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CONTENTS TO VOLUME XIV.

NUMBER I.

INTELLIGENCE AND MISCELLANIES.

I. Domestic.

II. Foreign.

NUMBER II.

INTELLIGENCE AND MISCELLANIES.

I. Foreign.

II. Domestic.

ERRATA FOR VOL. XIV.

Page 60, fifth line from bottom, for *quuntities* read *quantities.*
" " last line but one, for P × .6366 = &c. " P × .6366 × &c.
" 61, third line from top, for *Hogan* " *Hoyau.*
" " twenty third line from top, for *on the* " *or the.*
" " sixth line from bottom, But *cf* = AB " But C*f* = AB.
" 62, fifteenth line from top, for *Hogan* " *Hoyau.*
In the diagram, page 61 for *b* on the circumference, between *c* and *d* read *f.*
" 64, for *frontispiece* read *plate.*
" 101, for *Cleavland* read *Cleaveland.*
" 87, line 4 from bottom, for *combustible* read *combustibles.*
" 145, line 18 from top, after expectation put a period.
" 146, line 11 from bottom, after slate, dele the comma.
" 147, line 19 from top, for *ruinous* read *numerous.*
" line 2 from bottom, after rock, dele the period, and insert a comma, and the same after ferriferous, the latter to begin with a small letter.
" 149, line 24 from top, for *slate* read *slaty*, same paragraph, for *Chip* read *Clip.*
" 265, line 20 from top, after with, dele *much.*

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*On the Mineralogy of Chester County, with an account of some of the Minerals of Delaware, Maryland, and other localities; by* GEORGE W. CARPENTER, of Philadelphia.

ASSISTED by my friend Mr. George Spackman of Philadelphia, I published in the 9th Vol. of this Journal, an account of the various minerals, which we found on a tour made in 1825, through Chester county and part of the state of Delaware. On a late revisit to these localities, and a further extent of investigation, I discovered many additional localities of interesting minerals, which with the previous catalogue already described, will embrace most of the minerals contained in the severals townships which have yet been explored.

Chester county presents to the mineralogists a rich field for investigation. Her limestone, serpentine and gneiss, the predominant rocks of the county, contain inexhaustible beds of interesting minerals, and the numerous quarries every where in operation, greatly facilitate the means of procuring them. These circumstances, with the polite attention manifested towards strangers by the inhabitants of the county, and the singular hospitality which particularly characterizes them, are inducements of the strongest nature for encouraging the mineralogist, to visit this county in preference to almost any section of country.

It is a gratifying circumstance for the lovers of natural history, to learn that mineralogy, its most interesting, useful and important department, is making rapid advancement in this county, and in the state of Delaware. Almost all classes of society are taking an interest in its promotion, particularly the farmers, and if the same zeal and ardor for investigation continue uninterrupted, we may reasonably expect some valuable acquisitions to result from their researches. Already several valuable materials have been found in abundance. Magnesite and ferruginous oxide of chrome, (chromate of Iron,)* have been extensively and advantageously worked for epsom salt, and chrome yellow. These articles, a few years since, were received exclusively from England; they are now made from the above materials of equal quality as the foreign, and at a lower rate than they can be imported, which has eventuated in the total exclusion of the foreign articles, and such has been the march of improvement, and the advancement of science, that a cabinet of Natural Science† has been established at West

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* This mineral has been very improperly termed chromate of Iron by the most respectable authors. Iron forms a very inconsiderable proportion of the mineral, and the chrome is not in the state of an acid but in that of an oxyde; it may therefore with more propriety be called a ferruginous oxide of chrome.

† The West Chester Cabinet of Natural Sciences was organised in 1826, and is already in possession of a fine collection of minerals, and an extensive herbarium, and contributions through the zeal and activity of the members are daily making to each department; under these circumstances the institution is now in a rapidly improving condition. The minerals are arranged in two departments, one of which is devoted exclusively to the minerals of Chester county, by which you may view at a glance, all the minerals which have yet been discovered. The other is a general cabinet, arranged according to Professor Cleavland's admirable system, and includes, besides those of the county and neighborhood, a considerable number from various localities in America and Europe.

Distinguished credit is due to Mr. John W. Townsend, corresponding secretary, and to H. H. Van Amringe, A. Marshall, and Townsend Haines, Esqrs. curators, for their indefatigable zeal, indnstry, and consequent success, as manifested by the present favorable condition, of this department of the cabinet; also to William Jackson, Vice President, and Mr. Joel Baily of East Marlborough, for their very liberal donations.

There are also two herbariums, containing upwards of two thousand species. One is devoted exclusively, to the plants of the county, and denominated the *Chester county* herbarium, which contains specimens of nearly all the known indigenous plants of the county. Since the publicationof the Florula Cestrica, a recent valuable work by Dr. Darlington, several species, not enumerated in the catalogue of that publication, have been added to the collection. The other is denominated the general herbarium, is arranged according to the natural order of Jusseau, and contains about one thousand two hundred specimens, many of which are from the United States, but the greater number have been received from France and Germany, and constant additions are making to the herbarium through Dr. William Darlington, President of the Institution, to whose scientific and critical knowledge of this interesting department of natural science, with his persevering industry and zeal, in arranging, collecting and exchanging specimens, the cabinet is exclusively indebted for the remarkable condition of its herbarium, which reflects high honor upon the institution. Dr. Darlington's arrangement, independently of many conveniences, affords so great facility, that a plant of any class and species may be selected, without the least difficulty

Chester, and is now in a flourishing condition, and under the most favorable circumstances for becoming a highly useful and important institution. An institution* of the same kind has just been established at Wilmington, under the most favorable auspices, and bids fair to prosper.

Among the townships of Chester county, East Marlborough, London Grove, Newlin and East Bradford, have been most examined. Pennsbury, Kennet, New Garden, West Marlborough, West Bradford, West Goshen and Westown, have been examined to a certain extent. Penn, Londonderry, Upper and Lower Oxford, East and West Fallowfield, New London, and East and West Nottingham, have been scarcely examined at all by the mineralogist. The townships which have not yet been explored, are in the south west part of the county, and as most of them contain abundant beds of limestone and ridges of serpentine, they will no doubt disclose, on examination, many new and interesting minerals.

East Marlborough is more remarkable for the great variety of minerals, than for the abundance of any one kind, except the carbonate of lime, which forms extensive beds throughout the township, and the extreme value of this mineral in enriching and improving the soil, is admirably displayed, in the luxuriance of almost every vegetable species within its influence.

Newlin is not only remarkable for a considerable variety of minerals, but particularly for the great abundance of its serpentine, quartz and beryl; the two latter occur of an interesting character, and are extremely abundant, particularly the beryl, which constitutes almost a distinct formation, and the place has, from this circumstance, been denominated by the mineralogists, beryl hill, by which name it is known

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in a minute of time, and without disturbing the arrangement. The rapid progress which this institution has made within the short period since its establishment, and the augmenting interest which the agriculturists of the county are taking in its support, warrant the most favorable anticipations of its future usefulness and importance.

* The Delaware academy of Natural Sciences has, within a few months, been established at Wilmington. They are pursuing the same course as the cabinet of West Chester, in collecting the natural productions of the country, and have already a good collection of the minerals which have yet been discovered in their state and vicinity. They possess some extremely active and zealous members who will no doubt exalt the institution, by increasing the means of its usefulness and prosperity.

through several townships. Large quantities of detached crystals of beryls, may, at all times, be dug within a foot or two from the surface. Drusy quartz, of white, yellow and rich green colors, occurs in considerable quantity, in the vicinity.

Westown Township.

This township was not noticed in the former description, and has been as yet but partially explored ; the following are the most important minerals which have been discovered.

Earthy and ferruginous oxide of manganese, of excellent quality, for employment in the arts and manufactures. I presented a sample to Mr. Abraham Miller, an ingenious potter of this city, who made use of it in his manufacture, and pronounced it equal to the imported. It occurs on Joseph Osburne's farm, three miles south of West Chester. It has not yet been worked, but its position and external appearances render it probable, that it is abundant.

Siliceous oxide and carbonate of manganese, of a reddish and yellowish brown color, and of a somewhat foliated structure, same locality.

Manganesian garnet, massive, of a reddish brown color, same locality.

Black schorl, traversing quartz in cylindrical crystals, very beautiful, on Joseph Osburne's farm.

Fine acicular and fibrous hornblende, of a jet black color, same locality.

Limpid and smoky quartz, in beautiful transparent crystals, hexahedral prisms terminated by pyramids, loose in the soil, Joseph Osburne's farm.

A mine was opened on this farm about sixty years since for silver ore, and a small portion of the metal was obtained. It was however abandoned in consequence of the minute quantity yielded, and a doubtful prospect of its producing advantageously. The oxides and carbonates of manganese, and the manganesian garnet, occur also, on William Osburne's farm adjoining.

East Bradford Township.

Cyanite, in oblique tetrahedral prisms, (primitive form,) from one quarter to one inch in thickness, and from one to three inches in length, occurs in mica slate and detached crystals, on the Strasburg road, near the bridge on the east branch of the Brandywine—abundant.

Zircon, an interesting locality of this mineral occurs in bluish quartz, near Jeffries' ford.

Feldspar, of a bluish color and lamellar structure, occurs near Jeffries' ford on the Brandywine.

Amethyst, of a rich violet color, highly transparent, in hexahedral prisms terminated by pyramids, occurs detached in the soil, on James Gibbon's farm, three miles south of West Chester. Fine specimens from this locality, are in the cabinet of Natural Sciences of West Chester.

Sulphuret of iron, in large cubic crystals, on R. Woodward's farm.

Red oxide of titanium, same locality.

Sulphuret of iron, in cubic crystals, on Job Darlington's farm.

Plumbago, same locality.

Necronite, well characterized in disseminated masses, in Benjamin Copes' quarry.

Schorl, of a beautiful jet black color, on J. Painter's farm.

Pennsborough Township.

Necronite, in carbonate of lime, in Mendenhall's lime quarries.

Amethyst, in beautiful violet crystals, on George Darlington's farm, adjoining Wister's.

Bog iron ore, same locality.

Mica, in regular hexahedral prisms, in granite, near Darlington's mill.

Newlin Township.

Green quartz, in drusy clusters and prismatic crystals, on the serpentine ridge near Mason's farm.

Limpid quartz, in hexahedral prisms terminated by pyramids, in carbonate of lime, in Edwards' lime quarries.

Fluate of lime, of a deep blue color, in small cubic crystals, same locality.

Calcareous spar, in rhombic crystals and hexahedral prisms, having irregular sides, same locality.

Schorl, in beautiful cylindrical crystals, of a jet black color, same locality.

Beryl, of a rich green color, near William Embrie's malt house, in detached crystals.

Green mica, in foliated masses and crystallized in granite, near the celebrated beryl locality.

Green foliated talc, same locality.

Sulphuret of iron, in cubic crystals, same locality.
Mica, of a grass green color, beautifully striated, near Brandywine bridge, three miles west of Chester county poor house.

East Marlborough Township.

Iserine, in detached crystals and granular masses, at David Persey's mill race, also in quartz, in tetrahedral prisms striated, in John Baily's lime quarry.
Tremolite, beautifully crystallized, in oblique four sided prisms, the acute lateral edges truncated with dihedral summits, in John Baily's lime quarry.
Sulphuret of iron, in cubic crystals occasionally truncated, on all its angles, also in dodecahedrons, in John Baily's lime quarries.
Epidote, in hexahedral prisms, sometimes truncated on the edges, of a yellowish green color, on Isaac Taylor's farm, adjoining John Baily's, south.
Foliated talc, white and green, on A. Marshall's farm, also on McCloud's, adjoining.

West Marlborough Township.

Phosphate of lime, in hexahedral prisms, of a yellowish green color, in granular limestone, in Bernard's quarry.
Iserine. Beautiful specimens of this mineral occur in tetrahedral prisms, truncated on the angles, longitudinally striated, with oblique summits, in Bernard's lime quarry.
Brown spar, in small rhombic crystals, with the planes slightly curved, in Bernard's lime quarry.
Dogtooth spar, (carb. of lime) in semi transparent straw colored crystals, McNeal's lime quarry.

New Garden Township.

Fibrolite, of a greyish white color, in little bundles of delicate fibres and acicular crystals intimately connected, on Nathan Scarlet's farm, south of Phillips' quarry.
Black schorl, in cylindrical crystals and fibres, a very beautiful variety of this mineral, same locality.
Phosphate of lime, in hexahedral prisms, of a green color, same locality.
Garnets, in dodecahedral crystals, of a deep red color, in mica slate, same locality.
Fibrous carbonate of lime, in J. Phillip's lime quarry.

Carbonate of lime, in beautiful arborescent mammilary and botryoidal concretions, in Joshua Pusey's lime quarry.

Tremolite, in fine acicular crystals, and fibres of a pure snow white color, radiating and diverging, in Brown's quarry.

Kaolin, an extensive bed of this mineral occurs on Israel Hoope's farm, New Garden township. This substance is extensively employed in the manufacture of porcelain ware. Two manufactories, and the only ones yet established in this country, are supplied from this locality.

West Bradford Township.

Diallage and saussurite, near Worth's tavern, onthe Strasburg road.

Chromate of iron, in detached masses, and disintegrated crystals, same locality.

Epidote, in beautiful hexahedral prisms, with dihedral summits, of a resplendent bottle green color; the crystals are from one half to three inches in length, and from $\frac{1}{16}$ to $\frac{3}{4}$ of an inch in diameter, fully equal in size and beauty to those of the celebrated locality of Arendal in Norway, occurs in primitive hornblende, on Smith's and McMullins farms, adjoining each other.

Zeolite, in fascicular groups of minute crystals and fibres, radiating from a central point, of a snow white color, and pearly lustre, forming narrow veins in primitive hornblende, on Robert Lambern's farm.

Chabasie, in rombic crystals, of a reddish brown color, in hornblende associated with zeolite, same locality.

Silico-calcareous oxide of titanium, in rhomboidal prisms, with dihedral summits, in a gangue of hornblende and feldspar, same locality.

Blue feldspar, of the lamellar variety, striated on the surface, same locality.

Mica, in rhomboidal and hexahedral prisms, in granite, one mile north of Sharplesstown, on the Wilmington road.

Amethyst, of a deep violet color, in hexahedral prisms, with pyramidal terminations, loose in the soil, on George Passmore's farm.

Fetid quartz, well characterized, in R. Wood's lime quarry.

Limpid quartz, in hexahedral prisms, with pyramidal terminations, in the lime quarries near the poor house.

Iserine, in striated cylindrical crystals, imbedded in quartz, same locality.

Sulphuret of iron, in cubic crystals, occasionally truncated on the angles, same locality.

London Grove Township.

Tremolite, in fibrous and radiated masses, in Ephraim Wilson's quarry.

Phosphate of lime, perfectly transparent, of a rich bottle green color, in hexahedral prisms and massive, on Allison's farm ; this interesting locality was discovered by Dr. Allison who has liberally distributed specimens among our mineralogists.

Tourmaline, of a beautiful velvet black, in hexahedral prisms, terminated with trihedral faces, set on the lateral edges, on William Jackson's farm.

Red oxide of titanium, in tetrahedral prisms, with dihedral summits in gneiss, also massive, on Wm. Jackson's farm.

Iserine, in tetrahedral prisms, truncated on the angles, and longitudinally striated, in W. Jackson's lime quarry.

Tremolite, crystallized, and in radiated fibres, same locality.

Foliated and fine scaly talc, of a white color, in Mitchiner's quarry, adjoining W. Jackson's.

Brown tourmaline, in hexahedral prisms, in carbonate of lime, a beautiful mineral, in W. Jackson's, and Pile & Morrisson's lime quarries.

Crystallized quartz,* in hexahedral prisms with pyramidal summits, transparent, in Pile & Morrison's quarry.

Brown spar, in rhombic crystals, slightly curved, of a brownish color and beautiful pearly lustre, same locality.

Fetid quartz, well characterized, same locality.

Magnesian carbonate of lime, in rhombic masses and crystals, same locality.

Quartz, of a milk white color, on W. Jackson's farm.

Cyanite. An interesting locality of cyanite in the primitive form, has been discovered in this vicinity, by Dr. Allison.

Garnets, in dodecahedral crystals, abundant in the gneiss rocks, and detached, on W. Jackson's farm and neighborhood ; a specimen in the museum of the West Chester cabinet, measures 6.75 inches in circumference.

