglass, glue, and size, appear to be precisely similar, and the precipitates obtained in such cases seem to be uniform in their properties and composition; nor are they affected by the presence of any of the mineral acids in excess. The operation of astringent infusions, as oak-bark, nutgalls, and catechu, on solutions of the different varieties of gelatine, is not uniform. According to Sir H. Davy, catechu contains a much larger quantity of the tanning principle than oak-bark; yet I found that an infusion of it produced no precipitate in solutions of size, of different degrees of concentration. The size I employed was such as paper-hangers use; it had been recently prepared, and was, previous to its being dissolved in water, in the form of a tremulous jelly. The sulphate of platinum occasions, after a short time, a brown precipitate in astringent infusions; but this substance I have not examined.

7. *On a gray Oxide of Platinum.*

In the course of my experiments to ascertain the composition of fulminating platinum, I treated it with nitrous acid, and thus procured, as I have elsewhere stated, a gray oxide of platinum, which has not yet been described. It may be obtained by adding strong nitrous acid to fulminating platinum, boiling it to dryness, and exposing the dry mass to a heat just below redness, so as to expel all the nitrous acid. The oxide of platinum remains. It is to be finely pulverized, and boiled, first in pure water, and then in a weak solution of caustic alkali to separate the last portions of acid, which adhere with great tenacity to it. It is now to be well washed, and dried at a heat not exceeding that of boiling mercury. I have usually made the experiment in a platinum crucible on a hot sand-bath. The oxide thus prepared exhibits the following properties.

8. *Properties and Composition of the gray Oxide of Platinum.*

Its colour is dark iron gray. It has the metallic lustre. It is sufficiently hard to cut brass, which it polishes, and when the polished surface is rubbed a little with the oxide, a delicate coating

ing of platinum remains. It does not touch steel. It is not affected by cold or hot water, nor by the nitrous, sulphuric, or phosphoric acid at a boiling heat. It is insoluble in nitro-muriatic acid, and in cold muriatic acid; but it slowly dissolves in this last acid by the assistance of heat. It is not acted upon by a strong solution of the fixed alkalies. When the oxide is put into liquid ammonia, minute globules of air are evolved from it, but the quantity has been too small to admit of being examined; probably it is common air, as the oxide appears to undergo no change by being kept for some weeks in ammonia. When heated with sulphur, the oxide yields sulphureous acid gas and a gray sulphuret of platinum. When mixed with zinc filings and heated, the oxide is decomposed with vivid ignition, and white oxide of zinc is formed.

When the oxide is mixed with borax, and exposed to a strong red heat before the blowpipe, it forms a black glass, which becomes of a lighter colour on urging the heat to whiteness, and the oxide appears to be reduced. If the oxide is mixed with powdered glass and fused, a glass is obtained of a dull brown colour. The oxide is readily reduced by moistening it with oil of turpentine, and heating it moderately; or by exposing it to a dull red heat in the atmosphere; but it requires a strong red heat to reduce it in close vessels. Some of the oxide which had been well dried, first on a hot sand-bath, and then exposed to a heat just below redness, on a slip of platinum, was decomposed in very small green glass retorts, over mercury. In two experiments in which I used seven grains of the oxide, I obtained in each instance six grains of platinum, and 2·1 cubic inches of oxygen, the thermometer being at 60° and barometer 30°. I found also in the necks of the retorts, a slight trace of a fluid that reddened litmus paper, and had an odour similar to that of nitrous acid. Now, if six grains of platinum combine with 2·1 cubic inches of oxygen, 100 grains will take 34 cubic inches; and calculating from Sir H. Davy's statement, that 100 cubic inches of oxygen weigh 34 grains, the gray oxide of platinum will be found to consist of

100 platinum,	} or per cent., of	89·366	platinum,
11·9 oxygen,		10·634	oxygen.
——		——	
		100·000	

It will be readily seen, that I have here deduced the composition of the gray oxide from the actual quantity of oxygen and metal obtained in the experiments; and this mode of analysis seems liable to little objection, and can very rarely be resorted to, in ascertaining the composition of metallic oxides. On comparing my previous experiments upon the gray oxide, with the

 above

above results, I am most inclined to place confidence in the latter. There is, indeed, a near coincidence between them, and the difference, which is only about one per cent., may be referred to the presence of a little more acid in my first experiments. The gray oxide is insoluble in aqua regia, a fact which seems to add additional support to Sir H. Davy's opinion respecting the action of aqua regia on platinum*. This menstruum, according to Sir H. Davy, does not oxidate platinum, but merely causes its combination with chlorine. Now, if the metal were oxidated previous to its solution, the oxygen, there is reason to think, would be derived from the nitrous acid, and the gray oxide formed by this acid be produced, which can scarcely be the case, as it is insoluble in aqua regia. Add to this, the fact, that by evaporating a common solution of platinum to dryness, no nitrate can be obtained, but only a muriate, or a compound of the metal and chlorine.

If, according to the statements of Professors Vauquelin and Berzelius, the black oxide of platinum contains about 15 per cent. of oxygen, the gray oxide may be considered as the protoxide, containing one proportion, and the black oxide one and a half proportion of oxygen; and the number representing the element or proportion in which platinum combines with bodies will be 126, taking Sir H. Davy's number 15, to represent the proportion in which oxygen unites with bodies.

Mr. Cooper states the black oxide of platinum to consist of 100 platinum, with only 4·317 of oxygen †; but he has, I think, considerably under-rated the oxygen in it. On repeating his experiments on a small scale, I obtained results different from those he has stated. Thus, he says the powder obtained from the muriate of platinum by a neutral solution of mercury, is a compound of calomel and the protoxide of platinum; but by decomposing this powder in a little retort over mercury, I found the neck of the retort partially lined with metallic mercury; and this fact alone, I think, is sufficient to awaken suspicion as to the accuracy of his results. Mr. Cooper, I presume, used a nitrate of mercury to decompose the muriate of platinum, but he seems to have overlooked the nitrous acid in stating his results.

The chemical history of platinum is far from being complete. The great want of uniformity in the statements of chemists respecting the composition of the known compounds of this valuable metal, and the circumstance of their not harmonizing with the doctrine of definite proportions, prove the necessity of submitting them to a more rigid examination; and this could not be done without rendering our information on the subject more accurate and extensive.

Cork Institution, Sept. 1, 1819.

* Journal of Science and the Arts, vol. i. † Ib. vol. iii.

LII. *On the recent Alterations said to be made by some Tuners of Musical Instruments, in the Places of the Wolves, or largely tempered Concords, on common 12-stringed or Douzeave Keyed-Instruments. With some Queries thereon, to Musicians.* By Mr. JOHN FAREY Senior.

To Mr. Tilloch.

SIR, — TEN years ago I drew up and communicated through your pages*, SIX MUSICAL THEOREMS, showing the various relations of the *Temperaments*, of all the 72 concords capable of being taken on a Douzeave Instrument, or one having only 12 Notes in the Octave; and soon after, Fifteen *Musical Corollaries*, derived from those Theorems, were also given in your Work †: at this period, it was the general opinion of the professional Tuners and scientific Musicians whom I had opportunities of consulting, that it was usual and proper, to consider the five short Finger-keys of Instruments, as producing the Notes F*, C*, G*; Eb and Bb; and the resulting Fifth or Quint Wolf to lie, between G* and Eb: since then, the arrangement of the Pedals of the improved Instruments made by Mr. Loeschman, and for Mr. Liston, and the excellent Work of the latter (entitled "An Essay on perfect Intonation,") have shown, that these ingenious Individuals considered, the common or original Scale, or that which would be found by using the twelve ordinary Finger-keys on their respective Instruments (none of their Pedals were in action) to consist of the seven natural Notes, and of those three sharpened and two flattened Notes, above mentioned: and every thing contained in my Papers alluded to, relative to *the places in the Scale*, in which the several Wolves, or resulting, and mostly also the largest tempered Concords, were to be found, depended on this assumption, viz. of it being the practice of Tuners, to effect their tuning, upwards by the Tempered Fifths CG, GD, DA, AE, EB, BF*, F* C*, and C* G*, and downwards by the similar Fifths cF, FBb, and Bb Eb, so as to meet in the resulting or Wolf Fifth G* Eb: such however appears now, not to be the invariable practice of Piano-Forte Tuners; since the Rev. C. J. Smyth, of Norwich, has informed me, that several Tuners for Mr. Wornam, of Wigmore-street, and other makers of Piano-Fortes in the newest fashion, are in the habit, of laying *the Bearing* as they sometimes call it, or throwing the Quint Wolf, between the Notes C* and Ab; or in other words, their Scale is made to contain, seven natural, two sharpened and three flattened

* See P. M. vol. xxxvi. p. 39.

† P. M. vol. xxxvi. p. 374.

flattened Notes, instead of those assumed in my Theorems and Corollaries; which they effect, by stopping in their upward series of consecutive tempered Fifths, with C*; and continuing their downward series of similar Fifths, one note further than is mentioned above, viz. to Ab.

The magnitudes and proportions of the several Temperaments and Wolves (although not their places) will still all be truly represented by my Theorems or Corollaries, in this new manner of laying the Quint Wolf, or in any other, which the convenience of Musicians, or the fancies of Tuners, may suggest; provided only, that eleven of the Fifths out of the twelve, *are precisely equal in magnitude*. In either of two particular cases of *equally Tempered Fifths**, my Theorems will still apply, viz. first, in the Isotonic or common equal-temperament Scale, wherein each of the twelve Fifths is *flattened* the same quantity (or 1-12th of the Diaschisma, $12\Sigma + m$†); and second, the Scale wherein each of the twelve temperaments of the Fifths are equal, (each 1-10th of the Diaschisma) yet eleven of them are *flat*, and one *sharp*, viz. G* Eb.

I have ventured to call the attention of your Musical Readers to this subject, in order to request to be informed, through the medium of your pages, or otherwise:

1st. Whether this method of laying the Quint Wolf on C*, rather than on G*, has yet prevailed to any considerable extent?

2nd. Whether, for the general run of Piano-Forte Music, it be really an Improvement to make this change, or otherwise?

3rd. Whether either of the three Systems of *equal Fifths*, but some of them sharpened, which are mentioned herein, have been tried?: and if so, how were they approved?

I am your obedient servant,

JOHN FAREY Sen.

37, Howland-street, Fitzroy-square,
Oct. 17, 1820.

* As the amusement of occasional leisure Hours, I have considered and calculated the Intervals of some other *equal Temperaments* of the Fifths, to which my Theorems above quoted, will not apply; in one of these, the Fifth Temperament is $\frac{1}{8}$th of the Diaschisma (or $1{\cdot}5\Sigma + \frac{1}{8}m$), this being the *sharp* Temperament of two of the Fifths, viz. C* G* and G* Eb, while all the 10 other Fifths are *flattened* the same quantity. In another of these Systems, $\frac{1}{6}$th of the Diaschisma (or $2\Sigma + \frac{1}{6}m$) is the sharp Temperament of three of the Fifths, viz. F* C*, C* G* and G* Eb, while the 9 other Fifths are as much flattened.

† See P. M. vol. xxviii. Plate V. p. 140.

LIII. *On*

LIII. *On the Methods of cutting Rock Crystal for Micrometers.* *By* William Hyde Wollaston, *M.D. F.R.S.**

For the mere purpose of examining the phænomena of double refraction, it is extremely easy for any skilful workman to combine a wedge of rock crystal, or any other doubly refracting substance, with another wedge of crown glass opposed to it, in such a manner that a luminous object seen through them shall appear in its true place by ordinary refraction, accompanied by a second image at a small distance, produced by the extraordinary refraction of the crystal.

In consequence of the dispersion of colours which occurs in employing different substances, the above combination is not suited for the purpose of the micrometer invented by the Abbé Rochon; but it is not difficult to obtain such a section of rock crystal as may be substituted for the wedge of glass, so that the pencil of light shall be restored to its original direction void of colour, without diminishing the separation of the images occasioned by the first wedge.

But since the degree to which the double refraction of rock crystal separates the two portions of a beam of light transmitted through it, is not so great as may frequently be wished, it becomes desirable to increase this effect beyond what can be produced by the most obvious method of employing that substance; and it does appear from M. Rochon's own account of his contrivance †, that he fully succeeded in accomplishing this end. But although he informs us that the means employed, as best suited to his views, had exactly the effect of doubling the amount of deviation produced by ordinary means, he has not chosen to explain the mode of construction he adopted, and has merely referred to a certain artist living at that time in Paris, who was in possession of his secret, and skilful in applying it to the construction of micrometers.

As I have reason to think that the method to which he alludes in his memoir has never yet been described, I design, in the present communication, to explain a combination which I have found advantageous, and which I think must be the same as that of M. Rochon.

I shall hope to render the principles of this construction intelligible to every one acquainted with the original observation of Huygens on the properties of polarised light, and to enable any competent artist to cut wedges from hexagonal prisms of

* From Transactions of the Royal Society for 1820, Part I.

† *Journal de Physique*, An. 9.

rock

rock crystal, in the positions requisite to produce, by their combination, the double effect to which I allude.

There are three principal directions in which a crystal may be cut specifically different from each other, which require to be distinctly understood.

In the first place, let us suppose a prismatic crystal to be placed with its axis in a vertical position, and a portion to be cut off from the base by a plane surface at right angles to the axis, and sufficient to form a wedge of 20 degrees, by giving it a second surface duly inclined to the former. For distinction, this may be called the *horizontal* wedge.

Next, let the crystal be bisected vertically by a plane passing through two opposite edges of the prism, in order to make two other wedges which are to be cut in different directions from the two portions, and to have each the same angle of 20 degrees.

Let one of the halves thus obtained be slit in a plane which meets the surface of bisection in one of the edges of the original prism, and consequently in a line parallel to the axis. The wedge thus formed may be called a *lateral* wedge.

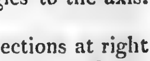
Let the remaining half be cut by another plane not vertical, but inclined to the vertical plane at an angle of 20°, and meeting it in a line parallel to the base, or at right angles to the axis. This may be called a *vertical* wedge.

We have thus three wedges cut in different directions at right angles to each other, and, accordingly, having their axes of crystallization differently placed in each.

In the first, or horizontal wedge, the axis is at right angles to the first surface. In the second, or lateral wedge, the axis is parallel in the first surface, and parallel to its acute edge. In the third, or vertical wedge, the axis is also in the first surface, but it is at right angles to the acute edge.

An object seen through the first wedge in the direction of the axis, does not appear double; but, since rays transmitted through the second or third pass at right angles to the axis, both of these wedges give two images of any object seen through them.

There are obviously three modes in which these wedges may be combined in pairs, by placing two of them together with their acute edges in opposite directions. The first pair may be represented by L H; the second by V H; the third by V L. In the two first cases the separation of the images will be the same: since the angles of all the wedges are supposed to be made equal, the compound medium will be comprised under parallel surfaces, so that a ray ordinarily refracted by both emerges in its original direction; but since the extraordinary ray is made to deviate about 17 minutes from the ordinary



dinary

dinary course by the wedge which refracts doubly, this difference is not corrected by the horizontal wedge, so that an object seen through either of the combinations L H or V H, appears doubled to the amount of 17′.

The third combination, consisting of the vertical and lateral wedges combined, as in the former cases, with their acute edges in opposite directions, produces an effect perfectly distinct from either of the former combinations; for, by reason of the transverse position of their axes of crystallization, the separation of the two images becomes exactly doubled. The consequence of that position is, that the pencil ordinarily refracted by the first wedge, is refracted extraordinarily by the second, and that which has been refracted extraordinarily by the first, suffers a similar interchange, and is now ordinarily refracted, so that neither of the divided pencils returns to its true place; and since one falls as much short of the mean as the other exceeds the truth, they emerge ultimately separated twice the usual difference between the ordinary and extraordinary refractions, and thus present two images separated 34 minutes, just double of that which is effected by either of the preceding combinations.

Though it could scarcely be doubted that this is essentially the construction which was employed by M. Rochon, there is an additional circumstance concerning the effect of such a pair of wedges when otherwise combined, which fully establishes the identity of the method here proposed with his. If the two wedges be placed with their edges together, so as to form by their union a wedge of 40°, the consequence is, that though a pencil of light is in fact divided into two parts by the first wedge, both parts in the end emerge together; the refraction of one being $o + e$, and of the other $e + o$: they both deviate from their original direction by exactly the same quantity, and present only a single image of the luminous object; but it is coloured, as usual, in proportion to the amount of deviation occasioned by the sum of the wedges. This, without doubt, is the first of two opposite directions mentioned by M. Rochon, in which he says the double refraction was not perceptible.

"Pour cet effet," says M. Rochon, "j'employai deux prismes égaux taillés dans le sens le plus favorable à mes vues, et en les présentant dans les deux sens opposés je trouvai, que dans la première disposition la double réfraction n'étoit pas perceptible, mais, en faisant prendre à mes prismes un sens inverse, la double réfraction de chaque prisme étoit presque doublée."

The correspondence in the effect which I have described renders this passage from M. Rochon perfectly intelligible; and I hope the directions above given will be sufficient to enable any one to cut a crystal to the greatest advantage for making this

sort

sort of micrometer. But it must be observed, that in attempting such a construction, great nicety is requisite, not only in cutting the wedges so that the refraction in each shall take place at right angles to the axis, but also in cementing them together, so that the axes of the two wedges shall be at right angles to each other. And it may further be remarked, that even then, unless the pencil of light pass truly in the common plane of refraction of the wedges, four images will be formed, so as to destroy the effect of the combination.

LIV. *On Mr.* BONNYCASTLE'S *Dissertation on the Influence of Masses of Iron on the Mariners' Compass published in our 55th Volume.*

SOME time ago we received from a Correspondent, N., the first of the subjoined communications, with an intimation that the Editor might either communicate the article to Mr. Bonnycastle, or publish it in the Philosophical Magazine, as he might think would prove most agreeable to that gentleman, to whom no disrespect was intended by the author. The Editor in consequence sent Mr. N.'s letter to Mr. Bonnycastle, who has since returned it with the letter which we have subjoined to that from Mr. N.*

To Mr. Tilloch.

SIR,—IN reading Mr. Bonnycastle's Dissertation on the "Influence of Masses of Iron on the Mariners' Compass," I have met with a part which carries with it considerable difficulty. At page 453 of the 55th volume of your Philosophical Magazine he says,

"Were the needle acted on by no other attraction than that of the sphere, its position would be such that

$$\tan.\ \delta' = 2\cos.\ \phi\,;$$

where δ' in this case is the dip. This formula follows immediately from the equations (1) and (2); for from them we have

$$2.\cos.\ \phi : \sin\ \phi :: 1 : \cos\ \delta'$$

$$\cos\ \delta' = \tfrac{1}{2}\tan.\ \phi$$

$$\tan\ \delta' = 2\ \cot.\ \phi."$$

Now I do not mean to dwell upon the enunciation $\tan\ \delta' = 2\cos\ \phi$ differing from the result $\tan\ \delta' = 2\cot\ \phi$, for that is the consequence evidently of a press error; but I own that I neither see,

* This communication should have appeared in our last Number, but was somehow mislaid by the Printer.

see, in the first instance, why $2\cos\varphi : \sin\varphi :: 1 : \cos\delta'$; nor, if that is granted, can I make out from it that $\tan\delta' = 2\cot\varphi$. It is clear that the expressions (1) and (2) are to each other as $2\cos\phi$ to $\sin\phi$; but why in this particular instance have they also the ratio of 1 to $\cos\delta'$? Again, if

$$\cos\delta' = \tfrac{1}{2}\tan.\varphi$$

$$\cos\delta' = \frac{1}{2\cot.\varphi}; \text{ therefore,}$$

$$2\cot.\varphi = \frac{1}{\cos\delta'} = \frac{\tan.\delta'}{\sin.\delta'}, \text{ not } \tan.\delta', \text{ as in the text.}$$

Mr. Bonnycastle can very probably clear all this up immediately; and if he would be good enough to do so, it would be an obligation to others, who may not see further than myself. N.

To Mr. Tilloch.

SIR,—I FEEL myself much obliged to your Correspondent N. for having pointed out a probable source of embarrassment in the paper on Magnetism, which you inserted in your Magazine for June last. The passage occurs in page 453; where, speaking of the position a needle would assume if influenced by the magnetism of a sphere of iron, I have said:

"Were the needle acted on by no other attraction than that of the sphere, its position would be such that

$$\tan\delta' = 2\cos\varphi."$$

In this expression, as well as in the proportion from which it is derived, viz.

$$\text{"}2\cos\varphi : \sin\varphi :: 1 : \cos\delta',\text{"}$$

an error of the press has been committed by substituting cos for cot.

Making this correction, the truth of the equation

$$\tan\delta' = 2\cot\varphi$$

follows very readily from the proportion,

$$2\cos\varphi : \sin\varphi :: 1 : \cot\delta';$$

for thence

$$\cot\delta' = \frac{\sin\varphi}{2\cos\varphi} = \tfrac{1}{2}\tan\varphi,$$

$$\frac{1}{\cot\delta'} = \frac{2}{\tan\varphi},$$

$$\tan\delta' = 2\cot\varphi.$$

But it has also been observed, that there is a want of clearness in the origin of the proportion

$$2.\cos\varphi : \sin\varphi :: 1 : \cot\delta'.$$

Which difficulty I am inclined to attribute to the former; had

 the

the expression been correct, I think there would have been little embarrassment in deriving it thus:

When a magnetic needle is governed only by the attraction of a sphere, it has been demonstrated, in what precedes, that it is acted on by two forces; one of which tends to the centre of the sphere, and the other urges it from the centre, in a line drawn in the magnetic meridian, at right angles to the direction of the first force. Hence, joining the centres of the needle and sphere, and from the latter drawing a line as above; and further making these lines bear to each other the ratio of $2 \cos \phi : \sin \phi$, which has been shown (page 450) to be the ratio of the forces in those directions, they will represent those forces; and hence the direction of the needle will be that of the hypothenuse of the triangle of which these lines are the sides.

But it is manifest that the angle included between the hypothenuse and the second of the above lines is equal to the dip of the needle, or to its deviation from a tangent to the sphere; therefore putting this angle equal δ', the first line will be to the second as 1 to $\cot \delta'$; combining which ratio with that of the lines themselves there arises the required proportion

$$2 \cos \phi : \sin \phi : : 1 : \cot \delta'.$$

Having now, I trust, sufficiently explained those points which have been objected to as obscure, I will take the opportunity of mentioning an improvement which has occurred to me since my paper was inserted; the nature of which will be best seen by referring to our former expression 8; where it will be observed that, since the constant quantity A is not given, the quantity of the deviation cannot be determined without having recourse either to experiment, or to a further application of the theory than has yet been made; in which last manner the value of A may be found as follows:

Since it has been shown (page 450) that the force in the direction CO varies as

$$\left\{ \frac{1}{d^2} - \frac{d + e . \cos \phi}{d^3 + 3e\, d^2 \cos \phi} \right\};$$

and that, *cæteris paribus*, the attraction is as the cube of the diameter; it follows that this force may be represented by

$$\frac{nr^3}{e} \left\{ \frac{1}{d^2} - \frac{d + e \cos \phi}{d^3 + 3ed^2 \cos \phi} \right\}.$$

Which formula expresses the difference of the attractions of the two spheres A N B S and A N′B S′; the attraction exerted by the first of these will therefore be equal to

$$\frac{n r^3}{e\, d^2}.$$

But the attraction of a point on the surface is to that of a point within

within the sphere, as the radius of the sphere is to the distance of the latter point from the centre; putting which equal to e', this attraction may be expressed by $\frac{n\,d'}{e}$. A similar mode of reasoning will also hold for the attraction of a point in the interior of the second sphere; and, consequently, the force which acts in the direction of the dip, upon a point within both spheres, will be equal to n. But this force is equal to the intensity of the terrestrial magnetism at the place; wherefore the constant coefficient n must be equal to the same intensity.

From what has been demonstrated above, it appears that nothing more is necessary to convert the formulæ, before given, for the laws of magnetic attraction to a sphere of iron, into equations, than to multiply them by $\frac{n\,r^3}{e}$; care being taken, if the directive power of the needle is concerned, to reduce it to the horizontal plane.

Applying these observations to the expression (7), and putting the dip $=d$, it may be readily converted into

$$\tan \delta = \frac{3 r^3 \sin i . \cos k . \cos \varphi}{(d^3 - r^3) \cos d + 3 r^3 \cos k \cos i \cos \varphi};$$

which putting $\frac{3 r^3}{d^3 - r^3} = m$ becomes

$$\tan \delta = \frac{m . \sin i \cos k . \cos \varphi}{\cos d + m . \cos k . \cos i \cos \varphi};$$ or, which will often be found a convenient transformation,

$$\cot \delta = \cot i + \frac{\operatorname{cosec} 2k \operatorname{cosec} 2i}{m . (\tan d . \sec i + \cot k)}.$$

The utility of these formulæ is manifest: they enable us to find the deflexion occasioned by the attractions of spheres, or of masses of iron which can be assimilated to them, without having recourse to any previous observations; provided only that the dip is known; and when this element is not given, they enable us to find it, with very considerable accuracy, from the data furnished by a single experiment; which latter point will not be esteemed of trivial importance when it is considered that the high price of dipping needles precludes their being brought into very general use; whilst their delicacy, and the circumstance of their motion being in a vertical plane, renders it impossible to employ them at sea.

As the determining the dip with precision is an object of much moment, it will be necessary, in making experiments with this view, to place the ball at a considerable distance from the horizontal plane, within which the deviation is totally independent of of the dip*. It would also be advisable to make corrections for the form of the needle, and the effect which its reaction produces upon the magnetism of the sphere; on these points however I shall take some future opportunity of speaking more fully.

I am, sir,

Your most obedient humble servant,

CHARLES BONNYCASTLE.

* *From this circumstance it follows, that if a ship's compass be moved until the ball, placed according to Mr. Barlow's plan, has its centre in the plane of the needle, the attraction for all parts of the world will be the same.*

LV. *Copy of the Report to the Secretary of State for the Home Department, from the National Vaccine Establishment; dated* 18*th May* 1820.

To the right honourable Lord Viscount Sidmouth, principal Secretary of State for the Home Department, &c.

National Vaccine Establishment,
Percy-street, May 18, 1820.

MY LORD, THE Board of the National Vaccine Establishment have the honour to report to your Lordship, That the number of persons vaccinated during the last year, in London and its vicinity, exceeds the number of any former year; it amounts to 8,957. Within the same year, 51,005 charges of vaccine lymph have been distributed to the public.

An abundant, an unceasing supply, which could only be afforded by such an institution as that which the Board have the honour to direct, has enabled us to answer the earnest demands for vaccine lymph, from various parts of Great Britain and Ireland,—from Jamaica, St. Vincent's, Dominica, Tortola, Grenada, Nevis, Montserrat, Antigua, St. Christopher's, Demerara, Hayti, and the Cape of Good Hope.

Lymph has also been occasionally requested from the Continent of Europe, and charges were lately transmitted to Hamburgh and Hanover.

Our correspondents in Great Britain and Ireland have reported to this Board, that the number of persons vaccinated by them during the year 1819 amounts to 74,940; forming with the number vaccinated in London and its vicinity a total of 83,897 persons in one year; yet many send no returns, or the number would be considerably greater.

From these facts the Board think themselves entitled to conclude, that the practice of vaccination in His Majesty's dominions continues to advance, and therefore that the confidence of medical practitioners, and the confidence of the public in that practice, remain unshaken; notwithstanding many unfavourable occurrences,

occurrences, with which it will be our duty to acquaint your Lordship.

The Reports transmitted to this Board likewise warrant the conclusion, that wherever small-pox inoculation is abandoned, and vaccination exclusively favoured or commanded, the most striking illustrations of the value of the Jennerian discovery are uniformly afforded; for, in addition to those places mentioned in former Reports, in which small-pox is now unknown, the Board have received information that no case of that disease has occurred since the year 1804 at Shottesham in Norfolk, nor since the year 1817 in the city of Gloucester. The boroughs of Clonmell and Newton Limavady in Ireland, and Mothvey in Carmarthenshire, with the whole country for twenty miles around it, are reported to have completely succeeded in the extirpation of the small-pox; and in the island of Guernsey, only one solitary case of that fatal distemper is known to have occurred during the last year.

The career of vaccination appears, however, to have been less brilliant in its native country than in some parts of the Continent of Europe, where the practice of it is enforced by legal enactments, and inoculation for small-pox is prohibited by severe penalties. Under such regulations, it is affirmed that the small-pox has ceased to exist in Denmark for the last eight years; and that the knowledge of this fact has now induced His Danish Majesty to proclaim the same decrees in his West India colonies.

The Board are also informed, by a most interesting communication from Dr. De Carro of Vienna, that similar decrees have been published in the Austrian dominions, and that small-pox is now confined to that portion of the poor who by concealment contrive to evade the Imperial ordinances. He announces, that since the year 1799, when he gave the first example to the Continent of Europe by vaccinating his two elder sons, he has never seen a single case to weaken his confidence in the efficacy of that practice.

An important letter, together with a treatise on this subject, has also been transmitted to the Board from Dr. Krauss, an intelligent physician, who is charged with the superintendence of vaccination in the circle of Rezat in Bavaria. He affirms, that in that circle, containing half a million of people, small-pox has never occurred since the year 1807.

If these facts be correctly reported to us, they would appear to afford convincing proof, that the extinction of small-pox is entirely within our own power.

The testimonies of some of our correspondents in this country are by no means so favourable. They concur in showing, that

great

great numbers of persons who had been vaccinated, have been subsequently seized with a disease presenting all the essential characters of small-pox; but that in the great majority of such cases, the disease has been of comparatively short duration, unattended by symptoms of danger. In several of these cases, however, the malady has been prolonged to its ordinary period; and in eight reported cases it has proved fatal.

It appears to us to be fairly established, that the disposition in the vaccinated to be thus affected by the contagion of small-pox, does not depend on the time that has elapsed after vaccination; since some persons have been so affected who had recently been vaccinated; whilst others, who had been vaccinated 18 and 20 years, have been inoculated, and fairly exposed to the same contagion with impunity.

Nor is it undeserving of remark, that whilst cases of small-pox in the vaccinated have frequently been reported to us, from some parts of the kingdom remote from the metropolis, no cases of a similar nature are known to have happened in other districts equally populous. Very intelligent surgeons in the different counties of Norfolk, Devonshire, Middlesex, Cheshire, and Staffordshire, who together have vaccinated more than 30,000 persons, assert that they never saw or heard of small-pox in any one of their vaccinated patients.

But no assertions of individuals, however respectable, are so well calculated to direct the judgement of your Lordship as the registers of public charities.

The practice of vaccination was begun in the Small-pox Hospital of London in the year 1799, soon after the promulgation of Dr. Jenner's discovery, and has been continued to the present day. In the last annual Report it is stated by Dr. Ashburner, "That the benefit of vaccination has been extended within the year to 3,297 persons; that one only of the 46,662 cases mentioned in former Reports, has been since affected with the varioloid eruption occurring after vaccination."

At the Foundling Hospital, vaccination was introduced nineteen years ago; and we are informed by Dr. Stanger, that only two cases of disease bearing any resemblance to small-pox have hitherto occurred in the vaccinated of that institution.

Mr. MacGregor assures us, that in the great assemblage of the sons and daughters of soldiers who are brought up at the Royal Military Asylum, no case even of the mildest small-pox has ever occurred after vaccination.

Under the immediate direction of the National Vaccine Establishment, more than 60,000 persons have now been vaccinated in London and its vicinity; and of this large number only five are reported to have been subsequently affected with small-pox; although

although positive orders are given, at every station, to report all such cases as are even suspected.

This success in London, where the vaccinated are continually exposed to the contagion of small-pox, is strong evidence in favour of the practice adopted and inculcated by this Board, and induces us to believe that a departure from that practice is one source of the evil which has prevailed in different parts of the kingdom.

The great principle of that practice is to affect the constitution of each individual very completely with the vaccine disease; and the Board have thought it right to direct that lymph should never be employed from any vesicle in which the slightest irregularity or imperfection can be observed; nor even from a perfect vesicle after the areola is formed; that two punctures be made in each arm, in order to secure at least three perfect vesicles; that one vesicle on each arm should be left unopened, and the lymph be suffered to be absorbed or desiccate; that if the vesicles be accidentally broken, or much injured, or if they present any irregularity, the patient should be carefully re-vaccinated as at first.

From extensive experience and numerous reports, the Board have become most earnestly desirous that more rather than fewer vesicles should be produced. We think it especially wrong to confide in one vesicle, and highly imprudent to open all: but no treatment will be effective in certain constitutions; for twenty-one cases of small-pox occurring after small-pox, have been reported to us within the last twelve months, three of which were fatal.

We have regarded it, my Lord, as one of our first duties, to consider attentively the different cases of small-pox after vaccination, as they have been transmitted to us. We have endeavoured to investigate them, free from the influence of theory, and solely intent on the discovery of truth. And when we take into our view the immense number of the vaccinated, when compared with the reported failures;—when we reflect on certain peculiarities of constitution, that will exempt some individuals from all common laws;—when we think on the ignorance and carelessness which the vaccinator has but too often betrayed;—when we recollect the mild form which small-pox is reported to have very generally, though not universally, assumed in the vaccinated;—We cannot hesitate to assert, that our conviction in favour of the experiment of universal vaccination is unshaken.

It is a painful duty for us to state to your Lordship, that 712 persons are reported, by the bills of mortality of London, to have died of small-pox within the last year; and that the ravages committed by this disease, in many other cities, and in many

 parts

parts of the country, have also been great: yet we believe them to be fairly attributable to the neglect of universal vaccination, and the partial but too frequent practice of small-pox inoculation.

J. LATHAM, M.D. President.

ARTHUR DANIEL STONE,
ROBERT BREE,
EDWARD THOMAS MUNRO,
GEO. L. TUTHILL. } Censors of the Royal College of Physicians.

DAVID DUNDAS,
Master of the Royal College of Surgeons.

THOMPSON FORSTER,
EVERARD HOME, } Governors.

By Order of the Board,
JAMES HERVEY, M.D. Registrar.

LVI. *On the Lunar Period.* *By Mr.* THOMAS YEATES.

[In continuation from p. 89.]

To Mr. Tilloch.

SIR, — YOUR ingenious Correspondent's remarks on my papers, page 14, are very curious, I must allow; but whether they apply to the substantial parts of my argument I leave for others to determine. My argument is the list of corresponding eclipses which I have been at the pains to collect, and trust you will allow me the credit of having advanced my hypothesis on some foundation. It is true, I have filled up the list with many computed dates, and especially from the learned and laborious compilation entitled *L'Art de vérifier les Dates;* but since these fill up the steps in the ladder in their true places, and give a consistency to the whole, I presume little apology may be required for their introduction. These corresponding eclipses do certainly give a limit to the lunar period, confirmed by all observation ancient and modern, from the age of the Babylonian astronomers to the present time: this period I have stated at 912 years, and it matters not whether they are solar, lunar, Julian or sidereal; the argument is nevertheless valid, and appears to merit the consideration of all those who cultivate the science of astronomy, and especially the Lunar theory. See Catalogue of Ancient Eclipses with the Dates of corresponding Eclipses at one and two Periods Distance, vol. 55, p. 244 of Phil. Mag.

In another paper, page 344, is attempted to show the verity and precision of the ancient historical eclipses by introducing the requisite

requisite equations; and whether or not the attempt is successful, certain it is that an admirable harmony is discoverable even in the rude and unfinished method there followed. The like method is pursued in a subsequent communication, page 439, where the same is given at large, bringing the corresponding dates up to the very day, and in many instances within a few hours, leaving the difference of meridians, and other particulars, to the skill of those who are disposed to investigate them more minutely. In this paper the number of lunar cycles is stated at 48, which is the quotient of 912 divided by 19, the years of one cycle, and the revolutions of the moon's ascending Node at 49; and thus, if you divide 912 years by 49, there will be given the period of one revolution, viz. 18 years about 224 days. M. La Caille's Elements, translated by Robertson, page 285, makes this period 18 years, 224 days, 5 hours, reckoned from the first point of Aries.

I presume, sir, there is no occasion here to introduce anomalistic calculations of the sun and moon; the mass of evidence already produced in the corresponding eclipses at 912 years distance, and the eclipses recorded to have happened, show most evidently that the true motions of the sun and moon's apogee and node must agree at and after such an interval, or such phænomena could not take place. I do not think these substantial parts of the argument at all affected by Mr. Utting, who appears to have resorted to hypothesis in adducing such long and endless calculations, wherein tables constructed by the most eminent astronomers become exhausted, and all their perfections lost in unknown and multiplied error. The moon is a wonderful planet, and in every respect our nocturnal sun; her path in the heavens demonstrates her equinoxes and solstices, summer and winter, and day and night, all performed in the space of one month. How possible is it then for men to err in such vast and immeasurable calculations as some authors have stated! I utterly disavow the possibility of any man to prove the reality of any lunar period surpassing the age of the world itself, and indeed do most justly suspect that the principles of such calculation, multiplied upon and unreasonably augmented, absolutely deceive both those who invent them, and those who use them.

The ancients seem not to have gone beyond 900 or 1260 years in their great lunar and ecliptic period, page 18, vol. 56; but Mr. Smith, quoted by Ferguson, Astron. page 251, by a strange process, augments this period into no less than 12000 or 13000 years, and remarks, that "the eclipses which happened about the creation, are little more than half-way yet of their ethereal circuit; and will be 4000 years before they enter the earth any

more.

more. This grand revolution (says Mr. Smith, p. 253) seems to have been entirely unknown to the ancients." And I may add, truly, sir, this period might well be unknown to the ancients, who, with all their adsurdities, never thought of such a useless astronomical dream! The best answer is, that it requires no less than 12 or 13000 years to prove the assertion; and since there are no historical data to maintain the argument, the whole rests upon hypothesis. The manner and principle by which this calculation is made is largely shown in Mr. Ferguson's Treatise; and whoever calculates by the same process will arrive at the same conclusion: but I deny that the principle is correct beyond certain limits; as for instance, that the eclipse of the sun which happened about 88 years after the Conquest, traversed the voids of space ever since the Creation, and never appeared until A.D. 1153, when it was eclipsed 11 digits on January 26th. I say, we must take all this upon trust, that no such eclipse happened or could happen from the creation of the world until that time, computing this interval at 5157 years! Mr. Utting computes the entire period of any respective eclipse about 760 Chaldean periods, or about 13700 years; the whole terrestrial phænomena being completed in about 76 Chaldean periods, or 1370 years, allowing for some irregularities in the lunar motions which may lengthen or protract this period 100 years, page 15. So that subtracting 1370 years from 13700, we have 12330 years for the said eclipse to travel *incognito* in the voids of space. Mr. Ferguson attributes the vast length of this period to the falling back of the line of conjunction at the rate of 28 minutes 12 seconds every Chaldean period, page 245: thus all this superlatively grand and exquisite system is founded on subtilties, and a difference of a few minutes and seconds of a degree in eighteen years!

Mr. Utting pursues his lunar calculations to the vast amount of 36512 solar years, in which he says are contained 488695 lunations, wanting about 5″ only of the line of conjunction of the ☉ and ☽. Science ought to be indebted to so laborious a calculation, provided it be true. But let me ask if Dr. Maskelyne ever ventured to obtrude such romantic speculations on the public, or any others profound in this science, and experienced in the intricacies and subtilties of the lunar motions. It was acknowledged by La Caille, an excellent astronomer, *that there is no likelihood of coming at a perfect theory of the moon*, page 373: in short, any astronomical computation surpassing the age of the world itself, and founded on mere arithmetical process, is only fit for the admiration of the credulous, and is of no utility in human concerns.