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* A specimen of limpid quartz from Morrison's quarry, presented to the cabinet of Natural Sciences by W. Jackson, and now in their museum, a hexahedral prism with pyramidal termination, measures sixteen inches in circumference.

Specular oxide of iron, in quartz, near London Grove meeting house.
Mica, of a leek green color, on W. Jackson's farm.
Cyanite, in fascicular groups, of bladed crystals, of a pale and sky blue color, on W. Jackson's farm.
Black and reddish brown schorl, in acicular diverging crystals, and fibres in quartz, on W. Jackson's farm.
Smoky quartz, six sided prisms, detached in the soil, on W. Jackson's farm.
Calcareous spar, striated diagonally, to the rombic cleavage, on W. Jackson's farm.
Dogtooth spar, of a straw yellow color, in semi-transparent crystals, in W. Jackson's lime quarries.
Epidote, in hexahedral prisms, of a bottle green color, in Mitchiner's lime quarry.
Red jasper, in detached masses, on W. Jackson's farm.

New London Township.

Fibrolite, in delicate fibres, intimately connected, of a greyish white color and glistening aspect, on Robert Hudson's farm.
Schorl, in cylindrical crystals, of a jet black color, same locality.

Sundry Localities in Chester County.

Zoisite, in rhomboidal, cylindrical and acicular crystals, of a grey color, in gneiss, in Bathwoods, near West Chester, West Goshen township, discovered by Townsend Haines, Esq.
Oxide of iron, the red hematitic variety, on the serpentine ridge, Nottingham township.
Magnesite, forming narrow veins, in the serpentine ridge, West Goshen.
Mica, in beautiful hexahedral prisms, Kennet township.
Stalactical carbonate of lime, of a snow white color, in arborescent, reniform, mammilary and botryoidal concretions, in John Robert's lime quarry, West Whiteland, Chester county, four miles north of West Chester.
Actynolite, in chlorite slate, near Waggontown, Chester county.
Amianthus, in delicate silky fibres, forming minute veins in serpentine, Joseph Taylor's quarry, West Goshen, near West Chester.

Plumbago, in quartz, near Charleston village, Charleston township.

Epidote, in hexahedral prisms, of a yellowish green color, Strode's mill, near West Chester.

Oxide of iron, highly magnetic, near Goshen meeting house, East Goshen township.

Garnets, in dodecahedral crystals, of a brown color, abundant on A. Hoope's farm, East Goshen township.

Bog iron ore, on Pennypacker's farm, Charleston township.

Little Britain Township, Lancaster County, Penn.

Octahedral magnetic oxide of iron, on the serpentine ridge, on Joel Jackson's farm.

Massive and crystallized ferruginous oxide of chrome, or chromate of iron, occurs on a minor ridge of serpentine, about a mile north of the main serpentine ridge, being about two miles west of the south western point of Chester county, on the property of McKim, Sims, & Co. of Baltimore, adjoining Joel Jackson's farm. The disintegrated crystals of chromate of iron, are found coating the cavities of all the ravines made in the sides of the hill, and indicate the existence of this valuable material in quantity.

Magnesite. An extensive locality of this valuable mineral occurs, forming veins in the serpentine of considerable thickness, same locality; and is now extensively quarried and manufactured by Messrs. McKim, Sims, & Co. of Baltimore, into sulphate of magnesia, (Epsom salts.) These gentlemen have succeeded in making a purer salt at a much less price than it can be imported, which has entirely excluded importation; and the United States are now almost entirely supplied from this establishment. Four hundred or five hundred tons of magnesite, have been obtained from this locality, and Messrs. McK. & S. manufacture 1,500,000 lbs. of Epsom salt annually.

Actynolite, in green compressed crytals, in talc, serpentine ridge, on Joel Jackson's farm.

Noble serpentine, with delicate veins of amianthus, serpentine ridge, on Joel Jackson's farm.

Chalcedony. An interesting locality of this mineral occurs near the magnesite above described, and about one and a half miles distant from the celebrated locality at Rocks springs, described in my former paper, and near the locality of magnesite and chromate of iron.

DELAWARE.

New Castle County.

Phosphate of lime, in granite, of a bluish green color, in hexahedral prisms, occasionally longitudinally striated, from $\frac{1}{16}$ to one and a half inches in diameter, and from half to two inches in length, abundant on a farm adjoining Wistar Dixon's east, and about six miles from Wilmington.

Beryl, of a fine apple green color, in hexahedral prisms, in granite, on a farm adjoining Dixon's, and near the serpentine ridge.

Precious garnets, in granite, of a brilliant red color, in dodecahedrons, on Dixon's farm in the wood near the house.

Schorl, of a dark red color, in cylindrical crystals, in granite, same locality.

Brown and red hematite, on the serpentine ridge, near.

Jasper, of a reddish brown, and yellowish color, forming veins, in serpentine, Dixon's farm.

Quartz, of a reddish brown color, in six sided prisms, terminated at both extremities, by six sided pyramids, resembling the quartz of COMPOSTELLA, same locality, also, near the Centerville turnpike.

Drusy quartz, limpid, yellow and green, in beautiful clusters of minute crystals, same locality.

Feldspar. An extensive bed of this mineral, occurs adjoining Dixon's farm, the land containing it has lately been purchased by Mr. W. E. Tucker of Philadelphia, who employs the article extensively in the manufacture of porcelain ware. This ware of which the feldspar, is an important constituent, has been brought to such perfection by Mr. William E. Tucker, that it is pronounced by competent judges, to possess a soundness of body, smoothness of glazing, and beauty of lustre, fully equal to the imported, and surpasses in purity of whiteness, either the French or English china, which is met with in our market.

Epidote, massive, and crystallized, in primitive hornblende, on the Kennet turnpike, near the Buck tavern.

Lamellar hornblende, possessing somewhat the lustre and colors of the hypersthene, same locality.

MARYLAND.—*Cecil County.*

Schorl, of a velvet black color, in beautiful cylindrical crystals, disseminated in quartz, near the falls of north east creek.

Actynolite, of a bottle green color, in compressed acicular crystals, in talc, near Cooptown, Harford county.

Magnetic oxide of iron, massive, and in octahedral crystals, in chlorite slate, same locality.

Fibrous talc, of a reddish color, same locality.

Magnesite. An extensive locality of this valuable mineral, occurs at Bare Hill, near Baltimore, and has been extensively employed in the manufacture of Epsom salts; it is now obtained from Little Britain township, Lancaster county, as before described.

Bucks County, Penn.

Magnetic oxide of iron, half a mile above Newport, on the Neshamony creek. This ore was formerly worked, but has been abandoned, in consequence of not producing advantageously.

Serpentine, having distinct laminæ, slightly curved. These pervade the serpentine in spots, and when viewed in direction of the laminæ, have a shining and pearly lustre, and when contrasted with the greenish black, dull, and opaque color of the serpentine, have a glistening and metallic appearance, somewhat resembling hypersthene, half a mile below Newport, on Roldman's run.

Lamellar feldspar, the glassy variety and graphic granite, at Newport.

Tourmaline, of a rich black color, in eight sided prisms, longitudinally striated, terminated by three sided pyramids, in granite which forms veins in gneiss, at Nevil's academy, near Bustleton.

Cyanite, of a fine blue color, in flat crystals or blades, in quartz, forming a vein in gneiss, near the same locality.

Scaly talc, in detached masses, occasionally containing asbestos, same locality.

Asbestoid actynolite, in silky fibres and acicular crystals, radiating from a centre in beautiful tufts, in detached masses, from one to fifty pounds weight, in a wood, half a mile east of Bustleton.

Magnesian garnets, massive, of a lamellar structure, on the Penny pack creek, three miles from Bustleton, at the mouth of the Sandy run.

Black oxide of manganese, in gneiss, same locality.

Phosphate of lime, in six sided prisms, terminated by six sided pyramids, of a light green color, in quartz, same locality.

Iridescent feldspar, of a bluish white color, resembling the Labrador spar, on the farm of Mr. Jacob Van Arsdalen, three miles west of Attleboro,' and seven north of Bustleton.

Tremolite, of a grass green color, in carbonate of lime, in oblique tetrahedral prisms, having the acute edges truncated, with dihedral summits, occasionally transparent, Van Arsdalen's farm, same locality.

Actynolite, of a deep green color, same locality.

Mica, in six sided prisms, in granite, fibrous structure, in a diagonal direction to the angles of the prism, in which direction it may be cleaved, and numerous delicate fibres separated, on the Penny pack creek, one mile south west of Bustleton.

For the discovery of the above localities, in Bucks county, we are indebted to our friend Dr. Edward Swift, an indefatigable mineralogist of Bustleton, Penn.

At the locality of tremolite, iridescent feldspar and actynolite, on Jacob Van Arsdalen's farm, the following interesting minerals, also occur, which render this locality sufficiently attractive to mineralogists.

1. Tabular spar, in masses of several tons weight, analyzed by Dr. Morton, and Mr. J. P. Wetherill, who obtained the following constituents:—

Silex, - - - -	51.50
Lime, - - - -	44.10
Oxide of iron, - - -	1.00
Lost by calcination, - -	.75
	97.35

2. Scapolite, massive and crystallized. 3. Pyroxene, in hexahedral prisms. 4. Zircon, forme soustrative of Hauy. 5. Mica, clove brown, and emerald green. 6. Blue quartz, in small quantity. 7. Feldspar, massive, of a dark blue color, also in rhombic prisms, with the terminal angles truncated, *Unitaire* of Hauy. 8. Garnet, granular and in small dodecahedral crystals. 9. Phosphate of lime, massive, and in hexahedral prisms. 10. Graphite, massive, and in delicate hexagonal tables. 11. Sulphuret of iron, massive, and in octohedral crystals. 12. Silico-calcareous oxide of titanium, in oblique four sided prisms.

I have *merely* given a *catalogue* of these minerals, as an elaborate and detailed account of them, has been published by Dr. Samuel G. Morton, of Philadelphia, in the Journal of the Academy of Natural Sciences of Philadelphia, for June, 1827.

Philadelphia County.

Sil.-calcar. oxide of titanium, in olique four sided prisms, at Radner's mill, near the falls of Schuylkill, also on the township line road, near Rittenhouse's smith shop.

Phosphate of lime, massive, and in hexahedral prisms, imbedded in feldspar, on the township line road, same locality.

Graphite, massive, in gneiss rock, on Robinson's hill, on the Schuylkill, five miles from Philadelphia.

Limpid quartz, in hexahedral prisms, with pyramidal terminations, in detached crystals, same locality.

Chalcedony, on Longstroth's farm, near the York road, five miles from Philadelphia.

White beryl, in granite, hexahedral prisms, in Day's cave, near the residence of William Wister, Esq.

Graphic granite, and laminated feldspar, same locality.

Cyanite, in bladed crystals, from a pale to a deep sky blue, in granite, near Livezly's mill, on the Wisahicon.

Tourmaline, of a velvet black color, in hexahedral prisms, near Rittenhouse's paper mill, on the Wisahicon.

Hematite, (brown oxide of iron,) in mammilary masses, near Jacob Wise's mill, on the Wisahicon.

Red oxide of titanium, massive and crystallized, in clay slate, on Wise's lane, near Wisahicon.

Limpid quartz, in pyramidal clusters and drusy aggregates, same locality.

Smoky quartz, highly transparent, near the township line road, six miles from Philadelphia.

My friend Mr. John Wister, of Germantown, has obtained very fine specimens from each of the above localities of Philadelphia county.

Having on hand duplicates of all the above minerals, with an extensive collection from other localities, I shall be happy to exchange them for those from other districts.

George W. Carpenter, *No.* 221, *Market street.*

P. S. The manufactory of porcelain at Jersey city, one of the two mentioned in the above account, has we understand been discontinued, and that at Philadelphia, is stated to be the only one in the United States.—*Ed.*

ART. II.—*On the Geology and Mineralogy of the country near West Chester, Penn.; by* J. FINCH, M. C. C. &c.

CHESTER COUNTY, in Pennsylvania, possesses much interest to the geologist and mineralogist, on account of the beauty, and variety of the specimens it affords.

If a line be drawn from the battle ground near Chad's ford, passing through West Chester in a northerly direction, and extending beyond the bounds of the county, the following formations may be noticed on the route.

1 Gneiss, containing subordinate strata of hornblende slate, serpentine, and limestone. - -	8 miles
2 Mica slate, - - - -	2 do
3 Primitive limestone, - - -	$1\frac{1}{2}$ "
4 Transition quartz rock, - - -	$1\frac{1}{2}$ "
5 Gneiss, and hornblende slate, - -	6 "
6 Second or variegated sandstone, - -	4 "
7 Newest flœtz trap, - - -	1 "

1. Gneiss. This is composed of the usual ingredients, quartz, feldspar, and mica, arranged in slaty laminæ, at an angle of 70° to 80° to the horizon. On some of the hills, hard masses of the rock may be seen, but, more frequently, it has undergone decomposition to a depth of twenty or forty feet. In the defiles formed by many of the roads, this may easily be seen, and the superior fertility of Chester county, is to be attributed to this cause. The surface of the rock is distinguished by its undulating character, which forms a pleasing feature in the landscape.

The hornblende slate, contained, in the gneiss formation, is composed of quartz, feldspar and hornblende, the latter mineral predominates and forms two thirds of the mass. Frequently only feldspar and hornblende occur. It is slaty, and the rock will usually break, though with difficulty, in the direction of the laminæ. Where it is abundant on the surface of the ground, it is very troublesome to the farmers, as it resists decomposition. The limestone occurs in several strata, varying in breadth from thirty to one hundred feet, and in some situations probably more. It is rendered lamellar by mica, and the laminæ vary from two to twelve inches in thickness. It is crystalline and contains magnesia. Color, white, greyish white, reddish and blue. The strata of limestone are probably contiguous with the gneiss, although quarries have been opened in few places. In the intervening spaces, it is in general too much covered with earth to be worked to advantage.

Serpentine. This occurs in masses at irregular distances, and appears to form superincumbent masses reposing on the gneiss. It is universally distinguished by its sterility, and the fields, where it occurs have received the emphatic title of the "Barrens." There is a great difference in the external character of this rock, color usually blackish or yellowish green, sometimes red. On the exterior it decomposes white, and more rarely black. It is sometimes of a slaty structure and distinctly stratified.

2. Mica Slate. This rock passes into clay slate, covered with a glaze of mica. The decomposition of the rock, yielding mica and quartz, produces a porous soil, distinguished by its sterility. By adding lime, it has been ameliorated. The water on this tract, is remarkably pure and limpid.

3. Primitive Limestone. This varies much at different quarries. Color white, black and veined. Some varieties contain much carbon. In strata, inclined 70° to 80° and frequently contains fissures of unknown extent. It forms a district of country called the great Valley, which extends from the Schuylkill, to the Susquehanna. Soil fertile.

4. Transition Quartz rock. This constitutes a range of hills, forming the north west boundary to the great valley. The rock is chiefly quartz, occasionally intermixed with feldspar, and colored of a slight red tinge, from oxide of iron. Slaty, surface barren. Strata highly inclined.

5. Gneiss, with hornblende slate, similar to that already described. The yellow springs are situated on this formation, and from this source, derive their supply of chalybeate water.

6. Second, or variegated Sandstone. It presents the usual varieties. The predominant rock, is an argillaceous sandstone, containing much oxide of iron ; it is easily quarried, and makes a good building stone ; it alternates with slaty sandstone, which decomposes on exposure to the atmosphere, and produces a soil easily cultivated. Inclination of the strata, 10° to 20.° The lead mines of Perkiomen, are situated in this stratum, as are also, those in the vicinity of the farm of Wm. Everhart, Esq. six miles south west of Unionville.

7. Newest flœtz trap ; sometimes resembles the primitive hornblende slate, but is usually in amorphous masses, and the hornblende is not so distinctly crystallized.

In general it is a rock of an homogeneous appearance, fracture conchoidal, splintery on the edges, color dark grey, passing to black, decomposes on the exterior, and is covered with a light grey crust. The formation extends ten miles in length, and half a mile to one mile in breadth. It is probably a continuation of the range which crosses the state of New Jersey, and appears to be a superincumbent mass reposing on the second sandstone. The trap rocks occur in immense masses on the surface of the ground. A highly picturesque view of them is afforded at the falls of French creek. The desolate wildness of the scene is seldom surpassed. Large blocks of trap rock, some of them weighing two or three hundred tons, have fallen from the summits of the adjacent hills, and nearly filled the bed of the creek for a space of two hundred yards. When the stream is small it finds a passage between or underneath the masses of rock, but, after much rain has fallen, the stream increased in size, dashes over with violence, and presents a splendid scene.