The

The period of the moon's ascending node, which is the lunar equinoctial point, if I may be allowed so to express myself, seems very fairly to confirm my hypothesis in fixing on 912 years for the completion of the moon's motion. Mr. Whiston's Collection of Tables annexed to his Lectures gives the mean motion of the moon, apogee, and node, as follows:

Comp. Years.	Mean Motion of the Moon.				Mean Motion of the Apogee.				Mean Motion of the Node.			
	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.
900	8	10	33	45	8	22	41	15	4	7	41	30
12	5	2	18	27	4	8	18	10	7	22	6	9
912 =	1	12	52	12	1	0	59	25	11	29	47	39

These numbers bring every period within 3½ days of the calendar time, and so far answer to the observed dates of the corresponding eclipses as to leave little doubt of their correctness. Subtract and add equal to 3½ days.

Years.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.
912 =	1	12	51	12	1	0	59	25	11	29	47	39
3½ days	1	16	7	2			23	23			11	8
		3	5	50	1	0	36	2	11	29	58	47

The mean motion of the node for 19 complete years is 7 deg. 27 min. 22 sec. by Whiston's Tables; but if we say 7 deg. 30 min. in every cycle, the whole ecliptic motion is performed in 912 years; the mean motion for four cycles or 76 years is equal to one sign, and in 12×76 years the node revolves through the whole of the signs.

There is no difference between the Chaldean period and the Metonic lunar cycle, but the method of calculation. The Chaldean period is one lunar year shorter than the Metonic, and consists of 223 lunations according to Dr. Halley's account, and the Metonic consists of 235 lunations: and hence it is, that the Chaldean periods and eclipses follow in the order of the signs. The same celestial phænomena are common to both these periods; so that in every eclipse found by one method the same is to be found by the other also, but the method of calculation is different. The Chaldean period runs through all the signs in about 612 years, including 34 revolutions in order from the date of any assigned new or full moon, adding 18 Julian years 11 days 7 hours 43 seconds when four leap-years are included, and 10 days 7 hours 43 minutes when five leap-years come in the period.

Period

Period 1°	18°	●	New Moon.	January	4
2	36	..	..	January	15
3	54	..	..	January	26
4	72	..	..	February	6
5	90	..	..	February	16
6	108	..	..	February	28
7	126	..	..	March	10
8	144	..	..	March	20
9	162	..	..	April	1
10	180	..	..	April	11
11	198	..	..	April	22
12	216	..	..	May	3
13	234	..	..	May	14
14	252	..	..	May	24
15	270	..	..	June	5
16	288	..	..	June	15
17	306	..	..	June	26
18	324	..	..	July	7
19	342	..	..	July	18
20	360	..	..	July	28
21	378	..	..	August	9
22	396	..	..	August	19
23	414	..	..	August	30
24	432	..	..	Sept.	10
25	450	..	..	Sept.	21
26	468	..	..	October	1
27	486	..	..	October	13
28	504	..	..	October	23
29	522	..	..	November	3
30	540	..	..	November	13
31	558	..	..	November	25
32	576	..	..	December	5
33	594	..	..	December	16
34	612	..	..	December	27

By subtracting 11 years from the above sum, we shall very nearly bring it to the *Magnus Annus* of the ancients, or 600 years, when they supposed the motions of the sun and moon to be completed, according to Josephus*; for in 11 years the moon returns to the sun within about 10 degrees, or less than one day. It was by the aid of this great period of 600 years that Hipparchus extended his science in calculating Ephemerides of the sun and moon as he is related to have done, and that with sufficient exactness for the regulating of their calendar.

* Præterea tum propter studium virtutis, tum propter utilitatem inventarum artium, ut astronomiæ, ac geometriæ, Deus illis prolixiorem largitus est vitam: quarum certitudinem assequi non poterant, si minus DC annis vixissent, ex tot enim Magnus Annus constat. Lib. 1. cap. 4.

LVII. *On the "Connoissance des Tems pour l'An* 1820."

Baron de Zach has published in the October number of the *Journal des Voyages, Découvertes, et Navigations modernes*, a curious criticism on the *Connoissance des Tems*. The Observatory of Paris never had a more unsparing critic than this learned foreigner. "The whole calendar," he says, "of the *Connoissance des Tems* for the year 1820 is false from the beginning to the end. The four ember-weeks, the ecclesiastical computation, every thing is erroneous: there is not a Sunday or a feast which answers to its true date, nor even to the true day of the week. Easter Sunday, for example, is marked opposite the 17th of April, which was a Tuesday; Ash Wednesday is made to fall on a Thursday; the feast of Corpus Christi is allotted to a Saturday; and the first Sunday of Advent, which should fall in December, is given to November; and so with others."

Certainly these are very serious faults, and may have serious consequences. Baron de Zach admits that they have been in part corrected in the *Connoissance des Tems* for next year. But these corrections, he observes very judiciously, come *after the feast*, and never had the phrase a more literal application. Persons who, deceived by the learned calendar of 1820, may have eaten a chicken on Good Friday, believing that they were only the length of Shrove Tuesday, will not discover till 1822 that they have violated the precepts of their religion!

The learned Editors of the *Connoissance des Tems* have pretended that the errors with which they are reproached are only to be found in some copies. M. de Zach takes notice of this excuse, but gives it no credit. "All our correspondents," he says, "have expressed themselves to us with more or less acrimony and surprise in this respect. I have had all the copies at the booksellers' shops of Genoa verified, and there was not one of them which was not false;—many have been already sent into various parts of the world, to the great risk and peril of navigators."

The Nautical part of this Almanack does not appear to M. de Zach more carefully prepared than the liturgic. It is in vain that the Editors have published successively long lists of *errata*. M. de Zach corrects their corrections; he finds *errata* even in their *errata*. Thus in the month of December there is a lunation wanting. This is not much, to be sure; but when a quarter is overlooked, why may not as well a whole moon be forgotten?

All the annuaries; all the ephemerides of Europe have announced the passage of Mercury across the disk of the sun, which was to take place in 1822. The astronomers of Paris alone have not remarked this very remarkable phænomenon. In the *Connoissance des Tems* there is no mention of it.

The

The Editors of the *Connoissance des Tems* say, p. 372, that all the faults imputed to them are unimportant, and easy to be noticed. M. de Zach asks them, if, when in the estimate of distances they make a mistake of seven degrees, such an error is of no importance? "If (he adds) the astronomers of Paris have so easy a method of reconciling errors, they would deserve well of science and humanity by communicating the discovery to other nations. But, in the mean time, how much reason have I to complain on account of those poor navigators who are gone on long voyages with the *Connoissance des Tems* of 1820 for their guide! May God help them!"

LVIII. *An entirely New Method of extracting the Cube Root in Numbers. By Mr.* Peter Nicholson.

To Mr. Tilloch.

Sir,—Having published a work entitled "Analytical and Arithmetical Essays, containing the Demonstrations and Rules for extracting the Roots of Equations of all Degrees," I beg leave, for the promotion of the mathematical sciences, to introduce to the readers of your excellent work the Philosophical Magazine an entirely new method of extracting the cube root in numbers,—which method I consider to be one of the greatest improvements the science of Arithmetic has received for many years,—and I flatter myself that it will also be thought so by others who are capable of appreciating its value. I am, sir,

Your most obedient servant,

London, Nov. 13, 1820. Peter Nicholson.

To extract the Cube Root of any Number.

Divide the number into as many periods of three figures each from right to left as possible. Find the nearest cube to the remaining figure or figures on the left, and subtract that cube from the number formed by these remaining figures; then the root of the cube is the first figure of the root to be extracted.

Call the triple root now found the first coefficient, the triple square of this root the second coefficient, and the difference between the cube and the number to be extracted the absolute number; then write these numbers separately in one line.

1. Divide the remainder by the second coefficient without the last figure only to one place of figures in the quotient.

2. Under the first coefficient, construct a column of three numbers, so that the right hand figure may advance one place to the right hand of the units place of the coefficient. Under the

the second coefficient construct a column of two numbers, so that each number may advance two places of figures before the units place of the coefficient under which they are placed, and under the remainder construct a column of one number so as to advance three places of figures before the remainder.

3. Annex the quotient figure to the first coefficient, and the sum will be the first number underneath; each of the two remaining numbers will be found by increasing the number above it by the quotient figure.

4. Multiply each of the first two numbers in the first column in succession by the quotient figure, and the opposite number in the second column will be found by adding the product to the number above it.

5. Multiply the first number under the second coefficient by the quotient figure and subtract the product from the remainder, and this last remainder is the number which forms the third column: then if the product be less than the preceding remainder, the quotient figure is the second figure of the root; but if not, the quotient figure must be diminished till it is found to be so.

Now, considering the last two numbers in the first and second columns as the first and second coefficients, and the last remainder as a new absolute number, the step of the work for the next figure will be found exactly in the same manner as that for the last figure.

Example.—Extract the cube root of the number 13.

Here the nearest cube to 13 is 8, the root of which is 2; therefore the coefficients of the first step are 6 and 12, and the remainder or absolute number is 5: now 5 will be found to contain 1, which is the second coefficient wanting the last figure ·5 times: now ·5 being tried will be found not to succeed, therefore try 3 in the operation: thus

6	12	5 . . .(·3
63	1389	833
66	1587	
69		

Proceed with these opposite columns of numbers according to the second, third, fourth and fifth parts of the rules.

Since 3 succeeds, divide 833 by 158, which is the coefficient of the second term without the last figure, and the quotient 5 is the next figure of the root, which must now succeed; therefore proceed with the next step

69	1587	833 . . .(5
605	162175	22125
700	165675	
705		

Again

Again divide 22125 by 16567, and the quotient 1 is the next figure of the root; therefore proceed with the next step

705	165675	22125 . . . (1
7051	16574551	5550449
7052	16581603	
7053		

And so on; so that the root is 2·351.

This process being sufficiently understood, the learner may then work the whole of the steps in one continued operation; thus

6	12	5 . . . (2.351 root
63	1309	833 . . .
66	1587	·
695 . . .	162175 . . .	22125 . . .
700	165675	·
7051 . . .	16574551 . . .	5550449
7052	16581603	&c.
7053	&c.	
&c.		

In this operation we may observe that the multiplications and additions, as also the multiplications and subtractions may be performed in one line, as shown in some of our best systems of arithmetic.

It may now be observed, that wherever the operation is terminated without having obtained the correct root, as many more figures except one as the number of figures in the root already obtained may be found by dividing the last remainder by the second coefficient, wanting as many of its last figures as the number of figures to be found.

Thus in the present instance 5550449 divided by 16581 gives 334, which annexed to the part 2·351 of the root already found gives 2·351334, which is true to the last figure.

This operation will admit of a proof at every step, which may be done by the following rule:

Consider the coefficients and remainder from which the step to be proved is found as whole numbers, and the figure of the root as a decimal in the place of tenths; then add into one sum the cube of the new figure, the product of the first coefficient and the square of the new figure the product of the second coefficient, and the new figure itself together with the last remainder; then, if the work is right, the sum will be equal to the preceding remainder or absolute number.

Example.—The coefficients and absolute number by which the third figure of the root 5 in the example given are 69, 1587 and 833 considered as whole numbers; then

$$(\cdot 5)^3 = \cdot 125$$
$$69 \times (\cdot 5)^2 = 17\cdot 25$$
$$1587 \times (\cdot 5) = 793\cdot 5$$
$$22\cdot 125 = 22\cdot 125$$
$$\overline{\quad 833\cdot 000 \quad}$$

LIX. *De-*

LIX. *Description of Mr.* Malam's *Gas-Meter**.

As soon as coal-gas came to be extensively applied to the purposes of street illumination and to domestic use as a substitute for lamps and candles, it became an object of great importance to the proprietors and managers of the different gas-works to ascertain with accuracy the quantity of gas expended in proportion to the number of jets or burners made use of.

The essential conditions of any apparatus for this purpose are, that the pressure on the gas while passing through the measurer shall at all times be uniform; and that it shall register truly when that pressure is very small, and when the current of gas is very feeble.

The first gas-meter was constructed by Mr. Clegg, and is secured to the inventor by a patent. It consists essentially of a cylinder, divided into cells, inclosed and revolving in an outer cylinder, which is less than half filled with water. The gas enters laterally through the perforated axle, into that cell of the inner cylinder which happens to be nearest the surface of the water. It displaces the fluid from this cell, consequently destroys the equilibrium of the cylinder, and communicates to it a rotatory motion. When the cell, so filled with gas, has made nearly half a revolution, it comes again in contact with the water, which forces the gas out of the cell into the exterior cylinder, from which it passes into the conducting pipes. A train of clock-work is placed so as to register each revolution of the interior cylinder; and the cubic contents of this being known, of course the whole quantity of gas passing through the machine in a given time is ascertained.

Mr. Malam's gas-meter is constructed on the same general principles, but with such improvements as induced the Society to confer on him a high honorary reward; but whether the machine, in their opinion so improved, is completely open to public use before the expiry of Mr. Clegg's patent, the Society does not presume to determine. *Secretary*.

No. 10, Romney-Terrace, Westminster,
March 10, 1819.

Sir,—Herewith I have forwarded to you a gas-meter of my invention, capable of supplying four Argand burners, each consuming about four cubic feet of gas per hour. In doing so, I am to inform you, that it is now nearly two years since I first put my invention into practice, during which time the action of the

* From the *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, vol. xxxvii. The gold Isis medal of the Society was voted to Mr. John Malam, of Westminster, for this communication, and a model of the machine is placed in the Society's Repository.

meter

meter has been proved in the most satisfactory manner upon the Westminster gas-works. I therefore take the liberty of requesting you will have the goodness to let the meter now sent be brought before the Society of Arts for its consideration. The meter herewith sent being one for actual use, I am now preparing a model of the same dimensions, partly constructed of glass so as clearly to exhibit its operation; and to the model alluded to, I have also attached a dial, and the necessary wheel-work for pointing out the number of revolutions, and consequently the quantity of gas passing through it in any specified time for supplying one or more burners, which I shall be most happy to present to the Society on receiving their commands for my doing so.

I am, sir, &c.

A. Aikin, Esq. Secretary, &c. JOHN MALAM.

References to the Engravings, Plate III.

Fig. 1 is a section across the axis of the machine.

Fig. 2 is a section through the axis.

A A is the outer case of the gas-meter, within which the interior cylinder B B revolves upon the pivots *y z*. The former of these pivots is attached to the inverted pipe D D, which brings the gas into the central chamber E. Hence it is conveyed by the openings *a*, *b*, *c*, *d*, into the compartments or cells B, K, G, H, in rotation, as each of them rises above the level of the water *x x*. The gas is then discharged into the outer case by the openings 1, 2, 3, 4, from which it passes into the regulator by the pipe L.

M M is the outer case of the regulator which is kept full of water; N N is the inner vessel, attached to the exterior one by the hinge *f f*, so as to allow this part with the cone *g* to rise and fall freely.

O is the pipe which conveys the gas into the interior vessel.

P is the exit pipe which transmits the gas to the burners.

Fig. 3 is a cross section of the valve; the use of which is to prevent any gas from passing into the meter, unless a sufficient quantity of water is in the instrument.

R is the inlet pipe to the partition, *i* the cup, *k k* the float, *l l* the clip-pipe which carries off the superfluous water that would otherwise run over through the inverted pipe D till it had attained its level.

Fig. 4 is the dial and pointer which is secured by a strong glass in a brass ring being soldered over it.

Fig. 5 is a section of the counter, showing the wheels and stop.

Fig. 6 is a section of the lever and crank in the trough.

Fig. 7 is a cross section of the crank, the lever, the trough, the wheels, dial and pointer.

The use of the counter is, to register the number of revolu-

tions

tions of the interior cylinder; and, as the capacity of this is known, and the number of teeth in the wheels adjusted accordingly, the dial indicates, on inspection, the number of cubic feet of gas that have passed through the meter since the counter was last set.

Now, supposing the exit pipe R is connected with the great gasometer, or with the street main, and that the gas is flowing in above the partition *h* of the detecting valve, and that there is a proper quantity of water in the machine, the cup *i* will be elevated above the opening in the partition by the float *k*, which, allowing the gas to pass through the inverted pipe D, fills the central chamber E, fig. 1; and, as the opening *a* is above the surface of the water, the gas passes into the compartment G. The water being displaced by the entrance of the gas, and the equipoise being disturbed, the interior cylinder will move on its axis towards the left hand, till the compartment G is filled with gas, the water passing out by means of the exit opening 2. By this time the opening *a* will have sunk beneath the surface of the water, and the opening *b* will have risen above the water, and the gas will continue to flow into the compartment H, till the exit opening 2 rises above the water, and allows the gas in the compartment G to escape into the outer case in proportion as the water enters by the opening *a*. So that the compartments on the left hand are in succession emptied of water and filled with gas, while those on the right hand are filling with water which expels the gas into the outer case. From this it is conveyed by the pipe L, fig. 2, to the regulator; the inner division of which it enters through the pipe O, at the entrance of which is a blunt cone suspended by a piece of wire with swivels attached to the inner vessel N; in this entrance there is a plate with a hole in it, of equal diameter to that of the frustum of the cone: consequently, as the inner vessel rises, the cone closes up the opening in the plate, which action is regulated by the pressure of the gas between the surface of the water and the top of the inner vessel. Thus an uniform pressure is maintained in the inner vessel, and the gas passing from thence by the pipe P to the burners, is also necessarily under the same pressure; the effect of which is, that the flame from the jets is never wavering or intermitting, but always preserves the same height, and with gas of the same quality affords at all times the same quantity of light.

LX. *Thoughts*

LX. *Thoughts on the Probability, Expediency and Utility of discovering a Passage by the North Pole*.*

The interesting nature of the subject to which this paper relates, would at any time justify its publication; but at the present moment it derives an additional value from the recent account of the Discovery Ships, and from the fact that Lieutenant Franklin continues to pursue his journey with the distinct view of exploring the Arctic Regions.

The possibility of making discoveries in this way (that is, by steering directly north), though now treated as paradoxical by many, was not, as will hereafter appear, formerly looked upon in that light, even by such as ought to be reputed the properest judges. There have been a variety of causes, that, at different times, have retarded undertakings of the utmost importance to the human species.

Among these we may justly consider the conduct of some great philosophers, who, as our judicious Verulam wisely observes, quitting the luminous path of experience to investigate the operations of nature by their own speculations, imposed upon the bulk of mankind specious opinions for incontestable truths; which, being propagated by their disciples through a long series of years, captivated the minds of men, and thereby deprived them of that great instrument of science, the spirit of inquiry.

In succeeding ages a new impediment arose, from the setting up profit as the ultimate object of discovery; and then, as might well be expected, the preferring the private and particular gain of certain individuals to the general interests of the community, as well as to the interest of the whole world, in the extension of science. This it was that induced the States General, at the instance of their East India Company, to discourage all attempts for finding a north-east passage, and to stifle such accounts as tended to show that it was practicable.

We may add to these, the sourness of disappointed navigators, who endeavoured to render their own miscarriages proofs of the impracticability of any like attempts. This was the case of Captain Wood, who was shipwrecked upon Nova Zembla, and who declared, that all endeavours on that side were and would be found vain; though Barentz, who died there in a like expedition, affirmed, with his last breath, that, in his own opinion, such a passage might be found.

That the earth was spherical in its form was an opinion very early entertained, and amongst the learned generally admitted. It seemed to be a plain deduction from thence, that a right line,

* From the Hull Packet of November 6, 1820.

passing

passing through the globe, would terminate in two points diametrically opposite. Plato is thought to be the first who spoke of the inhabitants (if such there were) dwelling at or near those points, by the name of Antipodes. This doctrine occasioned disputes among philosophers for many ages; some maintained, some denied, and some treated it as absurd, ridiculous, and impossible. Whoever will examine impartially the sentiments of these great men, weigh the contrariety of their opinions, and consider the singularity of their reasonings, will see and be convinced how unsatisfactory their notions were, and discover from thence, how insufficient the subtle speculations of the human understanding are towards settling points like these, when totally unassisted by the lights of observation and actual experience.

The division of the globe by zones being agreeable to nature, the ancients distinguished them very properly and accurately into two frigid, the Arctic and Antarctic circles; two temperate, lying between those circles and the tropics; and the torrid zone within the tropics, equally divided by the equinoctial. But judging from their experience of the nature of the climates at the extremities of the zone which they inhabited, they concluded, that the frigid zones were utterly uninhabitable from cold, and the torrid from intolerable heat of the sun. Pliny laments very pathetically upon this supposition, that the race of mankind were pent up in so small a part of the earth. The poets, who were also no despicable philosophers, heightened the horrors of these inhospitable regions by all the colouring of a warm and heated imagination; but we now know, with the utmost certainty, that they were entirely mistaken as to both. For within the Arctic circle there are countries inhabited as high nearly as we have discovered; and, if we may confide in the relations of those who have been nearest the Pole, the heat there is very considerable, in respect to which our own navigators and the Dutch perfectly agree. In regard to the torrid zone, we have now not the least doubt of its being thoroughly inhabited; and, which is more wonderful, that the climates are very different there, according to the circumstances of their situation. In Ethiopia, Arabia, and the Moluccas, exceedingly hot; but in the plains of Peru (and particularly at Quito) perfectly temperate, so that the inhabitants never change their clothes in any season of the year. The sentiments of the ancients, therefore, in this respect, are a proof how inadequate the faculties of the human mind are to discussions of this nature, when unassisted by facts.

The Pythagorean system of the universe, revised and restored near two hundred and fifty years ago by the celebrated Copernicus, met with a very difficult and slow reception, not only from the bulk of mankind, for that might have been well expected, but

but even from the learned; and some very able astronomers attempted to overturn and refute it. Galileo Galilei wrote an admirable treatise in its support, in which he very fully removed most of the popular objections. This, however, exposed him to the rigour of the Inquisition, and he was obliged to abjure the doctrine of the earth's motion. Our noble philosopher, the deep and acute Lord Verulam, could not absolutely confide in the truth and certainty of the Copernican system; but seems to think, that its facilitating astronomical calculations was its principal recommendation, as if this had not been also a very strong presumption at least, if not a proof, of its veracity. It was from this consideration that the church of Rome at length thought fit so far to relax in her decisions, as to permit the maintaining the earth's motion in physical and philosophical disquisitions. But Sir Isaac Newton, who built upon this basis his experimental philosophy, has dispersed all doubts on this subject, and shown how the most sublime discoveries may be made by the reciprocal aids of sagacity and observation. On these grounds, therefore, all inquiries of this nature ought to proceed, without paying an implicit submission to the mere speculative notions even of the greatest men; but pursuing steadily the path of truth, under the direction of the light of experience.

It may be urged, in excuse of the ancients, and even of our ancestors in former times, that, as they were unassisted by facts, they could only employ guess and conjecture, and that consequently their conclusions were from thence erroneous. But to waive the visible impropriety of deciding in points where observation was so obviously necessary, without its direction; let us see whether this plea of alleviation may not be controverted in both cases. Cornelius Nepos reports that some Indians being cast on shore in Germany were sent by a prince of the Suevi to Quintus Metellus Celer, then the Roman proconsul in Gaul. A very learned writer, in discussing this point, has shown, that it was possible for these Indians to have come by two different routs into the Baltic. He thinks, however, that it is very improbable they came by either, and supposess, that they were either Norwegians, or some other wild people, to whom, from their savage appearance, they gave the name of Indians. But though this observation may well enough apply to the Romans, who at that time had no knowledge of these northern people, yet it is not easy to conceive, that the Suevi could fall into this mistake; or, if they did not, that they should attempt to impose upon the Romans. It appears incontestably, that in the time of King Alfred, the northern seas were constantly navigated upon the same motives they are now; that is, for the sake of catching whales and sea-horses. Nicholas of Lynn, a Carmelite friar, sailed to the most distant islands in the north, and even as high as the Pole.

Pole. He dedicated an account of his discoveries to King Edward the Third, and was certainly a person of great learning, and an able astronomer, if we may believe the celebrated Chaucer, who, in his Treatise on the Astrolabe, mentions him with great respect.

After Columbus discovered America, under the auspices of Ferdinand and Isabella, the sovereigns of Europe, and especially Henry the Seventh, turned their thoughts towards, and gave great encouragement to discoveries. Mr. Robert Thorne, who resided many years as a merchant in Spain, and who was afterwards Mayor of Bristol, wrote a letter to Henry the Eighth, in which he strongly recommended a voyage to the North Pole. He gave his reasons more at large in a long Memorial to our Ambassador in Spain, which show him to have been a very judicious man, and for those times a very able cosmographer; and accompanied this Memorial with a Map of the World, to prove the practicability of his proposal. Though this project of his was not attended to, yet a variety of expeditions were made for discovering a passage by the north-west, and others by the north-east, into the South Seas on the one side, and into the Tartarian Ocean on the other, until at length both were declared impracticable by Captain James and Captain Wood; soured by their own miscarriages, and being strongly persuaded, that as they did not succeed, none else could. But even these unsuccessful voyages were not unprofitable to the nation upon the whole, as they opened a passage to many lucrative fisheries, such as those in Davis's Straits, Baffin's Bay, and on the coast of Spitzbergen. Besides this, they laid open Hudson's Straits and Bay, with the coast on both sides, which have been already productive of many advantages, and which, in process of time, cannot fail of producing more, in consequence of our being in possession of Canada, and being thereby sole master of those seas and coasts.

It is, however, very remarkable, that, notwithstanding the views, both of our traders and of such great men as were distinguished encouragers of discoveries, the ablest seamen (who without doubt are the best judges) were still inclined to this passage by the north, such as Captain Poole, Sir William Monson, and others; and this was still the more remarkable, as they were entirely guided therein by the lights of their own experience, having no knowledge of Mr. Thorne's proposal, or of the sentiments of each other. From the reason of the thing, however, they uniformly concurred in the motives they suggested for such an undertaking. They asserted, that this passage would be much shorter and easier than any of those by the north-west or north-east; that it would be more healthy for the seamen, and attended with fewer inconveniences; that it would probably open a passage to new countries; and, finally, that the experiment might be made with very little hazard, at a small expense, and would redound highly to our national honour, if attended with success. It may be then demanded, why it has not hitherto been attempted, and what objections have retarded a scheme so visibly advantageous? These objections, as far as they can be collected, are the fear of perishing by excessive cold, the danger of being blocked up in ice, and the apprehension that there could be no certainty of preserving the use of the compass under or near the Pole.

In respect to the first, we have already mentioned, that the ancients had taken up an opinion, that the seas in the frigid zone were impassable, and the lands, if there were any, uninhabitable. The philosophers of later ages fell into the same opinion, and maintained that the Poles were the sources and principles of cold, which of course increased and grew excessive in approaching them. But when the lights of experience were admitted to guide in such researches, the truth of this notion came to be questioned, because from facts it became probable, that there might be a diversity of climates in the frigid as well as the torrid zone. Charlton Island, in which Captain James wintered, lies in the bottom, that is, in the most southern part of Hudson's Bay, and in the same latitude with Cambridge, and the cold there was intolerable. The servants of the Hudson's Bay Company trade annually in places ten degrees nearer the Pole, without feeling any such inconvenience. The city of Mosow is in the same latitude with that of Edinburgh, and yet in winter the weather is almost as severe there as in Charlton Island. Nova Zembla has no soil, herbage, or animals; and yet in Spitzbergen, in six degrees higher latitude, there are all three; and, on the top of the mountains, in the most northern part, men strip themselves of their shirts that they may cool their bodies. The celebrated Mr. Boyle, from these and many other instances, rejected the long received notion, that the Pole was the principle of cold. Captain Jonas Poole, who in 1610 sailed in a vessel of seventy tons to make discoveries towards the north, found the weather warm in near 79° of latitude, whilst the ponds and lakes were unfrozen; which put him in hopes of finding a mild summer, and led him to believe that a passage might be as soon found by the Pole as any other way whatever; and for this reason, that the sun gave a great heat there, and that the ice was not near so thick as what he had met with in the latitude of 73°. Indeed, the Dutchmen, who pretend to have advanced within a degree of the Pole, said it was as hot there as in the summer at Amsterdam.

In these northern voyages we hear very much of ice, and there

is

is no doubt that vessels are very much hindered and incommoded thereby. But after all, it is, in the opinion of able and experienced seamen, more formidable in appearance than fatal in its effects. When our earliest discoveries were made, and they reached further north than we commonly sail at present, it was performed in barks of seventy tons, with some trouble, no doubt, but with very little hazard. At this day it is known, that in no part of the world are there greater quantities of ice seen than in Hudson's Bay; and yet there is no navigation safer, the Company not losing a ship in twenty years, and the seamen, who are used to it, are not troubled with any apprehensions about it. It is no objection to this, that we hear almost every season of ships lost in the ice on the Whale Fishery; for these vessels, instead of avoiding, industriously seek the ice, as amongst it the whales are more commonly found than in the open sea. Being thus continually amongst the ice, it is no wonder that they are sometimes surrounded by it; and yet the men, when the ships are lost, generally speaking, escape. But in the seas near the Pole, it is very probable there is little or no ice, for that is commonly formed in bays and rivers during the winter, and does not break up and get into the sea till the latter end of March or the beginning of April, when it begins to thaw upon the shores. It is also, when formed, very uncertain as to its continuance, being broken and driven about by the vehemence of the winds. As a proof of this we have an instance of a vessel frozen in one of the harbours of Hudson's Bay, which, by the breaking of the ice, drove to sea, and, though it was Christmas, found the Straits quite free from ice, which are frequently choked with it in May and June, and made a safe and speedy passage home. All our accounts agree, that in very high latitudes there is less ice. Barentz, when his ship was frozen in Nova Zembla, heard the ice broken with a most horrible noise by an impetuous sea from the north, a full proof that it was open. It is the invariable tradition of the Samoides and Tartars, who live beyond the Waygat, that the sea is open to the north of Nova Zembla all the year; and the most knowing people in Russia are of the same opinion. These authorities ought certainly to have more weight than simple conjectures.

The notion, that approaching to a passage under the Pole would destroy the use of the compass, is a popular opinion without any just grounds to support it. For it presumes that the needle is directed by the Pole of the World; which it certainly is not, as appears from the needle's variation, and even the variation of that variation, which, if this notion was true, could never happen. In Sir Thomas Smith's Sound in Baffin's Bay, the variation was found to be 56° westward, the greatest yet known. Captain Wood is very clear upon this point, and main-

 tains,

tains, that no danger was to be apprehended from this cause. Those who asserted, that they had advanced within a degree of the Pole, estimated the variation there at five points of the compass. Captain Wood, in stating the account given of the Dutch seamen's voyage by Captain Goulden, omits one very material point, of which we are informed by Mr. Boyle, which is, that one of the Dutch captains coming over to England, Captain Goulden carried him to some of the Northern Company, who were perfectly satisfied as to the truth of his relation. On the whole, therefore, whether we respect reason or facts, there are no just grounds for apprehensions on this head, more especially as there are other means by which the true situation of a vessel might be determined, and the difficulty, if any arose, would be of very short continuance.

As notions long received acquire from thence a degree of credit due only to truth; and as new opinions, contrary to these, and in other respects perhaps extraordinary in themselves, meet from these causes with slow and difficult belief, however they may appear to be supported by arguments, authorities, or facts (which it is presumed have been freely and fairly urged in the present case, to a degree that may at least entitle the matter to some attention); let us now proceed one step further. This shall be to show, that what seems to be so repugnant to the common course of things (viz. that near the North Pole the cold should relax, and the ice be less troublesome) is perfectly conformable to the laws of nature, or, which is the same thing, to the will and wisdom of our great Creator. If this can be proved, there can be no further dispute as to the possibility of this passage; more especially when it shall also appear, that this affords a full solution of all the doubts that have been suggested, and at the same time clearly accounts for, and effectually confirms, the facts and reasonings deduced from them, which have been already advanced upon this subject. To come, then, at once to the point.

Sir Isaac Newton, who it is universally allowed was equally accurate, cautious and judicious, in his philosophical decisions, has demonstrated clearly, that the figure of this our earth is not spherical, but of an oblate spheroidal form, the diameter at the equator being the greatest, and at the axis the least of all the lines that can pass through the centre. He also determined, by a most curious calculation, the proportion of these diameters to be as two hundred and thirty to two hundred and twenty-nine. These sentiments of his have been experimentally verified by the means which he also pointed out, viz. observing the motion of pendulums in very different latitudes, and the actual measurement of a degree at the Equator and under the Arctic Circle. This last evidently proved the depression of the earth's surface

towards

towards the Pole, which no doubt gradually increases. The very learned and sagacious Dr. Hooke asserted in one of his lectures, and brought very strong reasons to show, that there is nothing but sea at the Poles. These points then, being maturely considered, will be found to militate in favour of a free passage this way, and at the same time give much light into other things that have been advanced in the course of this inquiry, by showing the true causes of those facts that, at first sight, have appeared to many very strange and unaccountable. For example, if there be no land near the Pole, then there can be no bays in which ice can be formed to interrupt the navigation. Again, the rays of the sun, falling on so flat a surface, and being continually reflected from the water, must afford a great degree of heat to the air. At the same time this will account for the sun's being seen by the Dutch in Nova Zembla a fortnight earlier than he should have appeared according to astronomical calculations. Many other circumstances might be mentioned, but these will doubtless occur to the intelligent, and therefore it is unnecessary to dwell longer upon them.

LXI. *Notices respecting New Books.*

THE Philosophical Transactions, Parts I. and II., for 1820, have made their appearance, and the following are their contents:

I. The Croonian Lecture. A further Investigation of the component Parts of the Blood. By Sir Everard Home, Bart. V.P.R.S.—II. The Bakerian Lecture. On the Composition and Analysis of the inflammable gaseous Compounds resulting from the destructive Distillation of Coal and Oil, with some Remarks on their relative heating and illuminating Powers. By William Thomas Brande, Esq. Sec. R.S. Prof. Chem. R.I.—III. On the Elasticity of the Lungs. By James Carson, M.D. Communicated by Thomas Young, M.D. For. Sec. R.S.—IV. On the Action of crystallized Bodies on homogeneous Light, and on the Causes of the Deviation from Newton's Scale in the Tints which many of them develop on Exposure to a polarised Ray. By J. F. W. Herschel, Esq. F.R.S. Lond. and Edin.—V. A Case of the human Fœtus found in the Ovarium, of the Size it usually acquires at the End of the fourth Month. By A. B. Granville, M.D. F.R.S. In a Letter addressed to Sir Everard Home, Bart., V.P. R.S.—VI. On some Combinations of Platinum. By Edmund Davy, Esq. Professor of Chemistry, and Secretary to the Cork Institution. Communicated by F. Babington, M.D. F.R.S. —VII. On the Methods of cutting Rock Crystal for Micrometers. By William Hyde Wollaston, M.D. F.R.S.—VIII. On a new

new Principle of constructing Ships in the Mercantile Navy. By Sir Robert Seppings, F.R.S.—IX. On the Milk Tusks and Organ of hearing of the Dugong. By Sir Everard Home, Bart., V.P.R.S.—X. Upon the different Qualities of the Alburnum of Spring- and Winter-felled Oak Trees. By Thomas Andrew Knight, Esq. F.R.S.—XI. On the Mode of Formation of the Canal for containing the Spinal Marrow, and on the Form of the Fins (if they deserve that Name) of the Proteosaurus. By Sir Everard Home, Bart. V.P. R.S.—XII. Some Experiments on the Fungi which constitute the colouring Matter of the Red Snow discovered in Baffin's Bay. By Francis Bauer, Esq. F.L.S. In a Letter addressed to the Right Hon. Sir Joseph Banks, Bart. G.C.B. P.R.S.—XIII. Some Account of the Dugong. By Sir Thomas Stamford Raffles, Governor of Sumatra. Communicated in a Letter to Sir Everard Home, Bart. V.P.R.S.—XIV. Observations on the Human Urethra, showing its internal Structure, as it appeared in the Microscope of F. Bauer, Esq. By Sir Everard Home, Bart. V.P.R.S.—XV. On the Errors in Longitude as determined by Chronometers at Sea, arising from the Action of the Iron in the Ships upon the Chronometers. By George Fisher, Esq. Communicated by John Barrow, Esq. F.R.S.—XVI. An Account of a new Mode of performing the High Operation for the Stone. By Sir Everard Home, Bart, V.P.R.S.—XVII. A Sketch of an Analysis and Notation applicable to the Estimation of the Value of Life Contingencies. By Benjamin Gompertz, Esq. F.R.S.—XVIII. On the Measurement of Snowdon by the Thermometrical Barometer. By the Rev. F. J. H. Wollaston, B.D. F.R.S.—XIX. On Sounds inaudible by certain Ears. By William Hyde Wollaston, M.D. P.R.S.—XX. Particulars respecting the Anatomy of the Dugong, intended as a Supplement to Sir T. S. Raffles's Account of that Animal. By Sir Everard Home, Bart. F.R.S.—XXI. On the Compressibility of Water. By Jacob Perkins, Esq. Communicated by the late Right Hon. Sir Joseph Banks, Bart. G.C.B. P.R.S.—XXII. Astronomical Observations. By Stephen Groombridge, Esq. F.R.S.

On Mr. HOLDRED's *Tract entitled* "A new Method of Solving Equations," *&c. and Mr.* NICHOLSON's "Essay on Involution and Evolution."

To Mr. Tilloch.

SIR,—IF you will insert the inclosed in your Philosophical Magazine, you will greatly oblige

Your humble servant,

THEOPHILUS HOLDRED.

SINCE

Since the publication of my Tract, entitled "A new Method of solving Equations," &c. Mr. Nicholson has added a Postscript to his Essay on Involution and Evolution, for the purpose of reprobating me, as if I had injured him, instead of his having injured me.

In my original manuscript I had written the letter *a* for the unknown root, and the letter *g* for the first assumed root. Mr. Nicholson would insist I should not be understood, unless I wrote *x* for the unknown root; the *g* also displeased him by its having so long a tail. I had also the initials of two alphabets of capital letters. Mr. Nicholson recommended to use but one, and to make the distinction by a small figure underneath.

After Mr. Nicholson had discovered another demonstration, he requested me to annex it to my Tract, by way of Supplement; lest any other person should discover the same way of demonstrating the rule after it should be published, as quick as he had done before; by which he should lose the honour of being first. This being agreed to, he requested me to adopt his notation, in the general demonstration, to pave the way to his Supplement; for which I have been blamed by a very good mathematician. Many more words appeared to be necessary to explain the matter, than by the old notation.

Mr. Nicholson did recommend arithmetical equivalents; but I saw no reason why he should be complimented as the inventor, since he took it from Mr. Henry Briggs, the calculator of logarithms. It is very convenient for practice, but has nothing to do with the theory.

I was master of the figurate method in theory in the year 1780, but poverty kept me from publishing or practising it: and had it not been for Mr. Robert Gibson, I doubt if it would have been published yet.

In October 1818 Mr. Nicholson put an article into the Philosophical Magazine, showing how to cube a number in a manner which was the reverse of my method of extracting the cube root. It would be a great satisfaction to me, if I could certainly know whether Mr. Horner had any idea of solving equations, by means of the figurate numbers, before that circumstance; or whether it were in consequence thereof. It is certainly remarkable, that no one seemed to have any idea of the kind, until I communicated it to Mr. Nicholson.

After the manuscript was re-written, upon looking over some examples in the old manuscript, I was surprised at Mr. Nicholson's saying, "Why this would have been easy enough understood." I am indeed of Mr. Nicholson's opinion; for if it could not be understood, none of the ancient authors could have been understood; all the examples being in the same form with all the ancient authors.