Localities of Minerals.

In Gneiss; at Joseph and William Osborne's farm.

Oxide of Manganese.

Do. covering Gneiss.

Manganesian Garnet, massive.

Schorl. This occurs abundantly in many other parts of the gneiss formation.

At an eminence, one mile south of West Chester.

Garnets, crystallized and amorphous.

Zircon, crystallized in four sided prisms, in a bluish quartz, in the vicinity.

Near the spring house.

Zoisite, in rhomboidal prisms.

At Way's hill, near Brinton's ford, on the Brandywine.

Brucite or condrodite, in limestone.

Coccolite, grey, and various shades of green.

Diopside.

Sahlite, in small crystals.

Augite.

Hornblende.

In serpentine, at Mr. Taylor's quarry.

Amianthus.

Asbestos ligniform.

Talc.

Scaly talc.

Protoxide of iron, in octohedral crystals.
Chromate of iron, forming a superficial blue covering on some specimens of serpentine.
Carbonate of magnesia, pulverulent, in crusts and stellated crystals, sometimes colored by iron.
Carbonate of lime, in veins.
Cereolite.
Zeolite.
Steatite.
Chlorite slate.
In serpentine, one mile from Mr. Taylor's house.
Jasper, yellow, brown and red.
Quartz crystals.
Asbestos, in serpentine.
Do. ligniform.
Talc.
Carbonate of magnesia.
In primitive limestone, at Mr. Cope's quarry.
Titanium, red oxide.
Brown mica.
Cyanite.
Magnesian limestone, decomposing, forming sand.
Coarse granular do.
Necronite or fetid feldspar.
Tremolite, glassy, fibrous.
Near the Friends' meeting house.
Sphene, augite and feldspar.

The minerals from these various localities may be seen in the Museum of the Chester county Cabinet of Natural History, which has been founded by the unremitted exertions of Dr. William Darlington and his friends.

Philadelphia, Dec. 1, 1827.

ART. III.—*On the Effect of the Physical Geography of the world, on the Boundaries of Empires; by* JOHN FINCH, F. B. S. &c.

THE limits of empires are controlled by two causes, the physical geography of the soil, and the power of man; the first is eternal, the last variable; thus, in examining history, we find that the first produces the most permanent effect.

Nations often war against those eternal limits, which are pointed out by nature.

The Turks and Persians have, in modern times, renewed the ancient contest between the Romans and Parthians, and have fought for several centuries, without gaining permanently, one square mile of territory.

The ancient Grecians fought for a thousand years, and their small republics, at the termination of the contest, retained their original boundaries.

England and France have amused themselves by wars, which may continue till the end of time, without joining under one sceptre, the vineyards of Burgundy and the vallies of England.

Alexander invaded the east, but he could not enlarge the confines of Macedonia.

Buonaparte subdued Europe, but France is not now more extensive than formerly.

Tamerlane overcame Asia, but it was not in his power to unite the fire worshippers of Persia with the sons of Confucius, nor could he join under one empire, the shepherds of Tartary and the agriculturists of India.

When these phantoms of universal empire perish, nations resume their ancient limits. Conquer them, exterminate them, destroy the memory of their existence as a people; still the new kingdom will have the same limits as the old. A nation, subduing those by which it is surrounded, resembles a river overflowing its banks; the flood gradually subsides, and the stream returns to its ancient channel. When successive hordes of barbarians invaded the dominion of imperial Rome, did they unite the frozen regions of the North with the olive gardens of the South?

When England was conquered successively by the Romans, Saxons, Danes, and Normans, did they surround with one rampart, Italy, Saxony, Denmark, Normandy and England? The decisions of nature soon cut asunder the artificial arrangements of man.

The barriers erected between communities of men vary in strength; let us examine them in their order.

1. Forest.—In the infancy of man, the gloom of a forest often deters him from entering within its shade. The Hercynian forest divided many of the ancient tribes of Germany, and its influence is still perceptible in that country. The divisions of some of the counties of England are derived from the same source. Many tribes of Indians in America are divided by thick woods. In the progress of time, nations

cut down the woods, and this is one reason why civilized nations have larger boundaries than those which are savage.

2. *Rivers.*—In the first ages of man, rivers are a real boundary; they prevent the passage of armies. They are now used as a boundary because they afford a definite line about which there can be no dispute. Europe, Asia, and America, afford numerous examples. A singular fact takes place in regard to them; a small stream is a better division between nations than a large river. The Danube would not form a line of demarcation between Russia and Turkey, but that there is a sparse population on its banks. France has fought to obtain the boundary of the Rhine; she must either advance to the mountains beyond, or retire to the next range of hills in her present territory. The reason of this law is obvious; the fertile banks of large rivers are usually inhabited by numerous tribes of men, the calm and tranquil surface of the river invites them to cross over, the interests of commerce keep up a continual intercourse, the river is easily passed, and both banks must be united under one government. Never have the Ganges, the Nile, the Danube, or the Rhine seen hostile nations in possession of the opposite shores.

The small stream which divides Spain and Portugal is a more lasting boundary than the Tagus would be if it flowed in the same direction.

> "Where Lusitania and her sister meet,
> Deem ye what bounds the rival realms divide?
> Or ere the jealous queens of nations meet,
> Doth Tago interpose his mighty tide?
> Or dark Sierras rise in craggy pride?
> Or fence of art, like China's vasty wall?
> No barrier wall! no river deep and wide!
> No horrid crags! nor mountains dark and tall!
> Rise like the rocks that part Hispania's land from Gaul."
>
> "But there between a silver streamlet glides,
> And scarce a name distinguisheth the brook,
> Though rival kingdoms press its verdant sides."

3. *Seas and Oceans.*—These form a decided boundary to the greater number of nations; but the effect of dominion at sea will be noticed hereafter.

4. *Monntains* form a permanent and frequent boundary. They vary in their power to restrain nations within proper limits according to their breadth and altitude, but, on the whole surface of the earth, they form a real barrier. An individual ascends a mountain, but he returns to dwell in the

valley. The peasant of Hungary fears to ascend the hill which overlooks his native plain.

> "Mountains interposed
> Make enemies of nations, which had else,
> Like kindred drops, been moulded into one."

5. *Deserts.*—I have mentioned the wars between the Turks and Persians, which are carried on across the deserts of Mesopotamia. The ancient kings of Egypt made frequent expeditions to conquer the Arabs dwelling on the sands of Africa, but they defied their armies. Ali Pacha has exerted himself in a similar way, with the same success.

A desert forms a safe barrier to China. A desert and the Rocky Mountains form a boundary to the United States of America on land.

1. *The surface of the earth is thus separated into certain natural divisions, which may be called natural kingdoms.* Every island is a natural kingdom. Every part of the world which is surrounded by strong natural boundaries, is a natural kingdom. It is impossible to conquer one half of these divisions. In waging war with them, you must complete a total conquest, or return. No army could conquer half China. The Tartars and native Chinese once made a treaty of partition; nature declared its execution to be impossible.

Nor could the plains of England be divided between two kings. Canute and Edmund drew an imaginary line through the centre. The treaty could not be observed.

When nations occupy part of natural kingdoms, they must advance or recede. The kingdom of Prussia must be bounded by new acquisitions, or she must recede. This is the reason why she is constantly armed.

2. *Small natural kingdoms, in the vicinity of those which are larger, often lose their independence.*

Small islands are always subdued. No one could now erect the standard of empire on the island of Ithaca, or become king of the Fortunate Islands. We see this rule exemplified in the history of Great Britain. The British Islands contain five natural kingdoms, England, Cornwall, Wales, Scotland, Ireland. Wars took place among the Saxon monarchs of the Heptarchy for four hundred years, until the vallies of England were united under one monarch. She then united to herself the smaller natural kingdoms, by which she is surrounded in the order of their respective strength.

The powerful empire of Austria has subdued the smaller divisions by which she is surrounded.

3. *Where natural kingdoms have a certain size it is difficult to conquer them.*

Nothing but the fury of religious dissension could have subjected Bohemia, with her circular rampart of mountains, to a foreign power.

Let us now consider how the power of man modifies these laws. There is scarcely any law known among nations but force. The power of empire ebbs and flows like the tide; the savage tribes of Britain were easily defeated by the cohorts of Rome; at another period their descendants conquered the veteran troops of France, led on by their emperor.

> "Nations melt
> From power's high pinnacle, when they have felt
> The sunshine for a while."

The legions of Rome, the peasants of Switzerland, the infantry of Spain, the chivalry of France, the cross-bowmen of England, and the battalions of Sweden, have, in succession, given law to Europe, and then retired to their native land.

The process of conquests is usually this. Nations become luxurious, they are invaded by a neighboring tribe, some of the vanquished fall in battle, and their place is supplied by the conquerors. The kingdom retains its ancient boundary and has merely sustained a change of inhabitants, together with the havoc and distress which a state of war occasions.

Fears have been expressed that France and Spain would be united under one empire! Europe was in arms many years to prevent it. The Pyrenees have made it impossible. The union of Russia and Siberia is dreaded! when Siberia possesses a large population, she will no longer be under the dominion of Russia.

The empire of Rome may be cited as an instance against this theory, but on examination, will be found to yield it support. It required all the ferocity of the Romans, aided by their naval power, and their permanent national council, to subdue the nations around. On the decline of their high fortunes, their empire was broken into its original limits.

Naval Power.

"War is the trade of barbarians." "The whole art consists in assembling a force superior to that of your adversary." A great naval power is enabled to do this, by seizing on all the small detached portions of the world, and on large kingdoms which have not yet arrived at their full power, and which have become imbecile. This is easier, to such a power, because all countries are easily approached by sea; nature has made few impervious coasts, she intended that man should make use of the ocean. This produces the somewhat anomalous appearance of countries the most distant under one sceptre.

If we examine the reason of this law which binds nations within certain limits, we shall find it arises from similarity of habits and feelings, which at the same time leads them to hostilities with all around.

The Indians of America war with all but their own tribe.

In the highlands of Scotland, each clan was accustomed to combat all those who lived in the neighboring valley.

Denon has given a correct and vivid description of the combats which take place between the villagers of the Nile. On enquiring the reason, " They knew not; but their ancestors had been accustomed to fight, and it would be improper to break so laudable a custom."

Even in civilized countries, this hostile spirit is shewn. Wherever two villages, of nearly equal size, are situated within ten miles of each other, rivalry takes place, and they would occasionally combat, but they are restrained by the laws. Cities within one hundred miles of each other, have the same spirit of enmity.

If we examine the map of Europe, we perceive that Great Britain, France, Spain, Holland, Switzerland, Bavaria, Denmark, Sweden, and Austria, are natural kingdoms. Norway has always been in vassalage, because her population is much scattered. Turkey, Asia Minor, and Egypt are joined by the power of a fleet, as they were under the Greek empire. Persia has its ancient limits. China has had the same from time immemorial. The Arabians subdued Asia, but they retain their sway over nothing more than their original sandy deserts. Hindoostan is a natural empire, too weak to defend herself. America is arranged in natural divisions.

Thus on the surface of the world, man has done little to change the decrees of the Almighty Power, whose fiat governs the universe.

Art. IV.—*On the Atomic Theory of Chemistry; by* John Finch, M. C. S., &c.

The Atomic theory, or the system of chemical equivalents, is justly considered of the greatest importance, because it has introduced the certainty of mathematical science into the daily operations of the laboratory.

By this system, the lowest proportion in which bodies combine is represented by a number attached to each substance, which is called its atomic weight, and it is found by experiment, that bodies combine either in that ratio, or in some multiple of that ratio.

The following are atomic numbers given by Prof. Brande in his elaborate System of Chemistry :—

Hydrogen.	Oxygen.	Nitrogen.	Chlorine.
1.	8.	14.	36.

Carbon.	Sulphur.	Iodine.	Phosphorus.
6.	16.	125.	12.

These numbers are very similar to those given by Mr. Dalton, and by Drs. Thomson, Henry, Wollaston, and Murray.

All chemists agree in fixing the atomic numbers for oxygen and hydrogen by the proportions in which they combine in water, and the equivalent numbers for other substances depend in a great degree upon those which are thus conferred.

Mr. Dalton, in his Elements of Chemical Philosophy, endeavours to establish as a formula, that where two substances combine in only one proportion, it must be considered as a combination of one atom of each, or, as he expresses it, a binary combination. On this principle, although it is known that water is composed of two volumes hydrogen and one volume oxygen, he considers it as composed of one atom of each, which therefore have to each other the relative numbers 8 oxygen, 1 hydrogen.

The chemists, whose names are recited above, have, in general, adopted the Daltonian formula ; the following reasons may be alleged against its adoption.

First.—The rule, if correct, cannot apply in the instance of water, because there is another combination known of oxygen and hydrogen, the peroxide of hydrogen, which has been described by Gay Lussac, and contains twice the oxygen contained in water. As therefore there are two compounds of oxygen with hydrogen, the formula cannot apply.

Second.—Having obtained the representative numbers of oxygen and hydrogen, if we examine by the same formula, ammonia, which is the only compound known of hydrogen and nitrogen, and if we suppose it to be composed of one atom hydrogen united to one atom nitrogen, it gives a number for the latter substance, which is only one third of its real representative value.

Mr. Dalton carried his rule through the whole system in a rigorous manner, and hence obtained a number for nitrogen, which has, by all other chemists, been considered as erroneous.

Drs. Thomson, Henry, and Wollaston, and Professor Brande, follow the Daltonian formula as it regards water, but, when they arrive at ammonia, finding it will not bend to the hypothesis, they lay aside the rule, and consider it as composed of three atoms hydrogen and one atom nitrogen; because it is composed of three volumes of the former and one of the latter.

Third.—If water is composed of one atom of each, hydrogen and oxygen, or, is a binary combination; it forms an exception to all other known compounds. If we examine the union of metals with each other, with oxygen, with sulphur, or the acids, we find they are all ternary, or superior combinations; so also are atmospheric air, and all animal and vegetable substances.

The union of one atom of each of two substances can be formed, only by great skill and care on the part of the chemist, and is usually effected by abstracting from the higher combinations a portion of one of its constituent parts. Nature forms few binary compounds.

Fourth.—If we examine a mathematical demonstration of the fact, we shall be led to believe, that, were a number of atoms of two substances placed together without previous arrangement, affinity would be exerted in the highest degree, when two atoms, of a similar kind, were arranged on the opposite sides of an intervening atom, and where the line of attraction passed through the centre of each.

Dr. Bache, in his valuable book on chemistry, has endeavored to obviate the difficulty, by supposing the combining volume of oxygen, to be only half the size of the combining volumes of other substances, but this would subject us to the serious inconvenience of giving a varying size to the same substance, in its different combinations.

Let us now state the advantages which arise from considering water, as composed of two atoms, hydrogen, united to one atom oxygen, which theory has been adopted by Sir H. Davy in Great Britain, Berzelius in Sweden, and Gay Lussac, and Thenard in France.

The theory of volumes, which has been so ably illustrated by Gay Lussac, will then coincide with the theory of atoms, and the same numbers may be applied on either hypothesis; it of course destroys the necessity, which has heretofore existed, of dividing the volumic representative of any substance by two, in order to obtain the atomic equivalent. In this mode, much complexity of ideas, and of language, will be avoided in treatises on chemistry.

It will also be perceived, that the numbers representing the atoms, or volumes of substances, will approach very near to their specific gravity. From the coincidence, in many well authenticated instances, it is probable, that, on more accurate investigation, the specific gravity, and atomic weight, and volumic weight, will correspond with each other in every simple substance. By the Daltonian hypothesis, the representative number of the atom of oxygen, was eight, of nitrogen, fourteen ; thus the atomic weight of the latter, was nearly twice as great as that of the former, although its specific gravity is much less—other instances of a similar kind might be adduced.

It may be supposed, a matter of slight importance, whether water is composed of two atoms hydrogen, and one atom oxygen, or one atom of each, but when it is known that the whole fabric of chemical equivalents rests on these as a foundation, and that an alteration of these numbers, affects the whole scale of substances, it will then be considered a subject of importance.

Chemical Equivalents.

Hydrogen. 1.	Oxygen. 16.	Carbon. 12.	Nitrogen. 14.
Sulphur. 32.	Chlorine. 36.	Iodine. 125.	Phosphorus. 24.

Water is composed of two atoms hydrogen, united to one atom oxygen.

Hy.	Oxy.	Hy.
1.	16.	1.

Carbonic Oxide.

Carb.	Oxy.
12.	16.

Carbonic Acid Gas, is composed of two volumes oxygen, united to one volume of gaseous carbon, the three volumes condensed into two; or, the carbon in uniting with the oxygen produces no increase in its bulk.

Oxy.	Carb.	Oxy.
16.	12.	16.

Sulphurous Acid Gas, three volumes condensed into two.

Oxy.	Sul.	Oxy.
16.	32.	16.

Hydro Chloric or Muriatic Acid Gas, no condensation.

Chl.	Hy.
36.	1.

Protoxide of Chlorine or Euchlorine, three volumes condensed into two.

Oxy.	Chl.	Oxy.
16.	36.	16.

Proto Carbureted Hydrogen, three volumes condensed into one.

Hy.	Car.	Hy.
1.	12.	1.

Per. Carb. Hydrogen, five volumes condensed into two.

Hy.	Hy.	Carb.	Hy.	Hy.
1.	1.	12.	1.	1.

Hydro Carbonic Oxide. This gas, which burns with a green (blue?) flame, may sometimes be distinguished in common fires.

Hy.	Carb.	Oxy.	Hy.
1.	12.	16.	1.

Sulphuretted Hydrogen, three volumes condensed into two.

Hy.	Sul.	Hy.
1.	32.	1.

Cyanogen or Carburet of Nitrogen.

Carb.	Nit.
12.	14.

Atmospheric Air, is a chemical compound, in which four volumes of nitrogen unite to one volume of oxygen, without condensation.

	Nit. 14.	
Nit. 14.	Oxy. 16.	Nit. 14.
	Nit. 14.	

Nitrous Oxide, three volumes condensed into two.

Nit.	Oxy.	Nit.
14.	16.	14.

Nitrous Gas, no condensation.

Nit.	Oxy.
14.	16.

Ammonia, four volumes condensed into two.

Hy.	Nit.	Hy.	Hy.
1.	14.	1.	1.

Gases.	Sp. Grav. compared with hydrogen	Atomic Number.	Whether condensed.	Collected over.	Discovered by	Date.	
Oxygen,	16	16		Water	Dr. Priestley	1774	
Carbonic Oxide,	14	28		Do.	Dr. Priestley	1774	In fires.
Carbonic acid gas	22	44	Cond.	Mercury	Dr. Black	1756	Grotto del Cane.
Sulphurous acid gas,	32	64	Do.	Do.	Dr. Priestley	1774	Near volcanoes.
Chlorine,	36	36		Water at 80°	Scheele	1774	Used in bleaching.
Euchlorine,	34	68	Cond.	Mercury	Sir H. Davy	1811	
Deutoxide of Chlorine,	1		Do.	Do.	Do.	1815	
Muriatic gas,	18.5	37		Do.	Priestley	1772	
Fluo Silicic,				Do.	Do.	1775	
Fluo Boracic,				Do.	Gay Lussac	1808	
Hydrogen,	1	1		Water	Cavendish	1770	Balloons. Forms water.
Olefiant,	14	14	Cond.	Do.	Bondt, &c.	1796	White light.
Per hydro carburet,	8	16	Do.	Do.			{ Safety lamp.
Proto. Phos. Hy.	13	26	Do.	Do.	Sir H. Davy	1812	{ Coal Gas.
Per. Phos. Hy.	14	28	Do.	Do.	Gengembre	1783	
Hydriodic acid Gas,	63	126		Mercury	Clement	1813	
Hydro Sulphuret,	17	34	Cond.	Do.	Scheele	1777	Noxious.
Arseniureted Hydrogen,			Do.	Water	Do.	1776	Gehlen poisoned.
Telluret Hy.			Do.	Mercury	H. Davy	1809	
Seleniureted Hy.			Do.	Do.	Berzelius	1818	Intense smell.
Potassureted Hy.			Do.	Do.	H. Davy	1810	
Nitrogen,	14	14		Water	Dr. Rutherford	1772	Incombustible.
Atmospheric Air,	14.5	72		Do.	Scheele, &c.	1774	
Nitrous Oxide,	22	44	Cond.	Mercury	Priestley	1776	Exhilerating.
Nitrous Gas,	15	30		Water	Dr. Hales		Eudiometry.
Ammonia,	8.5	17	Cond.	Mercury	Priestley	1773	Arabia
Cyanogen,	26	26	Do.	Do.	Gay Lussac	1815	Prussian Blue.

ART. V.—*Pluviometrical Observations, made at West Chester,* Pennsylvania; by* WILLIAM DARLINGTON, M. D.

TO THE EDITOR.

West Chester, Penn. Jan. 7, 1828.

SIR,—About five years ago, I sent you a statement of pluviometrical observations made at this place; which is inserted in the 6th volume of the Journal of Science, page 326. My original design was, to note the quantity of rain and snow which should fall, annually, for a series of years sufficiently extended to afford data for a tolerable estimate of the character of our climate,—so far as those phenomena are concerned. I proposed to myself a period of *ten years*, as probably sufficient for that object: and as the term is now completed, I offer the result for insertion in the Journal—if you should deem it worthy of a place.

My former communication contained the observations of the first half of the term proposed; the present one gives those of the last five years—with an additional column, showing the average results for *the whole period*.

Synopsis of Pluviometrical Observations.

Months.	1823.	1824.	1825.	1826.	1827.	*Average the last* 5 *years.*	*Average of* 10 *years.*
January,	4.1	5.1	2.5	1.4	2.9	3.2	2.8
February,	1.7	4.95	4.7	2.5	4.5	3.67	3.485
March,	6.9	3.5	5.7	5.3	2.5	4.78	4.09
April,	1.9	5.3	1.4	3.9	3.8	3.26	3.38
May,	4.05	2.5	2.8	0.7	3.5	2.71	4.555
June,	2.15	6.00	5.8	8.1	3.95	5.2	4.4
July,	6.00	6.9	2.5	2.55	4.5	4.49	4.425
August,	5.25	5.4	6.1	2.6	6.3	5.13	4.475
September,	5.00	6.2	2.4	4.2	0.8	3.72	4.11
October,	2.5	2.00	2.1	5.2	6.5	3.66	3.73
November,	2.55	2.3	0.9	2.4	5.5	2.73	3.615
December,	9.3	3.95	5.4	1.2	4.7	4.91	3.855
Inches.	51.4	54.1	42.3	40.05	49.45	47.46	46.92

It thus appears, that the *average* quantity of water which fell, annually, for the last ten years, was 46.92—or *nearly forty-seven inches*. The greatest quantity, in any one year, was 54.1 inches, (viz. in 1824)—and the least 39.3 inches,

* Twenty five miles west of Philadelphia.

(in 1822); making a difference of almost 15 inches—the one being a year of unusual wet—the other of distressing drought.

The most rain which has fallen in *one day*, for the last ten years, was 4 inches.

The quantity of *snow* during the last five years, was as follows:—

	Inches.		Inches.	
In 1823, the total depth,	30.	equal to	3.	of water.
1824, - - -	13.	- -	1.6	
1825, - - -	20.	- -	2.	
1826, - - -	14.	- -	1.5	
1827, - - -	4.5	- -	.5	
	Snow, 81.5		8.6	water.

The water which fell in the form of *snow*, is included in the table of rain. The quantity of snow, for the last ten years, was 194 inches, or about 16 feet—averaging nearly 20 inches a year. The deepest snow in that time, was 18 inches; which fell on the 7th January, 1821. The usual depths have been from 2 to 4, or 5 inches. It is quite certain, I think, that the *quantity* of snow, in this region, is much diminished within half a century—and, indeed, within the last thirty years. The same remark may be made respecting its *duration*, after it has fallen; both which circumstances are probably owing, in a great measure, to the clearing of forests, and the extended cultivation of the country.

The number of days of *falling weather*, (including rain and snow,) is exhibited in the following table:—

Months.	1823.	1824.	1825.	1826.	1827.	*Average the last 5 years.*	*Average of 10yrs.*
January,	8	6	3	7	4	6	6
February,	3	7	10	6	7	7	7
March,	9	10	8	12	6	9	8
April,	10	7	7	6	8	8	8
May,	10	7	6	2	6	6	9
June,	9	13	9	12	8	10	9
July,	9	8	7	5	8	7	8
August,	8	11	10	6	7	8	8
September,	11	10	6	8	2	7	7
October,	5	4	2	7	6	5	5
November,	8	6	3	6	4	5	6
December,	10	6	8	4	15	9	9
Days.	100	95	79	81	81	87	90

The *average* of ten years, shows about 90 days, in the year, of falling weather—or *nearly one day in four.* It must not, however, be inferred that we bask in *sunshine*, three days out of four. On an average of the year, it is probable there is nearly *one other day in four* which is dull and cloudy—although without any appreciable quantity of rain.

I am, Sir, very respectfully, your obed't servant,

Wm. Darlington.

Professor Silliman.

Art. VI.—*On the Fossil Tooth of an Elephant, found near the shore of Lake Erie, and on the skeleton of a Mastodon, lately discovered on the Delaware and Hudson Canal; by* Jer: Van Rensselaer, M. D.

TO THE EDITOR.

New York, Dec. 24, 1827.

Dear Sir—An extremely interesting relic of former ages having been lately presented to the Lyceum of Natural History, I take the liberty to offer you a few observations upon it, for the pages of your Journal: premising that what is now proffered, is the substance of a report which I have made to that institution upon this subject, and which is their property.

This "medal of nature," or "medallion of creation," as it is the fashion to term organic remains, is the fossil tooth of an elephant—and was, by the kindness of Dr. Micthill, secured to the cabinet of the Lyceum from Mr. Sanford, the proprietor, who has liberally presented it. This gentleman states it to have been found in the town of Beaverdam, Erie county, state of Pennsylvania, near the border of a small rivulet, about six hundred feet above the level of lake Erie, and not far from it.

When first discovered, it was supposed to belong to the Mastodon, but the first glance enables us to pronounce it elephantine. It is eight and an half inches long, three and one third inches broad, and has six inches for its greatest depth; in a line four and an half inches long, there are thirteen layers of enamel, and twelve of cement—not differing materially in dimensions from other fossil elephant teeth in our cabinet.

The enamel remains in good condition, the lines thin, and nearly straight. The plates are parallel and nearly straight, scarcely exhibiting any enlargement in the centre, and therein differing specifically from the fossil teeth of this animal usually found. Most of the fossil, as well as perhaps all recent elephants teeth examined in the United States—or perhaps I may say in this quarter of the globe, have exhibited well marked festoons or angles in the centre.

We have in our cabinet, specimens of fossil elephantine teeth from the Val d'Arno, and from several parts of the United States. That from Middletown, Monmouth county, in New Jersey, is supposed by Dr. Mitchill (in his notes to Cuvier,) to be allied to the Asiatic Elephant. One from the eastern shore of Maryland, the same learned gentleman informs us, is similar to the African species. There are others in our city—and perhaps about fifteen in Philadelphia—some of which I have had an opportunity to examine.

Cuvier has treated at large on fossil Elephant teeth, and has minutely described their distinctive characters.* His researches have led him to the conclusion that the fossil teeth of this animal are distinct from those of either of the living species. From his detailed account of these teeth, and from an examination of several fossil and recent teeth, I must be allowed to say that the specimen before me is more closely assimilated to the Siberian than to the African species, and may in fact be regarded as a fossil tooth of the former animal.

A specimen very similar to this was taken by Humboldt from South America to Paris, and is, or was a few years ago, contained in the splendid cabinet of the king of France.

The fossil remains of the Elephant have been discovered in many places in this hemisphere. Those of South America have been noticed by Buffon, and have been somewhat wonderfully described by Hernandes (Hist. Nov. Hispan.) Acosta (Hist. Nat. des Ind.) and by Torrelbia (Gygantologie Espaniola,) particularly those of Mexico and Peru.

Those of the United States have been more or less minutely described by Catesby,† Drayton,‡ Turner,§ Jefferson, Peale,|| Mitchill,¶ Hayden,** Barton,†† Stranger,‡‡ Dr. Harlan.§§

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*Recherches sur les Ossemens Fossiles.

† Carolina, 11 Ap.

‡ View of South Carolina.

§ Am. Phil. Trans.

|| Disc. on the Mammoth.

¶ Obs. on the Geology of North America, appended to his edition of Cuvier's Theory.

** Geological Essays.

†† Cuvier's Ossemens Fossiles, Tom. 1, p. 155.

‡‡ Amer. Monthly Mag. May, 1818.

§§ Journ. Acad. Nat. Sciences.

No fossil remains of the Elephant, that have come to my knowledge, have been found so far north in our country as the one now under consideration, although that circumstance may be supposed to add but little to the interest of the specimen. Yet it might lead to very important discussions, should more remains of the Elephant or other animals of Siberia be found in greater abundance, and still farther to the north and west upon our continent. The consequences of such discoveries would be to force upon us disquisitions into which it is not my intention at present to enter.

Yours very truly,

JER: VAN RENSSELAER.

Prof. Silliman.

P. S.—Perhaps you are not aware that the fossil remains of A MASTODON GIGANTEUM were discovered last autumn, by the workmen, while digging the Delaware and Hudson Canal. A considerable portion of the skeleton has arrived in this city, and I have enjoyed an opportunity of examining it. The bones which I saw, are in good preservation, and seem to justify the wishes of the proprietors to set up the entire skeleton. The teeth are in perfect order. One of the tusks has arrived; it is a beautiful and perfect specimen, nine feet long. When the other parts of the animal are brought to this city, I shall offer you a more detailed account. J. V. R.

ART. VII.—*Observations on the Inefficiency of the Cathartic powers of Rhubarbarine, with some Remarks on the different varieties of Rhubarb; by* GEORGE W. CARPENTER, *of Philadelphia.*

THERE is, perhaps, no maxim more generally admitted than that "there is no rule without an exception." Even among the useful discoveries, and important researches in the various departments of Arts, Science, and manufactures, there is occasionally found one, which (either from being overrated by too hasty a conclusion, or defective from difficulties in manufacture or construction,) fails to support the characters and properties assigned to it either by its inventor, or discoverer, or by those, who may have described it. When an instance is known to exist under these circumstances, any one acquainted with the fact, from ample proof, or careful experiments, should consider it his duty, to contradict the statements erroneously made, and substitute those which, from a more extensive trial, have proved to be the true characters of the substance.

Vegetable chemistry, has added to our materia medica, a catalogue of highly useful, and important remedies, among which stand eminently conspicuous, quinine, cinchonine, morphine, strychnine, cornine,* piperine, &c. all of which continued from full, and extensive trial, to support the characters originally assigned them, with the exception of *one*, which is the subject of the present communication.

Disagreeable as it is for me, to criticise the writings and discoveries of men, eminent in the profession, yet for the promotion of science, and for the propagation of truth, I feel satisfied they will cordially agree with me, inasmuch as the errors of description were inadvertent, and their sole object no doubt, was, to give the article its real character.

A chemical principle, discovered by M. Pfaff, and also prepared by M. Nani, a distinguished chemist of Milan, has been obtained from the rheum palmatum. M. Nani denominated this principal, sulphate of rhubarb, which name it still retains. M. Nani states that this medicine is cathartic in doses of a few grains, and has many advantages over the rhubarb, from the circumstance of its possessing an uniform strength, while the different kinds of rhubarb have qualities so various, that in many cases the ordinary dose is very uncertain, &c. &c. See Bib. Univers. July, 1823, also this Journal, vol. vii. page 385.

From the high commendation of this medicine, I was induced, at the instance of several of the Faculty of this city, to prepare some of it, as there had not yet been any received in this country. I accordingly adopted a process founded, with some modifications, on that of M. Nani, and published my formula, with some observations on the preparation, in the Philadelphia Journal of Medical and Physical Sciences, and in this Journal, from which it was translated and inserted in the Bulletin des Sciences Medicales, for

* It is much to be regretted that the cornus florida, should yield the cornine in so minute a proportion as to prevent the discoverer from supplying the demand. This medicine has uniformly supported the character, and description given by our friend, Dr. S. G. Morton, and the author can produce testimonials of the highest authority, from different parts of the United States, corroborating this statement, and adding new proofs of the efficacy of the *cornine,* in the treatment of intermittents.