At

At page 60 Mr. Nicholson has given an example, in which, after the subtrahend is formed, the figures necessary to produce the coefficients for the next step are none of them exhibited. Mr. Nicholson calls it his own; but in my opinion he ought to call it his way of working my rule. In the next page he falsely asserts that higher multipliers than 9 are necessary in my method.

The method I have given at the end of my Supplement, Mr. Nicholson calls Mr Horner's method; and says I have been anticipated by himself in point of publication: but it resembles Mr. Horner's in no respect, but there being no regard had to the figurate numbers; so that I have been anticipated by no one in this method; but Mr. Nicholson has taken good care that I should not be long before him, he having made use of it, without any alteration in principle, in that very Postscript, written to reprobate me for having said a little of the truth concerning him. He has left out the products and the constant figures, which he would have the reader to think is a great improvement. As to leaving out the products, it would have been perfectly easy and natural to me, who learnt the short Italian method of division when a child at school, which I could prove to any one by showing my first ciphering book; in which method the multiplication and subtraction are performed together in one line. I have recommended this method of division to several; but the common answer I have had is, that it would be ill done to add any burden to the memory, for the sake of saving the writing down a few figures. Upon recommending it to a teacher, he said, I could not form any idea of the trouble with young boys and girls, when any thing is imposed on their memory; which made me think the generality of authors on arithmetic must be of the same opinion, since so few of them take any notice of that method of division. This consideration has made me write down the subtrahends throughout the whole tract; thinking it was not my office to teach another kind of arithmetic, but to show principle.

In June or July 1819 Mr. Robert Gibson told Mr. Nicholson that I had made an improvement in the method of solving equations, beyond which (I believed) nature could not go; so that Mr. Nicholson need not pretend to think that it could have been derived from what he published in the following May.

In a letter I wrote to a subscriber at Woolwich, dated December 1, 1819, I spoke of this method (I being then waiting impatiently for the printing of it); my words were: *In which there will be found a method of solving equations, with great ease, without any regard to figurate numbers, in addition to my first method.*

I showed the method to a subscriber, Mr. Jonathan Horn, of Bowes

Bowes in Yorkshire, in the house of Mr. Bayles, in the Strand, on Monday, January 3, where Mr. Horn was on a visit. This was long before Mr. Nicholson's publication, which he pretends (in one place) contains my method, and a little further on, says it is superior; but that he does not think it superior, is obvious from his having instantly adopted mine. He has not altered the principle, but has disguised it, and made it look shorter by not exhibiting all the figures.

It may be inquired, what made the Tract so long coming out. To which I can only give the following hints: In June 1819, a printer had the manuscript in hand, who declined printing it, because I could not put ten pounds into his hands before he commenced the work. An advance of money was also asked by the printer who did print it at last; and Mr. Robert Gibson prevailed on him to begin without, by saying he would see it paid. It proceeded slowly, being about nine months in hand, although it came out earlier than Mr. Nicholson represents.

What idea Mr. Nicholson means (in page 64) that he communicated to me, I am at a loss to know. If it were any thing relative to figurate numbers, I certainly stood in no need of any hint from him on that subject; but Mr. Nicholson is so sublime in his ideas, that there is no following him: and he loses himself, and forgets what is more natural, or he would not expect to find a rational root in decimal parts when it cannot be found in whole numbers; none of the numbers in the given equation having any decimal parts, which certainly is his meaning at page 79.

The true account I have given in my preface, together with the demonstration in the Supplement, clearly prove the simplicity of the ideas which produced it. I have not been beholden to Mr. Nicholson for any of his complicated ideas. The abstruseness of his notation in his Essays on the combinatorial Analyses, renders that book of little use to those who get hold of it.

Mr. Nicholson has called my demonstration in my Supplement, a clumsy demonstration; he has therefore invented a neat demonstration of his own. There is no doubt but Nr. Nicholson will understand his own neat demonstration; but I do not expect that one out of ten will besides himself.

I knew nothing at all about Mr. Horner's nonfigurate method until Mr. Nicholson's Essay on Involution and Evolution came to my hand. The Evolution is not his own, but mine and Mr. Horner's; and his Involution is only Evolution reversed (like the article he put into the Philosophical Magazine of October 1818); so that no merit attaches to Mr. Nicholson for that work.

In Mr. Horner's nonfigurate method, multiplying and adding in one line is indispensably necessary, which has been the means of Mr. Nicholson's learning it; I have seen him work division, and he always did it by the long Italian method, in which the products are written down.

Mr. Nicholson must have an ill intention in wondering that I should have made no mention of Mr. Horner; I should have made no mention of Mr. Nicholson, if I had not thought myself ill-used by him.

I had the Supplement complete in theory, in the month of May 1819; my object was to dispense with the figurate numbers (as related in the preface), which are so inconvenient in equations above the fifth or sixth powers as to render it necessary to have recourse to the abridged method. The dispensing with the arithmetical equivalents was not in my thoughts, as is evident from those numbers being used in the Supplement. I had no thoughts of a complete example being necessary, not doubting whoever understood the theory would know how to put it in practice.

Afterward, considering the arithmetical equivalents needless, I made several trials in solving equations; and finding various advantages attend the not making use of them, I thought an example in that form could not be deemed superfluous; I therefore added the last example afterwards: all the rest had been in the printer's hands from the first.

Mr. Nicholson is not perfectly consistent with himself in all parts. While in some places he seems to acknowledge my being the inventor, in other places he seems to deny it as much as he can. In page 81, he says: "I am confident that he never had any clear notions of treating the subject. The sum of the whole is, that he submitted his work to me for my opinion," &c. But the fact is as follows: I having prepared the manuscript for the press, but dreading the thoughts of being in debt with a printer, without a prospect of being able to pay in a reasonable time, was eager to get as many subscribers as possible; and being persuaded that a recommendation from Mr. Nicholson would be of service, I applied to him for that purpose. He readily said he would be willing to do that; but he must see it first, in order to know what he was to recommend: the manuscript was therefore put into his hand. He afterwards recommended such alterations in the notation, as to make it necessary to write it all over again. This being done, he wrote a recommendation on the inside of one of his book covers, and read it to me, when no third person was present. I asked him to let me have it; he answered he would publish it himself. I then informed Mr. Robert Gibson, of Hampstead, of this affair, who said he would endeavour

endeavour to get it for me. He accordingly took a friend with him, and succeeded. But Mr. Gibson informed me that Mr. Nicholson gave it with seeming reluctance.

At page 49 of his Essay on Involution and Evolution, Mr. Nicholson informs us, that his examples were wrought in the year 1818, and January 1819, so that he was preparing his examples while I was rewriting my manuscript. This does not well agree with what he says in his Postscript, page 82, that he had no intention to publish a separate work in competition with mine.

My work was complete before he saw it. I had nothing to extract from him; Mr. Nicholson extracted all from me, even his demonstration is derived from mine, by reversing the equation. He has no where accused me of making use of his demonstration, though he has not scrupled to publish my discovery.

No. 2, Denzell-street, Clare-market. THEOPHILUS HOLDRED.

Recent Publications.

Illustrations of the capital Operations of Surgery, Trephina, Hernia, Amputation, Aneurism, and Lithotomy. Part I. Imperial 4to. By Charles Bell, Esq. The Work is to consist of five Parts; Plates either plain or coloured.

An Account of Timbuctoo and Housa; by El Hage Abdsalam Shabeeny; with Notes critical and explanatory, and Letters descriptive of Travels through West and South Barbary, and across the Atlas Mountains. By James Grey Jackson, Esq.

A Guide to the Stars, being an easy Method of knowing the relative Position of all the principal fixed Stars. By Henry Brooke. 4to. 15*s*.

An Analytical Calculation of the Solar Eclipse of 7th September 1820. By D. MacGregor. 8vo. 3*s*.

Pomarium Britannicum; an Historical and Botanical Account of Fruits known in Great Gritain, with coloured Plates relating to the Parts of Fructification. By Henry Phillips. Royal 8vo. 1*l*. 1*s*.

The Botanist's Companion; or, An Introduction to Practical Botany and the Uses of Plants. 2 vols. 12mo. 12*s*.

The British Botanist. 16 Plates. 12mo. 7*s*. 6*d*.

Sketches representing the Native Tribes, Animals and Scenery of Southern Africa. By William Daniell, Esq. 4to. 3*l*. 3*s*. Proofs on India Paper 4*l*. 4*s*.

Picturesque Scenery on the River Meuse and its Banks, from Drawings by G. Arnold, A.R.A. No. 11, containing six Plates. 1*l*. 1*s*.

No. VI. of the English Lakes, containing four highly-coloured Engravings, with descriptive Letter-press. Demy 4to. 6*s*.

Pyne's History of the Royal Residences, with 100 coloured Engravings; 3 vols. 4to. 24 guineas. Large paper 36 guineas.

Zoological Illustrations; or, Original Figures and Descriptions of new, rare, or otherwise interesting Animals, &c. By William Swainson, F.L.S. M.W.S. &c. No. I. 4to. 4*s*. 6*d*.

No. XXII. of the Cabinet of Arts. Royal 4to. 3*s*.

The Rudiments of linear, plane and solid Geometry. By N. J. Larkins. 12mo. 4*s*. 6*d*.

The Horticultural Repository, containing Delineations of the best Varieties of the different Species of English Fruits, &c. No. I. Royal 8vo. 5*s*.

Dr. Shaw's Select Cabinet of Natural History. 6*s*.

Atkinson's Compendium of the Ornithology of Great Britain, with reference to the Anatomy and Physiology of Birds. 3*s*. 6*d*.

A Picturesqure Tour from Geneva to Milan, by Way of the Simplon; 36 coloured Plates and a Map. 2*l*. 12*s*. 6*d*.

A Treatise on Topography, in which the Science and practical Detail of Trigonometrical Surveying are explained; together with their Application to Surveying in general. 2 vols. 8vo. 1*l*. 6*s*.

An Arabic Vocabulary and Index for Richardson's Arabic Grammar. By James Noble. 4to. 10*s*. 6*d*.

Preparing for Publication.

The Elements of Geology; by John MacCulloch, M.D. F.R.S. E. 8vo.

Flora Scotica; or, Description of the Plants indigenous to Scotland and the Isles; by W. J. Hooker, LL.D. F.R.S.L. & E., Regius Professor of Botany in the University of Glasgow. 1 vol. 8vo.

Transactions of the Association of Fellows and Licentiates of the King's and Queen's College of Physicians in Ireland. vol. 3. 8vo.

A His-

A History of the various Species of Palsy, with the Method of Cure; being the first Part of the second Volume of Dr. Cooke's Treatise on Nervous Diseases.

Recollections of a Classical Tour made in 1818 and 1819 in Turkey, Greece and Italy. By P. E. Laurent, Esq. 4to.

Account of a new Method of making dried Anatomical Preparations, in such a Manner as to prevent offensive Smell, and the destructive Effects of Heat, Damp, and Insects, &c. By Mr. John Swan, of the Royal College of Surgeons, Surgeon to the Lincoln County Hospital.

Remarks during a Tour through the United States of America in 1817, 1818 and 1819. By William Tell Harris.

An Essay on the medical Application of Electricity and Galvanism. By Mr. Price.

A detailed and embellished Prospectus of a Work to be entitled "Physiognomical Portraits" will be published on the first of December.

The Young Navigator's Guide to the Sidereal and Planetary Parts of Nautical Astronomy. By Mr. Kerrigan, of the Royal Navy.

LXII. *Proceedings of Learned Societies.*

ROYAL SOCIETY.

Nov. 16. A most interesting paper by Sir Humphry Davy, was read On the Magnetising Influence of Galvanism, in which various new and curious experiments on this subject were detailed, which clearly establish the fact, that the Galvanic fluid, directed in a proper manner, is capable of communicating magnetic properties to bars of steel. If steel bars or rods be exposed to the Galvanic current, placed in the direction of the magnetic axis, no effect follows; but if they be placed parallel with the magnetic equator they become magnetic—the end placed to the west becoming the north pole of the new magnet, and that towards the east becoming the south pole. And so great is the Galvanic influence in producing this effect, that it exerts its power at a distance of some inches (even ten or twelve); so that if the steel bar be moved in a circle round the course of the Galvanic current, but always kept parallel to the magnetic equator,

equator, it becomes magnetic. If we rightly heard the paper, it is necessary to the success of these experiments that the Galvanic current be sent not along the bar, but at right angles to it, across its middle: that is, while the direction of the bar is east and west, that of the Galvanic current must be north and south.

These experiments were made in the laboratory of the Royal Institution, and also at the London Institution. They will be understood from the following description:

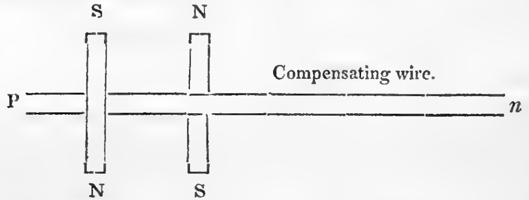
When an electrical or a Voltaic battery of considerable quantity is charged, the compensating or discharging wire becomes magnetic upon the completion of the discharge.

Common needles or small bars of steel placed *transversely* on the wire, or under it, or on its sides, become permanent magnets on the discharge.

If the quantity of electric fluid be very great, contact with the wire is not requisite. In one instance magnetism was communicated at fourteen inches distance from the conducting wire. It was also communicated through plates of glass, and even when the bars or needles were immersed in water.

The annexed simple diagram may perhaps be useful to show the peculiarity of polarization, as it follows steadily the rule indicated.

P Positive end, *n* negative end.
N S Bar *on* the wire—N north, S south.
S N Bar *under* the wire—S south, N north.



At the London Institution the electrical batteries used were from 18 cubic feet to 70 cubic feet. The Voltaic were 12 troughs of four-inch plates, mounted with double coppers agreeable to Dr. Wollaston's plan.

ASTRONOMICAL SOCIETY OF LONDON.

Nov. 10.—The members of this Society met, for the first time this season, at their new apartments in Lincoln's Inn Fields. A notice was read respecting the Pleiades; in which it was stated that

that the Moon was now, and would for the next three or four years continue to be, in such a position with respect to her nodes, as to pass over the Pleiades every lunation, thus affording a favourable opportunity of observing the occultation of those stars. A map of the Pleiades was exhibited, on which the apparent place of the moon, across that remarkable cluster, was laid down, for those particular days when it will be most interesting to the observer.—Some valuable tables were presented by Mr. Groombridge, on the method of reducing observations of the fixed stars; accompanied with instructions for the use of the same.—A communication was made by M. Gauss, of Göttingen, respecting a new repeating circle which had been fixed up in the observatory of that place. This circle was made by Reichenbach, of Munich. The telescope is attached to an axis, *each* end of which rests on a stone pier, similar to a transit instrument: and it is capable of being reversed in the same manner as that instrument. To the axis is annexed a *fixed* circle, three feet in diameter; and also a *moveable* circle bearing the level and verniers, by means of which the repeating principle is obtained. The telescope is five feet focal length; and so powerful that M. Gauss states that he has observed the pole-star, by reflection in water, when nearly on the meridian at mid-day. Several observations of stars, with this instrument, accompanied the communication.

LXIII. *Intelligence and Miscellaneous Articles.*

RETURN OF THE DISCOVERY SHIPS.

The general anxiety that was felt for the safety of His Majesty's ship Hecla and the Griper gun-brig, employed on a voyage of discovery in the Arctic Seas, has been at length happily relieved by the return of these vessels after an absence of eighteen months. The particulars of their voyage will no doubt be given to the public with all possible expedition. In the mean time we give a place to the following letters:

"Griper, at Sea, 22d September, 1820.
"Lat. 68. 07½—Long. 60. 00. W. Baffin's-Bay.

"I am quite well, and have enjoyed perfect health all the voyage, although it has been a hard fagging piece of service for all hands.

"After having encountered the usual delays of an icy sea, and got through the ice in Baffin's Bay, by the first week of August 1819, we got into Lancaster Sound; by the second week we got beyond where the ships had been in the former voyage (they having reached 82 deg. or 83 deg. W. and were stopped by land). We

We were now as far as 90 deg. nothing to stop us but ice, which delayed us some time; but, after repeated trials, we at length succeeded in getting through a passage into the long-looked-for Polar Sea; our course was as much to the west as the ice would admit of. By the first week of September we had reached as far west as 113 deg. W. when we were completely stopped by ice. Winter set in about the middle of September. A harbour was then most anxiously looked for, which we were fortunate enough to put the ships into by the 26th of September. It was a close shave as to time. The sea, or the lanes of water amongst the ice, which we had hitherto navigated, were now entirely frozen over. The ships were housed over, and all things prepared for the winter, which, thank God, we passed pretty comfortably, though cold. We lived on board the ships. Our greatest degree of cold was in January, 52 degrees below zero. Our mean temperature for twelve months was one degree and a half above zero, Fahrenheit. On the 1st of August we got out of the harbour, and resumed our exertions to get to westward: reached 114 deg. W. in the latitude of 74 N.: but all our expectations ended on the 23d of September 1820, when winter reappeared, and no hopes left. We turned our heads to the eastward, and have got thus far on our passage home. Our discoveries are many, in geography—magnet—birds—beasts—fishes, &c. &c. but no inhabitants in the Polar regions. The latitude we wintered at is 74 deg. 47 min. N. 110 deg. 49 min. W.—designated Melville Island."

In addition to the above private letter, we have procured from an authentic source the following particulars, which are highly interesting, as they obviously show that the navigators were in the sea seen by Hearne, and give almost the certain prospect of their being enabled, in a future attempt, to penetrate into the Pacific Ocean through Behring's Straits:

"The Discovery Ships, under Captain Parry, sailed up Lancaster Sound. After passing through it, in an open sea, they reached 115 deg. W. long. and 75 deg. N. lat., which is obviously the sea seen by Mr. Hearne. They returned to W. long. 110. being unable to proceed, owing to the tempestuous weather. In long. 110 they put the vessels into a creek, where the ice was 30 feet thick. Here they remained during the winter for 84 days. The darkness was such, that at noon they could scarcely see the letters of a book printed with large types.

"During the prevalence of the winds the thermometer fell so low as 57½ deg. below zero, at which periods they could not venture into the open air; but when the winds fell, they found the air quite supportable, and amused themselves in shooting partridges and ptarmigans, which they found in great quantities.

Captain

Captain Parry met with no inhabitants, but he frequently saw deserted huts on the shore. Only two of the crew had a slight touch of scurvy.

"The Magnetic Pole appeared to be about 100 deg. of west longitude, as the needle indicated a peculiarity of condition when they were in that meridian. The dip, however, did not exceed 86 deg. so that they were not above the Magnetic Pole."

Another account says—

"We understand that Lieutenant Parry entered by Lancaster Sound, proceeded over Captain Ross's special chart of land, and reached in the parallel of 74 or 75.—114. or 115. W.—about 550 miles further than Captain Ross asserted the Polar Sea to be navigable. In 90. the ships fell in with islands which continued successively till they reached the extreme westerly point of one in 115. where winter overtook them.—They wintered in a snug bay in Lancaster Sound; and did not get clear of the ice till the 5th of August this year. From October till February, or for about 100 days, they were in darkness; but with abundance of wholesome provisions, and other requisite comforts, they passed the time very agreeably. The crew were amused with games of every kind; and occasionally they acted plays for mutual entertainment. On the breaking up of the ice this season, attempts were made to proceed westerly; but immense barriers of ice from the Polar Sea to the northward, shut out all hope of succeeding in the parallel of 74; and before they could return to the eastward and renew the attempt in a lower latitude, the navigable season, which is confined to August and a few days in September, offered no reasonable chance of succeeding this year; independent of which, the provisions would not have held out, in so precarious and dangerous a navigation, for the winter, and the time they would certainly have been frozen up. The existence of a polar sea to the westward of Hearne's river, is incontestably established; and experience has taught those hardy navigators, that in the month of August such a powerful radiation from the land takes place, as to render a channel sufficient to demonstrate the certainty of the existence of a north-west passage, and that a practicable one, but not open to any possible commercial purposes.—In 90. the compasses were useless on board; the attraction of the needle was extreme. The crews of the vessels have conducted themselves as became men in such a momentous expedition, where the breath of every one in his sleeping place formed a sheet of ice over his head in the morning. The ships have been out for about eighteen months, having sailed from Sheerness on the 18th May 1819."

From the London Gazette.

Admiralty Office, November 4, 1820.

Copy of a Letter from Lieutenant William Edward Parry, commanding His Majesty's ship Hecla, (lately employed with the Griper gun-brig on a Voyage of Discovery in the Arctic Seas,) to John Wilson Croker, Esq. dated His Majesty's ship Hecla, West coast of Davis's Straits, lat. 70 deg. 41 min. N., long. 69 deg. 17 min. W. September 5, 1820.

"SIR,—I avail myself of an unexpected opportunity by the Lee, of Hull, whaler, to acquaint you, for the information of my Lords Commissioners of the Admiralty, that His Majesty's ships under my orders succeeded in discovering a passage through Lancaster's Sound into the Polar Sea, and penetrated, during the summer of 1819, as far as the longitude of 112½ deg. west of Greenwich, between the parallels of 74 deg. and 75 deg. north latitude.

"In this space twelve islands have been discovered, and named the Islands of New Georgia, in honour of His Majesty. The expedition wintered in a harbour on the south side of the largest of these islands (called Melville Island), in latitude 74 deg. 47 min. N. and longitude 110 deg. 47 min. W., and proceeded to the westward immediately on the breaking up of the ice at the commencement of the present season, the ships being in perfect condition, the officers and men in excellent health, and with every prospect of the final accomplishment of our enterprise.

"At the south-west end of Melville Island, however, the quantity and magnitude of the ice was found to increase so much, that for 16 days (being above one-third of the whole navigable season in that part of the Polar Sea) it was found impossible to penetrate to the westward beyond the meridian of 113 deg. 47 min. W. In order, therefore, that no time might be lost, I determined to try what could be done in a more southern latitude, and, for that purpose, ran back along the edge of the ice, which had hitherto formed a continuous barrier to the south of us, in order to look out for any opening which might favour the plan I had in view. In this endeavour I was also disappointed; and the season being so far advanced as to make it a matter of question whether, with the remaining resources, the object of the enterprise could now be persevered in with any hope of success, I consulted the principal officers of the expedition, who were unanimously of opinion that nothing more could be done, and that it was, on that account, advisable to return to England.

"In this opinion it was impossible for me, under existing circumstances, not to concur; and I trust that the detailed account of our proceedings, which I shall shortly have the honour to lay before their Lordships, will prove highly satisfactory; and that though

though our exertions have not been crowned with complete success, they will not be found discreditable to the naval honour of our country.

"I beg you will be pleased to acquaint their Lordships, that having proposed to survey the west coast of Davis's Straits, previous to my return, and being desirous of losing as little as possible of the remaining part of the present season which is favourable for the navigation of these seas, I have not considered it right to detain the expedition for the purpose of transmitting, by the Lee, a more full account of this voyage. I shall only therefore add, that having accomplished the object now in view, I hope to reach England by the first week in November.

"I have the honour to be, &c.

"W. E. PARRY, Lieut. and Com."

Admiralty Office, Nov. 4, 1820.

"Lieutenant Parry, accompanied by Captain Sabine of the Royal Artillery, attached to the expedition, arrived at this office this morning.

"Lieutenant Parry states, that the officers and men of both vessels passed the winter without any considerable inconvenience, notwithstanding the intense cold (the thermometer having been so low as 55 deg. below zero); and that only one man was lost, who died of a chronic disease of the heart."

After sailing over the Croker Mountains of Capt. Ross, Lieut. Parry gave to the continuation of Lancaster's Sound the name of Barrow's Sound.

On the north side of Barrow's Sound the voyagers discovered a broad channel, up which they could not descry any land, though the weather was clear and favourable. To the land bounded on the west by this unexplored channel, and on the south by the Sound, the name of New Devon was given. Nearly opposite the channel, *i. e.* on the south side of the Sound, they met with another broad inlet (nearly as broad it seemed as the Sound itself), on which the name of Regent's Inlet was bestowed. The expedition sailed up this inlet a considerable way. The land opposite to New Devon was denominated New Somerset. Many whales and seals were seen about this part. Other places discovered, received names in honour of Major Rennell, Capt. Sabine, and others.

Among the curious discoveries made, was an American musk ox, on Melville Island, the principal of the group of islands in a cove of which this enterprising navigator wintered in 1819. This animal has a large head and shaggy mane resembling the lion. It was the only one of the species seen during the stay of the expedition at that island. A white hare was the only small animal which was met with. It was found upon another island. Partridges were seen in great numbers, and the newly discovered islands also abounded with florescent plants of different unknown species. The huts, of which some vestiges remain, are presumed to have belonged to some Esquimaux, whom chance or enterprise may have carried into these inhospitable regions. Numerous dresses, canoes, &c. &c. have also been brought over from Baffin's Bay, which are constructed with astonishing natural genius, industry, and neatness.

We mentioned the only serious casualty which befell during the wintering of the crews in these high latitudes. Nevertheless the cold was so intense, that the utmost care was necessary to prevent fatal consequences. An idea of this may be formed from the fact, that a servant of Captain Sabine's, on some alarm of fire, ran into the air without covering his hand—it was immediately frost-bitten, and the poor fellow lost three of his fingers. No natives were seen, nor any traces of human beings.

Notwithstanding attempts made to decry the value of the discoveries that are accomplished or contemplated, much commercial benefit has already resulted from the navigation of those trackless seas. The confidence acquired by the experience of Capt. Parry, has this year induced the whalers, who had been intimidated at the horrors of the higher regions, to venture, as was suggested, to the mouth of Lancaster Sound; and the consequence has been, that they have returned with fuller cargoes than were ever known. In fact, the expenses incurred by the voyages of Capt. Ross and Lieut. (now made master and commander) Parry have already been more than repaid to the nation by the full cargoes of the whalers, and the certainty obtained, that they may navigate Lancaster Sound with safety, and always bring home full cargoes.

Perhaps the most surprising and curious information derived from these voyages, is the force of vegetation during the short vegetative season in the northern latitudes; of which the botanic specimens brought home in the Hecla, and the experiments made on the New Georgia Islands, with several of our common garden seeds, afford most striking proofs.—Besides their winter amusements of hunting, &c., the officers of the Hecla invented also some of an intellectual nature. We believe we before noticed they performed plays, to which we might add that they were their own dramatists. The New Georgia Gazette, or Winter Chronicle, of one of the officers, contains some very fair *jeux-d'esprits*, for which the mistakes of some preceding navigators afforded abundant scope. We have been informed, but we know not how correctly, that the *aurora borealis* was, with our voyagers,

voyagers, to the southward. If so, it must be a magnetic phænomenon.

It is the opinion of one of our first hydrographers, that possibly the opening to the south of Lancaster Sound, to which the name of "Prince Regent's Inlet" has been given, extends to Repulse Bay, or to Hudson's Bay.

THE OVERLAND NORTHERN EXPEDITION.

The last accounts from Lieutenant Franklin state his arrival at Great-Bear Lake (W. long. 120°, lat. N. about 67°) where he means to hut for the winter. He could have reached Coppermine River, but not in time to obtain the desired information this season; and he therefore resolved to winter at Great-Bear Lake, and to start with the return of proper weather, so as to have the whole summer before him for the object of the expedition.

SOUNDINGS AT SEA.

In answer to a query by J. K. K. on this subject, I beg to inform him, that a method very similar to that suggested in his letter is in use,—a graduated glass tube of some length, full of air, excepting a known portion, in a curve at the bottom, of any viscous coloured liquid, which being forced up the tube by the pressure of the sea water, indicates, by the mark which it leaves inside the tube, the degree to which the contained air had been compressed, and consequently (if the specific gravity of the sea water be ascertained) the depth to which the instrument had descended. This instrument needs no piston. T.

VOYAGE OF DISCOVERY.

The French corvette L'Uranie, commanded by M. de Freycinet, sailed from New South Wales to pursue her voyage of discovery on the 25th of December last. On getting under weigh she was saluted by the fort, which was returned by the battery from Dawes' Point.

LIGHT-HOUSES.

A new light-house is erecting at the Tower *Des Baleines*, Isle of Rhé. The light will make one revolution in six minutes. In the interval will be four appearances of a white, very brilliant light. At each interval of 90 seconds a very sparkling lustre will be seen for about 15 seconds, and will gradually diminish till it disappear.

The Bey of Tunis has erected a light, maintained by oil, in the anchorage of the Goletta. It is elevated on the top of a mast of the height of 40 feet. It will be of great service in guarding against an error that has often proved fatal, the mistaking the Gulph of Porto Farino for that of the Goletta,

The

The Swedish Board of Marine has announced, that the light-house of the Tower of Carlsten, near Marstrand, will be pulled down and rebuilt in the course of 1822. The light is to be extinguished from the 15th of April 1821.

ISLAND NEAR JAVA RENT ASUNDER.

Japava, 27th Jan. 1820.

"During the late stormy weather, since the 3rd instant, an island, which we find by the map of Java is called Fisherman's Island, has been rent asunder. It is known to the natives under the name of Pulo Pontangan. As soon as the weather will permit, a further investigation will be held respecting this extraordinary event."—*Bat. Courant, Jan.* 1.

LANGUAGES.

According to a "View of all the known Languages and their Dialects," published by M. Fred. Aderburg, counsellor of state to the emperor of Russia, their number amounts to 3,064, viz. in all Asia 937, European 587, African 276, and American 1,264.

ANCIENT MANUSCRIPTS.

Some new discoveries of great interest and importance have been made in the Vatican Library by M. Mai, the principal librarian.

In a Greek *palimpseste* manuscript (where the first writing has been effaced in order to make the parchment serve a second time) containing the Harangues of the orator Aristides, the leared librarian has succeeded in discovering a part of the Extracts of Constantine Porphyrogenetus, belonging to the Chapters of Sentences, Harangues, Succession of Kings, Inventors of Things, and Sententious Answers. As the Byzantine prince had made extracts from a multitude of historical and political works, which have been long lost to the world, this discovery has naturally promised an ample harvest of interesting gleanings. M. Mai announces, that he has discovered parts of the lost books of Polybius, Diodorus Siculus, and Dion Cassius, and fragments of Aristotle of Ephorus, of Timeus, of Hyperides, and of Demetrius Phalereus. The names of some other authors from whom extracts have been made are not given. There are also some fragments of the Byzantine writers, such as Eunapius, Menander of Byzantium, Priscus and Petrus Protector, historic authors of a very interesting period. Among the fragments of Polybius, there is one of the 39th book, in which he announces that the 40th and last was to treat of Chronology.

In another *palimpseste* M. Mai has found a political treatise posterior to the time of Cicero, in which that orator is quoted with many other Greek and Latin authors.

M. Mai

M. Mai has further discovered several speeches of Aristides, seven books of the physician Oribarius, which will be of much value to the physical sciences, fragments of Philo, a copy of Verrines, &c.

It has been also just announced, that in the MSS. of Herculaneum, lately unrolled at Naples, some treatises of Epicurus have been discovered of more importance than any we are yet in possession of. In one of these MSS. there are quotations from a treatise on Political Economy by Aristotle, very different from the work which we possess under that title.

M. de Niebuhr, Prussian minister at Rome, has published some fragments of the Orations of Cicero, of Titus Livius, and of Seneca, accompanied with notes full of profound erudition. It is a valuable present to philologists.

M. Hase, Professor of modern Greek to the School of Oriental Languages at Paris, who has just returned from a literary tour through Italy, has further increased the number of these discoveries. He has found in the Ambrosian Library at Milan a complete MS. of a Byzantine historian, George Acropolite, of whom we have hitherto had nothing but an extract.

Baron Niebuhr, Prussian ambassador to the Holy See, has again discovered and published several manuscript works hitherto unknown. They are chiefly fragments of Cicero's Orations *Pro M. Fonteio* and *Pro C. Rabirio;* a fragment of the 91st book of Livy; and two works of Seneca. He has dedicated the publication to the Pope, by whose favour he was enabled to discover these literary treasures in the library of the Vatican.

The Abbé Amadeus Peyran, professor of oriental languages in the university of Turin, has discovered some fragments of Cicero in a manuscript from the monastery of St. Colomban de Rabbio, a town on the Trebia, in the dominions of the king of Sardinia. This MS. presents important new readings of orations already known, and confirms the identity of several texts that have been tortured by indiscreet critics. It contains also fragments of the orations *Pro Scauro, Pro M. Tullio, In Clodium,* orations unfortunately lost.

A manuscript of Eutropius's Roman History, supposed to have been carried from Rome to Bamberg by the Emperor Henry, the founder of the bishopric of that place, has been found in the Royal Library there by Mr. Jacks the librarian. It is more complete than any of the printed editions, and will probably furnish means for correcting many false readings.

Professor Goeller of Cologne, had previously discovered in the same library a MS. of Livy.

A manu-

A manuscript of the eleventh century, containing illustrations of Juvenal, which was discovered about two years ago in the library of the convent of St. Gallen, by Professor Cramer, is about to be committed to the press. A specimen was published by the Professor on occasion of the king's birth-day, under the title of *Specimen novæ Editionis scholasticæ Juvenalis.*

The French *literati* are occupied at this time in a work of some importance—preparing translations of Plutarch, Salust, Tacitus, Aristotle, Hippocrates, &c. from the Arabic MSS., into which language many or all the best Greek and Roman authors are known to have been translated.

The French ambassador at Constantinople, M. Giardin, lately sent to Paris fifteen valuable MSS. in Arabic, from the Imperial library there, among which are the complete works of Plutarch and Herodotus.

VESUVIUS AND POMPEII.

During a late eruption of Vesuvius a shower of ashes fell on the now uncovered part of Pompeii. M. de Gimbernat, a Spanish naturalist, having compared the substances of which this recent shower is composed, with those which anciently overwhelmed the city, could not find the smallest resemblance between them, and doubts whether that city really was ruined by a shower of ashes. He also observed, within a few days after the eruption, that the crater of Vesuvius was covered with crystals of common salt—a pretty plain indication that the admission of sea-water into the interior of the mountain has something to do with the phænomenon.

POMPEII.

A public edifice, supposed to be the Chalcidium, and an inscription importing that the edifice was built at the expense of the priestess Eumachia, has lately been excavated at Pompeii, near the forum. A statue of the same priestess was found a few days after in perfect preservation. This is one of the best statues yet found there.

AN EXAMPLE THAT OUGHT TO BE FOLLOWD.

The iron masters of Sweden have settled an annuity of 500 crowns on M. Berzelius, in consideration of the services that meritorious philosopher has rendered to the arts dependent on chemistry, and to manufactures of several kinds, by his discoveries and communications.

VERATRINE ALKALI.

We announced in our last volume, p. 67, that MM. Pelletier and Caventan had discovered a new alkali in the seeds of the *Veratrum Sabadilla,* or Cevadilla: it has been found also by these chemists in the *Veratrum album,* or white hellebore, and in the

Col-

Colchicum autumnale, or meadow-saffron. It has been named *Veratrine.*

The seeds of the Cevadilla were those principally operated on. Ether separates from them a yellow, greasy, unctuous acid substance, being a mixture of elaine, stearine, and a peculiar acid. [*See next Notice.*] The seeds were then boiled in alcohol, which on cooling deposited a little wax. The solution was evaporated to an extract, re-dissolved in water, and again evaporated, during which some colouring matter was precipitated. On pouring acetate of lead into the solution, an abundant yellow precipitate fell, leaving the liquid nearly colourless. The excess of lead was precipitated by sulphuretted hydrogen, and the filtered liquor concentrated by evaporation was treated with magnesia and again filtered. The precipitate boiled in alcohol yielded a solution, which being evaporated left a pulverulent matter extremely bitter, and with decidedly alkaline characters. This matter was yellow; but being dissolved in alcohol and precipitated by water, a fine white powder was produced.

The precipitate by the acetate of lead was found to contain gallic acid; and hence it was concluded that the new alkali existed in the seed as a gallate.

Veratrine is white, pulverulent, without smell, but excites violent sneezing: it is very acrid, but not bitter; produces violent vomitings in so small doses, that, according to some experiments, a few grains may cause death: it is but little soluble in cold water: boiling water dissolves about a thousandth part, and acquires an acrid taste: it is very soluble in alcohol, and less so in ether: it melts at 50° of the centigrade therm. = 122 Fahr., and then appears like wax: when cooled it becomes an amber-coloured translucid mass: heated more highly it swells, is decomposed, and burns: decomposed by oxide of copper it gives no indication of nitrogen: it acts on test papers as an alkali, and forms uncrystallizable salts by evaporation; these salts appear like a gum.

The super-sulphate alone appears to form crystals. Strong solutions of these salts are decomposed partially by water: veratrine is thrown down, and the solution becomes acid. The sulphate appears to be composed of

Veratrine	93·723	100·0000
Sulphuric acid	6·227	6·6441

In both there was an excess of acid. Supposing it an acid salt, and in analogy with the salts of brucine, the neutral salt will consist of

Veratrine	100·000
Sulphuric acid	3·322

The muriate contains

Veratrine	95·8606	100·0000
Muriatic acid	4·1394	4·3181

 Iodine

Iodine with Veratrine produces a hydriodate and an iodate; Chlorine, a muriate and a chlorate.

Cevadilla was found ultimately to contain elaine, stearine, cevadic acid, wax, acid gallate of veratrine, a yellow colouring matter, gum, lignin, and ashes. White hellebore analysed in the same manner, gave nearly the same results; but was found to contain also starch, and the ashes varied a little in the salts they contained. Both contained carbonates of lime and of potash, also silex: the Cevadilla contains also muriate of potash; and the white hellebore sulphate of lime.

The Colchicum, examined in precisely the same manner, gave the same results, but with the addition of inuline. The ashes were in so small a proportion as not to call for attention.

CEVADIC ACID.

This acid is obtained by distilling the greasy, unctuous acid substance (mentioned in the preceding notice), saturating what passes over with barytes, and evaporating to dryness, which produces a white salt. An addition of phosphoric acid caused the appearance of crystals; and distilling at a low heat made the acid pass over. This acid is crystallizable, soluble in water, fusible, and volatile at a low temperature; soluble in ether and in alcohol, and capable of forming salts with bases.

GALVANIC MAGNETISM.

In our notice of the proceedings of the Royal Society (p. 381 of the present Number) we have given a brief account of Sir Humphry Davy's recent interesting electro-magnetic experiments. We have here to notice also an important result obtained by Professor Oersted. He states that a plate of zinc (about three inches high and four inches broad) placed in, and by an arch of small wire connected with a trough nearly fitting it, made of thin copper and containing a mixture of one part of sulphuric acid, one part of nitric acid, and 60 parts of water, forms an apparatus, which, being suspended by a very small wire (only sufficiently strong to bear its weight), will, if a powerful magnet be presented to it, exhibit magnetic polarity—turning its corresponding pole to the pole of the magnet. The suspending wire is attached to the apparatus by a thread rising from one side of the trough to the wire, and descending to the other side of the trough; and the plate of zinc is kept from coming in contact with the copper case, by a piece of cork interposed on each side of the plate.

STATISTICS, ETC.

France. It appears from a late publication of the Academy of Sciences, that Paris contains 714,000 inhabitants, of whom

25,000

25,000 are not domiciled. The average number of births annually is 21,000, and of these, the proportion of males to females is as 25 to 24. The annual consumption of bread is 113,880,000 kilogrammes; of oxen 70,000; of heifers 9,000; of calves 78,000; of sheep 34,000; of swine 72,000; of eggs 74,000,000; of pigeons 900,000; of fowls 1,200,000; of wine 870,000 hectolitres.