April 1826, with some editorial remarks. Although I feel bound to acknowledge that I was the first to introduce this article into Philadelphia, and have sent a considerable portion to physicians in different parts of the United States, I must say however, in justice to myself, that my province was confined, exclusively to the preparation of this principle from the crude material. Its modus operandi was submitted to the judgment of those, upon whom, from practice and experience the consideration of it more properly devolved, and from the result of whose observations the conclusions should be made.

My paper went to press early after I had prepared the rhubarbarine, and before I could collect sufficient facts to justify any conclusions as to its effects in the hands of those who had first employed it in this city; my observations therefore, in relation to its virtues, were founded upon the authority of M. Nani, and although modified a little, and made less commendable for its cathartic energy, its reputation was nevertheless greater than it merited, and further experiments would warrant.

The physicians who first employed this medicine, were so disappointed as to its activity, that I was apprehensive I might have failed in some part of the process of its manufacture. I accordingly prepared it with great care several successive times, both according to the formula of Nani, and that which I modified, but the results were the same. In order to prove positively that there could be no defect in its manufacture, I sent to Paris, and procured some, manufactured by *Pelletier* (a chemist of the highest reputation,) which was found to be equally feeble, as that, which I had prepared, if not less active. This proved the fact beyond a question, that the powers of the rhubarbarine had been much overrated. The rhubarbarine, manufactured by Pelletier, required a larger dose than the extract of rhubarb, prepared according to my formula in the Philadelphia Journal of Medical and Physical Sciences. I have taken several times, as much as twenty grains, without the least sensible action.

The rhubarbarine resembles more an extract, than any of the vegetable principles. It is solid, dark brown, opaque, possessing the odor of rhubarb, and a taste slightly nauseous and bitter; it is deliquescent and very soluble in water, alcohol and æther. I cannot consider this to be the active principle of rhubarb, as a considerable portion of cathartic matter is retained by solution in the water, from which the rhubarbarine is precipitated. The term sulphate of rhubarb, is an extremely erroneous application, as there is no sulphuric acid in its composition. The sulphuric acid first employed in the acidulated decoction, is entirely neutralized by lime, by which the rhubarbarine is precipitated, perfectly uncombined with acid ; it is then taken up by alcohol, which separates it from the sulphate of lime. The alcohol containing the rhubarbarine is then evaporated, until the rhubarbarine is obtained in the form above described. It is evident, therefore, that from this process there can be no sulphuric acid in its composition, and that the term sulphate of rhubarb is inapplicable. I employed the term sulphate of rhubarb in a former paper; this was done in consequence of its having received that name, a name sanctioned by custom and by authors.

The process for manufacturing the rhubarbarine is expensive, and the product small. This renders it as costly an article as the sulphate of quinine, and on this account it is particularly necessary that its true properties should be known.

The rhubarb of commerce differs materially in activity, and great deception is practised, in selecting and artificially preparing the roots.* From this circumstance, the same species will frequently be sold under several names, such as East India, Russia and Turkey, and command corresponding prices. There are four varieties of rhubarb indigenous in France, and cultivated there; viz. the Rheum Palmatum, Compactum, Undulatum, and Rhaponticum. The superiority of the Palmatum has, however, caused the others to be neglected or abandoned. The difference between the activity of the French and English rhubarb and that of the rhubarb of China and Turkey is caused by the age of the root. The former, after three years growth, decay in the ground, while the latter are not taken up until the seventh or eighth year of their growth. The China and Turkey varieties grow without culture in almost any situation, while the French and English require a moist soil, a particular degree of exposure, and considerable attention in cultivation. It is necessary to plough

* We are informed that a number of persons in London, known by the name of Russifiers, gain a regular livelihood, by the art of dressing rhubarb, which they do by boring, rasping and colouring the inferior kinds, for which they charge eighteen pence per pound. (Paris's Pharmacologia.)

during the winter, and to give two or three ploughings in the summer. The former possesses a color more fixed, a stronger odour, and a taste quite aromatic, and slightly bitter. The latter a taste more mucilaginous and herbaceous, and evidently a less degree of strength. From chemical analysis, first by M. Henry, and afterwards by the celebrated M. Caventon :* we find that one hundred parts of China rhubarb, contain seventy four parts soluble in alcohol and water; a like quantity of the cultivated Rheum Palmatum, furnished but sixty four, the Rheum Compactum but fifty, the Rheum Undulatum but thirty two, and the Rhaponticum but thirty. Thus the Rheum Palmatum is proved to be the most active of the indigenous rhubarbs, but is inferior to that of China. It will be well to observe here, that the root of English and French rhubarb was of three years growth, while the exotic, furnished by commerce, was at least seven or eight years of age. It has been proved by observation, that the strength of the indigenous rhubarb increases with its age, but as it cannot, from circumstances already quoted, attain the age of the exotic, it never can equal it in strength. Numerous experiments, made by Dr. Geoffrey, M. Itard, and M. Ribes, in several public institutions of France, prove, that the indigenous rhubarb is purgative, and may be substituted for the exotic, in pharmaceutical preparations, by employing one fourth more than the latter.

Art. VIII.—*On the Efficacy of Paragrêles.*

The efficacy of Paragrêles, in affording protection against the ravages of hail, appears to be too well ascertained to admit of doubt ;† and we are not certain that the fact is "in opposition to the theories of the learned." There is an explanation, in consistency with these theories, which seems to be so simple and obvious, that we shall deem it strange, if it has not occurred to those who have applied their minds to the investigation of the subject. Not having access to extensive sources of information, we are unable to say whether this is the case or not.

It is a defect in the common theory of the formation of hail,—that it does not embrace all the observed facts. From

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* Bulletin des Sciences Medicales, Avril, 1826.

† See Vol. 10, p. 196. Vol. 12, p. 398 of this Journal.

the rapidly decreasing temperature, as we ascend from the earth's surface, it must happen that the clouds will frequently be so elevated, that a congelation of the watery particles will ensue; but it is by no means certain that this is always the fact when hail is formed during the warm season: the contrary is more probable from observation. But even supposing the theory to be perfect in this particular, there is a circumstance, for which it finds no place. "Hail is most frequently attendant upon thunder; and it is upon such occasions that the hailstones are sometimes enormously large and destructive."* Is not then this connexion of a high degree of electricity with hailstorms too general, and too uniform, to be passed over, as uninteresting, in attempting to account for the phenomena? So it appears to us. That electricity performs a very important part in the formation of hail is established from the facts,—that hailstorms are usually accompanied by large quantities of that fluid;—and that by discharging the electricity of a cloud, (by means of Paragrèles) the formation of hail is prevented.

How then does the electric fluid aid in freezing the drops of water? is the question for our consideration; and its answer may be deduced from what we know to be the effects of the discharge of an electric battery. De même que l' on détermine la formation de l' eau par l' étincelle électrique, on est parvenu aussi à la décomposer. On l' est d' abord servi, pour cela, de violentes décharges transmises à travers ce liquide, et qui y perduisaient des explosions accompagnèes d' ètincelles."† The explosions of an electric cloud, will therefore, in passing through the surrounding water, decompose a part of it; and the quantity will be incomparably greater than by our batteries, as the cause is inconceivably more powerful. We may very reasonably conclude, therefore, that considerable quantities of water will be resolved into its constituent gases. But the water, in passing from the fluid to the gaseous state, will absorb very large quantities of heat; which is required to convert the bases of the gases into the æriform state; and this heat must be derived from the adjacent fluid; and consequently there will be a great reduction of temperature, sufficient in many cases to freeze the particles of water.

* Rees' Encyclopedia, Art. Hail.

† Biot, Traite de Physique, Tom. 2, p. 436.

There is an objection, which at once presents itself,—that after the water is decomposed, the succeeding flash of lightning, would cause the reunion of the gases, and thus completely neutralize the effects of the previous decomposition. If the gases remained stationary after their production, this would certainly be the case: but the specific levity of the hydrogen will cause it to ascend with great velocity through the dense vapours which press upon it from all sides; and the oxygen will have a tendency to take the opposite direction.

In our attempt to give a reason for the efficacy of Paragrèles in preventing the destructive effects of hail, we are not sensible of having advanced any thing that is hypothetical. The decomposition of water by the electric spark is too well known to be called in question. The absorption of heat, when a body changes from the solid to the liquid, or from the liquid to the æriform state, has been matter of common observation, since the days of Dr. Black; and that a great depression of temperature, in the contiguous bodies, must result, is too obvious to be denied. The most questionable thing perhaps is, whether this reduction of temperature would be sufficient to freeze the drops of rain. A few words on this point may be acceptable.

The combustion of one pound of hydrogen gas evolves sufficient heat to melt three hundred and twelve pounds of ice.* This gas has entered into combination with eight pounds of oxygen, and the heat evolved is the latent heat of the two gases. If we take the weight of one hundred cubic inches of hydrogen to be 2.119 grains, and that of one hundred cubic inches of oxygen, 33.915 grains,† the above weight of the gases will be equal to about one hundred and fifty-seven cubic feet of hydrogen, and 78.5 of oxygen. These quantities form 186.5 cubic inches of water. The decomposition therefore of 186.5 cubic inches of water will absorb as much heat as is required to melt three hundred and twelve pounds of ice: or, supposing the heat absorbed by melting ice to be 140° F.‡ If the temperature of the drops of water be 72°, the heat abstracted will reduce the temperature of one thousand and ninety two pounds to the freezing point,

* Biot, Traite de Physique, Tom. 4, p. 704. (A Paris, 1816.)
† Thomson's First Principles of Chemistry, Vol. 1, p. 71. (London, 1825.)
‡ Thomson's Principles of Chemistry, Vol. 1, pp. 87,88. (Philadelphia, 1818.)

32°. The decomposition then of a single cubic inch of water will reduce the temperature of 5.85 pounds from 72° to 32°. But it is very improbable that the temperature of the clouds should be so high as 72° at their usual elevation. If we suppose their temperature to be 54°, which is likely to be nearer the truth, though still perhaps too high, the decomposition of a cubic inch of water will cause the temperature of 10.58 pounds to fall to the freezing point.

The same fact may be illustrated, more forcibly perhaps, in the following manner: the combustion of one ounce of hydrogen will raise the temperature of an equal weight of water 23400° of the centesimal scale,* equal to 42120° F. But an ounce of hydrogen, uniting with eight ounces of oxygen, will form nine ounces of water. The latent heat therefore of the gases which combine to form one ounce of water, will raise the temperature of an equal weight of that fluid 4680°: or will raise the temperature of one hundred and seventeen ounces from 32° to 72°. The decomposition of a single ounce of water, therefore, will reduce the temperature of 9.75 pounds from 72° to the freezing point.† We think then that the frequent explosions of a highly charged cloud must soon reduce its temperature to the point of congelation, and even below this; and consequently the fluid particles will be changed into the solid state.

If there be any truth in the above theory of the formation of hail, it will follow, that the most violent hail storms will be attended by the most frequent and powerful explosions of electricity. Such appears to be the fact. Further observation may reduce this to great probability, if not to certainty.

Z.

Oxford, *Ohio*, *Nov.* 23, 1827.

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* Biot, Tom. 4, p. 716.

† We were curious enough to examine whether the results from the different tables of Biot referred to, would coincide; and we found that for the decomposition of a cubic inch of water, the table of page 716 gave a reduction of temperature of only 5.64 pounds from 72° to 32°. We suspected that perhaps Biot had not subtracted the water formed by the combination of the gases, from the whole quantity received from the calorimeter; and bringing this conjecture to the test by taking from the three hundred and twelve pounds, nine, formed by the union of the oxygen and hydrogen, the remainder gave a reduction of temperature of 5.68 pounds from 72° to 32° for the decomposition of a cubic inch of water. The almost perfect agreement of this weight with the former, proves to a high degree of probability that our suspicion is well founded; and consequently there is a slight error in excess in our reasoning, on the supposition, that three hundred and twelve pounds of ice were melted by the combustion of one pound of hydrogen. The quantity should be three hundred and three pounds.

Art. IX.—*Some Remarks on the Crude Sodas of Commerce; by* John Revere, M. D. *Lecturer on Chemistry, applied to the Arts, at the Maryland Institute for the promotion of the Arts and Manufactures.*

TO THE EDITOR.

New York, October 15, 1827.

Sir—In a course of lectures on chemistry, applied to the arts, I had occasion to collect the facts contained in the following paper. To those who are familiar with the science of chemistry, there will be little that is new. I have been induced to offer these remarks to your Journal, rather from its title, than the general scope of its contents, which I observe are almost purely scientific.* The importance of this substance in the useful arts, the ignorance observed among manufacturers and dealers respecting its nature, and the shameful impositions sometimes practised, constitute its chief claim to your attention. The facts stated may be relied upon, as they have been established by repeated experiments.

John Revere, M. D.

Crude soda, in whatever manner procured, is generally known in this country, among manufacturers and merchants, by the name of *barilla.* But as the value of the article depends very much upon the former circumstance, it will be proper to observe, that it is obtained as an article of merchandize, chiefly in four different modes, viz. 1, in a saline form, on the surface of the earth, and from the water of certain lakes; 2, from the incineration of certain land plants; 3, from the combustion of marine plants; and 4, from the decomposition of sea salt by chemical processes.

The crude soda, formerly known by the name of *natron,* is found in considerable quantities in Egypt, the interior of Africa, and in South America. It exists in lakes, and in particular districts, and forms an efflorescence upon the surface of the earth during the dry season. I am not aware that in this form, it is known as an article of commerce, in the United States.

The most valuable of the crude sodas known in this country, are obtained by the incineration of several kinds of

* The Editor would be happy to receive more communications on the *Arts,* while he would not wish to lower the character of this Journal for *Science.*

plants, which grow in the vicinity of the sea. The best is brought from Alicant, Malaga, and Carthagena, in Spain; it is obtained from an annual plant, the *salsola sativa*, which is cultivated and cured like hay, and afterwards burnt in holes dug in the earth. From the great quantity of soda it contains, it melts into thick paste, which on cooling, becomes condensed into a stonelike mass; the popular name of this plant in Spain, is *barilla.* So highly is this plant esteemed in Spain, that, according to Mr. Parkes, the exportation of the seed is prohibited, under penalty of death. There are several varieties of the *salsola* cultivated on the shores of the Mediterranean, especially in the island of Sicily, and also in the Canary Isles, which yield an abundance of soda. For convenience, all the crude sodas obtained by the combustion of land plants, may be called *barilla.* The barilla most common in our market is brought from Spain, Sicily and Teneriffe. Although many parts of the United States are favorably situated, I have known but one attempt to cultivate them. It was made on the eastern shore of Maryland, from seed procured for the purpose in Sicily. The attempt failed, owing evidently to the imperfection of the seed.

The increased demand for soda for the arts throughout the civilized world, has led men to seek other sources from which this useful substance may be procured. Modern science and industry have succeeded in extracting a large supply from marine plants, which were accounted so entirely worthless among the ancients, that *algâ projectâ vilior* was a common proverb at Rome. The substance procured by the combustion of these plants is called by the French *varech*, and by the English *kelp.* The inhabitants of the coast of Europe have been in the habit, from time immemorial, of collecting the *sea weed*, *wrack* or *sea ware*, as it is indiscriminately called in Great Britain, and manufacturing it into a coarse alkali, for domestic purposes. It is only, however, within a century that any attempt has been made in Great Britain to prepare the kelp in a large way. It was in the year 1723 that this substance was first brought into the market as an article of merchandize. But the great consumption of the alkalies in the modern arts, especially by the bleacher, soap and glass manufacturer, and other manufacturing chemists, has attracted more and more attention to the subject, until the manufacture of kelp in Great Britain has become a very important department of industry. I am under the impression that kelp has never been brought into our market, or attempted to be manufactured in the United States, but as it appears to me that this manufacture may be introduced advantageously among us, I propose to give some account of the most approved method at present practised, in the hope that it may direct the attention of those persons to the subject, who are conveniently situated for making the attempt. From the increase of our manufactures, and as all the crude sodas at present consumed are imported, it is highly probable that there would be a full demand for the article. The material may, for the trouble of collecting it, be had, in immense quantities, along our extensive sea coast, nor can any thing be cheaper or more simple than its manufacture. Some idea may be formed of the advantages that may be derived from this manufacture, from the great and obviously increasing importance that is attached to the subject in Great Britain. There are frequent communications on the subject in their best journals, and prizes offered to encourage its cultivation, by their societies for the promotion of the arts and manufactures. As long ago as 1798, it was stated by Prof. Jameson in his Mineralogy of the Shetland Isles, that "farms which before the introduction of kelp rented at forty pounds, now rent for three hundred pounds." It is also asserted by Mr. Parkes that Lord McDonald of the Isles, now realizes ten thousand pounds per annum from his kelp shores, which his ancestors considered valueless.

Nearly all marine plants, especially the *fuci*, are found to yield soda from combustion. Those which are preferred are the *fucus vesiculosus*, *nodosus*, *and serratus*;* they are found spontaneously growing on the rocks near the shore, generally between high and low water marks. Generally speaking, bays and caves that are sheltered from the winds and tides are found best, though some of the *fuci* flourish best in the most exposed situations, and the strongest tideways. Formerly, the kelp was made entirely from the floating sea ware, as it washed up on the shore, but, since the manufacture has become profitable, greater care is taken in its preparation. It is now common to cultivate these plants by depositing on sandy beaches, large boulder stones, to which the *fuci* may readily attach themselves, and to cut and collect the ware; colcareous stones are found best. In the Repertory of Arts,

* It would appear that this class of plants has not received much attention from botanists in this country. I have been informed, however, by good authority, that these *fuci* are found in abundance along our coast.

there is a particular description of the process employed in the manufacture of one hundred and fifteen tons, on the farm of Stroud in Horris, which received the prize of the Highland Society.

This sold for five pounds ten shillings per ton. As this is considered the most approved method, I will give an abstract of it. In the Orkneys, they account the spring the best season for cutting the ware, because they are then less exposed to the rains. The weeds that are left bare by the tide are cut with sickles, and those under water with bill hooks. It is considered important to land the ware, as fast as it is cut, and to carry it to a suitable situation to dry; it is thought that as soon as the weed begins to wilt, the pores of the plant become relaxed, and allow the soda to exude, which is dissolved and lost, if the ware be left in the water or exposed to the rains. There is no doubt that kelp made from such ware is weaker. It is spread on clean ground to dry, and, when pretty well dried, it is collected into large cocks, protected from the rain if possible, and allowed to heat for six or eight days, or even from fifteen to twenty if the ware has been collected from coves with muddy bottoms.—A dry day, when there is a brisk breeze, is selected for burning the ware, which is conducted in the following manner. The kilns are rudely constructed of stones and turf upon the firmest sward that can be found. The most convenient are about two feet six inches in height, two feet four inches in breadth, and from eight to eighteen feet in length, according to the quantity of ware to be consumed. A little dry straw is first spread over the bottom of the kiln, and kindled, to which the ware is slowly added, as fast as it is consumed, the combustion being accelerated by the breeze. Should the weather become calm, or if the ware is not sufficiently dry, the ashes cool and cake into white crusts, when it becomes necessary to rake the ashes until the combustion is perfect, before adding fresh ware. When the ware is all burnt, the last process consists in working or raking the ashes with iron rakes, so that the combustion of every part shall be perfect. It is transformed into a thick paste, which, on cooling, becomes solid, somewhat resembling good indigo; it is then broken up into masses of about two hundred weight, covered with dry ware, and is ready for the market. If the ware has been taken from a muddy situation, it sometimes happens that the ashes remain dry, and do not assume the form of a paste. By allowing the combustion to continue a little longer, or by adding some salt or saltpetre, the difficulty is easily overcome. The kelp is found to yield from three to six or eight per cent. of pure soda.

France was in the habit of depending principally upon foreign countries, for the supply of crude sodas, until the period of the revolution. In consequence of the wars lighted up by that event, she found herself cut off from the rest of Europe, and compelled either to abandon some of her most important manufactures, or to find within herself the means of supplying the raw materials. She was entirely destitute of many articles of daily, and indispensable use. Surrounded by enemies, she had not even the means of obtaining nitre for preparing gun powder for her armies. This state of things, and the great political excitement that existed at the time, resulted in prodigious and successful efforts, to supply herself from sources which had not before been thought of. The value of the physical sciences under these circumstances was perceived, nor is there perhaps a period in their history more honorable than this. No longer confining herself to the closet and laboratory, philosophy went forth, and relieved with her treasures, the distresses of the state. In the enthusiasm of the moment, the usual motives of human action seemed suspended; especially among men of science, every thing like private interest seemed lost sight of, in a desire to promote the public good. Important discoveries in the arts, which if practised in secret must have yielded immense emolument, were freely promulgated for the good of the republic. In this honorable competition of the sciences, chemistry stood pre-eminent. The most eminent chemists in France, were formed into committees, by the committee of public safety; the results of their investigations will be found in the early volumes of the *Annales de Chimie*, forming the most valuable series of papers on chemistry, applied to the arts, that can perhaps be found in the history of the sciences.

Among the most important of these papers is the report of Messrs. Lelievre, Pelletier, d'Arcet, and Girard, on the best means of extracting soda from sea salt. This led to the extensive manufactory of artificial soda in France, which is at present, not only principally employed in their own manufactories, but has become a considerable article of export. The process recommended by the committee, and which with some modifications, is still practised, was invented by Messrs. Leblanc and Dizè. The process is briefly this,—it consists in decomposing the muriate of soda, by sulphuric acid. The sulphate of soda, thus formed, is intimately united, in certain proportions, with charcoal and chalk pulverized. By the application of a suitable temperature, in a reverberatory furnace, a somewhat complicated series of chemical changes takes place. It has been supposed that sulphate of soda is decomposed, a part of the sulphur of the sulphuric acid, being consumed in the form of sulphuretted hydrogen, forms slight explosions, and exhibits the appearance of fire works, while the unconsumed sulphur, remains in combination with a portion of soda and lime, forming hydro-sulphurets, sulphates and sulphites. In the meanwhile, the carbonic acid of the lime, and that formed by the combustion of the charcoal, unite with the soda, and form the carbonate of soda. This part of the process, requires considerable tact in its management, as the value of the article depends upon the completeness of the decomposition of the sulphate of soda, and the quantity of carbonate of soda that is formed. The process lasts about seven hours, and the residuum, thus obtained, resembles in its appearance fine barilla.*

A considerable qnantity of the artificial barilla, has been imported into the United States. In consequence however, of the badness of the article in some instances, but especially from the quantity of sulphur, that even the best contains, it is entirely fallen into disrepute. So little is it esteemed in this market, that the soap makers, who are the principal consumers, as several of them have declared to me, would not accept the article as a present, though they are sensible that it contains a large proportion of alkali. They find the ley, obtained by the lixiviation of the artificial barilla, contains so much sulphur, that when boiled and mixed with the other materials for making soap, the quantity of sulphuretted hydrogen disengaged, is so great, as to render the works almost untenantable, while the soap becomes of a dirty blue color, and is rendered unsaleable.

Knowing that this substance is generally employed in the soap manufactories of Marseilles, and that these inconveniences are not complained of there, I was induced to enquire

* For a particular account of the process, see Ann. de Chim. v. 19.

into the cause of this, in order to ascertain, whether the evil complained of by our manufacturers, might not be remedied. My attention was naturally first directed to the difference of the two manufactories; the following are the principal points of difference. In France, soap is generally made from soda and olive oil; it is colored, and that most sought after is called *bleu pâle*. In this country, we generally use the animal oils, and in all but the very fine soaps, our manufacturers are in the habit of using a considerable proportion of rosin; the most saleable of this kind of soap, is of a bright yellow color. In France, the soap is marbled, by adding to it while in a mass, a solution of green vitriol, sulphate of iron. Now it appears, from the statement of M. Laurens, who is practically acquainted with the subject,* that in order to impart to the soap the precise tint, so much sought after, the *bleu pâle*, the presence of the sulphuretted hydrogen, or rather of the alkaline hydrosulphuret, (for both of the alkalies are found to answer the purpose,) is indispensable. In this process, the sulphuretted hydrogen, when united with the iron and oil, imparts a greenish blue color, which does not combine with the soap, but is dispersed through it, during ebullition, in small masses, so as to produce the marbled appearance. M. Laurens remarks, that the more scientific manufacturers at Marseilles, are in the habit of adding sulphurretted hydrogen, after treating the soap with the green vitriol, should it not be found to possess the proper color. This seems to afford a ready, and natural solution of the fact, that artificial barilla is used with advantge in the soap manufactories of France, while in this country it is so objectionable. I have had recourse to a number of experiments with different substances, for the purpose of devising a cheap method of getting rid of the sulphur, combined with artificial soda, so inconvenient to our soap makers, but without arriving at any very satisfactory results. Some advantage may be obtained if the ley be introduced into open vats, into which the clippings of tin plate, or iron have been thrown, and left standing exposed to the air, for several days, and occasionally agitated.

Economy of materials is the basis of successful manufacturing, and, as the intrinsic value of the crude sodas *depends entirely* upon the quantity of pure alkali they contain, the

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* See Ann. de Chim. v. 67.

manufacturer should be able to form a correct judgment in this respect. For this however, our dealers and manufacturers have a very inadequate standard—they depend almost exclusively on the senses, and the history of the article. The appearance, taste, and weight are their chief guides; after a long experience, and having paid dearly for that experience, no doubt they can form some general idea of the value of the article, but after all, their judgment, thus formed, must be loose. They generally break a piece of the barilla, and apply the tongue to the fracture; if the soda be in a caustic state, even though in small quantity, it will excite a much stronger sensation of taste, than when it exists in larger quantity, in the form of a carbonate. Nor is the history of the article more to be relied on, as there are several different qualities brought from the same market. Indeed I have known some instances in which the most experienced soap manufacturers, and even large manufacturing chemists, have been most egregiously deceived, by judging of the article in this loose way. I lately assayed a sample of artificial barilla, that was sold at eighty dollars per ton, the price of the best in which there was scarcely an appreciable quantity of soda, while a sample of Alicant barilla, yielded fifty eight per cent. of pure soda.

There are a great number of methods, recommended for assaying the crude sodas. An exact assay is undoubtedly, a very nice and even difficult operation, but with a little attention, any manufacturer may make a sufficient approximation for all practical purposes. I have tried several, but would recommend the following as the best; it is with some modification, the one recommended by Mr. Parkes.

Take a quantity of diluted sulphuric acid, say six parts of water to one of the sulphuric acid of the shops; this will be of a convenient strength, and will be found about the specific gravity of 1.100. Select a phial that pours and drops well; it should have a glass stopper with a score running lengthwise along it, and that fits accurately, so that we may be able exactly to fill the phial. With good scales, using a counterpoise for the phial, we should carefully ascertain the precise number of grains of the diluted acid that the bottle will contain. Lastly, we must ascertain with nicety the number of grains of the diluted acid that is required to saturate one hundred grains of *pure* soda. Having made these preparations, we may at any time, in the course of a few hours, determine the quality of a lot of barilla. We select a number of fragments, which may be considered as a fair sample of the whole; pulverize them finely in an iron mortar, and then weigh out two or three portions of one hundred grains each, which may be put in as many tumblers, together with about two or three ounces of water; distilled water is best. After it has stood for a few hours, being occasionally stirred with a glass rod, carefully strain off the solution into a clean tumbler, through bibulous paper. Wash the residuum by adding small quantities of water until it passes through the paper tasteless. Add a solution of litmus until the alkaline solution becomes decidedly blue. Having then filled the phial exactly with the diluted sulphuric acid, in order to observe the change of color more accurately, place the tumbler containing the alkaline solution, upon a sheet of clean white paper; and then pour the acid in slowly and at intervals, agitating at the same time with a glass-rod, until the litmus begins to assume a red color. We must now proceed still more slowly and carefully; the redness is at first faint and delicate, and is produced by the carbonic acid gas evolved and not by the sulphuric acid. On first adding the sulphuric acid, no effervescence is observed; probably because the first portions of acid combine with that part of the soda that remains in a caustic state. When the whole of the soda is saturated, this will be indicated by the marked deeper red color, and by the acid forming but a mechanical mixture with the solution, as it is added drop by drop, without any chemical action. By weighing the diluted acid remaining in the phial, we can determine how much has been consumed in saturating the alkali; and, as we already know the number of grains of the diluted acid, required to saturate one hundred grains of pure soda, by the rule of proportion we can at once ascertain the proportion of pure alkali in the barilla. By repeating this operation with the two remaining portions, we can make a still closer approximation to the truth.

But this process, which is found to answer very well in assaying barilla and kelp, is an insufficient guide for ascertaining the quality of the artificial soda, especially when indifferently manufactured. This always contains a quantity of the hypo-sulphite and hydro-sulphuret of soda, which are decomposed by, and assist in saturating the sulphuric acid, and thus give a too high return of the quantity of alkali; especially as these substances are positively injurious in the manufacture of soap, as pursued in this country. This difficulty, however, may be obviated, by the following process, recommended by Welter and Gay Lussac.—Mix a little of the oxymuriate (chlorate) of potass with the sample of crude soda to be tried, and expose the mixture to a low red heat; a platina crucible is recommended by them—but one of silver or porcelain will answer, if the process is carefully pursued; the latter was used by myself for the purpose. The sulphurets and sulphites are thus converted into sulphates, and the oxy-muriate into neutral muriate. After this process, the artificial soda may be assayed in the manner above described.

I shall close this paper, which has already extended much farther than was at first intended, by a few remarks on a point, in which I find there are very mistaken views entertained by the dealers in the crude sodas. It is a common opinion, that barilla that is broken into small fragments and powder has lost its strength; on this account there is generally an allowance made in the sale of the article, of from ten to fifty per cent. for this part of the barilla. This opinion, however, is true only to a very limited extent. A considerable part of the soda is at first in a caustic state; that part of the mass, therefore, that is exposed to the air, imbibes carbonic acid gas and moisture, but, unless the barilla has been wet, and thus lost a portion of its alkali, it is diminished in value only by the additional weight of the carbonic acid gas and humidity it may thus have acquired.

Art. X.—*Remarks on Inertia; by Z.*

TO THE EDITOR.

Oxford, Ohio, July 24, 1827.

Biot says of mobility and inertia, " ne sont nullement pas des propriétés de la matière mais la seule expression de son indifférence parfaite au mouvement ou au repos."* Inertia then, according to this writer, is to be classed with mobility, both having what may be very properly termed passive or negative properties of matter. Inertia does not signify any thing active, but the absence of all action. Matter is

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* Traite de Physique, tom 1, p. 1.

inanimate,—has no directive power of its own,—no will if we may so speak; and hence, to cause changes in matter, an external force is necessary, and this must be proportioned to the mass to be operated upon. By the application of such a force, we can change the place of any quantity of matter, and the change will be exactly in proportion to the force. Some speak of "vis inertiæ,"—"fuerza de inertia,"—"force d'inertie," and "force of inertia;" but those phrases sound to us like a contradiction in terms; and we do not believe that they are of any service to the student in natural science: On the contrary, we are convinced that they tend to confuse his reasonings, and suggest the idea of power, when that which should be conveyed is the absence of all power. We are happy in not being singular in this opinion: "This property, (inertia) says Dr. Young, is improperly called a force. 1st. Because, were it actually such it must be of some definite quantity in a given body; and therefore an impressed force less than that would not move the body; whereas any impressed force, however small, whether impulsive or constant, will move any body however great! 2nd. It is improper, because it seems to indicate an active force resident in matter."*

We by no means think this a subject of small moment: We are continually using language in comparing the thoughts which exist in our own minds, as well as in communicating those thoughts to others: and inaccuracy of expression will be very likely to draw after it inaccuracy of thought. We should endeavor to inform ourselves of the extent of our powers, and never attempt to search into those things which are beyond our ken: And this cannot be accomplished without having fixed and definite notions attached to our words. Many students receive the phrase "vis inertiæ" without examination; and when they come to translate it,—"the force of inactivity," which is the more classical meaning, is totally incomprehensible when applied to matter; and "the force of passiveness" is not much plainer. Others are still more unfortunate: They fix the expression "force of inertia" in their memories, and afterwards look upon it as denoting an active power inherent in matter.