Sweden. By the census taken in 1819, the population of the kingdom appears to be 2,543,412. The births in that year were 2329, and the deaths 3238—difference 909. Nearly a half of the children are born out of marriage. One out of three children have invariably died. Marriages 504, and divorces 24.

Prussia. From reports drawn up in 1819, it appears that all the States, exclusive of Neufchatel, comprehend 5014 square geographical leagues (15 to a degree of the equator, equal to 25 French leagues) or 2,202,541 acres Rhenish measure, with 10,800,112 inhabitants, including the military. All the great bodies of water occupy about 2,202,541 acres—about a 49th part of the whole surface. It results from a census by the police, that at the end of 1818 the population had been augmented 75,000, by foreigners having settled there: in Berlin alone were enumerated 1042 males and 1728 females that had arrived there in 1819 to seek employment as domestics.

The whole population of Greenland, according to the last Report of the Missionary Board, consists of 3586 individuals, spread through 17 colonies on the western coast. The interior is not habitable, owing to accumulations of ice. The population has increased 714 since the year 1789.

The entire population of the Tyrol and the Voralberg in 1819 consisted of 355,030 males and 377,052 females. Total 732,082. In the Voralberg alone the individuals were 81,966. The increase since 1808 has been very considerable.

REMEDY FOR MILDEW ON WHEAT.

Dr. Cartwright, to whom the agriculturists of the kingdom lie under great obligations for numerous improvements, has discovered that a solution of common salt, sprinkled on corn infected with mildew, completely removes the disease. In the year 1818, he was engaged in a series of experiments to ascertain the minimum of salt that would be required to destroy vegetation in certain weeds, as coltsfoot, bindweed, the common thistle, &c. The salt it was found had very little effect on weeds or other vegetables, when they had arrived at that stage in which they cease to be succulent and are becoming fibrous; but as soon as the rain washed the salt down to their roots, if in sufficient quantity, they languished and died. Happening to have some wheat at the time that was mildewed, the Doctor reasoned thus: The mildew is known to be a fungus, whose roots being in the straw of the corn, cannot, therefore, be very deep; if I sprinkle the corn with a solution of salt, why should not the fungi languish and die as well as weeds when properly dosed at their roots with salt? The experiment was tried, and the result such as was anticipated, and without any injury to the wheat, salt having no injurious effect on fibrous matter, whether vegetable or animal. The expense in this case ceases to be any object; for six or eight bushels will serve an acre, which, at the price of salt applied to agriculture, will be under twenty shillings, and this will be more than repaid by the improvement of the manure arising from the salted straw. Two men, one to spread, and the other to supply him with the salt water, will get over four acres in a day. The operation of the remedy is very quick: in less than eight-and-forty hours even the vestiges of the disease are hardly discernible. Its efficacy has been completely verified by more recent experiments.

ORGANIC REMAINS.

The Calcutta Mirror of 23rd March last contains a letter from Dr. Tytler, announcing that in an expedition to Kallingar he picked up a fossil *oyster-shell* on the summit of a high hill, above the village of Bheeamow, *in union with granite and basalt rocks.* "This proves that these hills were formerly all under water." Dr. Tytler has met with something still more wonderful. "In the bed of a river near Russur, I also found," says he, "the fossil remains of the first joint of *a human finger.* It is evidently the first phalanx of a finger, and I think the first finger of the right hand." *The bed of a river* might be considered rather a doubtful place for such a fossil; but we imagine, no doubts whatever will remain respecting the *real value* of this singular discovery, when we add what the writer further says respecting this bone: "It is more than twice the size of the joint of an ordinary man; *ergo,* the person it belonged to must have been at least twelve feet high." These two singular curiosities he was about to dispatch to the Asiatic Society.

THE PATENT WATER ENGINE.

This machine, the invention of Mr. Dickson, engineer, Edinburgh, is in its principal parts no way different from the common steam engine, receiving water by a pipe from a higher reservoir, instead of steam from a boiler, and discharging the water by another pipe, answering to the eduction pipe of the steam engine. Of course, if the reservoir be higher than the atmosphere would balance (say 34 feet), it will work with the same power as the steam engine,—provided the eduction pipe be also of 34 feet in height, that the discharge may be instantaneous, like that of steam when opened to the condenser. If of less height, there will be a proportionate reduction of the power of the engine.

LIST OF PATENTS FOR NEW INVENTIONS.

To John Birkinshaw, of Bedlington iron-works, county of Durham, for certain improvements in manufacturing and constructing of a wrought or malleable iron rail road or way.—Dated 23d October 1820.—2 months allowed to enrol specification.

To William Taylor, of Wednesbury, Staffordshire, for an improved furnace for the smelting of iron and other ores.—23d Oct.—6 months.

To Thompson Pearson, of South Shields, county of Durham, for his improvement on rudders.—1st Nov.—2 months.

To Henry Lewis Lobeck, of Tower-street, London, for a process for making yeast, communicated to him by a certain foreigner residing abroad.—1st Nov.—6 months.

To Samuel Wellman Wright, of Upper Kennington, Surry, for his combination in machinery for making bricks and tiles.—1st Nov.—6 months.

To Peter Hawker, of Long Parish-house, near Andover, Hants, for a machine, instrument or apparatus to assist in the attainment of proper performance on the piano-forte, or other keyed instruments.—1st Nov.—2 months.

To Thomas Bonsor Crompton, of Farnworth, county of Lancaster, for an improvement in drying and finishing of paper by certain means hitherto unused for that purpose.—1st Nov.—6 months.

To William Swift Torey, of Lincoln, for certain improvements on drills to be affixed to ploughs.—1st Nov.—2 months.

To John Winter, of Acton, Middlesex, for certain improvements on chimney caps, and in the application thereof.—7th Nov.—2 months.

To William Carter, of St. Agnes Circus, Old-street road, Middlesex, for certain improvements in steam-engines.—11th Nov.—6 months.

To Thomas Dyson, of Abbey Dale, Sheffield, for his improvements of plane iron and turning chisels.—11th November.—2 months.

METEORIC STONES.

According to M. H. Dutrochet, the height of the meteor which projected the stones at Charsouville, in the department of the Loiret, on the 23rd of November 1810, was about 14,724 toises.

Mr. Bowdich found that the perpendicular altitude of the meteor

teor which discharged the stones at Weston in North America, on the 14th of December 1807, was 15,360 toises, or about sixteen miles.

BAROMETRIC OBSERVATIONS.

To Mr. Tilloch.

Elstree, 14th Nov. 1820.

Sir,—I send you the observations made at Leighton with a barometer on the 10th instant.

Hour.	Barom.	Thermometers. Attached.	Thermometers. Detached.	Wind.
8 A.M.	29·797	48½	40½	N.N.E.
9	29·801	48½	41½	N.N.E.
10	29·811	48½	43	N.N.E.
11	29·811	48½	43½	N.N.E.
12	29·806	49	45	N.N.E.

The above heights are corrected for the size of the tube.

Not observing any corresponding observations in your last Number, I am almost afraid your readers, who possess barometers, are not fully aware of the great importance to the scientific world it is to know the altitude of the different towns and villages in the United Kingdom. Or perhaps they may suppose the course of observations a matter of difficulty. A single trial will convince them of the facility of the task.

I am this day favoured with the observations made by Colonel Beaufoy at his observatory, Bushy Heath, viz.

8 h.	29·527	44·5	41
9	29·529	44·0	42
10	29·540	44·7	43
11	29·543	45·0	45
12	29·539	46·0	46

By a comparison of my portable barometer with two excellent instruments of Colonel Beaufoy, I have discovered a slower subsidence of the mercury in the closed cisterns than I had been given to expect. I shall therefore avail myself of an early opportunity of attempting to find the length of time necessary to wait after fining up the instrument before the reading ought to be made. It is right to observe, that this precaution is not necessary with barometers that have an open basin, and on that account are more to be depended upon for simgle and expeditious observations; although for portability the mountain barometer, as improved by Sir H. Englefield, is by far the most convenient.

I am, sir, yours truly,

B. Bevan.

METEORO-

METEOROLOGICAL JOURNAL KEPT AT BOSTON, LINCOLNSHIRE.

[The time of observation, unless otherwise stated, is at 1 P.M.]

1820.	Age of the Moon.	Thermometer.	Barometer.	State of the Weather and Modification of the Clouds.
	DAYS.			
Oct. 15	8	61·5	28·70	Cloudy—rain A.M.
16	9	50·5	28·93	Fine
17	10	51·5	28·48	Cloudy—heavy rain A.M. with gale [of wind
18	11	51·	29·74	Ditto
19	12	49·	29·05	Fine
20	13	50·	28·65	Ditto—heavy rain A.M.
21	full	51·5	29·20	Ditto
22	15	49·	28·63	Stormy—heavy rain A.M.
23	16	51·5	28·33	Cloudy—rain at night
24	17	50·	28·57	Ditto—heavy rain P.M.
25	18	49·5	28·85	Fine
26	19	42·5	28·85	Rain
27	20	52·	28·82	Cloudy
28	21	51·	29·40	Fine
29	22	46·5	29·20	Rain
30	23	49·	29·36	Fine
31	24	49·5	29·30	Cloudy
Nov. 1	25	46·	29·24	Ditto
2	26	46·5	29·65	Fine
3	27	47·	29·66	Ditto
4	28	42·	29·80	Ditto
5	new	38·5	29·77	Cloudy
6	1	51·5	29·50	Ditto
7	2	57·	29·52	Ditto
8	3	51·5	29·65	Ditto
9	4	48·	29·86	Ditto
10	5	48·	29·80	Ditto
11	6	46·	30·04	Fine
12	7	40·	29·85	Cloudy
13	8	41·	29·44	Ditto—rain A.M.
14	9	38·	29·74	Ditto—hail-storm A.M.

METEORO-

METEOROLOGICAL TABLE,

By Mr. Cary, of the Strand,

For November 1820.

Days of Month. 1820.	Thermometer. 8 o'Clock Morning.	Noon.	11 o'Clock Night.	Height of the Barom. Inches.	Weather.
Oct. 27	47	54	46	29·11	Fair
28	41	52	40	·70	Fair
29	46	46	46	·30	Rain
30	40	53	42	·65	Fair
31	43	48	46	·45	Fair
Nov. 1	46	47	37	·63	Rain
2	35	48	36	·80	Fair
3	31	42	40	·90	Foggy
4	36	47	36	·90	Fair
5	29	38	47	·95	Cloudy
6	47	52	50	·83	Cloudy
7	50	56	50	·70	Fair
8	51	53	50	·90	Foggy
9	50	48	46	·99	Cloudy
10	42	47	44	30·06	Fair
11	42	49	41	·25	Fair
12	38	44	40	·05	Cloudy
13	37	37	36	29·56	Rain
14	33	38	35	·82	Cloudy
15	33	40	33	30·01	Fair
16	32	42	31	29·93	Fair
17	32	43	42	·65	Rain
18	33	42	36	·94	Fair
19	37	45	44	·99	Fair
20	45	50	49	30·02	Cloudy
21	49	51	48	29·94	Fair
22	47	47	46	·80	Rain
23	46	47	42	·52	Rain
24	41	47	46	·75	Fair
25	42	47	48	·65	Cloudy
26	49	51	42	·95	Fair

N.B. The Barometer's height is taken at one o'clock.

Erratum.—In the bibliographical notice of MacGregor's Solar Eclipse in our last Number, p. 300, for 44 seconds, read 4·4 seconds.

LXIV. *Observations on M.* Arago's "*Reclamation*" *respecting his Ocular Micrometer, published in the* Annales de Chimie et de Physique. *By the Rev.* W. Pearson, *LL.D. & F.R.S. Treasurer of the Astronomical Society.*

To Mr. Tilloch.

Sir, — A friend of mine has lately put into my hands one of the numbers of the *Annales de Chimie et de Physique* (August 1820) published by Messrs. Gay-Lussac and Arago at Paris, in which number is contained a paper subscribed by the initial A, which makes an unwarranted attack on me, on the score of plagiarism.

At the first meeting of the Astronomical Society of London, on March 10, 1820, a Memoir of mine was read "On the doubly-refracting Property of Rock-crystal, considered as a Principle of micrometrical Measurements when applied to a Telescope;" and at the subsequent meeting on the 10th of April, a second Memoir by me was read "On the Construction and Use of a new micrometrical Eye-piece of a Telescope," which Memoirs have not yet been published; but the reports given of these in your Philosophical Magazine, and in the Edinburgh Philosophical Journal, have produced a belief in the mind of the writer A, who can be no other person than Mr. Arago of the Royal Observatory of Paris, that an attempt has been made by me, or by your Reporter and Dr. Brewster's (who are unknown to me in that capacity), to deprive Mr. Arago of the honour of an original invention exclusively his own.

Mr. Arago states as reasons for the publication of his *Reclamation*, that he waited two months to see if the reports given in the Philosophical Magazine of June [or rather of March and April] should be contradicted by me, and that he had forgotten my address, or he would have written to me on the subject of my having claimed his invention of the rock-crystal micrometer; he then proceeds to inform his scientific readers, that he became acquainted with me in London four years ago; that in the summer of 1819 I visited the Observatory of Paris, with a view of learning the use of astronomical instruments (*quelque travail astronomique*); to justify the choice that the Royal Society of London, had previously made of me as a member; that he pointed out the observation of double stars as a proper object of my researches, which subject he says I had previously considered, but could not pursue it on account of the defects in my micrometers; that he then showed me a particular instrument of his contrivance, which he then applied to a telescope by Lerebours, and with it determined the diameter of a ball which terminates the steeple

steeple of Ville-Juif. The writer then states, that I manifested a desire to procure one of those new instruments, which would promote my views exactly, and that he recommended to me Mons. Soleil of Feydau Passage, who at that time he says was making a similar instrument for Dr. Gilbert of Leipzig, as a proper man to make me the instrument in question; that this artist undertook the commission at his request, and finished it by his direction, before I left Paris. The author then takes some pains to prove that his instrument had been made and used some years, and says that in accumulating proofs he apprehends he may be *injuring me*, and therefore he suggests the propriety of my replying, as I presume, through the medium of your Magazine. In a postscript Mr. Arago tells his readers, that a young Polish astronomer, Dr. Slawinski, had arrived in Paris from London, and had brought with him an instrument, made by an English artist, *exactly like* those which Fortin had constructed for the Observatory of Paris, except that the prisms were *ten times* thicker than are made in Paris, and that consequently they would be *useless* with a high power; and lastly, he asserts that the exterior faces of the prism ought not to stand at right angles to the optical axis of the telescope, and that he shall himself shortly publish a description of the *Ocular Micrometer*, together with all necessary details respecting its construction, and the various uses it has been put to in determining small angular measures.

In this plausible narrative there is, Mr. Editor, such a strange mixture of truth, conjecture, and misrepresentation, that I must beg permission of you to insert a quotation from the original Memoir, in which I am *supposed* to have robbed Mr. Arago of the originality of his invention; and then to offer such remarks on matters of fact, as will enable your readers to judge of the propriety of the attack on my character which I have just noticed.

The Memoir begins with an explanation of Abbé Rochon's application of an achromatic prism of double refraction to micrometrical measurements, states the defects of this mode of applying it, and then proceeds in these words; viz.

"On examining (at Lenoir's house) an object with the face of the prism in the focal point, to satisfy myself that the image then formed is a single well-defined image, I had occasion to adjust nicely for distinct vision; and in doing this I discovered that, when the prism was out of the focal point, a pair of images would be formed at the *anterior* side of this point, as well as at the posterior, as they have reference to the eye looking through the telescope; and it appeared probable, that equal distances on each side of the focal point gave equal measures, as far as the small space left near the eye-end of the tube would admit the prism

prism to go: from this circumstance I immediately concluded that two images might also probably be formed by a prism, after the rays had proceeded through the lenses constituting the eye-piece, but did not perceive, at the time, what the measure of an angle would be that might probably be so obtained. I desired Mons. Lenoir to adapt me a double prism of clear crystal to a cell, that I might apply it to the *eye-end of a telescope*, for the purpose of making experiments on this mode of application; on which he laughed at the idea, and assured me that as the angle of every prism is *constant*, there is no other way but that adopted by Rochon, by which a *variety* of measures could be taken; when I endeavoured to explain to him how Dr. Brewster had *varied the measure*, in his patent telescope, by a variation in the *power*, a term which it appeared he did not understand, till I hit upon the word *amplification*. At length Mons. Lenoir undertook to comply with my wish of his fitting a prism into a cell; but he had no idea that a small prism, somewhat larger than the pupil of the eye, would have been sufficient for my purpose, and therefore he mounted one large enough to be used on Rochon's principle.

"While this prism was preparing, I visited Mr. Arago at the Royal Observatory; and on informing him what I had in hand, he appeared surprised, and fetched from a private cup-board or drawer, a celestial eye-piece, with a small prism *actually applied* to it in a cell, in the way I had ordered Lenoir to fit up his. I then learnt that the objection, as to indistinctness of vision, which applies to Rochon's construction, is obviated by this new application of his prism, by means of which the image, regularly formed without previous transmission of the rays through the crystal, is viewed double; and I have since found, that the eye-lenses only modify the measure of the angle of the two images, as seen through them and the prism conjointly. What Mr. Arago had determined this modification to be, he did not inform me, except that he tabulated, from experiment, the angular measures which resulted from different arrangements of his lenses, that produced different amplifications; and that the angles so measured are very small; but the objects appeared, he said, much more distinct than when the images are formed by Rochon's Micrometrical Telescope.

"On my return from the Royal Observatory, where I learnt that Soleil made the *small* prisms, I applied to this optician to make me about half a dozen, similar to those which he had made for Mr. Arago, to be adapted to a similar eye-piece; but I was informed, that he knew *nothing* of the construction of Mr. Arago's eye-piece, nor to what purpose he applied his prisms."

The Memoir then relates how I determined what lenses would be suitable for an eye-piece having variable powers, and that Soleil constructed it solely under my directions; and, as I believe, without having any communication whatever with Mr. Arago on the subject while I remained in Paris; for he adapted the eye-piece to an old telescope of his own, to satisfy himself that its properties were really what I had verbally explained to him; and he seemed so pleased with the result, that he offered his services to execute any orders for me, that I might afterwards give him from England.

From the preceding extract, your readers will perceive, that I have acknowledged Mr. Arago's *prior claim* to the application of a prism of double refraction to the *eye-piece* of a telescope; and that the circumstances that led me to think of the same contrivance, *antecedently* to my visit to the Observatory, are fairly stated; and I may add, that I have yet by me the prism and cell made by Lenoir, the order for which was given some days *before* I saw Mr. Arago, or knew any thing about his eye-piece. It will also be seen that the conversation about an *ocular micrometer* commenced with *me;* and that Mr. Arago fetched out his instrument *after* I had informed him of what *I had in hand;* and perhaps your readers will think this gentleman's charge a little extraordinary, when I tell them further, that he took especial care that I should not examine the interior structure of his eye-piece, for he put it away again almost immediately after he had allowed me to see that it would give *two images,* when applied to a telescope: but how many lenses there might be, or what might be their respective focal lengths, and distances between them, were data I was left to conjecture; neither was I apprised of any optical theorem on which the measures depend: and on that account these considerations constitute the main subject of my second Memoir. Indeed I have some reason to conclude, that Mr. Arago derived the resulting measures of his micrometer from experiments only; for I happen to know, that he previously obtained from a London optician a very good dynameter, with which he was highly delighted, that would give him, with very little trouble, the *powers* of his telescope in all the positions of his lenses, independently of theory.

With respect to Mr. Arago's fancying that I went to the French Observatory for the purpose of learning from him how to manage good observations with French instruments, I do not quarrel with that; for, as I have long been in the possession of better instruments than any I saw in Paris, I could have no objection to learning so important a secret. But how it happened that both the Editors of the *Annales de Chimie* forgot my address, I have yet to learn; and I can only account for it, by supposing that they have both forgotten that I took them in my own carriage to the

the King's private observatory in Kew Gardens, brought them back through Richmond Park, and then gave them such a dinner as the season would afford, and invited eight eminent artists and chemists from London on purpose to meet them. It strikes me, however, that these *savans* might have recollected the *party* to which they were introduced, and the site of the *Observatory* near the gate of Richmond Park, where they dined, if they could not recollect the hospitality they experienced, and the instruments they professed to admire.

"But the English artists," says Mr. A. in his postscript, "have shown their ignorance in making the prisms of double refraction, or they would not have made them to a thickness of ten millimêtres, instead of one, thereby rendering them *useless*." This remark, coming from talents of the first eminence, would have struck at the root of English ingenuity, if it could have been brought fairly to bear on its marked object; but unfortunately for the writer, those *very prisms* of Dr. Slawinski's eye-piece, which are made the butt of his censure, were made not only *in Paris*, but by his *own optician Soleil!* To which may be added, that this *ocular micrometer*, which is stated to be *exactly similar* (*exactement semblable*) to those made by Fortin, is not only different from the one I contrived and superintended in Paris, but contains two instruments in one, equally good, viz. an instrument for measuring small gles, resembling in many respects Fortin's; and also an instrument for determining by a graduated circle, and without adventitious light, the *position* of any line joining two stars, as it relates to the prime vertical; which *new property* has *not yet* been described, and I merely mention it *here*, to prevent Mr. Arago from claiming it as a French invention, in case he has made himself acquainted with the concealed spider's line which it contains, and which is visible only in one position of the two lenses that constitute the eye-piece.

When I mention *two* lenses only, as constituting this eye-piece, the Editor of the Edinburgh Philosophical Journal, who attributed the invention thereof to Dr. Brewster, will perceive that he has laboured under a mistake, in supposing that *four* lenses were employed. It is a curious fact, that both Mr. Arago and Dr. Brewster have separately, and at the *same time*, laid claim to the invention of my eye-piece with variable powers, though neither of them has yet explained the method by which I constructed it.

I have only further to remark, that Mr. Arago, in order to convince his friends that *he* superintended the construction of the eye-piece made by Soleil, notwithstanding it differed from his made by Fortin, has said in a note at the bottom of page 436, "If I have a good memory, in the instrument that Soleil hath furnished

to

to Dr. Pearson, this artist, who does not generally work in brass, *contented himself* with making one of the lenses that compose the eye-piece to be moved along a *groove by friction;* whereas those made by Fortin were moved by a pinion and rack-work." Here the learned journalist has drawn on his memory, which before was treacherous, for more than it could fairly answer: the motion in question was effected by the means I laid down in my plan at Paris; namely, an endless screw, lying parallel to the optical axis of the eye-piece, in which position it yet remains; a clear proof this, that he never saw the eye-piece in question, nor had any thing to do with its construction. It is also quite clear to me, that if Soleil ever made an eye-piece for Dr. Gilbert, it must have been after mine had been constructed. My pocket journal fortunately contains the dates and particulars of all my conferences with Parisian artists and men of science; and I am ready to bring it forward, to substantiate every fact I have here asserted. I remain, sir,

Yours very respectfully,

East Sheen, Dec. 1, 1820. WM. PEARSON.

LXV. *On the Sugar and Spirits obtained in Dalmatia from the Fruit of the common Arbutus. By Counsellor* PRECHTL, *of Vienna**.

THE common arbutus (*Arbutus unedo* Linn.), which is not regarded as indigenous in any country in Europe, except Spain, grows spontaneously and in great abundance in Dalmatia. The Italians give to its fruit the name of *fragolini* or *corbezzoli*, and the Illyrians *magniche* or *planike*.

The fruit of the common arbutus is of the form of the strawberry, with this difference, that it is twice or thrice as large. Its taste is pleasant, rather tart than sour. The tree is bushy, and rises sometimes to more than twenty feet in height. It preserves its leaves during the winter, and does not drop them till the new shoots appear in spring-time. It is not till November that the fruits of the year ripen, and then they possess their greatest sweetness.

The inhabited islands of Dalmatia appear to possess a soil particularly favourable to the arbutus; it multiplies there to such a degree, that it covers vast plains, and renders them in a manner impenetrable. The enormous quantity of fruit produced by it was not turned to any profitable account till the year 1817, when the experiment was made of extracting spirits from it. At

* From the *Annales Générales des Sciences Physiques, par* MM. Bory de St. Vincent, Drapiez, & Van Mons, for August 1820.

first

first about a thousand hogsheads were obtained, and the following year this quantity was more than doubled.

The spirit was of a good quality; it was sold at Trieste at the average price of 100 livres the hogshead. The expense of manufacture amounted only to 30 livres. It has a taste singularly agreeable, and not in the least empyreumatic, so that it may be very well employed in the preparation of fine *liqueurs*. It was in great request at Trieste.

The fruit of the arbutus is attended with this precious advantage, that it succeeds perfectly in those years when the olive and the raisin fail, which it is well known are the principal productions of the Dalmatian islands.

To manufacture the arbutus spirit, the fruit is collected at the moment that it begins to soften, and is easily plucked from the tree; it is bruised, and put into vessels to ferment. When there is not enough of juice to cover the skins of the fruit, sea-water is added, and the mass is stirred twice every day. If the fruit were left in immediate contact with the air, it would become soured; besides, the sugar being badly dissolved and the mass too little diluted, it could not conveniently ferment.

From the moment that the fermentation has actively commenced, a quantity of liquid is withdrawn every day by a cock at the bottom of the vessel, and poured again on the surface of the matter in fermentation. This gives a uniform progress to the fermenting process throughout the whole mass.

As soon as the fermentation is finished, the liquid is withdrawn, and submitted to distillation. It furnishes about the fourth of its bulk in spirits of from 18 to 20 degrees of strength. Wine treated in the same manner gives a spirit of only 14 degrees.

After the abstraction of the alcoholic liquor, the remaining mass is served with the tenth of its weight of sea-water; it is then pressed, and the liquid obtained is submitted to distillation, either separately or conjointly with the direct produce of the fermentation. The preference is given to sea-water on account of its greater property of precipitating the viscous principle, and rendering thus the product more limpid, and more easy to be drawn off.

A thousand pounds of fruit furnished a hogshead of whiskey of 16 degrees strength.

The Austrian Government, wishing to verify an assertion contained in the *Annales des Arts et Manufactures* (1812), that the fruit of a sugar tree discovered in Spain (which tree was nothing else than the *Arbutus unedo*) furnished the fifth of its weight in syrup fit for crystallising, appointed M. Bignami, physician of Spiratro, to make an experiment on the subject.

Twenty pounds of fruit were broken down, diluted with water, and

and then pressed; the acid in the sugar saturated with chalk, and the liquid clarified with the white of an egg, skimmed, and boiled to the consistence of a syrup marked 29° in the areometer. The quantity of syrup produced was five pounds nine ounces. M. Bignami submitted one pound of this syrup to spontaneous evaporation in the open air; but he only obtained three ounces two drachms of concrete sugar; the syrup had doubtless not been sufficiently purified, or had experienced some degree of fermentation. A like quantity of five pounds nine ounces of the syrup of beet-root of the same degree of concentration, and the syrup of the arbutus cannot be supposed inferior to it, would have given two pounds nine ounces of pure concrete sugar. A new experiment of M. Bignami, in which the sugar had been converted with more care into the consistency of a crystallisable granulous syrup, produced four pounds two ounces and a half of sugar, which corresponds with the produce obtained in Spain, and proves that the fruit of Dalmatia is equally rich in sugar.

The sugar which was presented to the Government was white enough, very hard, and exactly similar in the grain and taste to cane sugar. The syrup was very agreeable, and might of itself form a valuable article of produce for the inhabitants of countries where the common arbutus grows spontaneously.

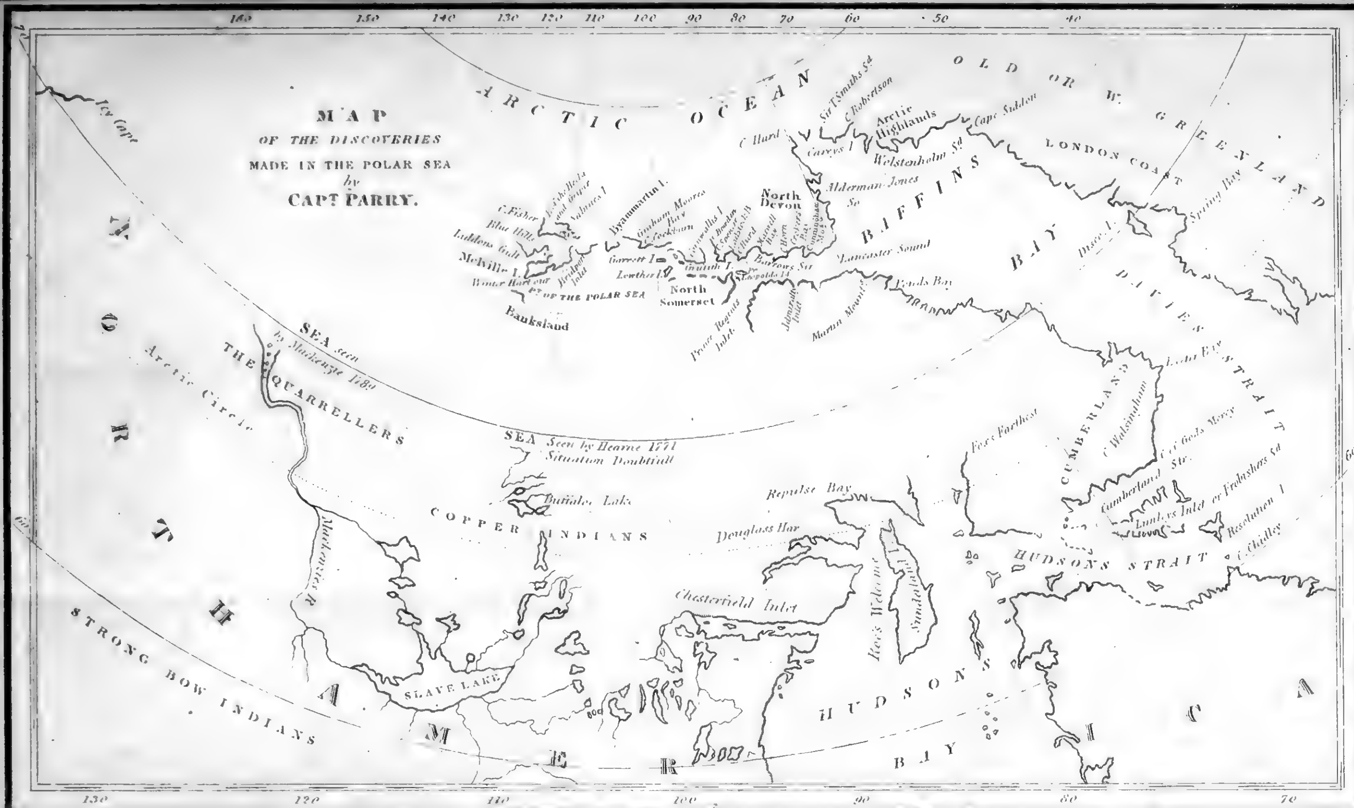
LXVI. *Remarks on Mr.* Yeates's *Papers on the Lunar Theory. By Mr.* James Utting, *of Lynn Regis.*

To Mr. Tilloch.

Sir, — In your Magazine for last month, your correspondent Mr. Yeates observes, that *my remarks* on his papers are *very curious*; but whether they apply to the *substantial* part of his argument he leaves for others to determine. Agreed, so do I. Again he says, "My argument is a list of corresponding eclipses, which I have been at the pains to collect, and trust you will allow me the credit of having advanced my *hypothesis* on some *foundation*. It is true I have filled up the list with many computed dates, &c. But since these fill up the *steps* of the ladder in their true places, and give a *consistency* to the whole, I presume little *apology* may be required for their introduction."

Now, sir, in the first place I deny that the argument is *substantial*; secondly, assert that if his *hypothesis* had a foundation, he has overturned it; and thirdly, that if a person ascends this ladder by treading on the substituted steps, he may probably be in danger of being precipitated to the bottom, and therefore an *apology* would give a *consistency* to the whole.

But



S. Porter sculp

and then
and the li
boiled to
ter. The
ounces.
taneous e
ounces tu
not been
fermentat
syrup of l
syrup of
have give
new expe
converted
granulous
sugar, wh
and prove

The su
enough, v
cane suga
form a val
where the

LXVI. *R*

Sir, — I
Mr. Yeat
curious ;
argument
Again he
which I h
low me th
foundatio
dates, &c.
true place
apology n

Now, s
stantial ;
tion, he
ascends th
probably l
therefore :

But to proceed. The Chaldean period is the most perfect and shortest of any, in which the solar and lunar motions, and the motions of their perigee and nodes, are nearly coincident. The other periods, which I before stated, show the analogy which subsists between the solar years and the lunar periods. But if the ☉ and ☽ were in conjunction at the beginning of those periods, the like circumstance would not take place in a series of consecutive returns, owing to the ☽'s perigee and nodes not being in conjunction also. The conjunction would likewise be affected by the ☽'s acceleration. In reference to the period of 39512 solar years (and not 36512 as stated at page 356), containing 488695 lunations, wanting only five seconds of the line of conjunction of the ☉ and ☽; this calculation is founded on the mean motion of the luminaries (see note, p. 14), and is given in order to show the absurdity of instituting such long periods, as the ☽'s accel. amounts to nearly 760 degrees! It is a matter of surprise to me, that Mr. Yeates could view it in any other light, it being actually so expressed. In regard to the period alluded to in Ferguson's Astronomy, as revised by me, viz. of 13700 years, it may be necessary to observe, that the lunar motions are arrived at a degree of perfection of which *Mr. Y. appears to be totally ignorant.* They did not attain their present elevation from *data* and proceedings similar to those of your correspondent, but from an accumulated mass of astronomical observations; viz. of transits, and zenith distances, &c. made during a period of many years, and the subsequent results compared with ancient observations and eclipses: so that, if the falling back of the line of the nodes can be ascertained during the space of about a century only, it is surely no great presumption to calculate their period, as is done in respect to the revolution of the earth's perigee, and the equinoctial points: some have even gone so far as to calculate when the time will arrive when the *ecliptic* will coincide with the *equator*, and a universal spring prevail all over the earth. But this idea is erroneous, as the revolutions of the former appear to be consecutive, while that of the latter is only vibratory. Mr. Yeates admits that it was by the aid of a period of 600 years, that *Hipparchus* extended his science in calculating ephemerides of the sun and moon, as he is related to have done, and that with sufficient exactness for the regulating of their calendar.—*Vide* p. 358. As I before remarked, in the time of Sir *Isaac Newton*, the lunar tables gave the ☽'s long. to within five minutes of a degree from the truth; whereas they now give it to within ten seconds, and generally much nearer. So that, embracing the lunar motions at the present day, and applying them to a period of 13700 years, the advantage in my favour is as 30 to 23, even admitting that no improvement was made in the lunar theory from the time of *Hipparchus* to that of *Newton!* I therefore contend that an entire period is completed within the limits of 760 Chaldean periods. As I before asserted, the difference produced by the ☽'s accel., even if it was completely neglected as far as the period affects the earth, would only amount to about one hour; and as the ☽'s accel. is proportional to the square of the time, it would in a complete period amount to but little more than four days only.

I do not contend that the knowledge of these long periods is a matter of any great importance; but they evidently convey an idea of the sublimity and grandeur of the celestial motions. Mr. Yeates (at p. 88) has given us a statement of the mean synodic revolutions of the ☽ as stated by different astronomers: the mean of the last ten of them, or from the time of *Hipparchus*, amounts to 29 days 12 hours 44 minutes 2 seconds 35 thirds, which differs from the respective results of Messrs. Vince, Gregory, Woodhouse, Squire, Young, Lalande, Laplace, Delambre, Biot, Burg, and Burckhardt, by less than one-fourth of a second only! Mr. Yeates on the opposite page has given four results adduced from his own calculations, the mean of which is 29 days 12 hours 44 minutes 28 seconds 9 thirds; the extremes of the above are those of Ptolemy and Whiston, 45 thirds in excess, and 2 minutes 35 thirds in deficiency respectively. Mr. Y.'s mean exceeds the mean of the ten results above referred to, by 25 seconds 34 thirds: his difference is therefore 34 times greater than that of Ptolemy in excess; and Whiston's difference from the mean result is only about one-tenth part in deficiency of what Mr. Yeates's is in excess! There must surely be some *subtilty*, or something *superlatively grand* and *exquisite*, in the calculations of Mr. Yeates, as he differs 34 times in excess, from that of any of those above mentioned, all of them most celebrated astronomers which have existed within nearly the last two thousand years!! This result is indeed *very curious*. Had Mr. Y. confined himself to giving a list only of the observed eclipses, divested of those which are inserted from calculations, much verbosity would have been spared, and he might have acquitted himself with credit. The inferences to be drawn from what Mr. Yeates has done, will in no wise refute my assertions; and in respect to the period of 912 years, I defy him to establish it, or to controvert the contents of my former letter. At page 355 he says, "I presume, sir, there is no occasion here to introduce anomalistic calculations of the sun and moon: the mass of evidence already produced in the corresponding eclipses at 912 years distance, and the eclipses recorded to have happened, show

most

most evidently that the true motions of the sun and moon's apogee and node must agree at and after such an interval, or such phænomena could not take place.

It appears, sir, to this gentleman, of little consequence, whether the ☽ is distant from her node ten degrees on the one side, or ten degrees on the other; or whether the ☽ is within 90 degrees of her perigee, it appears to be a circumstance which he has not given himself the trouble to ascertain. Where eclipses are observed in various parts of the globe, it is necessary to reduce the time to one meridian; and also to apply the equation of time before the interval between the eclipses can be truly ascertained. The difference of longitude of the ☉ and ☽ must also be taken into the account; the ☽ must likewise be divested of the equations which regulate the inequalities in her motion, and the correction for the acceleration applied before her mean motion in longitude, or her mean synodic revolution, can be correctly ascertained.

The acceleration of the ☽ is a periodical equation (as indeed are all the equations which regulate her motion); its period is very long, and is equal in length to that of the variation of the eccentricity of the earth's orbit, on which it depends; its period includes millions of years! It will be accelerated and retarded by the same quantity; and therefore if the mean motion be taken for the whole time of the acceleration, or retardation, it will be found never to vary: the mean motions of the perigee and nodes of the lunar orbit are also subject to secular equations, being always proportional to that of the ☽'s longitude. In consequence of the duration of this period being at present unknown, and also the time when the acceleration will attain its maximum, we are not enabled to apply this equation to its corresponding epoch. This equation, as given by Laplace, in its present form will for ever increase, which cannot be the case. But it may be extended back to the most ancient observations of the ☽, and probably for many centuries to come, without any sensible error.

That Dr. Maskelyne ever ventured to obtrude such *romantic speculations* on the public, is not disputed; the duties of his office as Astronomer Royal, and his superintendance of the calculations of the Nautical Almanack, were sufficient to occupy his time; and which have immortalised the memory of that illustrious astronomer: but, although he did not launch into such speculations, the elements on which they are founded were strictly applied under his directions by the computers of the above work. To render the theory of the moon perfect, researches as extensive as those which have already been made are required. Observations made at remote periods, in conjunction with theory, are

 requisite

requisite to elicit the magnitude of all the equations, which regulate the inequalities in the lunar motions.

If the revisers of the lunar theory had not been more successful in their efforts than Mr. Yeates towards *cultivating more perfectly the lunar astronomy*, the science would have been extremely low in the scale of improvement, compared with its present elevation.

I remain, sir, yours truly,

Norfolk-street, Lynn Regis, Dec. 4, 1820. JAMES UTTING.

P. S. With the *Editor's* permission, I beg leave to express my sentiments of esteem, being principally indebted to the works of *Dr. Hutton* for that information which I have acquired in the sciences, and by my own application only. I sincerely congratulate this gentleman on the receipt of the very respectful letter from the Marquis De Laplace, confirming the truth and originality of the very laborious and intricate Calculations of the mean Density of the Earth, and confirming beyond all doubt *the universal attraction of matter ! ! !* J. U.

LXVII. *On the Specific Gravities of the* GASES, *and the different Musical* SOUNDS *which they occasion in the same* ORGAN-PIPE. *By Mr.* JOHN FAREY *Sen.*

To Mr. Tilloch.

SIR, — I HAVE on two occasions* endeavoured to call the attention of any Experimentalists, who might have the opportunities which I myself do not possess, and who might be so inclined, to the trying experimentally, of the truth of that theory, which assigns *an Interval between the Sounds produced in a given Pipe, by two different Gases, which is measured by the inverse Subduplicate Ratio of the specific Gravities of these Gases.*

At the periods to which I allude, sufficient precision had not been given to the experimental determinations of the *specific Gravities*, of many of the Gases, but which important *data*, have now lately been supplied, by our eminent and indefatigable chemist, Dr. Thomson, of Glasgow; who has taken the utmost care in procuring 26 different Gases, unmixed, and in a state of purity, and in weighing these Gases, and calculating their specific Gravities, in which latter operation, he has availed himself (in all

* P. M. vol. xxxvii. p. 3, and Edin. Ency. vol. x. p. 120.

but

but one of these instances*) either of the known composition, or of the known combinations of the Gases, to correct his experimental results.

Names of Gases.	Specific Gravities. Multiples of Hydrogen.	Specific Gravities. Multiples of Atm. Air.	Intervals of Sounds Σ	+f	+m
Hydrogen	1	$\frac{5}{72}$	1177·5000	23	102
Vapour of Carbon . .	6	$\frac{5}{12}$	386·4291	8	33
Carburetted Hydrogen	8	$\frac{5}{9}$	259·5039	5	22
Ammonical Gas	$8\frac{1}{2}$	$\frac{85}{144}$	232·6593	5	20
Vapour of Phosphorus	12	$\frac{5}{6}$	80·5748	1	7
Phosphuretted Hydrogen	13	$\frac{65}{72}$	45·1346	1	4
Azote	14	$\frac{35}{36}$	12·4740	0	1
Carbonic Oxide	14	$\frac{35}{36}$	12·4740	0	1
Olefiant Gas	14	$\frac{35}{36}$	12·4740	0	1
Bihydroguret of Phosphorus . . .	14	$\frac{35}{36}$	12·4740	0	1
ATMOSPHERIC AIR . .	$14\frac{2}{5}$	$\frac{1}{1}$	0	0	0
Deutoxide of Azote . .	15	$\frac{25}{24}$	18·0709	0	2
Oxygen	16	$\frac{10}{9}$	46·5000	1	4
Vapour of Sulphur . .	16	$\frac{10}{9}$	46·5000	1	4
Sulphuretted Hydrogen	17	$\frac{85}{72}$	73·3011	1	6
Muriatic Acid Gas . .	$18\frac{1}{2}$	$\frac{185}{144}$	110·6276	2	10
Protoxide of Azote . .	22	$\frac{55}{36}$	187·0510	4	16
Carbonic Acid	22	$\frac{55}{36}$	187·0510	4	16
Cyanogen	26	$\frac{65}{36}$	260·8614	5	23
Sulphuretted Acid . .	32	$\frac{20}{9}$	352·5039	7	30
Fluoboric Acid	34	$\frac{170}{72}$	379·3407	7	33
Protoxide of Chlorine	$35\frac{1}{5}$	$\frac{22}{9}$	394·5510	8	34
Chlorine	36	$\frac{5}{2}$	404·5000	8	35
Chloracarbonic Acid .	50	$\frac{125}{36}$	549·5039	11	47
Hydriodic Acid Gas . .	63	$\frac{35}{8}$	651·5304	13	56
Vapour of Iodine	125	$\frac{625}{72}$	954·0039	19	82

* Dr. Thomson's experimental result as to *Fluoboric Acid* Gas, was 2·3694: the limits of probable errors in this determination, and the analogies of the Table in the Text, seem to me to point, at 34 times the weight of Hydrogen, or 2·3611, which I have assumed; it will be fortunate, if theoretical deductions from the composition of this Gas, should hereafter confirm and establish this.

In

In Dr. T.'s Table, the specific Gravity of *atmospheric Air* is assumed to be 1·0000, and that of *Hydrogen* is found to be 0·0694; this last, and 21 others of the numbers expressing the specific Gravities, being *repeating* decimals; as an expert Arithmetician would at once perceive, from observing the prime Number 3, to be a multiple, in so many of the Denominators of the Fractions, in the third column of my Table, in the last page; wherein I have omitted these repeating Decimals, and in column 2, set down the Numbers, expressing, how many times the weight of Hydrogen, answers to the weight of each Gas, under equal Bulks and Pressures. The vulgar Fractions in column 3, express the relations which the several specific Gravities, indicated in col. 1, bear to 1 (or $\frac{1}{1}$) which is here set against atmospheric or common air.

The square-roots of the Fractions in col. 3, have furnished the *Ratios*, from whence the corresponding musical Intervals in col. 4, have been calculated, and expressed in the correct Notation which I had the honour of proposing to musical Calculators, through your pages, in the year 1807 *.

For some of your Readers who may not have the Volume at hand, it may be useful here to mention, that the Symbols Σ, f and m, standing at the top of their respective ranges of Figures in col. 4, express three small musical Intervals; their respective magnitudes being such, that $612\Sigma + 12\,f + 53\,m$, exactly make an *Octave*, having the Ratio $\frac{1}{2}$; $358\Sigma + 7\,f + 31\,m$ make a *Fifth* ($\frac{2}{3}$); $197\Sigma + 4\,f + 17\,m$ make a major *Third;* and $11\Sigma + m$ make a major *Comma*, having the Ratio $\frac{80}{81}$, &c. as in the Table referred to: the Interval m being at the same time so exceedingly minute, as scarcely to be appreciable by the Ear, in the most extreme case; as may be judged from the fact, of the Fraction expressing the Ratio of the lengths of two Strings calculated to yield it, having the first five of its figures alike, in the Numerator and in the Denominator, and a difference of only 3 appearing, in the sixth places of these figures; its decimal value with respect to Σ as an unit is ·0078624; The middle Interval f, though more considerable in value, so that a difference of 7 appears in the fifth figures of its Fraction, and so that its decimal value in terms of Σ is ·1496610, is very small, and unimportant in practical utility, except in as far, as the number of f's in any expression in the Table, shows, how many of the vulgar *Half-notes* of Musicians, are contained in the Interval designated: it will for instance, be perceived from inspecting the middle or f range, that phosphuretted Hydrogen is the first Gas which exceeds atmospheric Air in the acuteness of its Sound, by the quantity of half a Note; and in like manner, that Oxygen is the first

* See vol. xxvii. Plate V. p. 140, and vol. xlix. pp. 360 and 362.

Gas

Gas whose sound is a half-note more grave, than the sound of this standard Air.

It so happens, through the peculiar progressions in which the numbers of the three ranges expressing Σ, f and m, increase each way, from 0 against the Standard Air, that for every purpose of comparison, and for almost the nicest purposes of calculation, the two latter ranges may be disregarded, and the numbers (and their decimals) in the Σ range, may be considered as *artificial Commas*, exactly 612 of which make up an Octave. It will be perceived, that only one Gas at the top of the Table, exceeds in acuteness by an Octave, the Standard Sound of common Air, and only two at its bottom, exceed it in graveness by an Octave.

Four years ago, when I first extended Mr. Liston's tuning process, by means of *perfect* Fifths, Thirds and Octaves, only, so as to produce 612 different Notes within the Octave, the object which I had in view, was, so to regulate the extension of my enlarged Tuning Table (which I have described in p. 444 of your 49th volume) in different directions, as to obtain *the most simple Literal Expressions* for the several Notes, near to the borders of the Table (p. 446 Note); that is, that the least number of ♯s or of ♭s, and of ′s, or ‵s, should appear, affixed to the original or simple Literals C, D, E, F, G, A and B: and it was not until some time after your 49th volume was completed, that I was sufficiently struck, with the derangements of the Series formed by the numbers of fs and the numbers of ms, in this my first extended Tuning Table.

Since then, I have, on further considering the subject, constructed such an enlarged Tuning Table, as produces 612 Notes in the Octave, such, that in each of the three Columns, headed Σ, f and m, *an increasing series of numbers appears*, without any exceptions: by which Table, such a close connexion is established, between my Notation of Intervals, and the most perfect (or common) Chord, K, III, V, VIII, and with the only correct mode of Tuning, (invented by Mr. Liston), as cannot ultimately fail, of causing its universal adoption by musical Writers, and by the Teachers, of the principles of the musical Scale: however the present race of Writers and Teachers may continue to act respecting it.

The numbers of f and of m, in the last column of the Table in p. 413, are conformable to my last Tuning Table above mentioned: and which Table, it is my intention to publish at no very distant day. I am

Your obedient servant,

37, Howland-street, Fitzroy-square, Oct. 27, 1820. JOHN FAREY Sen.

LXVIII. *On*

LXVIII. *On the Culture of Carrots. Drawn up by the Secretary of the Board of Agriculture, by order of the Board*.*

Chap. I.—*Climate.*

The circumstance which chiefly deserves attention under this head, is the fact, sufficiently ascertained, that they thrive to great advantage in Scotland: it may therefore be taken for granted, that this article of climate affords no objection to undertaking this branch of cultivation, in any part of the United Kingdom.

Chap. II.—*Soil.*

The best soil for carrots is a rich deep sand: in the carrot district in Suffolk, they have red sands with such a principle of adhesion, as to form small clods, which, however, break with a slight touch; these, according to fertility, produce from 500 to 700 bushels per acre, and sometimes even more. But here it is particularly necessary to observe, that the cultivation is not confined to such rich sand; for the root is sown on very poor ones, such as will not produce above 200 bushels per acre: nor is the culture confined to any sort of sand, but is found on all dry loams, so that it may be received as a maxim, that carrots may be sown on all soils on which turnips can be properly eaten, where they grow, by sheep. I cultivated this root for many years successfully, on a large scale on turnip loams, some of which were rather too wet for eating turnips on the land, when the season was unfavourable. Nor does this root require any considerable depth of soil, as I have known them produce greatly with common ploughing, on a soil only six inches deep; the roots were ill-shaped, but as good for live stock as the more handsome ones. They have also thriven to very great advantage on drained bogs, and other peat soils. It is of particular importance, that the notion of confining carrots to sand, should be exploded, as the fact is, that they do well on all dry soils.

Chap. III.—*Course of Crops.*

This is an object of the highest consequence, for success will depend greatly on the previous arrangement which has taken place. Among the great farmers in the carrot district of Suffolk, those who have most experience, and whose efforts have been attended with the greatest success, turnips fed off by sheep are reckoned the best of all preparations: next to this, and the more common practice, is to sow them on a barley stubble following such turnips, the farmer abstaining from all grass seeds, with a view to the carrot crop. Barley remaining but a short time on

* From the Communications to the Board of Agriculture.

the

the ground, and being well prepared for by the tillage, and manuring given for the turnips, and the soil being further enriched by eating them on the ground by sheep, the land is found to be in high order after the barley, for sowing the carrots. The following courses of crops will thus be found extremely advantageous:

1. Turnips,	4. Clover,
2. Carrots,	5. Wheat.
3. Barley,	

Also,

1. Turnips,	4. Barley,
2. Barley,	5. Clover,
3. Carrots,	6. Wheat.

If the soil be loam,

1. Turnips,	5. Wheat,
2. Carrots,	6. Beans,
3. Barley,	7. Wheat.
4. Clover,	

Also,

1. Turnips,	5. Beans,
2. Carrots,	6. Wheat,
3. Barley,	7. Winter tares,
4. Clover,	8. Barley, or wheat.

But there are farmers in Suffolk who have continued carrots for four or five years successively on the same land; the same practice has also occurred in Scotland. They have been often sown, and with great success, on the first ploughing of a layer which has remained from three to seven years. An excellent farmer in Suffolk, who has very poor sand, sows them for the first crop, on breaking up ray-grass layers three years old, getting clean and good crops.

A common error has been, that of sowing them after wheat, which is very bad management: that crop is so long on the ground, as usually to leave a stubble abounding much more with weeds than barley, and consequently much increasing the expense of hoeing the carrots. Mr. Burrows, of Norfolk, registers crops sown on a wheat stubble, which followed pease, and those pease succeeding a two-years' layer: in such a course, we cannot be surprised that the result was a multitude of weeds, and a necessity of eating these weeds by sheep.

Chap. IV.—*Tillage*.

The practice of the cultivators of this root in Suffolk, established after long experience, is, to plough but once, immediately before the sowing: they get what depth they can, by one plough following another in the same furrow; a work much better

 done

done by the use of Mr. Ducket's skim-coulter plough. An error committed by many persons in various parts of the kingdom, has been that of giving an autumnal and repeated spring ploughing; a mistake I committed when first I began the cultivation: weeds are thus multiplied, and the expense of hoeing greatly increased. Very early in Mr. Burrows's Norfolk practice, I remonstrated with him on this point, and at last he confessed the error. Mr. Billing persisted in it, as well as sowing on a wheat stubble, and the consequence was, his giving up the cultivation.

One caution should be added: when this root is sown upon land which has not before been ploughed to the depth necessary for carrots, the surface soil to the depth commonly stirred, may be clean; but increasing the depth of tillage may produce a foul crop; hence, therefore, a necessary caution is, when this root is to follow turnips, or barley after turnips, the autumnal ploughing for such turnips should be nine inches deep, in order that, if additional depth bring weeds, they may be destroyed in the turnip year: such depth will be as useful for the turnips as for the carrots.

Chap. V.—*Manuring.*

The only manuring admitted in Suffolk is that already described respecting the preparatory turnips; or the equivalent practice of sowing them on a layer. The importance peculiar to carrots is this, of being raised without dung: every other fallow-crop (winter tares, pease, and buckwheat, alone excepted) cannot be raised to advantage without dung: to give it therefore to this plant would be erroneous, as will be more fully explained in another chapter.

In Mr. Burrows's last communication to the Board, he registers two crops sown on a wheat stubble, one dunged, and the other not manured; and the latter cost about 10*s.* per acre less in hoeing than the other.

Chap. VI.—*Time of Sowing.*

In the carrot district of Suffolk, the general practice is to sow about the 25th of March: other seasons have been tried, and on much experience rejected: more than forty years ago, the Sandy gardeners in Bedfordshire, who cultivated great quantities of carrots, informed me, that Lady-day was also their time for sowing. Mr. Billing, trying a later season, suffered much in his crop.

Chap. VII.—*Seed and Steeping.*

There is a greater variation in this point than in most others: 3 lbs. have been trusted to by some cultivators, four by others; but five are the general allowance in Suffolk: Mr. Burrows, of Norfolk, sowed eight, and at last 10 lbs. Upon a rich dry sand the

the quantity may be smaller than upon loam: in my own practice I sowed 5 lbs., but had reason to think six, seven, or eight might have been better; the expense of hoeing will however somewhat increase with the quantity sown. The choice of seed is a point of great consequence; it should always be new, as old seed is always a week later of coming up, which increases the difficulty in hoeing: good seed, when rubbed in the hand, yields a pleasant aromatic scent. The most careful cultivators steep it for forty-eight hours in water; and Mr. Burrows mixes it well with earth for a week, with the same view. It is absolutely necessary to break the clinging fibres of the seed, by which it is so apt to adhere together, and render even sowing difficult: some force it repeatedly through wire sieves; others thrash it with flails; but at all events the object must be, by some means, attained, as it is, of all seeds, perhaps, the most difficult to sow well: with every precaution, it is necessary to sow it on a calm day, or a regular distribution will not be secured. I have had Woodbridge seedsmen, who came above thirty miles, to sow a crop, and not being sufficiently careful in respect to wind, I could see the error in the produce.

Chap. VIII.—*Broadcast Crops.*

The general practice in Suffolk is to sow the seed broadcast; and the farmers are so persuaded that this is the best method, that they will not hear of drilling: they think the roots should not be more than nine or ten inches asunder, which, in their opinion, excludes the use of the drill.

Chap. IX.—*Drilled Crops.*

Experiments have been made in various parts of the kingdom, and some of them with much success; but in other cases they have failed. Mr. Ray, of Suffolk, gained repeated crops in this manner, of 650 and 700 bushels per acre, at the distance of fourteen inches. Mr. Hewitt, of Yorkshire, had 640 bushels at twelve inches. Mr. Legrand, of Kent, drilled them at eleven inches; his crops were from twenty to thirty tons per acre; twenty tons are 800 bushels. At Wolverley, in Worcestershire, they have been drilled at one foot asunder, and produced fifteen tons, or 600 bushels per acre. Mr. Butterworth, of Scotland, also drilled them at a foot, and gained $13\frac{1}{4}$ tons per Scotch acre. The register of several failures is before me; but as they would not afford useful conclusions, I shall only observe, that when any practice is proved by experiment to be profitable, counter trials which fail do not merit much attention; we may always conclude that the experiments failed in some step of the progress (however difficult it may be to discover the particular cause of that failure), for want of the registered details of such trials being sufficiently minute: it is ascertained, that carrots will greatly succeed in drills, and we know, on much more extensive practice, that they will succeed equally well broadcast. The most material point is, to inquire in what situation and circumstances either of these modes should be applied. Where hoeing broadcast crops is common husbandry, and well practised, there can be no objection to this method; but where hoeing is ill understood, and the people must be taught how to do it, drilling is certainly the preferable mode, as the cleaning and setting out the plants in the rows, after men have hoed the intervals, may be well executed by women and children. Let it not however be imagined, that by proceeding in this manner, the expense will be reduced; it will, on the contrary, run higher than hoeing broadcast crops in Suffolk, until the women and children are become expert in the use of three- or four-inch hoes with short handles. Two or three hoeings should be given in quick succession after each other, for setting out the plants with as much regularity as possible to the distance of eight or nine inches in the rows; after which, no other attention is required than such as is necessary for destroying all weeds. Whoever have made the experiment of hoeing and weeding crops of carrots, must be deficient in common attention, if they do not see the necessity of three points already noticed; first, to sow them on clean land, after turnips, or turnip-land barley; second, not to dung for them; and, third, to plough but once.

The difficulty of drilling carrot-seed is so great, that it is much to be lamented that a premium is not offered by some public body, for procuring a machine that would do it accurately: I do not mean a premium of 20*l.* 30*l.* or 50*l.*, but such an one as should prove a recompense for time and ingenuity. I take the best method hitherto known, to be that of Mr. Honeybourne, mixing saw-dust with the seed most carefully, and drilling it with the wheat-cups of Cooke's machine: the distance of rows to be one foot.

Chap. X.—*Culture whilst Growing.*

§ 1.—*Weeding.*

In the carrot district of Suffolk, the only hand-weeding given, is that of sending in women now and then, to draw out such weeds as escaped the hand-hoes; and even this is not always necessary; the bargain made with the men is that of doing all that is necessary in the act of hoeing. But when crops are drilled in countries not well skilled in hoeing, weeding and thinning by hand are operations that require much attention: it must be done by women paid by the day; and men with hoes should follow them immediately. After the work of thinning and weeding is sufficiently completed for leaving the plants re-

gular

gular and clean, the women should be sent in repeatedly through the summer, to pluck out all weeds that shall appear, and also all carrots that have run for seed.

§ 2.—*Hand-hoeing.*

In the carrot district so often alluded to, the whole business of thinning and cleaning the crop has universally been performed by labourers, who contract by the acre, to leave the crop clean and well set out by three hand-hoeings: this was performed from thirty to forty years ago, at 18*s*. per acre, and it is done at present at 25*s*. to 28*s*. Mr. Burrows, in his first communication, observes, "The first hoeing is with hoes four inches long, and 2¼ inches wide; the second is performed with six-inch hoes, by 2¼ inches wide." The idea of having hoes only 2¼ inches wide, in order that less earth may be drawn over the weeds that are cut, is useful, and should be followed.

In Suffolk, when the crops are well sown and clean, they hoe at once with six-inch hoes. In regard to drill crops, the intervals, supposing them one foot, should be first hoed with hoes seven, eight, or nine inches long, according to the accuracy of the drilling and the skill of the workmen; then women may weed and thin the rows, which should afterwards be hoed with hoes of four or five inches. In regard to repetitions, one general rule governs in all crops, whether broadcast or drills—the operation should be repeated as often as necessary, to keep the land absolutely clean: if 20*s*. per acre will do this, well; but whether 30*s*. or 40*s*. be requisite, a firm determination must be taken, to complete the work effectually.

§ 3.—*Horse-hoeing.*

Some attempts have been made to horse-hoe carrots; and if a cultivator is determined to have them upon improper soils, which require ridges for dryness and depth, the practice may be necessary; but such cases do not merit particular attention.

§ 4.—*Mowing the Tops.*

Experiments have been published, tending to prove that the tops of a crop may be mown for feeding stock to a considerable value, without injuring the roots; but counter trials are also before us, made with great care and attention, by which the result of this practice is proved to be highly mischievous: it must certainly be condemned.

Chap. XI.—*Taking up.*

In Suffolk they leave the carrots in the land, and take them up as wanted through the winter: this was also the practice of Mr. Billing and Mr. Burrows, and will probably be pursued by all cultivators on a great scale: the roots are safe from frosts; but this circumstance forms an additional reason against mowing the

the tops: the only precaution is to have a store housed, in case a frost should prevent the work going on. The method of taking up is, for a man to strike a spade or a four-pronged fork into the earth against the root, and loosening it, a boy draws, cuts off the top, and throws the roots into heaps for the carts: the expense varies according to the soil, from something more than a farthing to a halfpenny and a penny per bushel; as in loams, cleaning the roots adds much to the trouble of the work; nor can the man raise them with equal ease. Mr. Billing ploughed them up, and harrowing the land, the crop was eaten by sheep: in this method, taking up cost nothing; but it is an operation which demands much attention, and is on the whole an inferior practice.

Carting home is an additional expense, which amounted, in Mr. Burrows's various accounts, from 6*d.* to 14*d.* per load of twenty bushels; that of Mr. Rodwell's to $13\frac{1}{2}$*d.*; and that of Mr. Brewer's to $22\frac{1}{2}$*d.*; but the last-mentioned gentleman adds to the words, *carting home*, an *et cætera*, probably including the expense of packing up in a small store. The charge must necessarily depend on the distance of the field from the home-stall. reckoned by one-horse loads of twenty bushels; of course I have the expense is double for tumbril loads of forty bushels.

Chap. XII.—*Storing.*

If the soil on which this root is cultivated be a dry sand, leaving them in the field is the preferable method, as carts can go on to such a soil the winter through without damage: but the case is very different on many loams sufficiently dry to produce carrots, but not enough so to bear winter carting. In this case the crop should be taken up in a dry autumnal season, and the whole stored at home for use, as wanted. Many methods of effecting this have been tried; but it must not be concealed, that they have on various occasions failed. If potatoes are safe against frosts, they are sure to be well preserved; but this is not the case with carrots, a root much more in danger of heating and rotting than of freezing. I have myself practised various methods, and seen the management of other skilful farmers, and the modes which have been most successful may be thus described: In taking up the crop, the boys should make the heaps of roots small, and rather scattered, that they may dry the better; and these heaps should be left, according to weather, till they are quite dry: this is a material point, and not to be neglected: when well dried, they may be close packed in a boarded building, with a very little straw surrounding them, or in a circular conical form four feet diameter, and six or seven high; and if the top is left upon one carrot in twenty, it will form a sufficient defence

against

against the frost; but a very thin coat of thatch will be a more regular defence. They have also with success been formed into pies, in the method used for potatoes, but much more slightly covered, against frost. But, whatever method is pursued, the farmer should not for a moment forget, that he should be more careful to guard against heating and rotting than against frost: if they are put together dry, and rain be entirely kept out, so that all steam may pass easily through the thatch, they will keep well. Mr. Burrows practised a method different from all these; and as it is a point in the cultivation of particular importance, it will be proper to insert his own account: "The method consists in putting the carrots together in large heaps of five or six hundred bushels each, in the field where grown, and covering the heaps with straw or stubble sufficient to keep them from frost. A slight covering of straw only is all that is necessary for those heaps that are likely to be soon wanting for use, as the object in putting them in heaps and covering them up, is to keep away the hares and rabbits, which, when the carrots lie scattered about, are very destructive to them. To secure the crop from the depredations of these animals, is of more consequence than the danger to be apprehended from slight, or than even from smart frosts: the frosts usual before Christmas are seldom severe enough to hurt a carrot-root, particularly if a thin covering of straw or stubble is thrown over the heap; and as to the rain doing them injury, I can only say I experienced no such thing; for after a heavy rain, I generally caused all the heaps to be uncovered, and exposed the first dry day to both sun and wind, and then had them covered over again. One thing I have to observe, I always took care to have the heaps put together when the roots were in a dry and clean state; therefore after-rains never made them dirty, and by uncovering the heap about an hour or two before the team came for them, I had the carrots carried to the stables in a state as clean as if they had been previously washed. Those heaps I intended should remain abroad all winter, I covered over with mould about six inches thick, in the same manner potatoes are preserved: these heaps were my stores in very severe weather, after the other heaps were all consumed, and when the ground was either covered with snow or locked up by frost. I found this a preferable way of storing carrots to that of housing them, and less expensive; at the same time it keeps them sweeter; for when too many are put together in a house, they are apt to heat, and then a great deal of trouble is occasioned, and sometimes injury sustained: all this is prevented, beside considerable expense saved, by storing them in the field."

Chap. XIII.—*Application of the Crop.*

The information to be procured under this head may be thus sub-

subdivided: 1. Horses; 2. Fatting beasts; 3. Cows; 4. Sheep; 5. Swine.

§ 1.—*Horses.*

In the carrot district of Suffolk, that root had formed the chief winter support of horses, far beyond the memory of the oldest men there living fifty years ago; and the writer of these sheets published the practice of many individuals above forty years since. At that time the district was of small extent in the vicinity of the sea, and the farmers sent a portion of their crops to the London market; a circumstance which, by some writers, was urged against extending the culture where this advantage could not be commanded. Fortunately the objection has been completely answered by the practice extending in every direction where the proper soil was found, with a view to horses alone; and in my agricultural journeys through the kingdom, I registered the experiments of many individuals who found carrots as profitable to them, as they had so long proved to Suffolk farmers.

In 1763, Mr. Billing, of Weasenham, in Norfolk, fed sixteen or eighteen horses on this root, to the entire saving of both oats and hay, except when the teams were employed in carrying out corn fifteen miles, or their work greatly increased by barley-sowing; on which occasions they had some oats in addition: two cart-loads saved him one load of hay; taking the load of carrots at forty bushels, and the load of hay at a ton, at 3*l.*, the carrots paid him 9*d.* per bushel.

In 1765, Mr. Hewitt, of Yorkshire, fed his horses on them with great success, working as usual, but without oats, and looking equally well. Mr. Cook, of the same county, found them of excellent use, and they saved his horses from a prevalent distemper. Mr. Fellowes, of Norfolk, from 1765 to 1770, fed his horses to his entire satisfaction. At Woodbridge, in 1770, they gave a bushel per day without corn. Mr. Acton, of Suffolk, also used them without corn, and they never did better. Mr. Legrand, of Kent, gave a ton per week to four horses, and found they did to admiration; this is about $1\frac{1}{3}$ bushel per diem. In Scotland they were found an excellent substitute for oats. In the register of several examinations which I took of the carrot farmers in Suffolk in 1784, &c., I found the average consumption to be 13 bushels a week, saving all the oats, and in some cases all the hay; in other cases half the hay; also that one bushel per diem saved the oats; this is the practice of many common farmers. One case occurs, in which a bushel per diem, cut small into chaff, saved both oats and hay. A variety of other instances are before me, which speak the same language; but I pass on to a late authority, occurring after many years, that of Mr. Burrows, of Norfolk, who during six years, ending with 1810, 1810, fed ten horses on 70 lbs. per diem, saving all the oats, and much of the hay usually given; they paid $10\frac{1}{4}d.$ per bushel of 60 lbs.; oats being at 32*s.* per quarter. In the winter of 1811, he fed 30 horses on this root during 210 days, giving two bushels a day to each horse, and being uncommonly hard worked they had a small allowance of hay in the night: the value saved in hay and oats, was equal to $10\frac{1}{2}d.$ per bushel, hay being at 4*l.* per ton, and oats at 43*s.* per quarter. It is worth observing, that the result of Mr. Burrows's experiments affords an exact confirmation of the facts which I laid before the public 30 years before.

One caution should here be added: if it is necessary to wash the roots before giving them to the horses, they should be kept till absolutely dry before feeding.

§ 2.—*Fattening Beasts.*

In 1763, Mr. Billing fattened 33 beasts on this root, which paid him to his satisfaction. Mr. Cope, of Nottinghamshire, above 40 years ago, found the fattening of oxen and cows to be a very profitable application of this crop. But by far the most important experiments that have ever been published on this application of carrots, were those by Mr. Moody, of Retford: he had been a butcher, who paid a minute attention to the business: he built a most complete ox-house, containing 26 stalls, for regularly fattening on oil-cake; but in 1776, being disappointed of cake, and in great danger of his beasts losing flesh, he thought of trying carrots, of which he had a crop, and to his amazement, his oxen did not go backward, but fattened so well, and paid such a value for the roots, that he continued the practice for several years, to his great emolument: half an acre and half a rood of carrots saved two tons 18 cwt. of cake, paying 20*s.* per ton for the carrots: the particulars of his trials are too detailed to quote here; but the carrot farmer would do well to read them carefully. Mr. Linn, in the carrot district of Suffolk, in 1784, fattened bullocks on them to late in the spring, to great profit. Mr. Kirby, of the same county, considered this as the most beneficial of all applications. Mr. Cotton also fattened ten or twelve bullocks every year on this food, to great profit; he has substituted them for oil-cake without the least injury to the beasts. Mr. Fuller, his neighbour, has long practised it with great success; he finds the oxen eat, according to their size, from one to three bushels per diem: but others found that large beasts would eat five or six bushels a day: another gave three bushels per diem. With an Essex farmer, four acres fattened 15 bullocks. In 1809, Mr. Burrows fattened four Galloway bullocks, which had for a part of the time (16 weeks) a bushel and a half allowed daily; hay also given: they ate in 16 weeks 796 bushels of carrots, and 28 cwt. of hay: with Mr. Burrows's crops, this is about one acre of the former. In another trial by the same person, accurately conducted, by weighing alive, but no hay given, the increased weight of the bullocks paid, beef at 9*d.* per pound from 7¼*d.* to 8*d.* per bushel of 54 lbs., and each two and a half bushels per diem for the first 28 days, but no hay was given.

From the preceding minutes, it is sufficiently obvious, that carrots may be safely relied on as a highly beneficial article for fattening oxen; and there is every reason to believe, that this application is profitable.

§ 3.—*Cows.*

The experiments which have been published on the result of feeding cows with carrots, are few, and not detailed in the most satisfactory manner; but they are sufficient to prove, that the food is excellent in relation to the condition of the stock, the quantity of milk, and the flavour of the butter. Mr. Billing was highly satisfied with the effect. The result with Mr. Cope was still more satisfactory, giving his cows two bushels per diem. Mr. Onley's, by one bushel per diem, with oat straw, produce 5 lbs. per week of the finest butter in January; if we reckon the butter at 20*d.* per lb., it is 8*s.* 4*d.* for seven bushels of carrots, or 1*s.* 2¼*d.* per bushel. In Sussex they have been found superior to potatoes. In Suffolk they are peculiarly beneficial for weaning calves. From Cambray to Bouchaine, in Flanders, I found them esteemed the best of all food for cows; and it should be observed, that they never give any bad flavour to milk.

§ 4.—*Sheep.*

That carrots must be an excellent food for sheep, it would be ridiculous to question: the only inquiry that merits attention is, what they will pay for this food. Mr. Billing's flock did better on this root, than ever he had experienced at the same season. Mr. Cope was never distressed for sheep-food in April and May, after he became a cultivator of carrots. Mr. Legrand, in Kent, made a careful experiment on fattening wethers in 1770; twenty ate a ton per week, and four cwt. of hay, which deducted, the carrots paid 14*s.* per ton, and being fed on grass land for twenty weeks, the improvement at a very low estimation was 3*l.*, or 3*s.* per ton: reckoning mutton in 1770 at 4*d.* per lb. the value of carrots becomes 28*s.* per ton, mutton reckoned only at 8*d.*; but at 9*d.* the carrots would be worth 31*s.* 6*d.*; at 10*d.* the value would be 35*s.*; and if the carrots be reckoned at 56 lbs. the bushel, the last supposition makes them 10½*d.* per bushel, exclusive of the improvement of the grass. In 1780 I made an experiment similar to that of Mr. Legrand, giving the roots to twenty-

six

six wethers on dry grass in hurdled pens: I attended the trial myself very carefully, and the carrots paid 4*d.* per bushel; the twenty-six eating, on an average, four bushels per diem, and manuring well an acre of land. In 1780 the price of mutton continued at 4*d.* per lb. which ascertains the value of carrots to be 10*d.* per bushel, when mutton is 10*d.* per lb.

§ 5.—*Hogs.*

In the application of carrots to feeding lean swine, I know not that any doubts have ever been expressed; but the trials published relation to fattening are not equally decisive, the result having been somewhat contradictory. Mr. Turner and Mr. Hewitt, both of Yorkshire, fattened porkers successfully. Mr. Ray, of Suffolk, failed entirely in the attempt. Mr. Cope fattened hogs of size on these roots, with entire success. The same result has been found at Woodbridge. Mr. Legrand, of Kent, fattened sixty porkers, the meat being excellent and delicate. Mr. Burke in 1770 (afterwards the celebrated and right honourable statesman) informed me, when I was with him at Beaconsfield, that in two successive years he entirely failed in the attempt to fatten. The same was the result with Mr. Baker, of Ireland. In 1779, Mr. Billingsley ascertained the value, thus applied, to be 3*s.* a sack. Mr. Burrows, of Norfolk, finds them of great use in supporting large herds of swine; and by that means converts much straw into excellent dung. Cabbages, Swedish turnips, and carrots, being compared for store-pigs, by weighing alive, to and from the food, the carrots much exceeded the other articles. There are two circumstances which demand particular attention relative to fattening this animal on carrots: first, the distinction of breed has an extraordinary effect; the Chinese race has paid me a fair profit on various articles of food, while other breeds feeding on the same substances have been attended with loss; and there are other breeds much superior to those which abound in some districts; this may evidently occasion a variation in results. Secondly, carrots are far superior in fattening when used in the spring, to what they are in autumn; the more dry and withered they are the more nourishing; and it is the same with potatoes. Of their great utility for lean swine, there can be no doubt.

Chap. XIV.—*Produce and Value.*

The produce of this root will, like that of all other crops, be proportioned to the goodness of the soil, and the skill exerted in the cultivation: among the great variety of notes which might be produced on this occasion, it may be sufficient to quote a few. Mr. Billing's crops, registered in the tract so often referred to, were, the good ones about 700 bushels, and the worst 300, supposing his loads 30 bushels each: but if, like the Suffolk loads, they were 40 bushels each, then his good crops might yield above 800 bushels, and his bad ones 400. Messrs. Cope, Mellish, Wharton, and Moody, all had 20 tons each; or at 56 lbs. the bushel, 800. Mr. Fellows, of Norfolk, 600. Mr. Gardner, 400 to 500. In the Suffolk district 480 to 800. Mr. Acton 760 to 960. Mr. Hilton, of Faversham, on a soil exceedingly rich, 17 waggon-loads, as much as four horses could draw: this must be at least 1200 bushels. Mr. Taylor, of Kent, has had crops so low as eight tons, or 320 bushels, but sixteen tons more commonly. Mr. Legrand, of the same county, generally from 20 to 30 tons; the medium of which is 1000 bushels. The Rev. Mr. Carter, 326 bushels. Messrs. Gerard, Weeden, and Wimper, on 10*s.* land, 400 bushels; on sheep walk, 200 and 220. Mr. Thomson, near Stockton, 30 tons. Mr. Bakewell, of Dishley, the same crop. Average in Surrey, 550 bushels. Mr. Burrows, of Norfolk, in 1807, 760 bushels: in 1810 he gained 11 tons 16 cwts.: he speaks of 7 or 800 bushels per acre as a common crop; but he has had 900 bushels. In Scotland, above 17½ tons have been gained per English acre.

Carefully reviewing the preceding minutes, and avoiding any assertions that may raise too high expectation in the minds of those who may be persuaded to try the cultivation, we may estimate the produce of the very worst soils at 200 bushels; of middling land at 450; and of the best soils at 700: there are cases of unusual fertility which may rise higher; but these products may generally be expected by such farmers as will be directed in their attempts by the circumstances noted in the preceding chapters.

In regard to value, and beginning with horses, we have already seen that carrots paid Mr. Billing in the proportion of 9*d.* per bushel, hay at 3*l.* per ton. At Woodbridge, a bushel per diem, saved the oats; reckon these, two bushels per week; now if oats be 32*s.* per quarter, it is 8*s.* for seven bushels of carrots, or 1*s.* 1¾*d.* per bushel; in another Woodbridge entry, 13 bushels per week saved two of oats, and half the hay; this may be called 14 lbs., and per week 98 lbs. saving by oats 8*s.*, and by hay 2*s.* 7*d.*, together 10*s.* 7*d.*, or 9¾*d.* per bushel of carrots. In the next case, with horses not so highly fed, seven bushels of carrots saved one of oats, or 4*s.*, and 5*s.* 2*d.* in hay, together 9*s.* 2*d.*; this is 1*s.* 3¾*d.* per bushel of carrots. The next entry gives 10¼*d.* per bushel. The next 10½*d.* In this case hay was valued at 4*l.* per ton, and oats at 43*s.* per quarter. The average of these six minutes gives, for the value of carrots in feeding horses, 11½*d.* per bushel.

In fattening oxen, Mr. Moody's carrots paid him 20*s.* per ton in 1767, &c.: now beef at that time was 4*d.* per lb.: the proportion to 9*d.* per lb. is 45*s.* per ton, and at 40 bushels to the ton, is 1½*d.* per bushel. In Mr. Burrows's trial they paid 7½*d.* It is not worth striking an average between these two sums; but as in Mr. Burrows's minutes nothing is allowed for the improved value of the lean carcase, perhaps we should be in no fear of exaggeration, if we valued the crop thus applied at 9*d.* per bushel.

We have but one entry in the article cows, which gives 1*s.* 2¼*d.* per bushel.

In Mr. Legrand's experiment on sheep, the value paid is 11¼*d.*: in my own trial 10*d.*

In the preceding notes, Mr. Billingsley's experiment on hogs, in 1779, ascertained the value to be 1*s.* per bushel. Mr. Reynolds, of Kent, a very noted, intelligent, and common farmer, made the same report in 1770; but as the price of pork then was about 5*d.* per lb., and continuing the same in 1779, both these prices per bushel must be doubled when the price of pork is 10*d.*: the reader, however, should have it in his contemplation, that in many trials they would not fatten at all, and consequently, that any estimation must be received with great doubt: in fact, the question is not sufficiently ascertained.