All inquiries respecting the cause of inertia are as utterly fruitless as those intended to discover the cause of gravita-

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* Analysis of the Principles of Natural Philosophy, p. 26.

tion. The only reason we can give for its existence is this: "Ειπεν ο Θεος, γενεσθω, και εγενετο." We were surprised therefore that Professor Farrar should give his countenance to such investigations; and our astonishment was not lessened by his conclusion as to the probability of his own theory.* The learned Professor supposes that every body may be acted upon, by an indefinite number of equal forces, in all possible directions, and consequently the body remains at rest. Where then an extended force is applied in any direction, it destroys the efforts, or forces of the body, which act in a contrary direction to the whole extent of its power; and therefore the forces of the body which have the same direction as the external force will no longer be balanced, and thus the body will be put in motion by them; and its velocity will be proportioned to the external force: since the efforts on one side of the body being destroyed by the force to an amount exactly equal to itself, those on the opposite side must be superior to the forces which before balanced them by an equal quantity. We suppose it to be a corollary from this reasoning, that the forces which are constantly acting upon bodies must be very powerful: for in proportion as we apply a greater force to any body, or in other words, as we destroy a larger amount of the forces which belong to that body, its velocity will be increased; and if the theory be carried out, we must conclude that this velocity is wholly caused by destroying the equilibrium of the equal and opposite forces:—nearly in the same manner as a body is put in motion by the pressure of the air on one of its surfaces, when the atmospheric pressure is removed from the opposite surface. Now, however ingenious this explanation of what may be the cause of inertia, appears, we would inquire, with all deference to the learned Professor, whether there would not be more light on the subject to every understanding from saying, simply, that matter is wholly passive; and therefore to cause motion in a body which is at rest, a force must be exerted; and also that the body's velocity will be exactly proportionate to the force impressed. We believe that this is all that is known with respect to the inertia of matter, and the commu-

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* "We do not pretend to decide whether the resistance which bodies oppose to motion, does or does not arise from a cause of this kind."—*Cambridge Mechanics, p.* 179.

nication of motion; and we know this much by experiment only; and all beyond is mere conjecture.

There is another passage that immediately follows Professor F's speculations on the causes of inertia, which savours still more of the doctrine of occult causes: "The force of inertia, therefore, is, properly speaking, the means of the communication of motion from one body to another."* Professor F. however, is not alone in this position: "Itaque concludendum nullam esse vim quâ motus communicetur, cùm nulla sit vis inertiæ."† "La fuerza de inercia es un medio para que los cuerpos se comuniquen el movimiento unos á otros."‡ Now will any person, after a moments reflection, pretend to say, that he knows the means by which motion is communicated from one body to another?—why a body in motion striking against another, should impart its motion, or how this is done? We presume not: We believe that no person has ever been able to point out the connexion between cause and effect, however indisputable the existence of such a connexion may be; at least we have not heard such a discovery announced; although the squaring of the circle, and the discovery of perpetual motion, are not unfrequent in our day. What then is the extent of our knowledge as regards the communication of motion? We know that matter is inert, and cannot move itself; and consequently that a force is necessary: but no human mind can explain the connecting link between the application of the force and the reception of motion by the body. A certain body is at rest: it is struck by another body in motion, and immediately also commences moving. The fact we know; but the rationale of the fact is beyond the powers of the mightiest minds. How then do writers prove that inertia is the means of the communication of motion? None of those, quoted above, have attempted this except Bails; who says "no podríamos concebir como se podria comunicar movimiento alguno a un cuerpo que no se nos resistiese."|| The best reason then which has been given, is that we cannot conceive of the thing otherwise, and therefore it is so. But unless we are greatly mistaken, the

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* Cambridge Mechanics, p. 179.
† R. Cotes, prœfatio in Lee. Edit. Newtoni Princip.
‡ Elementos de Matematica por D. Benito Bails, vol. 4, p. 9.
|| Elementos de Matematica, Prologo, vol. 4, p. 7.

proof of the position is still weaker than this: what is meant then by the body's resisting us? not surely that when we impel it in one direction, it makes an effort in the opposite; all therefore that can be intended is that the body does not assist us;—that is, it is entirely passive in our hands. Of course the gravity must be overcome by the force impressed; but abstracting from this, matter is wholly without action, or a tendency to motion. This being so, when it is said that we cannot conceive how motion could be communicated unless matter resisted us,—the meaning is, unless matter were passive. The proposition then is equivalent to this, that, if matter were active or in motion, we do not know how motion could be communicated; and certainly, if by communicating motion, be intended the commencing of it, the remark would be just, as the body is supposed to be in motion already. If by not being passive, or by being active, it be designed to express some active power in matter, to be exerted at pleasure, even though this matter should not be in motion, the argument is still unfounded: since it is unreasonable to suppose that all bodies would at all times be so perverse as to exert their efforts in opposition to ours:* perhaps they might co-operate with us, and thus our labor would be very much diminished. We think then that no author has any right to assert gravely, as if it were a decided point, that inertia is the means by which motion is communicated: to do this is to wander from ascertained fact and experiment into the field of learned scholastic trifling.

The last defence which we have seen of the phrase "force d'inertie," is given by Brisson: To the objection that, after a body, suspended by a string, has assumed a vertical position, it resists a change of place by its gravity, and therefore that what is called "force d'inertie," is the same thing as gravity, he answers, that when the line that supports the body is vertical, the gravity is wholly counteracted by it; and for this reason, cannot resist a force until the line of support is moved from the vertical direction: "Son déplacement doit donc précéder l'éffort de sa pesanteur. Mais pour opérer ce déplacement, il faut employer une force, réelle, qui, si elle est trop petite pour déplacer la boule n'en est pas moins une force réelle, et cependant n'a point d'effet. Dans ce cas-la,

* We are not Gnostics, nor Manicheans.

la boule resiste donc a une force réelle, et la détruit avant de pouvoir agir comme pesante ; elle resiste done par une force indépendante de sa pesanteur, et c'est cette force qu'on appelle force d'inertie."*

If any are not yet convinced, the following is supposed by its author sufficient to remove all doubts. Two homogeneous balls, similar in every respect, fall from the same height to the earth, in exactly the same length of time: "Si l'on veut que l'un des deux précéde l'autre dans sa chūte, il faut ā l'effort de sa pesanteur ajouter une autre force ; il faut lui donner une nouvelle impulsion, qu'il ne peut pas recevoir de sa pesanteur puisque nos supposons qu'il lui, obéit compléte-ment. Or tout ce qui exige une force pour ētre produit, est une véritable resistance. Ce corps qui en tombant librement, obéit complement à la pesanteur, résiste done à un mouvement plus prompt que celui qui vient de la pesanteur : il y résiste donc par une force indépendante de sa pesanteur, c'est cette force qu'on appelle force d'inertie."†

Now we do not contend that gravity and inertia are the same: on the contrary, we believe the former to be an active force, and the latter to be nothing more than the negation of action: but we do say, that all the phenomena may be explained from ascertained facts,—that matter is absolutely passive, and at the same time acted upon by the mutual attraction which influences all its particles. In the case of the suspended ball, which has been given, it is not accurate to say that any force would be too small to move it, nor that any force is destroyed in causing its displacement. If P be power applied to cause the motion of the suspended ball B, and a be the angle made by the direction of the line of suspension with the vertical, P will always be as B sin. a, while the angle a has a real value : that is, P : B sin. a. Now however small we take the angle a, this formula will be true, so long as the angle exists. When a is nothing, though we cannot say that P would also become nothing,—that is that B would move without a force because matter is inert, we are well assured that the force required to cause motion in such circumstances, would be indefinitely small. If the gravity of matter were annihilated, on the supposition that it would still exist in masses, we cannot conceive that it

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* Traite Ele. de Physique, tome 1, pp. 46, 47. † Ibid. p. 47.

would possess any self-moving power; but from what we know of the mutual repulsion between the particles of matter, so that no two are actually in contact, if gravity were destroyed, there can be no doubt that the particles, mutually repelling each other, would be dissipated throughout the universe. Nor is it true that any force is lost on the impact of bodies: in all cases, the equation $v = \frac{VM}{M+N}$ (when V is the velocity of the body M before it impinged against N at rest: v is the common velocity after the stroke) shows that v will have a positive value, unless N be infinitely great; and universally $v \times (M+N) = VM$: Therefore there is no force lost; and consequently there is no force in matter which must be overcome in causing motion. We grant that this meaning is not applicable to professor F's hypothesis.

A different statement of what Brisson deems his decisive argument, may perhaps place it in a clearer light. Two bodies, elevated above the surface of the earth, if they be free, will be put in motion by the force of gravity, as they have no self-directive power: they will move towards the earth with a certain velocity; and if we wish to increase the velocity of either of them, we must apply an additional force: not because of any force in matter, but because there is none. The same observation is applicable to a similar illustration of Prof. Farrar's: "If, while a body is falling freely, it be forced forward by the hand with a velocity greater than that of its natural descent, the hand will experience on overtaking the body, a blow, or resistance:"*—that is, to increase the velocity of a falling body, we must increase the cause of this velocity;—we must augment the force: and the resistance, which the hand experiences is a natural consequence of the reaction of the body; and the blow is exactly equal to what would have been received, if the hand had been at rest, and the body had struck against it with a velocity equal to the difference of the velocities of the hand and the body.

* Cambridge Mechanics, p. 180. "Supon gamos un cuerpo que cal libremente a impulsos de su pesantez; si le damos con la mano paraque cayga mas aprisa, esperimentaremos tambien resistencia." Elementos de Mat. vol. 4, p. 9. The verbal coincidence of this with the quotation given above from the "Cambridge Mathematics," arises from Bails' having also used the "Cours de Mathematiques par Bezout" in the composition of his work. The same may be said of the quotations respecting the communication of motion.

Why action and reaction are equal, we pretend not to give any reason except that such is the constitution of matter.

We have a striking example of the errors which arise from losing sight of the technical meaning of terms, and taking them in their literal signification, in the July number of the Franklin Journal: the new theory of falling bodies is in our opinion based upon the deception, which has originated in the phrase, "force of inertia," although this phrase is avoided in the essay. This is the age of discovery, and it appears that our western regions are not to be deficient in bringing forth things vast and wonderful, however we may fail in reducing them to shape and symmetry: but we are not all Symmesonians, neither do we all believe in the "Bakewellian Lecture," which Prof. Jones has thought worthy of a place in his Journal. Perhaps as this discovery came from the west, it will not be thought presumptuous in a western man to make a few remarks on it, especially as the theory proves, that in our observations on inertia, we have not been combatting with creatures of the imagination only.

Mr. Bakewell may mean one of two things in his first and principal proposition: (since the second is only a corollary from it,) either that the attraction of gravitation is a constant force at all distances;—always the same, and consequently always producing equal velocities: or that gravitating forces, however different in intensity will cause equal velocities. The first position is contradicted both by reason and experiment; and the second is in itself absurd: since it makes unequal causes produce the same effects. Force is explained, as well as that which expresses something in itself simple and indivisible can be, from its effect; force then is that which causes motion. That unequal forces therefore, or unequal causes of motion should produce equal velocities, is not very evident, to say the best of it: we mean that the truth of the proposition is not very evident; for as to the proposition itself, a man of the plainest judgment could decide upon it without a moments hesitation, but the theory is unworthy of a detailed consideration; we will endeavor "to trace the error to its fountain head and thus refute it."

"The fall of bodies," says Mr. B., "would be instantaneous from any distance however great, but for the inertia of matter." What can be the meaning of the term inertia, in this sentence? how can the passiveness of matter have any influence in diminishing the velocity caused by the force of gravity? The body is altogether without directive power, and yields itself to the impulse of gravitation without choice and without resistance; and how this state of things should diminish its velocity, and in such a remarkable degree too, (from passing over any distance whatever in an instant, to a few feet,) we confess that we cannot conceive. We conclude then, that Mr. B. did not intend to express what we understand by inertia; and after some examination of the different applications of the term throughout the essay, we think that Mr. B. conveys by it the notion of agency. Thus, when we are informed that inertia prevents the instantaneous descent of bodies, from any height, we are to look upon inertia as an active force striving to retard the fall of bodies, and increasing in intensity of action, as the descending bodies approach the centre of attraction. Now, if this assumption, as to the meaning of the term, be supported by fact, there will be some appearance of consistency and truth in the theory: but we venture to say that it is entirely groundless; and that by the inertia of matter, the only thing which can be understood as having a real existence in nature, to which it corresponds, is the absence of all action; just as darkness is the absence of light.

It may serve to show the real strength of Mr. B.'s theory, to substitute the proper meaning of the term, inertia, in other places where it is used. "A ball of one pound will fall from a height of sixteen feet to the earth in one second; a ball of one hundred pounds will descend over the same space in the same time:" we have been in the habit of thinking that the point to be explained in the instance just given, is why the large ball should fall as fast as the smaller one; since large bodies are moved with greater difficulty: and we believed the thing fully accounted for, from the known fact that gravitating forces increase as the quantity of matter; and hence, although one of the bodies were a hundred fold larger than the other, and therefore moved with greater difficulty, as the gravitating force was increased in the same proportion, the velocity of the greater body must just equal that of the smaller. Mr. B., however, views this matter in a different light, and considers it necessary to give a reason why the one hundred pound ball, does not fall faster than that which weighs only one pound:—his reason is, "because the impeding quality, inertia, increases as the attracting quality weight:"—that is, the one hundred pound ball, is one hundred times more passive than that of one pound! we candidly acknowledge that others may draw a different conclusion from the same theory, and that it will be as good as our own, except that it is totally unsupported by facts:—that as inertia acts in opposition to gravity, the larger the body, the more completely will the power of gravity be resisted. But we have not yet had Mr. B.'s own demonstration of his fundamental proposition; and we can inform all whom it may concern, that the hundred pound and one pound balls play no unimportant part in it. "If this one hundred pound ball were removed so far from the earth, that its weight should be lessened ninety nine per cent., the impeding quality, inertia, would also be diminished ninety nine per cent.; and consequently the ball would fall from this point sixteen feet in one second of time. Now let us suppose that while the heavy ball is at this distance from the earth when it weighs only one pound, the attraction of the earth should be increased one hundred fold, the velocity of the ball, which before this augmentation of the attractive force, fell sixteen feet in a second, would not be changed because the impeding quality, inertia, would also be increased: consequently the attraction of unequal quantities of matter, on unequal gravitating forces, will cause equal velocities; and therefore the rate of the fall of bodies pervades the universe." This impeding quality or property, which Mr. B. has imagined, is a very convenient agent. To a person who uses the word inertia in the only proper manner, Mr. B. seems to have advanced some strange assertions: thus, although all matter is perfectly passive on the surface of the earth, by placing a body some forty thousand miles nearer the stars, Mr. B. makes it one hundred times less passive: and then, when it is in one of its most untractable moods, a force, diminished one hundred fold, produces the same effect upon it, as was caused by the whole force, while the body was perfectly passive and most yielding. This is a whimsical hobby which Mr. B. has mounted: and we will e'en leave him and it together; requesting them, with all respect, to reconcile with the "new theory," the fact, that the versed sine of an arc of the moon's orbit, passed over by that luminary in one minute of time, is no more than about sixteen feet. Z.

Art. XI.—*On Crank Motion; by* Isaac Doolittle.

Bennington Iron Works, Sept. 22, 1827.

My Dear Sir—I had hoped to live long enough to see the discussion about the crank problem settled and dropped; but the dispute seems to be interminable.

The problem itself is as simple as any other in mechanics, and may safely be referred to the general principle adopted and laid down by all modern French mathematicians, when treating of the "*principe de la conservation des forces vives*"—That there can be no loss of power in any machine except what arises from one or more of the three following causes: *friction*, *shocks*, *or a sudden change in the direction of motion*," (the resistance of media and the stiffness of cords being included under the general term of friction.)

Now in considering the action of the crank, the two latter causes cannot operate; there can, therefore, be no loss of power, except what arises from friction, and in all the discussions which I have seen upon the subject, I do not now remember any in which this cause was taken into account.

If there be, as is contended by one of your correspondents, a loss of more than one third of the power, in transforming an alternate rectilinear movement into a continued circular one by means of the crank, I should like to be informed what would be the effect if the proposition were reversed, as in the case of the common saw mill, and in many other instances in practical mechanics.

Your correspondent has, in the last number of your Journal, p. 77, no doubt through inadvertency, attributed to me the following equation:

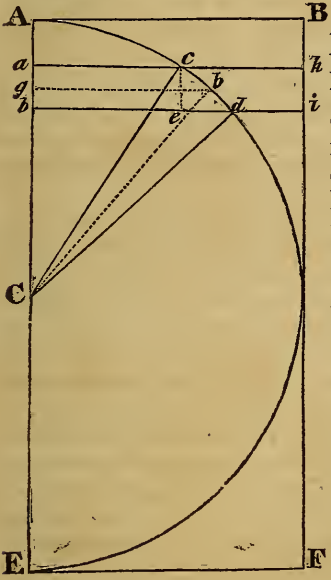
"$P \times .6366 \times$ semi circumference $= \phi \times$ diameter."