Recapitulation.	*s.*	*d.*
By horses	0	11½
By fattening beasts	0	9
By cows	1	2½
By sheep	0	10½
General average	0	11¼

If the unexperienced cultivator should limit his expectation to 9*d.* per bushel, it should seem that he need not apprehend disappointment; and it should be observed, that if he makes only 6*d.*, he is, with a middling crop, sure of some profit, without adverting to the advantages of cleaning his land, and much increasing his manure.

Chap. XV.—*Expenses and Profit.*

I have at different periods, for the last 40 years, published many accounts of the expense of cultivating carrots; but times are so changed in the articles of rent, tithe, poor-rates, wear and tear, and labour, that it is unnecessary to recur to them at present. Mr. Burrows, of Norfolk, and Mr. Rodwell, of Suffolk, having communicated to the Board a detail for the present period, I shall here insert them.

The following is Mr. Burrows's last account for 1811, of those articles which are applicable to a general statement:

Ploughing

Ploughing	£0	16s.	0d.	
Harrowing	0	2	9	
Rolling	0	0	4½	
Seed	0	10	0	
Sowing	0	0	3	
Hoeing	1	19	4	
Taking up	1	3	0	
Heaping	0	5	2	
Carting	1	7	9	—£6 4 7½*

The following is Mr. Rodwell's account:

One double ploughing ..	£1	0s.	0d.	
Harrowing and sowing	0	2	6	
Seed, 4 lbs. at 2s. ..	0	8	0	
Hoeing	1	5	0	
Taking up	0	10	0	
Carting	1	2	9	—£4 8 3

The average total of these two accounts is 5*l.* 6*s.* 5*d.*

Now, if we apply these particulars to the scale of supposed produce before inserted, of 200 bushels for the worst land, 450 for middling land, and 700 for the best soils; adding to the amount 15*s.* per acre, for rent, tithe, and rates for the worst land; 40*s.* for the middling; and 4*l.* for the best; and adopting Mr. Burrows's expenses, because they are the highest, the account may thus be stated:

Worst land, sundry expenses ..	£6	4s.	7d.			
Deduct, in taking up and carting	1	0	0	—£5	4	7
Rent, &c.				0	15	0
				£5	19	7
Middling land, sundry expenses	6	4	7			
Rent, &c.	2	0	0	—£8	4	7
Best land, sundry expenses ..	6	4	7			
Rent, &c.	4	0	0	—£10	4	7

Hence, then, 200 bushels, at 7*d.*, about pay the expense on the worst land; 450 bushels, at 4½*d.* on the middling land; and 700, at 3½*d.* on the best land.

In regard to net profit, to avoid all exaggeration, we will suppose the crop to pay 8*d.* per bushel, and then the account will stand thus:

Worst land, 200 bushels, at 8*d.*	£6	13s.	4d.
Expenses	5	19	7
Profit	£0	13	9

* These articles are the averages of the last accounts sent in MS. letter.

Middling

Middling land, 450 bushels, at 8*d.*	£15	0	0
Expenses	8	4	7
Profit	£6	15	5
Best land, 700 bushels, at 8*d.* ..	£23	6	8
Expenses	10	4	7
Profit	13	2	1

The cultivation well deserves the attention of a farmer, even if the profit amounts to no more than 13*s.* on land of 10*s.* per acre; it is alone a rent, and fully equal, or rather much exceeding, in that proportion, what is made on the average of all crops on farms; for, besides this advantage on the consumption, the land is well cleaned, and much manure raised: as to the benefit on other soils, it is too obvious to call for any observations; far exceeding, as it evidently does, the profit of all the more common applications of the soil.

Chap. XVI.—*Do they exhaust or ameliorate the Soil?*

If we reason by analogy, it is scarcely possible to doubt of carrots being an ameliorating crop; but this will be placed beyond all question, by inserting a few cases which prove the fact. Mr. Cope, of Nottinghamshire, was in a system which well deserves attention; he kept his carrots so long in the ground for spring use that he did not venture barley or oats after them, but sowed turnips; and these two hoed crops coming together, cleaned the land to an extraordinary degree, and so improved it, that the following barley yielded from six to ten quarters per acre. Mr. Moody, of Retford, gained eleven quarters five bushels of oats after them.

In Cambridgeshire, barley was found better after carrots, carted off the land, than after turnips eaten on the soil. The same result is found in the Suffolk carrot district; also by Mr. Cotton, of Hesgrave, provided the barley be sown at the right seasons.

In Nottinghamshire, the barley was better after carrots that had no manure, than after turnips which had dung. Mr. Billing dunged the middle of a field for turnips, and sowed the two ends of it to carrots without dung, and the barley after the carrots was better than after the turnips. On other occasions he got crops of barley after this root, which were, to use his own expression, *prodigious;* not less than three waggon-loads in the straw per acre. Mr. Kirby sowed them after turnips, and then barley; he got a quarter an acre more barley than the land would have yielded, if that crop had followed turnips without the carrots intervening.

Mr.

Mr. Harvey, in Worcestershire, gained as good barley after carrots without manure, as after turnips manured.

In the various experiments of Mr. Burrows, the barley which he gained after carrots yielded amply, rarely less than five quarters per acre.

These facts are sufficient to prove that carrots, so far from having any exhausting quality, do actually improve land to a very high degree.

Chap. XVII.—*Accidents and Distempers.*

Comparing carrots with every other fallow crop, their superiority is perhaps in no other point so decisive as in this: if the seed be good, the crop may be considered as certain; they are not subject to depredations by fly, slug, grub, or any other enemy, at least to such a degree, that in all the registers I have consulted, I do not recollect one absolute failure; and when the multitude of accidents to which other fallow crops are exposed, is well considered, this circumstance cannot fail of making a strong impression on the reader's mind. I have heard of but two enemies, rabbits and hares: these may so abound as to do much mischief, if the scale of culture be not great.

Chap. XVIII.—*Importance of the Culture for the Improvement of dry Land.*

The importance of a crop, which, after paying for deep tillage and incessant hoeings, yields an ample profit in the consumption of live stock, and gives a great quantity of the best dung, cannot for a moment be doubted; in fact, the advantage to the farmer may, upon the whole, be considered as superior to that attending any other common production of the earth. The circumstance of being able to feed or fatten all the live stock of a farm, by a crop which does not demand directly an ounce of dung, is singular and decisive. When the advantages are so prominent, it may excite some degree of astonishment, that the cultivation is not universally pursued on all the soils which admit it; and yet the fact remains, that it is known scarcely any where. Excluding the vicinity of London, where the object is, of course, the supply of the markets of that metropolis, there is but one district in the kingdom where the culture is thoroughly established. To what may we attribute this strange fact? Perhaps it is caused by the same circumstance which meets us in such a multitude of inquiries—the want of capital. But this circumstance is not applicable to the teams of a farm, or to the cows or wethers already upon it. In these respects we can attribute the neglect to ignorance alone; and it is much to be lamented, that effective steps are not taken to enlighten the farmers of the kingdom upon a point of such real importance.

LXIX. *Note upon the Combination of Sulphur with Chrome, and upon a new Process for obtaining the Oxide of that Metal.* By J. L. Lassaigne *.

In making lately some experiments upon the oxide of chrome, I endeavoured without success to decompose it by sulphur, in order to obtain a combination of metal with this combustible body, both by melting the mixture of the two bodies in a crucible, and by making the vapour of the sulphur pass over the oxide of chrome heated white red in a porcelain tube. I despaired of succeeding; when, reflecting upon the property which the greater part of the metallic chlorurets possess of being decomposed by sulphur and converted into chlorurets, the idea occurred to me of submitting the muriate of chrome in a dried state (which I consider as a chloruret) to the action of sulphur.

After having prepared some chloruret from pure chrome, by boiling together chromic acid and hydrochloric acid in excess, I evaporated it to dryness in a porcelain vessel: in this state it was of a hortensia-rose colour in the form of a mass very slightly puffed up: being reduced to powder and mixed with five times its weight of flour of sulphur, it was put into a bent tube of glass and brought gradually to a white heat.

At the commencement of this operation a little hydrosulphuric gas became disengaged; afterwards some hydrochloric gas; then the excess of sulphur sublimated with a small quantity of chloruret of rose chrome; lastly, very thick white vapours of a disagreeable smart odour, which I recognised to be the chloruret of sulphur, were emitted during the rest of the calcination.

The lower part of the tube inclosed a blackish gray matter, which was very friable, the slightest shock reducing it easily to powder, and several experiments convinced me that it was a true sulphuret of chrome.

Properties of this Sulphuret.

1. It is blackish gray, unctuous to the touch; it makes on any hard substance a blackish mark as brilliant as plumbago.

2. Heated to a wax red in a small crucible of platina, it burns like pyrophorus, exhaling a smart odour of sulphurous acid, and produces an oxide of chrome of a deep green.

3. Nitric acid has no sensible effect on this sulphuret even with the assistance of heat, but aqua regia converts it into sulphuric acid and into chloruret of green chrome.

Being desirous of ascertaining the proportion in which these

* From the *Annales de Chimie et de Physique*, for July 1820.

two bodies were combined, I transformed them into sulphuric and chromic acids by means of nitrate of potash, and I deduced the quantity of sulphur from that of the sulphate of barytes, obtained by precipitating the solution of the residue of that calcination by the nitrate acid of barytes.

According to the mean result of the two experiments, I concluded that the sulphuret of chrome, which I had prepared, was formed as follows:

Chrome........	100·00
Sulphur........	10·54

These experiments led me to a more prompt and œconomical method of preparing oxide of chrome of a beautiful green colour, and which may always be obtained of the same degree of intensity.

This method consists in calcining to redness, in a hard earthen crucible, a mixture of the chromate of potash and sulphur, in equal parts, and steeping in water the greenish mass which remains, in order to dissolve the sulphate and the sulphuret of potash which are formed by that operation. The oxide of chrome is precipitated, and may be obtained pure after several washings.

It is not necessary to have the chromate of potash crystallised, in order to extract from it by this process the oxide of chrome. I have also obtained a beautiful colour by calcining with the sulphur the produce of the evaporation of a solution of chromate of iron treated with nitre, which I had previously saturated by dilute sulphuric acid, in order to precipitate the alumine and silex which very often accompany that mineral.

LXX. *On the late Lunar Occultation of Jupiter; with Remarks on the late Solar Eclipse. By Mr.* George Innes, *Aberdeen.*

To Mr. Tilloch.

Sir, — I have just seen the last Number of your valuable Magazine; and, finding no account of any observation being made of the late occultation of Jupiter by the Moon, I send you the elements for calculation, and likewise the result of a calculation of the time of last external contact for Aberdeen.

The elements from the lunar tables of M. Burckhardt, and the tables of the Sun and Jupiter in Professor Vince's 3d vol. of Astronomy, are as follows:

Apparent

Apparent time of Geocentric conjunction at Greenwich, October $18^d\ 5^h\ 13^m\ 14^s.5$.

Longitude of the moon and Jupiter ..	344°	7′	1″·39
Latitude of the moon south, decreasing ..	0	46	11·44
Geocentric latitude of Jupiter	1	29	42·08
Horary motion of the moon in longitude ..	0	36	56·80
Horary motion of Jupiter, retrograde . ..	0	0	10·00
Horary motion of the moon in latitude towards the north pole	0	3	20·22
Moon's equatorial horizontal parallax ..	0	60	30·03
Moon's horizontal semidiameter	0	16	29·17
Semidiameter of Jupiter by observation ..	0	0	7·25
Sun's Æ. at noon per Nautical Almanac	13^h	32	42·3
Daily increase	0	3	45·6
Equation time at conjunction		−14	48·6

The resulting times for Aberdeen are, in mean time,

Visible conjunction .. .. October 18^d	4^h	52^m	$28^s.7$
Last external contact	4	58	6·8
Proportion of Jupiter's diameter immersed at greatest obscuration			$\frac{5·54}{14·50}$

At Aberdeen the beginning of the occultation could not be observed for clouds. About $5^h\ 0\frac{1}{2}'$ mean time, the Moon and Jupiter were seen for an instant very indistinctly. Jupiter appeared a little to the south of the moon's vertex, and nearly one-third of his diameter was judged to be obscured. At $5^h\ 1'\ 30''$ the moon emerged from the cloud, but a heavy shower of rain was falling at the place of observation. The external contact of the limbs at the end was determined to be at $5^h\ 1'\ 58''$. But the apparent relative path of Jupiter was, for a short time, so nearly in coincidence with the moon's circumference, that the bodies separated very slowly. Owing to this, and to the unfavourable state of the atmosphere, the above time is perhaps subject to an error of about 5″. The telescope used was $3\frac{1}{2}$ feet achromatic by Dollond, with a power of 70.

By comparing the above results of calculation with observation, it appears that the error of the tables of Jupiter in latitude is nothing; the error in longitude, about 2′ 23″ + or too far forward. But as no observation of the time of the moon's passing the meridian could be made, whether this difference arises solely from the error of the tables of Jupiter, or partly from those of the moon, could not be determined.

I am sorry so few observations have appeared respecting the late solar eclipse; one in your Magazine, by Mr. Bevan, appeared to me to have been most carefully made; and I make no doubt but the instants of beginning and end were observed

 within

within the limits mentioned by him. This induced me to make a calculation of the time of beginning for Leighton; and I was surprised to find the time differ more than four minutes from the time given by so good an observation. I take it for granted, thar Mr. B. has been misled by the equation of time in the Nautical Almanac being marked *Add*, instead of *Sub.*

I hope, if this has been the case, Mr. B. will have the goodness to give the times thus corrected in the same explicit manner in which he sent you his former observations.

In a calculation of this eclipse by Mr. MacGregor, noticed in your last Magazine, and upon which you have bestowed such merited encomiums, I have observed that he has made the equation of time rather too great; but his 14th and 31st equations of longitude, being respectively 0″·78, and 0″·9 too small, will very nearly balance the error in the equation of time.

Your inserting the above will oblige,

Sir, your most obedient servant,

Aberdeen, Nov. 10, 1820. GEO. INNES.

LXXI. *New Method of congealing Water in a Vacuum. By M.* T. GROTHUSS *.

THE beautiful discovery of Professor Leslie on the artificial congelation of water has successively engaged the attention of many learned philosophers and chemists. They have sought to give to this discovery a more extended application, in order to convert it to some great object of utility; and already their labours have led to the discovery of some particular results which might otherwise have remained long concealed. In the mean time it must be useful to make known all the facts connected with this discovery; and I am therefore induced to publish the result of an experiment by which I effected the congelation of water promptly and with the greatest facility.

Into a metal vase half filled with water, I poured very gently an equal quantity of ether, so that no mixture might take place of the two liquids. The vase was placed under the receiver of an air-pump, which was so fixed upon its support as to remain quite steady when the air was pumped out. At the first strokes of the piston the ether became in a state of ebullition; it was evaporated totally in less than a minute, and the water remained converted into ice. I made this experiment for the first time at Mittau, in an apartment the temperature of which was 16° R.

* *Annales Générales des Sciences Physiques.* By MM. Van Mons, &c.

LXXII. *Cal-*

LXXII. *Calculation of the Heliocentric and Geocentric Places of Venus, for 12th March 1808, at 21h 43m 15s m. t. at Greenwich.*

Epochs.	Mean Long.	Perihelion.	Node.	I.	II.	III.	IV.	V.	VI.	VII.	VIII	IX.	X.
1800.	4s 24° 9′ 25″·2	4 7° 43′ 6″·2	2s 14° 48′ 38″·6	874	824	506	026	774	132	227	177	535	585
8 years.........	0 1 32 13·1	6 16·1	3 59·5	996	670	792	992	984	752	675	988	757	412
March	3 6 7 48·4	7·7	4·9	897	747	852	959	753	728	014	020	995	029
12 days	17 37 25·9	1·1	0·9	981	954	973	992	955	950	003	004	999	005
21 hours.......	1 24 6·8			999	996	998	999	996	996				
43 min 15 s....	2 53·2												
	8 20 53 52·6	4 7 49 31·4	2 14 52 43·9	747	191	121	968	462	558	919	189	286	031
Sum of Eq. Cent. & Pert. in Long.	... 1 30 2·3	8 20 53 52·6	8 22 23 54·9										
	8 22 23 54·9	4 13 4 21·2	6 7 31 11·0										
Reduction.........	3 13·2	(Mean anom.)	(Arg lat. & red.)										
True eclipt. long.	8 22 27 8·1												

Equations of Long. & Rad. Vect.

Arguments			
Anom. 89′ 15″·7		...	0·7266990
I.	...	28·6	 61
II.	...	6·1	105
III.	...	0·5	 1
IV.	...	0·5	 16
V.	...	3·6	 33
VI.	...	1·6	 23
VII	...	2·9	
VIII.	...	0·4	
IX.	...	2·2	
X.	...	2·8	
		90 4·9	0·7267229
Sec. Var. 8·2 years		−2·6	−44
		90 2·3	0·7267185
Log. Rad. Vector ...			9·8613662

	s	°	′	″
Long of Venus	8	22	27	8·1
Long. of Earth at given time, by Delambre's Tables	5	22	40	58·9
Angle of Commutation ...	2	29	46	9·2
½		44	53	4·6
Complement		45	6	55·4

		Logarithms.
Radius Vector		9·8613662
Cos. Hel. Latitude		9·9999870
Curtate distance...		9·8613532
Earth's Rad. Vector		9·9977274
Tan.	36° 8′ 54″·5 ..	9·8636258
	45	
Tan.	81 8 54·5 ..	0·8076300
Tan.	44 53 4·6 ..	9·9982508
Cotan.	8 53 12·0 ..	0·8058808
.. ..	45 6 55·4	
	1 6 13 43·4 ..	Elongation
	11 22 40 58·9	Long. of Sun.
	10 16 27 15·5	True g l Venus from m. equinox.
	+ 14·6	Lunar nutation.
	+ 0·3	Solar Do.
	— 30·4	Aberration.
	10 16 27 0·0	Ap. Long. by Tabs.
	10 16 27 7·0	Do. obs. at Paris.
	— 7·0	Error of Tables.

Heliocent. Lat. to Arg. 6s 7° 31′ ... 26′ 36″·6 s.

Tan. hel. lat.		7·8887796
Sin. elongation 36° 13′ 43″·4 ..		9·7715949
Sin. commutation	ar. co.	0·0000035
Tan. geoc. lat. ..	15 43·6 ..	7·6603780
Observed latitude ..	15 41·9	
	+ 1·7	Error of Tables.

Precepts for the Application of the New Tables *of* Venus, *contained in a preceding Part of this Volume, illustrated by an Example. By the Editor of the Tables.*

The following concise precepts will apply, with very little alteration, to other planetary tables constructed according to the improved arrangement.

To find the Heliocentric Longitude and Latitude.

1. From Tab. II. take out the epochs of the mean longitude, perihelion, and node, with the ten arguments of perturbation, and place them in an horizontal line. But if the given year be not found in that Table, take the nearest preceding it *, and add underneath the motions from Tab. I. for so many years as the epoch taken from Tab. II. precedes the given year.

2. Under these, write down successively the mean motions for the given month, day, hour, minute, and second, from Tables III. IV. and V.

3. Add together the numbers in the several columns; rejecting in the longitude, perihelion, and node, 12 signs, and in the arguments of perturbation, 1000, or any multiples thereof respectively, if they occur.

4. From the tabular mean longitude thus found (increased by 12 signs if necessary) subtract the longitude perihelion; the remainder will be the mean anomaly, with which enter Tab. VI. (making proportion for the minutes and seconds), and take out the equation of the centre, which set down apart.

5. With the ten several arguments of perturbation enter Table VII. and take out the corresponding equations, which write down successively under the quantity found by the last precept, and add the whole together. Then recur to Tab. VI. take from it the secular variation of the elliptic equation, and apply the same according to its sign to the sum just found: observing that for a period anterior to 1800, the sign of the Table must be changed.

6. Add the corrected sum of the equations to the mean longitude, and from the quantity thus obtained (increased by 12 signs if necessary) subtract the longitude of the node, the remainder is the argument of latitude and of reduction.

7. With the last-mentioned argument take out from Tab. X. the reduction, which being added to the corrected longitude before found, gives the planet's true heliocentric longitude on the ecliptic reckoned from the mean equinox.

* Except 1700, which, not being a *Julian Bissextile*, cannot be used in conjunction with Tab. I.

8. The

8. The same argument applied to Table XII. obtains the planet's heliocentric latitude *.

To find the Radius Vector.

9. With the mean anomaly found by precept 4, enter Table VIII. for the elliptic radius vector; underneath which write the several corrections of the same taken from Tab. IX. by means of the six *first* arguments of perturbation. To the sum of the seven quantities, apply the secular equation, and the result is the true radius vector, corresponding to the mean distance 0·72333166.

To find the Geocentric Longitude and Latitude.

10. Calculate the earth's longitude and radius vector for the given time from the solar tables.

11. To the logarithm of the planet's radius vector, add the logarithmic cosine of its heliocentric latitude, either from Tab. XI. or from the common trigonometrical tables; the sum, rejecting 10 from the index, will be the logarithm of the planet's curtate distance.

12. Then, in the plane triangle formed by the sun, earth, and planet's ecliptic place, we have given two sides, viz. the earth's radius vector, and the planet's curtate distance, with their included angle, called the angle of commutation. This latter is found by subtracting the earth's longitude from that of the planet (increased by 12 signs if necessary). From these data the other two angles are found by the operations of trigonometry †. The angle at the earth is called the elongation, and, in the case of an inferior planet, it is always the least of the two.

13. When the angle of commutation is greater than six signs, *add* the elongation to the sun's longitude, the sum is the planet's true geocentric longitude reckoned from the mean equinox: but if the angle be less than six signs, the elongation is to be *subtracted*.

14. Add together the log. tan. heliocentric latitude, log. sin.

* In the Introduction to the original Tables, the secular variation of greatest latitude is stated to be $-7''{\cdot}24$ cos. inclin. but in the Tables themselves the co-efficient seems to be $+8''{\cdot}4$. On account of this discordance, and the smallness of the correction, it was thought proper in Tab. XII. to omit altogether the column of secular variation.

† There are two formulæ adapted to the solution of this case. The one employed in the following example, has generally been adopted in calculations of this kind; but since the introduction of equations of perturbation into Astronomical Tables has rendered it necessary to give the radius vector in natural numbers instead of logarithms, perhaps the more common formula would now be found preferable in practice. In that case, however, there must be substituted for Table XI. one of double entry for obtaining the curtate distance in natural numbers.

elongation,

elongation, and arithmet. comp. log. sin. commutation, the sum of these three logarithms, rejecting 10 from the index, is the log. tan. geocentric latitude.

Corrections for the Original Quarto Tables, which are not noticed in the List of Errata.

Page 1	1819	long. aphelion, *read* 10 8 57 59·3.
1	1820	——— .. 10 8 58 46·4.
1	1890	The mean long. aphelion, and node, are all for 1900, though in page 2 the numbers are right.
2	1809	Arg. I. *read* 245.
2	1840	——— .. 854.
4		200 years, Arg. VI. *read* 594.
5		Motions of aphelion and node for months are incorrect.
6		1 day, aphelion, *read* 0·1.
9		48 min. *read* 3 12·3.
10		Arg. 2^s. 8^o. *read* 43 36·1.
21		Tab. XXI. *read* (2V−M).
21		——XXIII. Arg. 280, *read* 26.
21		——XXIV. —— 500 to 600, sign +.
25		Change places with the arguments 45 21 and 47 22.

Corrections for the Reprint in the Philosophical Magazine.

Introduction. For Table X. *read* XII.

Tab. I. 4 years, Arg. VIII. for 404 *read* 494.

—— II. 1813, Mean Longitude, for 14·6 *read* 14·5.

—— X. Arg. 0^s. 14°, and 2^s. 16°, for 2 35·5 *read* 2 35·2.

—— XIII. Change places with the arguments 45 21 and 47 22.

—— VI. (Title) for 1820 *read* 1800.

LXXIII. *The Arctic Expedition.*

WITH our present Number we have given a Map of the discoveries of Captain Parry in the Polar sea. The official account of the voyage has not yet made its appearance, and we have but little to add to the statements laid before our readers in our last Number (p. 383). The subjoined particulars, among which are a few not before noticed, are from an officer on board one of the ships:—

ON the 11th of May 1819 the Hecla and Griper left England. In the middle of June they first fell in with ice; and at the latter end of that month they were beset by it, while making for the west coast of Davis's Straits. After some little time the ships were liberated, and steered northward along the edge of the ice, which

which led them up to Disco Island, in which no appearance of any opening was discovered. In lat. 72. 30. N. they fell in with a whaler, which reported that the ice was blocked against the land in 74 N. which determined the Commander of the Expedition to take the ice at the above spot. Accordingly they commenced, and persevered in warping and heaving through between the floes, when, being aided by a strong easterly wind, which opened the ice a little, they were enabled to force their way through, with all sail set. They were frequently stopped in their arduous exertions, from which they liberated themselves by sawing the ice.—This passage was never before attempted, and is a circumstance of great importance to whalers.

They were now in clear water, and saw no ice again until they made Lancaster Sound, where it appeared in small open streams. They made this Sound on the 1st of August, and, having a fair wind, steered up the Sound with every yard of canvass set, but in the greatest anxiety. At length, on the spot where Captain Ross, the former navigator, had placed Croker Mountains, they struck soundings, 200 fathoms, and passed it. Hopes now again revived, especially as in proceeding the Strait was found roomy.

They now ran to the meridian of 90 W., when having lost sight of the south shore, and having a long swell, they concluded they had reached the Polar Basin; but in stretching across the Strait, they were stopped, just before night, by the ice. There being an appearance of water to the Southward, they steered in that direction, and discovered an inlet, which they called Prince Regent's Inlet. The flood tide coming from the South, it was considered probable that this inlet communicated with Hudson's Bay; the ships, therefore (it not being the object of the Expedition to trace to that source), returned to the spot where they had been stopped by the ice. Finding on their return that the ice had in some degree cleared away, they again proceeded West, but the ice became so close as to leave only a narrow channel close along the shore; and they were frequently stopped altogether; when northerly winds generally opened it again.

On the 4th of September they reached Copper Mine Roads. Previous to this the variation had changed from 124 W. to 166 E., the ships having, as was supposed, crossed the magnetic meridian in about 100 W.—As the compasses there showed the ships' heads to be N. E. on all tacks, they judged themselves at no great distance from the magnetic pole. The compasses had indeed been perfectly useless from the time of their passing Lancaster's Sound, which obliged them to steer by the sun, when it was out, and how they could when it was not; often lying-to when the fog was thick, as a change of wind would sometimes clear the atmosphere sufficiently for the sun to penetrate it.

One morning, having run about 100 miles in a thick fog, they made the land, but could not tell whether it was a new discovery, or the island which they had left the day before, until the longitude was ascertained upon a floe of ice : it then proved to be Melville Island.

Considerable discoveries were made in the variation, dip of the compass, and magnetism in general during the voyage. On the 16th of September the sea was first frozen over, which carried the ships into dangerous situations, and rendered them immoveable. This obliged them to get into port for the winter, and by the 26th of September, a passage of three miles into Winter Harbour, Melville Island, was cut for the purpose. Soon after this period the thermometer fell below zero ; in November it stood at 50 below, and in April following at 55 ; which latter is the greatest degree of cold ever registered.

On the 16th of November the sun set from them, and did not rise again till the 6th of February. On the 21st of December, at noon, they could just read small print by turning the leaf to the light. They saw no clouds during the winter, and but little snow fell. The *aurora borealis* was frequently seen, but never brilliantly displayed. It was bitter cold when the wind blew, but at other times bearable. Its intensity may be judged of from the fact that port wine in the officers' cabins froze and burst the bottles ; and on the officers' beds the thermometer stood from 16 to 20 below the freezing point.

In April (1820) partial symptoms of thaw appeared. By the end of May pools and streams of water made their appearance, and soon after a regular thaw commenced. Captain Parry with a party now crossed Melville Island, and reached the sea on the opposite side in lat. 75° N. where they discovered another island. Fourteen days were occupied in this excursion, and making observations on the animal and mineral productions. Vegetation had now become active ; and *sorrel* was found in such quantity as to remove all symptoms of scurvy from the crew. By the end of July the ice disappeared in Winter Harbour ; but it was not till the last day of the month that the outside ice was rent sufficiently to permit their departure ; and on the 6th of August they reached the western termination of Melville Island, when the floe ice was from forty to sixty feet thick, and so compact that not a hole of water could be seen amongst it. The ships waited here eleven days (one-third of the summer in that clime) ; when seeing no change, and the general opinion being that all attempts to proceed westward in that parallel were useless, on the 23d of August they steered to the eastward, searching for a passage to the south-

southward, that would enable them to reach the continent (of North America); but finding none, and the ice having led them back into Lancaster's Sound, it was determined to return to England. During the eleven days the ships were off Melville Island, they were in the most critical situation, being obliged to dodge the ice round a point of land the whole time, to avoid being nipped: the beach was formed of ice, which projected under water more than thirty yards, having about two fathoms water on the outer edge of it, against which the ships lay in nine fathoms; so that had they been stove, they would have sunk deeper than their masts down, and nothing could have been saved.

[We make the following extract from a scarce work, entitled "Observations on a North-Western Passage, by William Goldson, Esq. of Portsmouth, published in the year 1793."]

If the authority stated be not questionable, the passage from Lancaster's Sound to the Pacific Ocean has been made:—"A voyage is said to have been made in the year 1598. The only account we have of it is from a memoir read at a meeting of the Academy of Sciences at Paris, Nov. 13, 1720, by Mr. Buachi, geographer to the French king. The substance of this memoir is, that M. De Mendoza, a captain in the Spanish navy, employed to form a collection for the use of that service, having searched various archives, found an account of this voyage, which was made under the command of Lorenzo Ferrer de Maldonado. From an inspection of this journal it appears that when he arrived in latitude 60 degrees North, and longitude 325 degrees East from Ferro, he steered to the Westward, leaving Hudson's-bay to the South, and Baffin's-bay to the North; and in the latitude 65 deg. North, and longitude 297 degrees East from Ferro (from which meridian the longitude is reckoned through the whole journal), he altered his course to the Northward, sailing through what he calls the Straits of Labrador, until he found himself in latitude 76 deg. North, and longitude 278 deg. East, in the Frozen Ocean; he then held his course South-West, and passed through the Strait which separates Asia from America. In latitude 60 deg. North, and longitude 235 East, he entered the South Sea, naming the Strait through which he had passed Anian, but which M. Buachi would have called Ferrer's Straits, in memory of its discoverer."

LXXIV. *On the Advantages of using Animal Empyreumatic Oil in the Manufacture of Prussian Blue.* By Dr. Haenle.

Among the accessory products of the fabrication of muriate of ammonia, empyreumatic oil is that of which hitherto the least use has been made: for we cannot consider as of much consequence the very trifling quantities of this article which are annually employed in pharmacy, and there is no other known consumption of it.

I have succeeded in obtaining with this oil a lye for the preparation of Prussian blue, which is as rich in colouring matter as that made of horns or with blood; it is a blue equally beautiful and clear.

The consistence of the blue precipitate which Diesbach obtained in endeavouring to prepare Florence lac with salt of tartar which he had got from Dippel, had induced some chemists to treat this salt with animal empyreumatic oil in the hope of converting it into prussiate of potash; but their experiments, which were made in the liquid way, had not any success, and could not have any; for, besides that in the animal oils the elements of the prussic acid are in a different state than in that acid, these chemists wanted the principal condition necessary to the acids forming and uniting itself to the alkali—namely, that of operating on it with a red heat.

I have followed the direct method, which was to reduce into charcoal by calcination the animal oil, and to redden this charcoal with alkali. The result was a prussiate, which, with the sulphate of iron and the sulphate of potash and alumine, yielded a very beautiful and abundant blue.

It would be wrong to rank in the same class for the improvement of the Prussian alkali the charcoal which remains after the distillation of animal matters for the purpose of extracting ammonia from them. The latter charcoal has experienced too strong an ignition for the elements of the prussic acid to be able to maintain an affinity favourable to the production of the acid by the calcination of charcoal with the alkali.

Chemists may by means of empyreumatic oil procure, in a little time and without being incommoded by the least odour, a prussiate of potash fit for serving as a reactive. For this purpose let them half fill with the animal oil a Hessian crucible of the capacity of from 8 to 16 ounces, and place it among burning charcoal. As soon as the oil begins to simmer, withdraw the crucible from the furnace and place it on the ground under the chimney, covering it with a leather pipe such as may, if necessary, be lengthened. The object of this covering is to promote the combustion, and the better to conduct away the smoke. In proportion as the oil is consumed let more oil be of new introduced into the crucible; and when the whole has been consumed, calcine the residue at a gentle red heat until a brown vapour begins to ascend, and till a portion of the mass put upon a cold body hardens on the instant, and presents the appearance of a porous and friable body, without any odour.

LXXV. *Notices respecting New Books.*

An Inquiry concerning the Power of Increase in the Numbers of Mankind; being an Answer to Mr. Malthus's Essay on that Subject. By William Godwin. 8vo. 18*s*.

Mr. Malthus had assumed, from some hypothetical calculations of Sir William Petty on the number of children which teeming women can bear,—some loose notions in the writings of Dr. Styles, &c.—a calculation of Euler, showing the various periods of doubling, according to the rate of excess of births over the deaths, that the population of a country, if left unchecked, could double itself, by propagation alone, every 25 years. The censuses of North America were confidently appealed to in support of this doctrine, which has been received by all the political economists of Europe.

Many a silly declamation has been poured out against Mr. Malthus, but no one before Mr. Godwin thought of examining the *data* on which Mr. Malthus's structure rests, to see whether they really bore him out in his conclusions.

Mr. Godwin has been at some pains to ascertain the extent of female productiveness. A variety of *data* on this subject are to be found in the work of the laborious Süsmulch, and the most accurate tables containing all the information which a philosopher would wish to obtain respecting the progress of population in a country, have been kept in Sweden for more than half a century. The lists from every part of Europe, town as well as country, give four children only to a marriage. In Sweden, in particular, as appears from its lists, almost every female, on attaining the marriageable age, changes her condition. If this is the rate of productiveness in Europe, what is it in North America? The returns obtained from that country, as might be expected, exhibit precisely the same result; and in America, as well as Europe, the number of children to a marriage is four.

The next point to be ascertained is, the law of mortality. This is pretty well known in Europe, but we possess few returns on this subject from North America. It is known, however, that the mortality is greater there than in Europe. All newly settled countries are more unhealthy than old countries; and North America in particular, from all accounts, is much more unhealthy than any country in Europe.

In Sweden, which is a healthy country, the excess of births over the deaths, is nearly that which Süsmulch assigns as the average for whole provinces in ordinary years, namely, as twelve or thirteen to ten. Sweden may be said to be cut off from the rest of Europe, sending forth few emigrants, and receiving few inmigrants.

grants. From this circumstance, it has been found possible to compare the population as taken at a particular period, with what it ought to be, by adding to the preceding enumeration the births, and subtracting the deaths, of the intervening period, in order to see whether the result approximates to the next enumeration, which it does to within a wonderful degree of nearness. In 54 years, from 1751 to 1805, a period of internal tranquillity, the population increased from 2,229,614 to 3,320,647, nearly one half.

How happens it then, that with no more births than those of Sweden, North America, where the deaths are more numerous in proportion to the births, has increased in population between 1790 and 1810, from 3,929,326 to 7,239,903, while Sweden, in 54 years, only increased its population one half?

Mr. Godwin, with the assistance of a friend, Mr. David Booth, has analysed the North American censuses, and cleared up this mystery.

The world believed too readily the assertion of Mr. Malthus, that the American increase was not owing to immigration. Mr. Booth has proved, that it is owing almost entirely to immigration. By tables he has shown with what amazing rapidity a population is increased by the annual influx of a comparatively small number of picked propagators. He then analyses the censuses, and shows how materially they differ from those of a regular society. When enumerations are taken every ten years, it is obvious, exclusive of immigration, that in any particular census the persons living above 10 years of age must have all existed in the census immediately preceding. In that of 1810, for instance, all above ten formed part of the population of 1800, and are in reality the same, except inasmuch as they are diminished by death. Now, the white population of 1800 was 4,305,971. These in 1810 would, without immigration, have been, by the most favourable laws that have hitherto been observed of human mortality, diminished by one fourth, leaving 3,200,000 alive. But the actual census above ten years of age was 3,845,389, giving a surplus of 645,389, which can only be accounted for by immigration. The census of 1810 contains also 2,016,704 children under ten years. Part of these, too, as proceeding from immigrants, should be added to the 645,389; and therefore, of the 1,556,122 persons which the census of 1810 exhibits beyond that of 1800, it is clear that nearly one-half was added by direct immigration. In an indigenous society there are nearly a fourth of its numbers above forty-five years of age. From the continued immigration into America, the higher ages bear no proportion to the rest. In none of the United States is the number of persons above forty-five more than from 16 to 17 per cent. of the population, while in many

many of the newly settled districts they do not exceed seven or eight.

Finding, therefore, that the number of children to a marriage is the same in America as in Europe, and that the mortality is not less in America than in Europe, that the increase in America is clearly demonstrated to have arisen chiefly from immigration, we must exclude America from all reasonings on the rate at which mankind can increase in number.

The population returns of this country are of little use to the statistical inquirer. We know that our population has increased, but it certainly has not increased at the rate of that of Sweden. The return of 1801 is evidently inaccurate; and though from 1801 to 1811, there has been an increase, that increase has not been so great as stated in the returns. If we take the number of houses for a guide, and suppose the same number of people to a house in 1690 as in 1811, the population at the former period was upwards of 7 millions, while at the latter it was 10,488,000. Mr. Rickmann's calculation from the Registered Baptisms is not to be depended on, as they have evidently been very irregularly kept. The births certainly fall far short of the true number. For instance, 6½ millions of people, at the rate of the Swedish tables, would produce all the births of 1801, while the return makes our population then 9,168,000.

We conclude with observing, that we think Mr. Godwin fully entitled to insist, that, taking all circumstances into consideration, there is every reason for supposing that the increase of the population of Sweden, being nearly one half in 54 years, is the greatest that has yet taken place in any country where there has been no immigration.

An Essay on the Origin and Progress of Stereotype Printing; including a Description of the various Processes. By Thomas Hodgson, Newcastle. 8vo. pp. 190. Crown 10*s*. 6*d*. Royal 18*s*.

This work, of which only 306 copies have been printed, viz. 270 on crown and 36 on royal paper, contains much curious information, not only respecting *stereotype printing*, but its sister art of *polytype printing*, or the art of producing by mechanical means, from engraved or otherwise prepared plates, any number of plates capable of multiplying writing or designs by the operation of copper-plate printing. The author has with great industry collected, not only what he could find in previous writers, but every information which he could possibly obtain by assiduous personal inquiries, respecting the kindred arts of which he treats; and has communicated the whole in a concise but perspicuous manner. The execution of the volume is highly creditable

ditable to his taste and accuracy as a printer, and will ensure it a place among valued and curious specimens of Typography, in the collections of those who may be able to procure a copy,—which we apprehend will, even now, be rather difficult, the impression being so limited.

Recently published.

Narrative of the Operations and recent Discoveries within the Pyramids, Temples, Tombs and Excavations in Egypt and Nubia, &c. With a volume of plates, atlas folio. By G. Belzoni.

The History and Antiquities of the See and Cathedral Church of Lichfield: illustrated by numerous Engravings. By John Britton, F.S.A. 1*l.* 18*s.* medium 4to. 3*l.* 3*s.* imperial 4to. 6*l.* 6*s.* royal folio.

The History and Antiquities of the Parish of Stoke Newington; with Maps and Engravings. By William Robinson. 8vo.

Number 1 of Costume in Persia; drawn from Nature by A. Olowsky, containing Six coloured Plates. Folio. 18*s.*

The Italian School of Painting, with Observations on the present State of the Arts. By the Rev. J. T. James. 8vo.

Number 1 of Ornaments and Designs from the Antique. 4to. 7*s.* 6*d.* To be completed in Ten Numbers.

Researches on the Nature and Causes of Epilepsy. By T. G. Mansford. 7*s.*

An Essay on Mercury. By David Davies, M.D. 2*s.* 6*d.*

The Characters of the Classes, Orders, Genera and Species; or, the Characteristics of the Natural History System of Mineralogy. By Fred. Mohs. 8vo. 6*s.* 6*d.*

Description of Instruments designed for the extending Meteorological Observations. By J. Leslie. 2*s.*

Letters written during a Tour through Normandy, Brittany, and other Parts of France. With numerous Engravings. By Mrs. C. Stothard. 4to. 2*l.* 12*s.* 6*d.*

Professor Leslie's Course of Mathematics. 2 vols. 8vo.

Lectures on the Philosophy of the Human Mind. By the late Thomas Brown, M.D. Professor of Moral Philosophy in the University of Edinburgh. 4 vols. 8vo. 2*l.* 12*s.* 6*d.*

The Elements of Chemistry, with its Application to explain the Phænomena of Nature, and the Processes of Arts and Manufactures. By James Millar, M.D. 8vo. 12*s.*

A Treatise on Mildew, and the Cultivation of Wheat; including Hints on the Use of Lime, Chalk, Marl, Clay, Gypsum, &c. By Francis Blaikie, Steward and Agent to T. W. Coke, Esq. 1*s.* 6*d.*

A De-

A Description of a new Agricultural Instrument, which, by the power of one horse, performs a variety of operations in cultivation, at the rate of three acres per day. By Major General Alexander Beatson. 8vo.

An Historical Essay on the Origin of Printing, translated from the French of M. de la Serna Santander. Crown 8vo. 6*s.* Large paper 12*s.*

A Memoir on the Origin of Printing, in a Letter addressed to John Topham, Esq. F.R. and A.SS. by Ralph Willet, Esq. F.R. and A.SS. Crown 8vo. 5*s.* Large paper 10*s.*

Views in Ceylon; a Series of Six Engravings, 22 by 15 inches, coloured, illustrative of Kandyan Scenery, Costumes, &c. 5*l.* 5*s.*

A Dictionary of Chemistry, on the Basis of Mr. Nicholson's, but principally re-written, containing an Investigation of the Principles of the Science and its Application to the Phænomena of Nature, &c. By Dr. Ure. 8vo. 1*l.* 1*s.*

An Introduction to the Study of Conchology. By Charles Woodarch. 8vo. 7*s.* plain; 12*s.* coloured.

The Gentleman's Mathematical Companion, being the Twenty-fourth Number, for 1821, continued Annually, with Answers for the last Year's Questions; also new ones for the next; together with some original scientific Papers selected from an extensive Correspondence. 12mo. 3*s.*

A new Method of solving Equations with ease and expedition; by which the true value of the unknown quantity is found without previous reduction; and a Supplement of two other Forms on the same improved Principle. By Mr. Theophilus Holdred. 4to. 7*s.*

Analytical and Arithmetical Essays; consisting of Continued Fractions—Figurate Numbers—an entire new Method of the Transformation of Equations, Determination of their Limits, &c. By Peter Nicholson. 8vo. 12*s.*

Preparing for Publication.

An Account of the Discovery of a new Continent, called New South Shetland; with a Description of the Manners and Customs of its Inhabitants; with Engravings. By Capt. J. Rogers. 4to. 2*l.* 2*s.*

Booth's Analytical Dictionary of the English Language. Part I.

A Historical and Picturesque Tour of the Seine from Paris to the Sea; illustrated by 24 highly finished coloured Engravings. To be published in Six monthly Parts. By Mr. Ackerman.

Mr. Ackerman is also preparing a Description of the Manners, Customs, &c. of the People of Dalmatia, Illyria, and the adjacent Countries; 2 vols. pocket size, with 32 coloured Plates.

The Principles of Medicine; written entirely on the Plan of the

the Baconian Philosophy, to prove that the only rational Method of curing Disease, is to induce, by Medicine, a counteracting Action. By H. D. Hamilton.

A Tabular View of Medicinal Combinations. By Dr. Paris.

New Editions of Ferguson's Electricity, his Perspective, and Ladies' and Gentlemen's Astronomy. Also Ferguson's Astronomy accommodated to the present State of the Science. By Dr. Brewster.

The Farmer's and Grazier's Guide; containing a Collection of valuable Recipes for the most common and fatal Disorders to which Horses, Horned Cattle, and Sheep, are subject. By L. Towne.

LXXVI. *Proceedings of Learned Societies.*

ROYAL SOCIETY.

The following is a brief sketch of the speech of Sir Humphry Davy on being elected President of the Royal Society.

After expressing to the members his deep sense of the honour they had done him in placing him in their chair, Sir Humphry entered into some general views of the present state of the Royal Society, its relations to other scientific bodies, and on the prospects and hopes of science. In the early periods of the history of the Society, experiments were made with the apparatus belonging to the body of their curators and operators, under the eyes of the Society; but since the progress of the useful arts had rendered it easy for individuals attached to scientific pursuits to procure chemical and mechanical apparatus, the Fellows in general had worked in their own laboratories. "There may, however," said the President, "occur instances in which instruments upon a great scale may be required; or very expensive experiments; and, in such cases, it is to be hoped the proposers will recur to the Society: for, by the commands of our august patron, Government has never been tardy in affording us assistance when our objects have been of national importance; and, on inferior occasions, the object might be effected by a division of expense among the members."

In speaking of the relations of the Royal Society to other scientific bodies, the President expressed a hope that they would naturally assist each other. He disclaimed any thing like patriarchal authority on the part of the Royal Society; but considered it as entitled to respect and affection "as an elder brother of the same family, acting for objects which ought to be a bond of harmony and of peace, not merely amongst the philosophers of the same country, but even amongst those of distant nations."

The

The President took an extensive view of the different departments of science which seemed to offer promising subjects of new investigation. In the Mathematical sciences he pointed at the application of the doctrines of quantity, weight, and number; to the elementary philosophy of chemistry; and to many other parts of general physics.

In Astronomy, he referred to the system of the fixed stars, the motions of the comets, and of the bodies which in passing through our atmosphere throw down showers of stones; for it cannot be doubted (he said) that these extraordinary phænomena do not depend upon fortuitous or accidental formations in the atmosphere; but are owing to heavy bodies which in a system where all appears harmonious must be governed by fixed laws and intended for definite purposes.

In Optics, he mentioned the discoveries of Wollaston and Young, which, followed by those of Malus, Arago, Biot, and Brewster, have opened a curious connexion between the crystalline forms of bodies and their relations to the particles of light.

In Electricity, the learned President alluded to the wonderful instrument of Volta, which he said had done more for the recondite chemico-physical sciences than the telescope for astronomy, or the microscope for natural history. He referred to the new field opened by the discoveries of Ersted, which promised to connect so intimately magnetism and electricity, and to solve the grand problem of the magnetic phænomena of the earth.

In speaking of the figure of the earth, the President took notice of Capt. Kater's experiments with the pendulum, and expressed a hope that his ingenious contrivance would be applied to determine the physical constitution of the surface. On this point he said, that he hoped there might be a co-operation with the members of the French Royal Academy of Sciences in completing the measurement of 20 degrees of an arc of the meridian; on which these able philosophers had laboured with so much zeal and address. He referred in this part of his discourse to the expedition to the polar regions, which he designated as equally honourable to those by whom the expedition was planned, and to the brave and enterprising navigators by whom it was executed. Such expeditions (said the President) are worthy the great maritime nation of the world, as applying her resources not for empire alone, but for the advancement of science and benefits common to all countries,—thus creating a purer species of glory than that dependent upon power or conquest.

In speaking of Chemistry, he mentioned various interesting objects of research, and congratulated the Society on the progress made in the theory of definite proportions since it was first brought forward in a definite form by Mr. Dalton.

In alluding to Vegetable and Animal Physiology, he described the imperfect state of these sciences, and said that the Society had a right to expect elucidation of them from those disciples of the schools of Grew and of Hunter, who had already done so much for the Anatomy of Plants and for Comparative Anatomy.

It would be impossible to follow the learned President through every part of his profound views on the improvement of science, as we could not do them justice; but we earnestly hope that he will himself be induced to lay them before the public in some lasting record. He concluded by recommending to the Fellows the sure path of investigation, and the same methods of reasoning that constituted the glory of the Founders of the Royal Society—cautious inductions from exact experiments. He expressed his ardent desire to assist in every way the progress of investigation, and stated, that though their good opinion had elected him to a high dignity, corresponding to that of a general, yet that he should always be happy to act with them as a private in the ranks of science.

Let us (said the President) labour together, animated by the noblest kind of emulation; let us prove that we are not unworthy of the name we bear, and of the times in which we live; and let us endeavour to transmit the glory of the Royal Society to posterity not impaired, but exalted.

Dec. 14.—An interesting paper by Mr. Farraday was read, On certain Combinations of Chlorine with Carbon and with Iodine. Contrary to the previously entertained opinion that chlorine could not be combined with carbon, Mr. Farraday succeeded in producing this compound by combining chlorine with olefiant gas: one portion of the chlorine combines with the hydrogen of the olefiant gas and forms muriatic acid; and another portion with its carbon. This new substance being similar in appearance to camphor allows the acid to be washed, leaving the chloroid of carbon, which is insoluble in water.

Dec. 15.—Mr. Farraday's paper was concluded, and the Society adjourned for the holidays.

ASTRONOMICAL SOCIETY OF LONDON.

Dec. 8.—Mr. F. Baily read a paper on the late solar eclipse, comprising the result of his own observations, as well as those of several other persons, both in this country and on the continent.—Mr. Groombridge presented a table showing the position of *Vesta* on several nights preceding and succeeding her ensuing opposition (which we have inserted in another part of our Journal).—A paper by Mr. Troughton was then begun, on the Repeating Circle, and on the Altitude and Azimuth Instrument; which will be continued at the next meeting of the Society.

LINNEAN SOCIETY.

Dec. 5.—A. B. Lambert, Esq. in the Chair. Some further particulars respecting the new genus *Rafflesia*, lately received from Sumatra, were laid before the Society. Several fresh specimens of this extraordinary plant, the flower of which is of gigantic dimensions, have been collected by Sir T. S. Raffles, after whom, as having been discovered in one of his progresses through the island, it is named.

Dec. 19. Part of a descriptive Catalogue, by Sir T. S. Raffles, was read, of a Zoological Collection made for the East India Company in Sumatra and its vicinity, by his direction, with many interesting notices illustrative of the natural history of those countries. The animals described in the part of the paper which has been read are the following: *Simia Satyrus*, called in Sumatra Oran Pandak, apparently the same with the Orang Utan of Borneo: *Simia Siamang*, a new species from Bencoolen: *Simia Lar*, called Oongka Etam, of the sensibility of which the Author relates a remarkable instance: one in his possession having, in consequence of being turned out of the house for some offence, twice hung itself on a tree; the first time it was discovered and cut down, but succeeded in its second attempt in destroying itself: another *Simia*, called Bruh by the natives, is employed near Bencoolen to gather cocoa-nuts; the ripest of which he selects, and pulls no more than he is ordered. Other species are named Chingkau, Simpai, Kra, and Lotong. *Lemur tardigradus*, *Galeopithecus volans*, *Vespertilio Vampyrus*, *Manis pentadactyla*, and *Canis familiaris*, a variety resembling the Australasian, which abound in the forests, and are said to hunt in packs.

CAMBRIDGE PHILOSOPHICAL SOCIETY.

On the 27th of November, several new members were elected Fellows of the Society. Afterwards a paper was read by the Professor of Mineralogy, Dr. E. D. Clarke, upon a remarkable formation of Native Natron in Devonshire. The Professor also communicated to the Society a discovery which he had made respecting the supposed Alabaster Soros brought by Mr. Belzoni from Upper Egypt; and which he had found to consist of one integral mass of *Arragonite*. The Rev. Mr. Cecil, of Magdalen College, also read a very important paper on the Application of Hydrogen Gas to produce moving Force in Machinery; giving at the same time a description of an Engine for that purpose, which was exhibited to the Society.

ACADEMY OF SCIENCES, ARTS, AND BELLES LETTRES OF CAEN.

A new discovery in the Fine Arts was communicated to this Academy

Academy in the sitting of the 10th November, of which the folowing announcement is given in *The Moniteur*.

"Caen, 12th Dec

"An interesting discovery for the Arts has just been made in our department. It is a new process for reproducing *ad infinitum* a design traced on a plate of porcelain. In this respect it is a method analogous to lithography: but it has many advantages over it. By means of tablets of porcelain impressions may be taken of the finest and most delicate sketches of the crayon or pencil; and long use of the plate will neither efface nor spread the touches, as too often happens in the processes of mezzotinto and lithography.

"We will not undertake to describe exactly the new process. We can only say that the lines traced with a particular metallic composition on the polished surface of porcelain become incrusted there by a second baking without forming any indentation or relief, and without being in the least enlarged or deformed. The parts drawn have acquired a sort of asperity not sensible to the touch, but which retain the ink perfectly, while that substance slides off the rest of the plate. It will be seen from this, that the design is *indelibly fixed*. On the contrary, in lithography a thousand accidents, the action alone of the press, may stretch and render blurred the lines traced upon a stone, which, being porous, must remain always more or less permeable to an ink of the same nature as that with which the sketch is first made.

"This discovery was communicated to the Academy of Sciences, Arts and Belles Lettres of Caen at its sitting of the 10th of November."

I strongly suspect that the writer of the foregoing letter knows nothing whatever of the discovery which he attempts to describe, excepting only that porcelain tablets are to be substituted for the stones now used in the lithographic art; and this I take to be the real discovery, namely, that porcelain plates may be used instead of stone, and the tracings be made with vitrifiable materials, instead of waxy or resinous. Every person acquainted with printing knows that printers' ink will attach itself to any smooth surface (even to glass), unless the material be pervious to and imbibed with water. It is the water that prohibits the adhesion of the ink. Contrary to what this writer insinuates, it seems likely that the porcelain plates are used in their *unglazed* state, and that the only glazed parts are those which exhibit the lines of the design. If this opinion be correct, it will follow that the porcelain plates are to be preferred to stone; because, should they get injured at any time by the touch of a greasy finger (which often ruins a lithographic design, by rendering the part adhesible to the ink, when the ball is applied to it), they may be perfectly restored to use by baking again in the kiln. A. T.

LXXVII. *Intelligence and Miscellaneous Articles.*

SEVERN, KING AND CO. *versus* THE PHŒNIX FIRE OFFICE.

To Mr. Tilloch.

"Who shall decide when Doctors disagree?"

Dec. 23, 1820.

SIR,—THE trial of Messrs. Severn, King and Co. *v.* the Insurance Companies is now concluded; and, whatever opinion may have been formed as to the real justice of the case, no one, excepting the parties immediately concerned, can regret that it has terminated as it has done; it would have been hard, that, when clearly proved no fraud was intended, the omission of giving information to the Insurance Companies, where no information was thought necessary, should have subjected the parties to so heavy a loss as 70,000*l*. This determination, however, does not alter the view of the scientific part of the question,—the discordant opinions which have been advanced concerning the nature and properties of oil, and its combustibility compared with that of sugar, are now before the public; and though the question at issue is no longer a legal, yet as a scientific one, it cannot rest here; the decision of a Jury may settle a legal, but it cannot settle a scientific point; and it remains for those who have advanced certain strong opinions on either side, to prove such opinions correct, unbiassed by those feelings which party generally engenders. The *Forum Scientiæ* is a different tribunal from a Court of Law, and assertions that may be listened to in the one would be scouted in the other. As a bystander, who has taken no part in the above proceedings, and only interested in them as a scientific subject, I have listened attentively to what has been advanced on both sides, and have placed on record, through the medium of your Magazine, the different opinions that have been given on this question. I have forborne any comments, though I may perhaps be inclined on some future occasion to enter more fully into the subject.

I am your obedient servant, M. R.

Witnesses examined on the scientific part of the question for the PLAINTIFFS.		*Witnesses examined on the scientific part of the question for the* DEFENDANTS.	
Mr. Wilson.	Dr. Thomson.	Mr. Farraday.	Dr. Bostock.
— Brande.	— Davy.	— J. Taylor.	Mr. P. Taylor.
— Parkes.	Mr. Accum.	— Children.	— Aikin.
— Booth.	— Cooper.	— Garden.	— Phillips.
— Coxwell.	— Dalton.	— J. Martineau.	— Daniel.
Dr. Paris.	— Bramah.	— Richter.	— Tilloch.
— Henry.	— Deville.		
— Jones.	— Allen.		
— Pearson.	— Sylvester.		

The

The points which these gentlemen wished to establish were	The points which these gentlemen wished to establish were
1. That the mode of heating by oil invented by Mr. Wilson, and adopted by Messrs. Severn and Co., was less dangerous than the ordinary mode of boiling sugar.	1. That the mode of heating by oil, &c. was dangerous, and much more so than the ordinary mode of boiling sugar.
2. That oil kept at a temperature of 360 degrees for two months, underwent no change whatever, excepting its colour becoming darker, and its substance thicker; that by such operation it did not become at all more inflammable.	2. That oil kept at a temperature of 360 degrees for two months did become changed; that a partial decomposition took place, and that it became much more inflammable.
3. That oil heated from 580 to 600 would give out an inflammable vapour (but none below this point), which ascending in a tube in the boiler would be condensed, and fall back again as oil, as the vapour could not pass off unless the tube through which it escaped were at the same heat as the oil in the boiler.	3. That oil heated to 600 would give out a vapour highly inflammable, burning strongly and continuously at the extremity of a tube between 4 and 5 feet long, and even at the end of a condensing worm 23 feet long; that inflammable vapour would be given out at a heat much below that point; that combustion has taken place at a heat below 210, and frequently at various heats from 400 to 600; the danger of using oil as a heating medium becomes increased from the uncertainty of the process.
4. That to heat oil to a dangerous point, it would require a very large and very fierce fire continued for eight or ten hours; and that no sized fire, placed under the boiler used by the Plaintiffs, could possibly produce danger.	4. That with an ordinary fire not larger than is usual for the size of the boiler, without any particular urging, oil, previously exposed for some weeks to a temperature of 360°, may be carried from a safe temperature to a highly inflammable one in less than twenty minutes.
5. Dipple's oil could not possibly be produced in a boiler similar to the one used by Messrs. Severn and Co. Whale oil passed	5. Oil was submitted to the process of distillation from the boiler in which the experiments were tried at a heat of 600; the vapour

passed three times successively through a red hot tube could not be converted into Dipple's oil; it is highly inflammable, and burns at 180°. Oil which had been kept heated in a leaden vessel for some time had dissolved a portion of the lead, and this was much more inflammable, giving out combustible vapour at 460°.

vapour was condensed through a worm; the product was again distilled in a glass retort, and a highly inflammable volatile oil came over, which boiled at 180 degrees.

6. That there would be no danger if the oil vessel leaked; a large leak would put out the fire, a small leak would burn like coal.

6. That a leak in the oil vessel would render the fire infinitely more fierce and less manageable, as it would increase the flame and prevent the heat of the oil being regulated as it should be.

7. That sugar was a much more inflammable substance than oil; that next to gunpowder it was the most inflammable substance in nature; that it boils at 250°, and at 260° gives out an inflammable vapour: if sugar in the pan boiled over, it would ignite and burn as it ran along the floor; and that this effect would be increased by its being combined with water.

7. That the process of boiling sugar in the usual mode was not at all dangerous; that before it could become combustible the water must be evaporated; that if it boiled over, it was impossible it could ignite: the vapour from sugar at a heat above 340 was not inflammable, and long before it reached that point it became charred.

VEGETATION OF AQUATIC PLANTS.

To Mr. Tilloch.

Banbury, Nov. 21, 1820.

Sir,—Having frequently seen it remarked by very respectable botanical writers, that the seeds of aquatic plants vegetating under water, are an exception to the generally received axiom, "that seeds will not vegetate unless oxygen gas or atmospheric air have access to them;" I beg leave to remark, that it is a well known fact, that river water contains an abundance of atmospheric air, mechanically combined; or at least, as Berger has demonstrated in the 57th volume of the *Journal de Physique*, that atmospheric air suffers a decomposition by its contact with water, and that its oxygen only is absorbed: consequently it is plain in this case, that it would be the more favourable to the germination of the seeds above mentioned.

Such a quantity of water as a river or pool must contain a very considerable portion of oxygen gas, thus absorbed from the air; and when we consider with what force the atmosphere presses upon the water, it will not be absurd to presume that the oxygen absorbed by the seeds is speedily replaced from the incumbent atmosphere.

I will here take the opportunity of remarking, that Saussure has attempted to prove that no oxygen gas is absorbed by the seed, and that the whole of it is thrown out in combination with the carbon, forming (of course) carbonic acid. If all the carbon is thus extricated, whence comes it that the plant increases? and if no absorption of oxygen takes place, on what principle can the palpable truth of seeds acquiring a sweet taste be explained, but by supposing it to be formed by the addition of oxygen to the mucilage or fecula which they contain? In the process of malting the seeds acquire a sweet taste, soon after the germination commences.

By allowing the above remarks to be inserted in your interesting and truly valuable Magazine, you will particularly oblige,

Sir, Your very obedient humble servant,

A. B.

THE NIGER.

It is at length ascertained that this river empties itself into the Atlantic Ocean a few degrees to the northward of the equator. This important fact is confirmed by the arrival of Mr. Dupuis from Africa. This gentleman was appointed Consul from this country at Ashantee (where Mr. Bowdich resided for some time). He is acquainted with the Arabic and Moorish languages, and got his intelligence by conversing with different traders with whom he fell in at Ashantee. He thought it so important as to warrant his voyage home to communicate to Government what he had learnt. We say that Mr. Dupuis has *confirmed* this fact; for it so happens that he has been anticipated in the discovery by the geographical acumen of a gentleman of Glasgow, who arrived at the same conclusion by a most persevering and diligent investigation of the works of travellers and geographers, ancient and modern, and examining African captives; and had actually constructed, and submitted to the inspection of Government two or three months ago, a map of Africa, in which he lays down the Niger as emptying itself into the Atlantic in about four degrees north latitude, after tracing out its entire course from the interior.

NATURAL HISTORY.

M. Lalande, commissioned by the French Government to make researches in the interior of Africa, arrived at Bourdeaux on the 3d instant, after an absence of two years. He has brought with

with him, among other objects of curiosity, the skeletons and skins of an enormous Hippopotamus, a Rhinoceros, and three Whales, one of which is 75 feet in length. It was not till after a month passed in the midst of imminent dangers, that M. Lalande met with that dreadful monster the Hippopotamus: when he received his death wound, he rushed rapidly into the river, which he discoloured with his blood. It required ten pair of oxen to draw him out of the river, and M. Lalande was compelled to erect a rampart of bamboo cane round the dead animal, to protect the carcase from being devoured by wild beasts. The whole collection brought home by M. Lalande for the Museum at Paris, comprises 15,000 articles. This enterprising naturalist speaks with rapture of the kind and hospitable conduct of the British settlers. A Paris Journal says, "Great praise is due to the English for their hospitable and generous conduct towards M. Lalande. The Hon. Commander on the station favoured him in every way in his power. Hunting the Hippopotamus is prohibited under severe penalties; but this interdiction was dispensed with in favour of the French naturalist; they aided him in every thing calculated to ensure success, without however concealing from him that they thought success impossible. When, contrary to all expectation, he had succeeded, the English cordially rejoiced, and loaded the fortunate hunter with sincere congratulations."

LARGE ORGANIC REMAINS.

In some of the Sandstone Rocks which alternate with the seams of Coal, in a great many if not all of the Coal-fields in England, the remains of very large, thin, hollow or *Reed-like Vegetables* have been found, sometimes lieing along in the Stone, and sometimes standing erect therein: the inside hollow of the Vegetable, being now completely filled with Sandstone, in all respects like that which surrounds it, and the vegetable case or sheath is found converted into perfect Coal *; on the outside of which coaly Case or Sheath, the papilia or places where very numerous large Leaves were once attached to the vegetable, are in general visible; and not uncommonly, particularly in the medium and smaller sizes of these Reed-like Remains, the Leaves

* It seems more than probable, that hollow *vegetable pipes* contributed greatly to supply the Masses of which the Coal-seams are now composed: because, on the tops of many Coal-seams, of inferior quality, and where much earthy Matter is found mixed in the bad Coal, such pipy Vegetables, nearly or quite collapsed, and converted into Coal, very numerously abound; the papilia, and sometimes the Leaves also, being visible on the outsides of such collapsed Pipes, or flattened *Reeds* as they are very commonly called. In the process of forming good or perfect Coal, a crystallization of the vegetable mass has taken place, by which all traces of organization are obliterated.

are yet attached, and in a coaly state, spread out into the Sandstone on every side: it is seldom that these Remains are quite round, but mostly somewhat oval, particularly towards the bottom, where they usually swell out into an irregular club-like form, much more resembling the lower parts of coralline and other aquatic Stems, than the commencement of the Roots of a Tree, or of any Land Plant; no Branches have ever been observed, proceeding from the sides or the tops of these Remains; but it is very common to observe the smaller and medium sizes of them, to terminate at top in a large Bud, very closely resembling the top of an Asparagus shoot, in the state the same are brought to market.

In a free Sandstone Quarry on the Western side of Glasgow, a large Organic Remain has lately been found, which in every essential particular seems to agree with the description above mentioned.

EXTRAORDINARY EEL.

A few days ago an eel, of the common species, but of extraordinary dimensions, got entangled in the herring cruives on the Firth of Forth, near Higgins' Neuk. On being approached by the fishermen, it flapped its tail most violently, and, had it struck one of them, there is no doubt he would have forfeited his life for his temerity. Aware of their danger, they cautiously approached it; and, after many efforts, they succeeded in fixing it with a hook to which was attached a cord, and dragged it on shore, where they triumphed over their victim. When measured, it was found to be 18 feet in length, and two feet in girth at the middle. The skin, which is stuffed, and which we understand is in the possession of Mr. Higgins, the proprietor of the cruives, must excite the attention of the naturalist. Part of the fish being dressed, was found to be most delicate eating.—*Stirling Journal.*

LIVE BAT FOUND IN THE CENTRE OF A TREE.

A woodman, engaged in splitting timber for rail posts, in the woods close by the lake at Haining, a seat of Mr. Pringle's, in Selkirkshire, discovered in the centre of a large wild cherry tree a living bat, of a bright scarlet colour, which he foolishly suffered to escape, from fear,—being fully persuaded (with the characteristic superstition of the inhabitants of that part of the country) that it was a "being not of this world." The tree presents a small cavity in the centre, where the bat was inclosed, but is perfectly sound and solid on each side.—*Caledonian Mercury, Nov.* 11.

WALL-FRUIT.

Mr. H. Daws, of Slough, has ascertained that the ripening of

wall-

wall-fruit is hastened, and the fruit improved, by having the wall painted black. He tried the experiment on a vine. The blackened part of the wall produced twenty pounds ten ounces of fine grapes; the other half of the wall yielded only seven pounds one ounce, neither so large nor so ripe. The wood on the blackened part was also stronger, and more clothed with leaves.

APRICOT TREES.

A gentleman of Chichester has now in his pleasure grounds a few standard apricot trees of an uncommon size. The history of them may prove of great advantage to horticulture. The present possessor recollects his ancestors having twelve or fourteen of them; but upon coming into his own hands, he cut most of them down as unproductive, never having known them to bear fruit. About four were left as ornamental trees to the ground, which have begun to produce within the last six years an annual abundant crop: one of these the last summer yielded five bushels of large ripe fruit. It appears by the above statement, that standard apricot trees will not bear fruit until 40 or 50 years old.

THE DEAF AND DUMB RESTORED.

The *Narrateur de la Meuse* contains the following article on the cure of two deaf and dumb persons, who recovered their hearing and speech. This novel and successful operation was performed by M. Deleau, a young practitioner, a doctor of medicine, of the Faculty of Paris, ex-surgeon to the 4th regiment of cuirassiers, and now established at Mibiel (Meuse). The two deaf and dumb who underwent the operations (whereby he perforated with dexterity and success the *meatus auditorius*) are Mademoiselle Bivier de St. Mibiel, aged 16 years, and the Sieur Toussaint, son of the assistant magistrate of Hans-sur-Meuse, aged 28 years.

The young girl is doing extremely well. It is more than a month since she underwent the operation. Her left ear is perfectly healed, and the opening made to the tympanum always continues; which is absolutely necessary. She takes notice of the least sounds, and begins to articulate words in a very satisfactory manner. Her vivacity pleases, and her figure changes for the better. She is incessantly humming various airs which her sisters teach her.

The young man of Hans-sur-Meuse, who was operated upon a short time since, hears as well as his comrades, and even more lively. His right ear is finer than his left—he makes constant efforts to pronounce all sorts of words. The surgeon, from whom we have the particulars, hopes that in three or four months the two subjects will speak perfectly. It is evident that they must

must be instructed like children, who begin to make the first efforts to articulate.

M. Deleau informs us, that he is constructing an instrument, which will afford the happy facility of finishing the operation in three minutes, by which its success will be rendered more certain. By means of this instrument he will raise on the tympanic membrane enough of substance to prevent the necessity of introducing probes into the perforation during from thirty to forty days. He is of opinion, that he can restore the hearing of all those who have been deprived of it by the obstruction of the Eustachian organ, and by the obesity of the membrane of the tympanum.

DRY-ROT IN SHIPS.

Col. Gibbs, of the United States, is of opinion, that the reason why the dry-rot is so much more frequent now-a-days than it was formerly, is, that in consequence of the great consumption of wood during the last century, for naval and architectural purposes, all the old wood has been consumed, and nothing is now left for these purposes but comparatively young wood, in which the alburnum bears a much greater proportion to the heart than in old trees. He mentions some facts that have been stated to him by Colonel Perkins, of Boston, and which seem entitled to attention. Several ships built at Boston have been salted, or filled in between the timbers with salt, while on the stocks, and after the lapse of 10 or 15 years the timbers have in every case been found to be perfectly sound. A large ship belonging to Col. Perkins, which had been salted (14 years old), required repairs, new decks, and new iron work. Considering the age of the ship, it was important to examine the frame in every part. The ceiling was therefore ripped up, and a complete examination took place. The result was, that the timber and plank were found completely sound in every part. A vessel of 500 tons required 500 bushels of salt; and two years after being built, 100 bushels were added to fill up the space of the salt dissolved.—*American Journal of Science and the Arts*, ii. 114.

DR. CARTWRIGHT'S PEDO-MOTIVE MACHINE.

In announcing the invention of this machine (see Phil. Mag. June 1819) Dr. Cartwright observed, "I should not despair of seeing, were I to live but a few years longer, carriages of every description travelling the public road without the aid of horses." The ingenious Doctor's expectation has been already in some degree realised. A letter in The Star, signed "A Traveller," states, that on the road between Tunbridge and Hastings he had met a cart loaded with coals, and travelling without horses, being impelled

impelled by an apparatus managed by two men,—the same, in short, as that invented by Dr. C. "Its pace," says the traveller, "was uniform, and, as the men informed me, varied very little whether it was on level ground or going up hill, provided the carriage was not overloaded. On expressing my doubts how this could be, the men could not explain the reason. But much as I might have doubted its facility of ascending a hill, I should have doubted still more (had I not seen it) the rapidity and safety with which it went down.—On coming to a short steep hill, instead of locking the wheel, considering how heavily the carriage was loaded, the carriage was suffered to run down with unrestrained velocity, much faster than any prudent man would have ventured with a light gig. I saw clearly, however, there was no danger; for the whole machine, I observed, was guided with the greatest accuracy, and its speed, as the men informed me (and of which, on inspecting the mechanism, I had no doubt), could be regulated at pleasure, or even stopped, should occasion require it, in the middle of its career, in an instant.

EARTHQUAKE.

Wanlockhead (Scotland), Nov. 30.

The weather for some time past has been remarkably stormy; heavy rains, accompanied by high winds, have prevailed; but at the end of last week and beginning of this, the clouds, which had for some time lowered, appeared to be dissipated, and we had some signs of returning good weather. Tuesday morning was remarkably fine, but hazy—the atmosphere still, and the clouds, when they were visible, had no particular appearance. About eight o'clock A.M. a slight shock of an earthquake was felt at Leadhills and Wanlockhead, attended with a hollow rumbling noise. The miners, who were at work 150 fathoms below ground, heard this alarming sound very distinctly; and being afraid lest the works were rushing down, many of them left their employment, and came above ground. In the evening of the same day, about eleven o'clock, a similar or still louder sound was heard at the above places, but not accompanied by any trembling or motion of the earth. These phænomena have been observed for eight or ten miles eastward, and three or four miles westward of these places, but whether they have extended further is not yet accurately ascertained. It is probable, however, that the more immediate effects of these awful convulsions of nature may have already been experienced in some distant quarter, particularly as the earthquake by which Lisbon was almost totally destroyed sixty-five years ago, was very distinctly felt in the district of Leadhills and Wanlockhead, according to tradition, and in the memory of several old residenters.

PRE-

PRESERVATION OF EGGS.

The best method for preserving eggs, either for zoological or œconomical purposes, is by varnishing them with gum arabic, and then packing them in charcoal. The gum is easily removed by washing them in water, and the charcoal prevents sudden alternations of temperature.—*Edin. Phil. Journal.*

ROSIN BUBBLES

The following curious fact is mentioned in a letter to Dr. Silliman from Mr. S. Morey, of Orford, New Hampshire :—

If the end of a copper tube, or of a pipe stem* be dipped in melted rosin, at a temperature a little above that of boiling water, taken out and held nearly in a vertical position, and blown through, bubbles will be formed of all possible sizes, from that of a hen's egg down to sizes which can hardly be discerned by the naked eye ; and from their silvery lustre, and reflection of the different rays of light, they have a pleasing appearance. Some that have been formed these eight months, are as perfect as when first made. They generally assume the form of a string of beads, many of them perfectly regular, and connected by a very fine fibre ; but the production is never twice alike. If expanded by hydrogen gas, they would probably occupy the upper part of the room.

* The stem of a tobacco pipe, we presume to be here meant.—Ed.

The *formation* of these bubbles is ascribed to the common cause, viz. the distension of a viscous fluid by one that is aëriform : and their *permanency*, to the sudden congelation of the rosin, thus imprisoning the air by a thin film of solid matter, and preventing its escape.—*Silliman's American Journal.*

MOUNTAIN OF SALT.

The story of the existence somewhere in the Trans-Mississippi country of a large mountain of salt, has been recently revived. Governor Miller, of Arkansaw, has written a letter, in which he mentions an extent of country covered with fine crystallized salt, six inches deep. He adds, "All men agree, both whites and Indians, that this article is in such abundance, some distance above where he was, that they cut and split off pieces a foot square." " It may be true," says the New York Commercial Advertiser, " that this vast mine of salt exists in the West; but we have not much confidence in Indian authority ; and we should have been much better satisfied of the fact, had Governor Miller traversed the country and split off and preserved a foot square of the salt for his own use. We all remember, that next to his red breeches, Mr. Jefferson was quizzed more upon this subject than any other ; and doubtless it was premature in the credulous philosopher to state positively the existence of such a mountain, in a message to Congress, without better evidence of the fact than he possessed."

STATISTICS.

A General Bill of the Christenings and Burials within the Bills of Mortality, from Dec. 14, 1819, to Dec. 12, 1820:

Christened in the 97 parishes within the walls, 981 ; buried, 1,082.

Christened in the 17 parishes without the walls, 5,342; buried 4,076.

Christened in the 23 out parishes in Middlesex and Surrey, 12,449; buried, 9,685.

Christened in the 10 parishes in the City and Liberties of Westminster, 4,386; buried, 4,505.

Christened, males, 11,993; females, 11,165 ; in all, 23,158. Buried, males, 9,794 ; females, 9,554: in all, 19,348.

Whereof have died

Under two years of age	4,758
Between two and five	1,975
Five and ten	887
Ten and twenty	667
Twenty and thirty	1,484
Thirty and forty	2,006
Forty and fifty	2,069
Fifty and sixty	1,878
Sixty and seventy	1,632
Seventy and eighty	1,208
Eighty and ninety	662
Ninety and a hundred	119
A hundred	2
A hundred and two	1

Increased in the burials this year, 120. There have been executed in London and the county of Surrey, 38; of which number ten only have been reported to be buried within the bills of mortality.

LECTURES.

Mr. Taunton will commence his next Course of Lectures on Anatomy, Physiology, Pathology and Surgery, on Saturday, January 20th, 1821, at Eight o'clock in the Evening.

LIST OF PATENTS FOR NEW INVENTIONS.

To James Ransome, of Ipswich, in the county of Suffolk, iron-founder, and Robert Ransome, of Colchester, in the county of Essex, iron-founder, for their improvement upon an invention

tion for which the said James Ransome now hath a patent bearing date the first day of June 1816, entitled an Invention for certain Improvements on Ploughs.—Dated 28 November 1820—2 months allowed to enrol specification.

To William Kendrick, of Birmingham in the county of Warwick, chemist, for his combination of apparatus for extracting a tanning matter from bark and other substances containing such tanning matter.—5th Dec.—4 months.

To Thomas Dobbs, of Smallbrook-street in the county of Warwick, plater, for his mode of uniting together or plating tin upon lead.—9 Dec.—2 months.

To John Moore the younger, of Castle-street in the city of Bristol, gentleman, for a certain machine, or machinery, or apparatus, which may be worked by steam, by water, or by gas, as a moving power.—9 Dec.

To George Vaughan, of Sheffield, in the county of York, gentleman, for his blowing machine on a new construction for the fusing and heating of metals, smelting of ores, and supplying blast for various other purposes.—14th Dec.—6 months.

To William Mallet, of Marlborough-street, Dublin, locksmith, for certain improvements on locks applicable to doors and to other purposes.—14 Dec.

To Andrew Timbrell, of Old South Sea-house, London, merchant, for improvement of the rudder and steerage of a ship or vessel.—22 Dec.—6 months.

To Sir William Congreve, of Cecil-street, Strand, in the county of Middlesex, Baronet, for certain improvements in printing in one, two or more colours.—22 Dec.—6 months.

To William Pritchard, of Leeds in the county of York, engineer, for certain improvements in an apparatus calculated to save fuel, and for the more œconomical consumption of smoke in shutting fire doors and air flues in steam engine boilers, drying pans, and brewing pans, and other fire doors and air flues.—22 Dec.—2 months.

To Marc Isambard Brunel, of Chelsea, in the county of Middlesex, civil engineer, for his pocket copying press, and also certain improvements on copying presses.—22 Dec.—6 mouths.

ECLIPSE OF THE SUN.

The late eclipse, contrary to the calculations of astronomers, was annular at Florence for the space of 1′ 44″. The end of the eclipse took place in that city at 4ʰ 26′ 6″; that is, 34″ after the time predicted by the astronomer Carlini, and 28″ after that calculated by Professor Linari.

NEW

NEW TERRESTRIAL GLOBE.

M. Charles P. Khummer, of Berlin, has recently published a Globe, on which the Mountains are boldly executed in relief. The idea is good, and we hope will be adopted in London, as being admirably calculated for geographical instruction.

BAROMETRIC OBSERVATIONS.

To Mr. Tilloch.

Midhurst, Sussex, Dec. 11, 1820.

Sir,—I take the liberty of sending you the subjoined observations, in compliance with an invitation published in a late Number of the Philosophical Magazine, by Mr. Bevan, to persons in different parts of the country, to make simultaneous observations for determining the relative elevations of their stations.

The height of the basin of the barometer may be estimated at ten feet above the level of the neighbouring river.

I am your obedient servant,

B. Powell.

Dec. 11. 1820. H. M.	Barom.	Therm. attached.	Therm. without.	Wind.
A.M. 11 30	30·064	56·	53·5	S.W. thick.
12	30·071	56·	53·	
12 30	30·070	56·	52·5	Inclining to small [rain.
P.M. 1	30·070	56·5	53·	Clearer.

I was prevented from making observations according to Mr. B.'s wish, from 8 to 12 A.M., but these may not be wholly useless.

Epping, Dec. 13, 1820.

Sir,—The following barometrical observations were made at Epping, latitude 51° 41′ 41″ 6, longitude 0° 6′ 45″ *east* of Greenwich.

1820.	Hour A. M. M. T.	Barom.	Ther. attached.	Ther. detached.	Wind.
November 10th	8h	29·626	47	42	N.E.
	9	29·633	47	43	N.E.
	10	29·640	46½	44	N.E.
	11	29·644	46	45	N.E.
	12	29·639	46	45	N.E.
December 11th	8h	29·523	51	49	S.W.
	9	29·526	51	49	S.W.
	10	29·531	51	50	W.S.W.
	11	29·538	51	51	W.S.W.
	12	29·540	51	51½	W.S.W.

The

The barometer is an excellent portable one, and with the attached thermometer hangs on the landing place of a first flight of stairs, with the surface of the mercury in the basin 12 feet from the ground, in a free circulation of the air, and where neither is affected by any artificial heat.

Yours most respectfully,

Mr. Tilloch. THOS. SQUIRE.

To Mr. Tilloch.

Leighton, Dec. 18, 1820.

Dear Sir,—I send you the barometrical observations made at this place, on Monday the 11th inst., from a standard barometer made by the late Mr. Ramsden.

	Bar.	Ther. att.	Ther. det.	Wind.
8h	29·577	47	49	S.
9	29·598	47	50	
10	29·622	48	50	W.S.W.
11	29·647	48	50½	
12	29·634	49	52	W.

I have been also favoured with the observations of Col. Beaufoy, at Bushy Heath, as below:

	Bar.	Ther. att.	Ther. det.
8h	29·383	49	49
9	29·384	49	49
10	29·400	49	50
11	29·401	49½	51
12	29·400	50	51

There is not that regular conformity in the motion of the two instruments that might have been expected, but this apparent anomaly ought to render us more diligent in search of the cause. I do not know how far the *equal pressure* of the atmosphere has been proved to extend; but if gentlemen will be careful to note the height of their barometers at the commencement of each hour from 8 to 12 on the *second Monday* of January 1820 and following months, and communicate the result to the public through your Magazine, it will enable us to know how far former observations of this nature ought to be relied upon for accuracy, and may lead us to discover the necessary corrections to be applied to past and future observations.

There may be some trifling difference in the height of the scale, upon instruments made by different artists; but it will be easy to find the error of the scale by a comparison with a good standard instrument; and it would be well if instrument-makers were to take the trouble of ascertaining and marking the errors of the scale upon the instrument before it was sold.

I have

I have also a single observation made at Ashridge Castle, the seat of the Earl of Bridgewater, which is about 604 feet above the level of the sea, as below.

11 December, 12^h 7^m Bar. 29·340. Ther. Att. 60° Det. 51°. And here it may not be amiss to state that a single observation, if correctly made at any stated time between the hours of 8 and 12 on the second Monday of the month, will be of use in determining the height of the station.

It will also be an additional object of importance, when any communication is made to the public on this subject, to state the relative height of the instrument to that of the nearest navigable river or canal. I am, dear sir, yours truly,

B. Bevan.

The Solar Eclipse, observed by the Rev. Mr. L. Evans, *on the 7th of September* 1820, *the Latitude of his Observatory being* 51° 29′ 7″·6 *N. and Longitude* 0′ 16″·7 *E. of the Royal Observatory, Greenwich, in Time; with a Table of the Right Ascensions and Polar Distances of* 46 *principal fixed Stars.*

To Mr. Tilloch.

Dear Sir,—I have sent you my observations of the sun's eclipse, on the 7th of September last, for insertion in your excellent Magazine, should you deem them deserving of such notice.

The time of the sun's passing the meridian of my observatory, on that day, was at 11^h 5′ 59″·7, sidereal time, by the transit clock, which was fast 2′ 16″·3, and its mean rate, for the preceding six days, +0″·6. I observed the beginning of the eclipse, at 11^h 31′ 16″·01, and its end, at 14^h 23′ 36″·08, sidereal time, making allowance for the gaining rate of the clock. These converted to mean time will make the beginning of the eclipse, at 0^h 23′ 2″·85, and its end, at 3^h 14′ 54″·56, making a duration of 2^h 51′ 51″·71. The telescope, I made use of, was one of the late Mr. Dollond's achromatic refractors, magnifying about sixty, which was affixed to a polar axis of sufficient stability.

I remain, dear sir, with great respect,

Your obliged humble servant,

Woolwich Common, Kent, L. Evans.

Nov. 27, 1820.

P. S.—I need not suggest to you, that every practical astronomer, generally, makes a fresh list of the right ascensions and polar distances of the fixed stars, at the commencement of every new year, deduced from their annual variations; the subjoined catalogue will be considered as no trifling acquisition to him, all the ensuing year.

The

The Right Ascensions, in Time, and Polar Distances of 46 *principal fixed Stars, for the* 1st *of January* 1821.

No.	Names of the Stars.	R. A. H. M. S.	N. P. D. ° ′ ″
1	γ Pegasi	0 4 1·92	75 48 39·95
2	α Cassiopeæ	0 30 24·30	34 26 44·28
3	α Polaris	0 57 15·77	1 38 46·12
4	α Arietis	1 57 6·36	67 23 17·29
5	α Ceti	2 52 56·01	86 37 3·44
6	α Persei	3 11 35·45	40 47 4·37
7	Aldebaran	4 25 39·71	73 51 31·72
8	Capella	5 3 29·00	44 11 43·92
9	Rigel	5 5 56·44	98 24 54·93
10	β Tauri	5 14 59·19	61 33 13·06
11	α Orionis	5 45 29·17	82 38 4·67
12	Sirius	6 37 15·51	106 28 35·03
13	Castor	7 23 9·96	57 43 43·37
14	Procyon	7 29 55·82	84 19 24·23
15	Pollux...	7 34 21·16	61 33 0·45
16	α Hydræ	9 18 47·56	97 53 12·38
17	Regulus	9 58 49·95	77 9 40·95
18	α Ursæ Majoris ...	10 52 35·82	27 17 5·90
19	β Leonis	11 39 55·52	74 25 37·97
20	β Virginis	11 41 22·47	87 13 34·66
21	γ Ursæ Majoris ...	11 44 22·33	35 18 35·25
22	Spica Virginis ...	13 15 46·60	100 13 22·23
23	η Ursæ Majoris ...	13 40 28·81	39 47 23·41
24	Arcturus	14 7 30·17	69 52 50·88
25	1 } α Libræ	14 40 48·32	105 14 40·80
26	2 } α Libræ	14 40 59·76	105 17 24·93
27	β Ursæ Minoris ...	14 51 20·04	15 6 46·53
28	α Coronæ Borealis	15 27 6·87	62 40 35·27
29	α Serpentis	15 35 27·61	83 0 13·06
30	Antares	16 18 25·89	116 1 24·72
31	α Herculis	17 6 29·56	75 23 50·07
32	α Ophiuchi	17 26 37·93	77 18 3·65
33	γ Draconis	17 52 27·27	38 29 9·15
34	α Lyræ	18 30 52·92	51 22 36·45
35	γ } Aquilæ	19 37 45·13	79 48 53·84
36	α } Aquilæ	19 42 3·07	81 35 46·33
37	β } Aquilæ	19 46 31·36	84 1 55·56
38	1 } α Capricorni ...	20 7 43·23	103 3 9·80
39	2 } α Capricorni ...	20 8 6·98	103 5 26·55
40	α Cygni	20 35 20·10	45 21 15·96
41	α } Cephei	21 14 18·13	28 10 13·35
42	β } Cephei	21 26 18·77	20 13 24·94
43	α Aquarii	21 56 35·35	91 11 3·18
44	Fomalhaut	22 47 44·30	120 34 6·70
45	α Pegasi...	22 55 51·22	75 45 16·53
46	α Andromedæ	23 59 9·44	61 53 50·32

The zenith distance, or co-altitude, of any of these stars, may readily be obtained, by subtracting the co-latitude of the place from the star's polar distance, if this distance be greater than the co-latitude; but if less, subtract it from the co-latitude.

OPPOSITION OF THE NEW PLANET VESTA.

The following Table, showing the position of *Vesta* on several nights preceding and subsequent to her ensuing opposition, has been presented to the Astronomical Society of London, by S. Groombridge, Esq.

Ephemeris of VESTA *at Midnight.*

1821.	Æ	N. Dec.
Jan^y 1	7^h. 54′. 23″	22°. 22½
2	53. 24	27½
3	52. 25	33
4	51. 24	38½
5	50. 23	44
6	49. 22	49½
7	48. 19	55
8	47. 16	23. 1
9	46. 11	6½
10	45. 6	12½
11	43. 59	18
12	42. 52	24
13	41. 45	29½
14	40. 39	35
15	39. 33	40½
16	38. 27	46
17	37. 21	51½
18	36. 15	57
19	35. 9	24. 2
20	34. 3	7
21	32. 58	12½
22	31. 53	17½
23	30. 50	22½
24	29. 47	27
25	28. 45	32
26	27. 44	36½
27	26. 44	41
28	25. 45	45½
29	24. 46	49½
30	23. 49	54
31	22. 53	58
Feb^y 1	21. 59	25. 2
2	21. 6	6
3	20. 14	10
4	19. 24	13½
5	18. 36	17
6	17. 49	20½
7	17. 4	23½

The opposition will take place on January 13th, at 8^h 20′.

METEOROLOGICAL JOURNAL KEPT AT BOSTON, LINCOLNSHIRE.

[The time of observation, unless otherwise stated, is at 1 P.M.]

1820.	Age of the Moon.	Thermometer.	Barometer.	State of the Weather and Modification of the Clouds.
	DAYS.			
Nov. 15	1	43·	29·80	Cloudy
16	11	40·	29·80	Fine
17	12	36·	29·43	Rain—snow A.M.
18	13	41·5	29·70	Cloudy
19	14	42·	29·86	Fine
20	full	48·	29·66	Cloudy
21	16	51·5	29·60	Fine
22	17	46·	29·53	Rain
23	18	47·5	29·35	Fine—rain P.M.
24	19	42·	29·60	Ditto
25	20	47·	29·45	Cloudy
26	21	49·	29·70	Ditto
27	22	45·5	29·75	Ditto
28	23	40·	30·	Ditto
29	24	41·5	30·10	Fine
30	25	43·	30·05	Ditto
Dec. 1	26	41·5	30·	Cloudy
2	27	41·5	29·70	Ditto
3	28	44·5	29·32	Rain
4	29	53·5	29·56	Cloudy
5	new	50·	29·98	Rain
6	1	44·	29·87	Cloudy
7	2	55·5	29·60	Ditto
8	3	55·5	29·80	Ditto
9	4	50·5	29·87	Ditto
10	5	54·	29·62	Ditto
11	6	53·	29·50	Fine
12	7	44·	29·30	Rain
13	8	38·	29·35	Ditto
14	9	40·5	29·80	Fine

METEOROLOGICAL TABLE,

By Mr. Cary, of the Strand,

For December 1820.

Days of Month. 1820.	Thermometer. 8 o'Clock Morning.	Noon.	11 o'Clock Night.	Height of the Barom. Inches.	Weather.
Nov. 27	42	45	40	30·01	Fair
28	40	38	38	·20	Cloudy
29	38	43	42	·34	Cloudy
30	42	42	38	·32	Cloudy
Dec. 1	38	42	38	·14	Cloudy
2	38	43	37	·01	Cloudy
3	39	46	48	·14	Cloudy
4	48	54	51	·05	Fair
5	47	53	47	29·92	Cloudy
6	47	46	50	30·10	Rain
7	51	55	50	·10	Cloudy
8	51	53	49	·25	Cloudy
9	47	50	48	·20	Cloudy
10	48	50	51	·09	Rain
11	50	54	50	29·94	Cloudy
12	50	52	49	·62	Showery
13	45	37	35	·54	Rain with sleet
14	32	39	36	·99	Fair
15	36	34	32	30·00	Fair
16	30	35	32	29·65	Cloudy
17	35	38	42	·82	Foggy
18	42	45	47	30·15	Cloudy
19	47	50	42	·35	Small Rain
20	42	47	50	·40	Cloudy
21	49	50	42	·16	Fair
22	37	42	40	·17	Cloudy
23	40	43	40	·01	Cloudy
24	37	34	32	29·95	Cloudy
25	32	32	30	·88	Cloudy
26	30	32	30	·85	Cloudy

N.B. The Barometer's height is taken at one o'clock.

Observations for Correspondent who observed the

11th instant 8 o'Clock, Morning 29·941 Ther. attached 54° detached 50
— — — 9 — — — — — ·941 — — — 54 — — 52
— — — 1 — — — — — ·948 — — — 56 — — 56

INDEX TO VOL. LVI.

END OF THE FIFTY-SIXTH VOLUME.

Printed by R. and A. Taylor, Shoe Lane, London.

BAADER's Method of communicating Rotatory Motion; Lieut. SHULDHAM's improved Method of working a Capstan; and STEELE's new Modification of NOOTH's Apparatus, &c.

Vol. L. A Plate to illustrate Sir HUMPHRY DAVY's new Researches on Flame, and Sir GEORGE CAYLEY's Paper on Aërial Navigation.—A Plate representing a Section of the Pneumatic Cistern, with the compound Blow-pipe of Mr. HARE; and a Sketch of a Steam-Vessel intended to run between London and Exeter.—Representation of Apparatus for Sublimation of Iodine—Model of a Safety Furnace by Mr. BAKEWELL—Apparatus for consuming Fire-damp in the Mine—and Apparatus for re-lighting the Miners' Davy.—A Plate illustrative of the New Patent Horizontal Water-Wheel of Mr. ADAMSON.—A Plate illustrative of Mrs. IBBETSON's Theory of the Physiology of Vegetables.—A Plate to illustrate Mr. DICKINSON's new System of Beaconing.

Vol. LI. A Plate illustrative of Mr. CAPEL LOFFT's Paper on the Probability of Meteorolites being projected from the Moon.—Two Plates: one, of Mr. H. TRITTON's Improved Apparatus for Distillation; and another, of the Figures in BRADLEY's Gardening illustrative of the Article on the KALEIDOSCOPE.—A Plate illustrative of Mrs. IBBETSON's Paper on the Anatomy of Vegetables; and Mr. TREDGOLD's on Revetements.

Vol. LII. A Plate illustrative of Mr. UPINGTON's Electrical Increaser for the unerring Manifestation of small Portions of the Electric Fluid.—A Plate illustrative of Mrs. IBBETSON's Paper on the Fructification of Plants.—A Plate illustrative of the Rev. JOHN MICHELL's Theory of the Formation of the Earth.—A Plate illustrative of Capt. KATER's Article on the Pendulum; and New Apparatus for impregnating Liquids with Gases.—A Plate illustrative of Sir H. DAVY's Apparatus for Volatilization of Phosphorus, and Mr. SMITH's Essay on the Structure of the poisonous Fangs of Serpents.

Vol. LIII. A Plate illustrative of Dr. URE's Experiments on Caloric, Mr. LUCKCOCK's Paper on the Atomic Philosophy, and Mr. BOLTON's on the Purification of Coal Gas.—A Plate representing Mr. RENNIE's Apparatus employed in his Experiments on the Strength of Materials; and the Marquis RIDOLPHI's Improvement on the Gas Blow-pipe.—A Plate illustrative of Mr. MEIKLE's Paper on Calorific Radiation; Mr. LOWE's on the Purification of Coal Gas; and Mr. HUGHES's on ascertaining Distances. — A Plate illustrative of Dr. OLINTHUS GREGORY's Paper on the different Rates of PENNINGTON's Astronomical Clock at the Island of Balta, and at Woolwich Common.

Vol. LIV. A Plate illustrative of the MENAI BRIDGE.—A Plate illustrative of Mr. LOWE's Description of a Mercurial Pendulum.—A Plate illustrative of Mr. HARE's Calorimotor, a new Galvanic Instrument.—A Plate illustrative of Captain SABINE's Paper on Irregularities observed in the Direction of the Compass Needles of the Isabella and Alexander in the late Voyage of Discovery; and Mr. SCORESBY's Anomaly in the Variation of the Magnetic Needle as observed on Ship-board.

Vol. LV. A Plate exhibiting Sketch of the Comet's Path of July 1819.—A Plate illustrative of the Annular Eclipse of the Sun on the 7th of September next.—A Plate illustrative of Mr. LANE's Instrument for gathering Fruit; Mr. YOUNG's Mode of preparing Opium from the *Papaver somniferum*; and of Captain FORMAN's Essay on a Property in Light which hitherto has been unobserved by Philosophers.—A Plate descriptive of Mr. CUTHBERT's improved Hydro-pneumatic Apparatus, &c.—A Plate illustrative of Capt. FORMAN's Essay on the Reflection, Refraction, and Inflection of Light, &c.; and Mr. CHARLES BONNYCASTLE's Communication respecting the Influence of Masses of Iron on the Mariner's Compass.

Vol. 56. Philosophical Magazine. July 1820.

Contents of Number 267.

*** Communications for this Work, addressed to the Editor, Pickett-Place, Temple Bar, will meet with every attention.

RICHARD AND ARTHUR TAYLOR, PRINTERS, SHOE LANE, LONDON.

BAADER's Method of communicating Rotatory Motion; Lieut. SHULDHAM's improved Method of working a Capstan; and STEELE's new Modification of NOOTH's Apparatus, &c.

Vol. L. A Plate to illustrate Sir HUMPHRY DAVY's new Researches on Flame, and Sir GEORGE CAYLEY's Paper on Aërial Navigation.—A Plate representing a Section of the Pneumatic Cistern, with the compound Blow-pipe of Mr. HARE; and a Sketch of a Steam-Vessel intended to run between London and Exeter.—Representation of Apparatus for Sublimation of Iodine—Model of a Safety Furnace by Mr. BAKEWELL—Apparatus for consuming Fire-damp in the Mine—and Apparatus for re-lighting the Miners' Davy.—A Plate illustrative of the New Patent Horizontal Water-Wheel of Mr. ADAMSON.—A Plate illustrative of Mrs. IBBETSON's Theory of the Physiology of Vegetables.—A Plate to illustrate Mr. DICKINSON's new System of Beaconing.

Vol. LI. A Plate illustrative of Mr. CAPEL LOFFT's Paper on the Probability of Meteorolites being projected from the Moon.—Two Plates: one, of Mr. H. TRITTON's Improved Apparatus for Distillation; and another, of the Figures in BRADLEY's Gardening illustrative of the Article on the KALEIDOSCOPE.—A Plate illustrative of Mrs. IBBETSON's Paper on the Anatomy of Vegetables; and Mr. TREDGOLD's on Revetements.

Vol. LII. A Plate illustrative of Mr. UPINGTON's Electrical Increaser for the unerring Manifestation of small Portions of the Electric Fluid.—A Plate illustrative of Mrs. IBBETSON's Paper on the Fructification of Plants.—A Plate illustrative of the Rev. JOHN MICHELL's Theory of the Formation of the Earth.—A Plate illustrative of Capt. KATER's Article on the Pendulum; and New Apparatus for impregnating Liquids with Gases.—A Plate illustrative of Sir H. DAVY's Apparatus for Volatilization of Phosphorus, and Mr. SMITH's Essay on the Structure of the poisonous Fangs of Serpents.

Vol. LIII. A Plate illustrative of Dr. URE's Experiments on Caloric, Mr. LUCKCOCK's Paper on the Atomic Philosophy, and Mr. BOLTON's on the Purification of Coal Gas.—A Plate representing Mr. RENNIE's Apparatus employed in his Experiments on the Strength of Materials; and the Marquis RIDOLPHI's Improvement on the Gas Blow-pipe.—A Plate illustrative of Mr. MEIKLE's Paper on Calorific Radiation; Mr. LOWE's on the Purification of Coal Gas; and Mr. HUGHES's on ascertaining Distances. — A Plate illustrative of Dr. OLINTHUS GREGORY's Paper on the different Rates of PENNINGTON's Astronomical Clock at the Island of Balta, and at Woolwich Common.

Vol. LIV. A Plate illustrative of the MENAI BRIDGE.—A Plate illustrative of Mr. LOWE's Description of a Mercurial Pendulum.—A Plate illustrative of Mr. HARE's Calorimotor, a new Galvanic Instrument.—A Plate illustrative of Captain SABINE's Paper on Irregularities observed in the Direction of the Compass Needles of the Isabella and Alexander in the late Voyage of Discovery; and Mr. SCORESBY's Anomaly in the Variation of the Magnetic Needle as observed on Ship-board.

Vol. LV. A Plate exhibiting Sketch of the Comet's Path of July 1819. —A Plate illustrative of the Annular Eclipse of the Sun on the 7th of September next.—A Plate illustrative of Mr. LANE's Instrument for gathering Fruit; Mr. YOUNG's Mode of preparing Opium from the *Papaver somniferum;* and of Captain FORMAN's Essay on a Property in Light which hitherto has been unobserved by Philosophers.—A Plate descriptive of Mr. CUTHBERT's improved Hydro-pneumatic Apparatus, &c. —A Plate illustrative of Capt. FORMAN's Essay on the Reflection, Refraction, and Inflection of Light, &c.; and Mr. CHARLES BONNYCASTLE's Communication respecting the Influence of Masses of Iron on the Mariner's Compass.

Vol. LVI. A Plate illustrative of Mrs. IBBETSON's Paper on the Physiology of Botany.

Contents of Number 268.

*** Communications for this Work, addressed to the Editor, Pickett-Place, Temple Bar, will meet with every attention.

Richard and Arthur Taylor, Printers, Shoe Lane, London.

ENGRAVINGS.

Vol. L. A Plate to illustrate Sir HUMPHRY DAVY's new Researches on Flame, and Sir GEORGE CAYLEY's Paper on Aërial Navigation.—A Plate representing a Section of the Pneumatic Cistern, with the compound Blow-pipe of Mr. HARE; and a Sketch of a Steam-Vessel intended to run between London and Exeter.—Representation of Apparatus for Sublimation of Iodine—Model of a Safety Furnace by Mr. BAKEWELL—Apparatus for consuming Fire-damp in the Mine—and Apparatus for re-lighting the Miners' Davy.—A Plate illustrative of the New Patent Horizontal Water-Wheel of Mr. ADAMSON.—A Plate illustrative of Mrs. IBBETSON's Theory of the Physiology of Vegetables.—A Plate to illustrate Mr. DICKINSON's new System of Beaconing.

Vol. LI. A Plate illustrative of Mr. CAPEL LOFFT's Paper on the Probability of Meteorolites being projected from the Moon.—Two Plates: one, of Mr. H. TRITTON's Improved Apparatus for Distillation; and another, of the Figures in BRADLEY's Gardening illustrative of the Article on the KALEIDOSCOPE.—A Plate illustrative of Mrs. IBBETSON's Paper on the Anatomy of Vegetables; and Mr. TREDGOLD's on Revetements.

Vol. LII. A Plate illustrative of Mr. UPINGTON's Electrical Increaser for the unerring Manifestation of small Portions of the Electric Fluid.—A Plate illustrative of Mrs. IBBETSON's Paper on the Fructification of Plants.—A Plate illustrative of the Rev. JOHN MICHELL's Theory of the Formation of the Earth.—A Plate illustrative of Capt. KATER's Article on the Pendulum; and New Apparatus for impregnating Liquids with Gases.—A Plate illustrative of Sir H. DAVY's Apparatus for Volatilization of Phosphorus, and Mr. SMITH's Essay on the Structure of the poisonous Fangs of Serpents.

Vol. LIII. A Plate illustrative of Dr. URE's Experiments on Caloric, Mr. LUCKCOCK's Paper on the Atomic Philosophy, and Mr. BOLTON's on the Purification of Coal Gas.—A Plate representing Mr. RENNIE's Apparatus employed in his Experiments on the Strength of Materials; and the Marquis RIDOLPHI's Improvement on the Gas Blow-pipe.—A Plate illustrative of Mr. MEIKLE's Paper on Calorific Radiation; Mr. LOWE's on the Purification of Coal Gas; and Mr. HUGHES's on ascertaining Distances. — A Plate illustrative of Dr. OLINTHUS GREGORY's Paper on the different Rates of PENNINGTON's Astronomical Clock at the Island of Balta, and at Woolwich Common.

Vol. LIV. A Plate illustrative of the MENAI BRIDGE.—A Plate illustrative of Mr. LOWE's Description of a Mercurial Pendulum.—A Plate illustrative of Mr. HARE's Calorimotor, a new Galvanic Instrument.—A Plate illustrative of Captain SABINE's Paper on Irregularities observed in the Direction of the Compass Needles of the Isabella and Alexander in the late Voyage of Discovery; and Mr. SCORESBY's Anomaly in the Variation of the Magnetic Needle as observed on Ship-board.

Vol. LV. A Plate exhibiting Sketch of the Comet's Path of July 1819.—A Plate illustrative of the Annular Eclipse of the Sun on the 7th of September next.—A Plate illustrative of Mr. LANE's Instrument for gathering Fruit; Mr. YOUNG's Mode of preparing Opium from the *Papaver somniferum*; and of Captain FORMAN's Essay on a Property in Light which hitherto has been unobserved by Philosophers.—A Plate descriptive of Mr. CUTHBERT's improved Hydro-pneumatic Apparatus, &c.—A Plate illustrative of Capt. FORMAN's Essay on the Reflection, Refraction, and Inflection of Light, &c.; and Mr. CHARLES BONNYCASTLE's Communication respecting the Influence of Masses of Iron on the Mariner's Compass.

Vol. LVI. A Plate illustrative of Mrs. IBBETSON's Paper on the Physiology of Botany.

Contents of Number 269.

*** Communications for this Work, received by the Editor, Pickett-Place, Temple Bar, will meet with every attention.

RICHARD AND ARTHUR TAYLOR, PRINTERS, SHOE LANE, LONDON.

ENGRAVINGS.

Vol. L. A Plate to illustrate Sir HUMPHRY DAVY's new Researches on Flame, and Sir GEORGE CAYLEY's Paper on Aërial Navigation.—A Plate representing a Section of the Pneumatic Cistern, with the compound Blow-pipe of Mr. HARE; and a Sketch of a Steam-Vessel intended to run between London and Exeter.—Representation of Apparatus for Sublimation of Iodine—Model of a Safety Furnace by Mr. BAKEWELL—Apparatus for consuming Fire-damp in the Mine—and Apparatus for re-lighting the Miners' Davy.—A Plate illustrative of the New Patent Horizontal Water-Wheel of Mr. ADAMSON.—A Plate illustrative of Mrs. IBBETSON's Theory of the Physiology of Vegetables.—A Plate to illustrate Mr. DICKINSON's new System of Beaconing.

Vol. LI. A Plate illustrative of Mr. CAPEL LOFFT's Paper on the Probability of Meteorolites being projected from the Moon.—Two Plates: one, of Mr. H. TRITTON's Improved Apparatus for Distillation; and another, of the Figures in BRADLEY's Gardening illustrative of the Article on the KALEIDOSCOPE.—A Plate illustrative of Mrs. IBBETSON's Paper on the Anatomy of Vegetables; and Mr. TREDGOLD's on Revetements.

Vol. LII. A Plate illustrative of Mr. UPINGTON's Electrical Increaser for the unerring Manifestation of small Portions of the Electric Fluid.—A Plate illustrative of Mrs. IBBETSON's Paper on the Fructification of Plants.—A Plate illustrative of the Rev. JOHN MICHELL's Theory of the Formation of the Earth.—A Plate illustrative of Capt. KATER's Article on the Pendulum; and New Apparatus for impregnating Liquids with Gases.—A Plate illustrative of Sir H. DAVY's Apparatus for Volatilization of Phosphorus, and Mr. SMITH's Essay on the Structure of the poisonous Fangs of Serpents.

Vol. LIII. A Plate illustrative of Dr. URE's Experiments on Caloric, Mr. LUCKCOCK's Paper on the Atomic Philosophy, and Mr. BOLTON's on the Purification of Coal Gas.—A Plate representing Mr. RENNIE's Apparatus employed in his Experiments on the Strength of Materials; and the Marquis RIDOLPHI's Improvement on the Gas Blow-pipe.—A Plate illustrative of Mr. MEIKLE's Paper on Calorific Radiation; Mr. LOWE's on the Purification of Coal Gas; and Mr. HUGHES's on ascertaining Distances. — A Plate illustrative of Dr. OLINTHUS GREGORY's Paper on the different Rates of PENNINGTON's Astronomical Clock at the Island of Balta, and at Woolwich Common.

Vol. LIV. A Plate illustrative of the MENAI BRIDGE.—A Plate illustrative of Mr. LOWE's Description of a Mercurial Pendulum.—A Plate illustrative of Mr. HARE's Calorimotor, a new Galvanic Instrument.—A Plate illustrative of Captain SABINE's Paper on Irregularities observed in the Direction of the Compass Needles of the Isabella and Alexander in the late Voyage of Discovery; and Mr. SCORESBY's Anomaly in the Variation of the Magnetic Needle as observed on Ship-board.

Vol. LV. A Plate exhibiting Sketch of the Comet's Path of July 1819.—A Plate illustrative of the Annular Eclipse of the Sun on the 7th of September next.—A Plate illustrative of Mr. LANE's Instrument for gathering Fruit; Mr. YOUNG's Mode of preparing Opium from the *Papaver somniferum*; and of Captain FORMAN's Essay on a Property in Light which hitherto has been unobserved by Philosophers.—A Plate descriptive of Mr. CUTHBERT's improved Hydro-pneumatic Apparatus, &c.—A Plate illustrative of Capt. FORMAN's Essay on the Reflection, Refraction, and Inflection of Light, &c.; and Mr. CHARLES BONNYCASTLE's Communication respecting the Influence of Masses of Iron on the Mariner's Compass.

Vol. LVI. A Plate illustrative of Mrs. IBBETSON's Paper on the Physiology of Botany.—A Plate illustrative of Mr. HALL's Percussion Gun-Lock; of Dr. KITCHINER's Pancratic Eye-Tube; and of Mr. PARK's Mooring Blocks.

Vol. 56. Philosophical Magazine. Oct. 1820

Contents of Number 270.

*** Communications for this Work, received by the Editor, Pickett-Place, Temple Bar, will meet with every attention.

RICHARD AND ARTHUR TAYLOR, PRINTERS, SHOE LANE, LONDON.

ENGRAVINGS.

Vol. L. A Plate to illustrate Sir HUMPHRY DAVY's new Researches on Flame, and Sir GEORGE CAYLEY's Paper on Aërial Navigation.—A Plate representing a Section of the Pneumatic Cistern, with the compound Blow-pipe of Mr. HARE; and a Sketch of a Steam-Vessel intended to run between London and Exeter.—Representation of Apparatus for Sublimation of Iodine—Model of a Safety Furnace by Mr. BAKEWELL—Apparatus for consuming Fire-damp in the Mine—and Apparatus for re-lighting the Miners' Davy.—A Plate illustrative of the New Patent Horizontal Water-Wheel of Mr. ADAMSON.—A Plate illustrative of Mrs. IBBETSON's Theory of the Physiology of Vegetables.—A Plate to illustrate Mr. DICKINSON's new System of Beaconing.

Vol. LI. A Plate illustrative of Mr. CAPEL LOFFT's Paper on the Probability of Meteorolites being projected from the Moon.—Two Plates: one, of Mr. H. TRITTON's Improved Apparatus for Distillation; and another, of the Figures in BRADLEY's Gardening illustrative of the Article on the KALLIDOSCOPE.—A Plate illustrative of Mrs. IBBETSON's Paper on the Anatomy of Vegetables; and Mr. TREDGOLD's on Revetements.

Vol LII. A Plate illustrative of Mr. UPINGTON's Electrical Increaser for the unerring Manifestation of small Portions of the Electric Fluid.—A Plate illustrative of Mrs. IBBETSON's Paper on the Fructification of Plants.—A Plate illustrative of the Rev. JOHN MICHELL's Theory of the Formation of the Earth.—A Plate illustrative of Capt. KATER's Article on the Pendulum; and New Apparatus for impregnating Liquids with Gases.—A Plate illustrative of Sir H. DAVY's Apparatus for Volatilization of Phosphorus, and Mr. SMITH's Essay on the Structure of the poisonous Fangs of Serpents.

Vol. LIII. A Plate illustrative of Dr. URE's Experiments on Caloric, Mr. LUCKCOCK's Paper on the Atomic Philosophy, and Mr. BOLTON's on the Purification of Coal Gas.—A Plate representing Mr. RENNIE's Apparatus employed in his Experiments on the Strength of Materials; and the Marquis RIDOLPHI's Improvement on the Gas Blow-pipe.—A Plate illustrative of Mr. MEIKLE's Paper on Calorific Radiation; Mr. LOWE's on the Purification of Coal Gas; and Mr. HUGHES's on ascertaining Distances. — A Plate illustrative of Dr. OLINTHUS GREGORY's Paper on the different Rates of PENNINGTON's Astronomical Clock at the Island of Balta, and at Woolwich Common.

Vol. LIV. A Plate illustrative of the MENAI BRIDGE.—A Plate illustrative of Mr. LOWE's Description of a Mercurial Pendulum.—A Plate illustrative of Mr. HARE's Calorimotor, a new Galvanic Instrument.—A Plate illustrative of Captain SABINE's Paper on Irregularities observed in the Direction of the Compass Needles of the Isabella and Alexander in the late Voyage of Discovery; and Mr. SCORESBY's Anomaly in the Variation of the Magnetic Needle as observed on Ship-board.

Vol. LV. A Plate exhibiting Sketch of the Comet's Path of July 1819. —A Plate illustrative of the Annular Eclipse of the Sun on the 7th of September next.—A Plate illustrative of Mr. LANE's Instrument for gathering Fruit; Mr. YOUNG's Mode of preparing Opium from the *Papaver somniferum*; and of Captain FORMAN's Essay on a Property in Light which hitherto has been unobserved by Philosophers.—A Plate descriptive of Mr. CUTHBERT's improved Hydro-pneumatic Apparatus, &c. | A Plate illustrative of Capt. FORMAN's Essay on the Reflection, Refraction, and Inflection of Light, &c.; and Mr. CHARLES BONNYCASTLE's Communication respecting the Influence of Masses of Iron on the Mariner's Compass.

Vol. LVI. A Plate illustrative of Mrs. IBBETSON's Paper on the Physiology of Botany.—A Plate illustrative of Mr. HALL's Percussion Gun-Lock; of Dr. KITCHINER's Pancratic Eye-Tube; and of Mr. PARK's Mooring Blocks.

Contents of Number 271.

*** Communications for this Work, received by the Editor, Pickett-Place, Temple Bar, will meet with every attention.

Richard and Arthur Taylor, Printers, Shoe Lane, London.

—Apparatus for consuming Fire-damp in the Mine—and Apparatus for re-lighting the Miners' Davy.—A Plate illustrative of the New Patent Horizontal Water-Wheel of Mr. ADAMSON.—A Plate illustrative of Mrs. IBBETSON's Theory of the Physiology of Vegetables.—A Plate to illustrate Mr. DICKINSON's new System of Beaconing.

Vol. LI. A Plate illustrative of Mr. CAPEL LOFFT's Paper on the Probability of Meteorolites being projected from the Moon.—Two Plates: one, of Mr. H. TRITTON's Improved Apparatus for Distillation; and another, of the Figures in BRADLEY's Gardening illustrative of the Article on the KALEIDOSCOPE.—A Plate illustrative of Mrs. IBBETSON's Paper on the Anatomy of Vegetables; and Mr. TREDGOLD's on Revetements.

Vol. LII. A Plate illustrative of Mr. UPINGTON's Electrical Increaser for the unerring Manifestation of small Portions of the Electric Fluid.—A Plate illustrative of Mrs. IBBETSON's Paper on the Fructification of Plants.—A Plate illustrative of the Rev. JOHN MICHELL's Theory of the Formation of the Earth.—A Plate illustrative of Capt. KATER's Article on the Pendulum; and New Apparatus for impregnating Liquids with Gases.—A Plate illustrative of Sir H. DAVY's Apparatus for Volatilization of Phosphorus, and Mr. SMITH's Essay on the Structure of the poisonous Fangs of Serpents.

Vol. LIII. A Plate illustrative of Dr. URE's Experiments on Caloric, Mr. LUCKCOCK's Paper on the Atomic Philosophy, and Mr. BOLTON's on the Purification of Coal Gas.—A Plate representing Mr. RENNIE's Apparatus employed in his Experiments on the Strength of Materials; and the Marquis RIDOLPHI's Improvement on the Gas Blow-pipe.—A Plate illustrative of Mr. MEIKLE's Paper on Calorific Radiation; Mr. LOWE's on the Purification of Coal Gas; and Mr. HUGHES's on ascertaining Distances. —A Plate illustrative of Dr. OLINTHUS GREGORY's Paper on the different Rates of PENNINGTON's Astronomical Clock at the Island of Balta, and at Woolwich Common.

Vol. LIV. A Plate illustrative of the MENAI BRIDGE.—A Plate illustrative of Mr. LOWE's Description of a Mercurial Pendulum.—A Plate illustrative of Mr. HARE's Calorimotor, a new Galvanic Instrument.—A Plate illustrative of Captain SABINE's Paper on Irregularities observed in the Direction of the Compass Needles of the Isabella and Alexander in the late Voyage of Discovery; and Mr. SCORESBY's Anomaly in the Variation of the Magnetic Needle as observed on Ship-board.

Vol. LV. A Plate exhibiting Sketch of the Comet's Path of July 1819. —A Plate illustrative of the Annular Eclipse of the Sun on the 7th of September next.—A Plate illustrative of Mr. LANE's Instrument for gathering Fruit; Mr. YOUNG's Mode of preparing Opium from the *Papaver somniferum;* and of Captain FORMAN's Essay on a Property in Light which hitherto has been unobserved by Philosophers.—A Plate descriptive of Mr. CUTHBERT's improved Hydro-pneumatic Apparatus, &c. A Plate illustrative of Capt. FORMAN's Essay on the Reflection, Refraction, and Inflection of Light, &c.; and Mr. CHARLES BONNYCASTLE's Communication respecting the Influence of Masses of Iron on the Mariner's Compass.

Vol. LVI. A Plate illustrative of Mrs. IBBETSON's Paper on the Physiology of Botany.—A Plate illustrative of Mr. HALL's Percussion Gun-Lock; of Dr. KITCHINER's Pancratic Eye-Tube; and of Mr. PARK's Mooring Blocks.—A Plate exhibiting Sections, &c. of Mr. MALAM's improved Gas-Meter.

Vol. 56. Philosophical Magazine. Dec. 1820

Contents of Number 272.

*** Communications for this Work, received by the Editor, Pckett-Place, Temple Bar, will meet with every attention.

RICHARD AND ARTHUR TAYLOR, PRINTERS, SHOE LANE, LONDON.