This is not my equation, nor is it true; for according to his own assumption, $P \times .6366 = \phi$; and therefore the equation attributed to me cannot be true, since the semi circumference is greater than the diameter, (in the ratio of 1 to .6366) and since it has been known, from the days of Euclid, that equal quantities, multiplied by unequal quuntities, cannot produce equal quantities.

The equation I gave, (see Vol. 12, page 367.)

$P \times .6366 =$ demi-circumference $= P \times$ diameter, is true, and shows that there is no loss of power.

I will offer one other demonstration, which I do not remember to have seen published, and for which I am indebted to Mr. Hogan, a practical mechanician, and lecturer on mechanics in Paris.



Suppose a force whose intensity is represented by the line A.B. moving in the direction A.E.; the whole quantity of force expended in passing from A to E may be represented by the surface of the parallelogram ABEF=the intensity of the force × the distance through which it acts. Suppose farther, that the force or power be applied to the extremity of a crank whose length is A.C. and whose center is in C. and that the crank has arrived at any point *c* of its revolution: the force tending to rotation, on the tangential force in this point, according to the laws of the resolution of forces, will be represented by *a c* perpendicular to the line of force. When the extremity of the crank shall have passed through an infinitely small space, and have arrived in *d*, the arc *c.d.* may be considered as a right line, the force tending to rotation, in this point, will be *b.d.* and the quantity of force tending to rotation during the passage from *c* to *d* will be$=\frac{ac+bd}{2}\times c.d.=gf\times c.d$; the quantity of force applied during that passage will be $A.B.\times ab.$=parallelogram *abhi.* —and because of similar triangles.

$gf:ce::Cf:cd$ whence
$ce\times Cf=gf\times cd.$

But cf=A.B. and $ce=ab$—therefore $AB\times ab=gf\times cd$, or in plain English, in whatever point of its progress the effect of the crank be considered, the power rendered is equal to the power applied—this being true as regards all the parts, must necessarily be true as regards the whole of its revolution.

The effect of an alternate rectilinear force, applied to the extremity of the crank to produce rotation, is exactly similar to that of the force of gravitation on the pendulum during its descending arc; and, if there were a loss of power in this case, the pendulum surely would not, in virtue of the force acquired during its descent, remount to the same height on the other side of the center.

This problem admits of a variety of demonstrations, based as well on the laws of dynamics, as on those of statics, and all, as far as I know, confirmatory of the principles above laid down, but I think enough has been said on the subject to establish the doctrine.

Having submitted the foregoing to the inspection of one of the ablest mathematicians of our country, he says, "It appears to me that Mr. Hogan has committed an error in not having taken time into consideration, and in estimating the space passed over as a measure of force," &c. But I apprehend, that this objection will fall, when it is considered, that the measure of an effective force is found by multiplying its intensity by its velocity—and that the velocity of two forces passing over unequal spaces in equal times, is as the spaces passed over respectively.—As in the above demonstration, the tangential force moves from *c* to *d* in the same time in which the applied force passes from *a* to *b*; and as it is shown that the intensity of these two forces is in inverse ratio to the distances through which they respectively act—it will, I presume, be readily conceded that the cause and effect are equal.

I am, sir, with high respect and esteem, your obedient servant.

I. Doolittle.

Art. XII.—*Abstract of Meteorological Observations, made at Marietta, Ohio, in North Latitude,* 39°, 25′, *West Long.* 81°, 30′—*in the year* 1827 ; *by* S. P. Hildreth.

Months.	Thermometer.				Warmest day.	Coldest day.	Fair days.	Cloudy days.	Depth of Rain Inch and hundreths.	Prevailing Winds.
	Mean temperature.	Maximum.	Minimum.	Range.						
Janunary,	27.00	53	-4	57	27th	5th	15	16	1.67	w—n w
February,	41.50	70	-6	64	27th	12th	14	14	6.38	n n w
March,	46.00	76	22	54	22d	16th	22	9	2.83	s s w—n n w
April,	56.33	80	30	50	14th	1st	13	17	3.33	s & s w—n n w
May,	60.70	89	30	59	27th	3d	24	7	3.00	s & s w—w n w
June,	69.33	90	36	54	8th	2d	24	6	3.09	s & s w—s e & n
July,	74.70	91	60	30	2d	26th	22	9	4.00	s & s w—n
August,	76.00	95	52	43	15th	22d	27	4	3.25	s & s w—s e
September,	67.00	92	34	58	2d	30th	24	6	1.05	e & s e—w n w
October,	54.33	81	24	57	2d	31st	18	13	3.33	s w—w—n w
November,	43.33	72	23	49	11th	28th	18	12	1.05	w n w—s & s w
December,	43.00	63	14	49	6th	23d	8	23	8.50	w & n w—w & s w
							229	136	41.48	

Mean temperature for the year, 54.92—Rain, 41.48 inches—Prevailing winds, S. and S. W.—Hottest month, August; coldest month, January.

N. B.—The thermometer, has a northern exposure, in the shade.—Observations taken at 7, A. M. in winter, and at 6, A. M. in summer—and at 2 and 9, P. M.

Observations on the year 1827.

The past year has been unusually salubrious and fruitful; the inhabitants remarkably free from diseases, more so than in any year since the first settlement of the country; no violent storms or tornadoes, excepting the heavy gale of wind in the afternoon of the 12th April, which continued for six hours, from the west, but without rain; it swept across the country, from the shores of the upper Mississippi to Vermont, blowing down much timber, and unroofing some buildings. Fruit and crops of grain and grass, have been very abundant; and the air so pure that in warm weather fresh meat kept free of taint, one or two days longer than usual. Early fruits were a week later than in 1826, owing to the diminished temperature in May and June of 1827, being less by ten degrees than in 1826. The temperature for the year is one degree greater than in 1826—amount of rain nearly the same. The latter part of September and first of October, Aurora Borealis seen for the first time for many years.

Art. XIII.—*Notice of the Profile Mountain in New Hampshire; by Gen.* Martin Field.

(See the Frontisepiece.)

TO PROFESSOR SILLIMAN.

New Fane, Vt. Nov. 22, 1827.

Dear Sir—On a late excursion, which I made among the White Mountains in New Hampshire, I visited Franconia and the Profile Mountain, which has long been considered a rare phenomenon. I there procured a sketch of the mountain, which I enclose to you, and if it meets your approbation, you will please to insert it in the Journal of Science, &c.*

I am sir, very respectfully, yours &c.

Martin Field.

The White Mountain range passes through the easterly part of Franconia, and presents numerous elevations and sublime mountain scenery. But the greatest elevation, in that vicinity, is Mount La Fayette, which forms the northern boundary of the *Notch*, so called, and is supposed to exceed four thousand feet, in height. The Profile Mountain is nigh the road leading from Franconia to Plymouth—is five miles from the lower iron works, in Franconia, and about three miles south of Mount La Fayette. The elevation of this mountain, I understand, has never been accurately ascertained, but it is generally estimated to be, at least, one thousand feet. The road passes very nigh the foot of the mountain, from which it rises abruptly, at an angle of about 80° to the profile rock. The bare rock, on which the profile is delineated, is granite, and having been long exposed to the atmosphere, its color is a dark reddish brown. A side view of the projecting rock, near the peak of the mountain, in a northern direction, exhibits the profile of the human face, in which every line and feature are conspicuous. But after passing the mountain to the south, the likeness is immediately lost.

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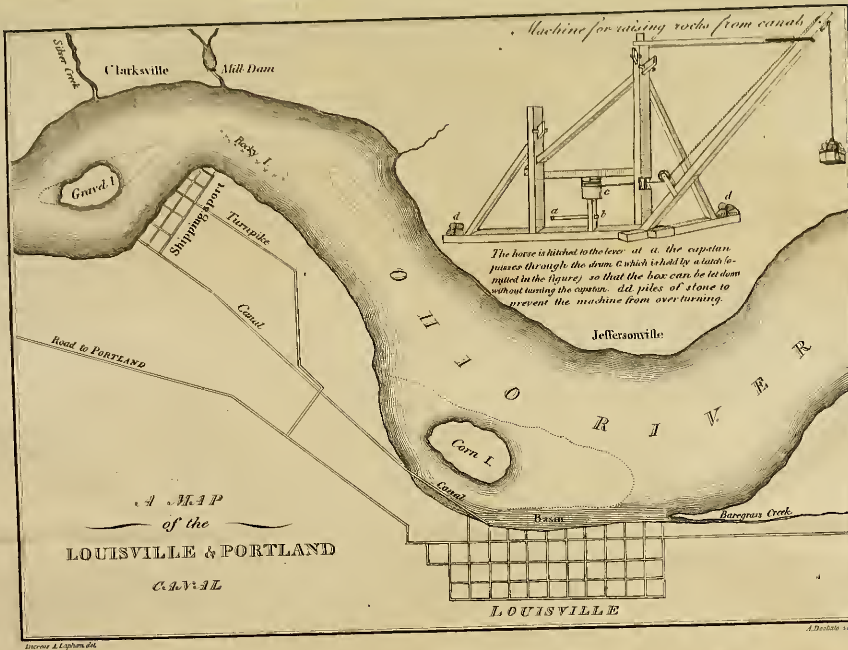
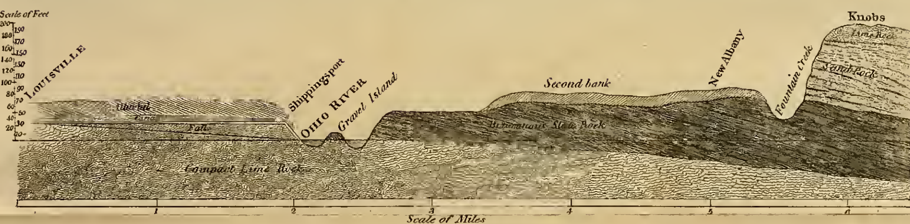
* The sketch of the mountain, profile, &c. was taken by a gentleman of Boston, and the likeness is a good one. The mountain scenery is filled up from fancy. The mountain is covered with trees and shrubbery, except the profile rock. The timber is a mixture of beach, birch, rock maple, bass wood, &c. with hemlock, spruce, and other evergreens.

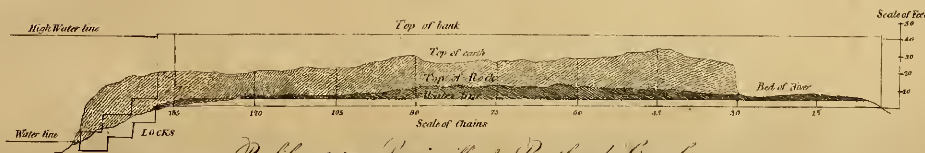
N&S.S.Jocelyn Sc.

PROFILE MOUNTAIN.





Geological Profile extending from Louisville to the Knobs



Profile of the Louisville & Portland Canal

Art. XIV.—*Notice of the Louisville and Shippingsport Canal, and of the Geology of the vicinity; by* Increase A. Lapham, *assistant Engineer.*

(with plans, sections, &c.)

The navigation of the Ohio river, which is of itself one of the most important, as well as most interesting waters of the west, is obstructed only by the rapids at this place, usually called the falls of the Ohio. In these rapids, the river has a descent of twenty-two and a half feet, in a distance of somewhat less than two miles; but in no case, has it a perpendicular fall of more than three. At high water, an acceleration of current, not usual to other parts of the river, is all that is perceived; but at low water, it cannot be passed by loaded boats, without great risk and danger. The direction of the river, above and below the rapids, is from north east to south west. The point where it meets the rocky obstruction, which occasions the falls, gives it a direction, nearly at right angles, to the course above noted, which consequently gives it a more unfavorable and dangerous appearance.

The necessity for a canal around these rapids, must have been felt ever since the Ohio river first began to be navigated, by boats of any considerable size; and an attempt was long ago made, to construct a canal on the Indiana side of the river, but it did not succeed well.

In January 1825, the present company was chartered, by the legislature of Kentucky, with a capital of six hundred thousand dollars, to construct a canal around the rapids of the Ohio, on the Kentucky side of the river. In December, of the same year, the work was put under contract to Collins, Chapman & Co. (formerly contractors on the New York canals) to be completed by the first of November, 1827.

It commences at the lower end of a basin, or estuary, which extends along the shore of the river, for the whole length of the village of Louisville, and is connected with the river at its upper end. From the lower part of this basin, the canal traverses the point formed by the bend of the river on the falls, and enters the river again at the lower part of the little village of Shippingsport. Its length is about two miles; it is fifty feet wide on the bottom; and its banks are forty two feet above its bottom, which is four feet below the surface of the water in the basin at Louisville, at the time of low water. A mark on a house in Louisville, is said to be at the height of the highest flood known, since the settlement of the place. This mark was found to be forty feet above the bottom of the canal; the banks are to be two feet above this indication of the highest floods.

The whole amount of earth excavation, according to the original estimates, is six hundred and eighty-seven thousand cubic yards. This is to be excavated so as to make a slope of one and three fourths base to one rise. There are several modes resorted to in the excavation of this earth, but the most efficient are (as is usual on canals,) carts, scrapers, and wheelbarrows. The last of these modes is used, where the runs (as the plank-ways for the wheelbarrows are called) are too steep to be ascended in the ordinary way, by fastening three or four of them to a rope, which at the top of the bank, goes over two pullies, and is then drawn by an ox team, parallel to the canal. When the barrows are at the top of the bank, the team is ready to retrace its steps, and draw up a similar set of barrows on another run and so on alternately.

The amount of rock excavation originally estimated, was one hundred and eleven thousand cubic yards, but a small part of which, has been removed in consequence of the backwardness of the earth excavation. It extends the whole length of the canal, varying in depth from one foot to ten feet; but on an average about seven. This is to be cut in a perpendicular manner, making the bottom of the canal, fifty feet wide. Consequently, we have a horizontal basis, on the surface of the rock, which is more or less according to the depth of the rock and serves as a foundation, and commencement of a pavement, which extends to the top of the banks. This pavement is necessary to prevent the abrasion of the banks, by the motion of the water produced by the wheels of steamboats, &c. The excavation of rock is done by drilling, and blasting, and is afterwards removed from the canal, by the use of a crane of the same construction as those used on the mountain ridge in New York, invented by Mr. Orange Dibble. Of the crane I enclose a figure.

There are four locks, three lift locks, and one guard-lock. They are all combined, and situated at the lower end of the canal, or immediately below Shippinsport. The guard-lock is one hundred and ninety feet long, and fifty wide in the chamber. Its walls are forty two feet high, thirteen feet thick on the bottom, and five at the top ; the upper ends are semicircular with a radius of thirteen feet. The three lift-locks, have a lift of nine feet each ; they are of the same dimensions in the chamber, as the guard-lock. Their walls are twenty feet high, eight feet thick on the bottom, and three at top. The upper gates to these locks, are sunk four feet below the canal, or lock above, so that the water can be discharged through them to fill, and empty the locks without inconvenience to passing boats. Culverts of sufficient size, through the walls in the usual way, would too much weaken them.

At the time of the last annual report of the President and Directors of the Louisville and Portland canal company, it was expected by them that the canal would have been completed by this time. But they have been disappointed, as will be seen from the following statements. Of the six hundred and eighty-seven thousand cubic yards of earth, one hundred and forty-one thousand yet remain to be excavated—forty-four thousand is about the number of perches of mason work, to be laid in the locks, of which only thirteen thousand have been laid—nearly all the rock is yet to be excavated—one stone arch bridge is yet to be built, where the turnpike crosses the canal, and a pavement extending from the top of the rock to the top of the bank.—Upon the whole it is considered as about one half completed. As a cause of this backwardnes of the contractors, perhaps it ought to be mentioned, that there is great difficulty in getting laborers in this part of the country, and particularly in the summer season.

One more year has been allowed by the Legislature for the construction of the canal, but whether it will be completed within that time is a matter of some doubt.

Having thus completed my description of the canal, it may not be unacceptable to add such observations relating to the geology of the country about the rapids, as I have made. Imperfect as they are, they may have their use.

Of the rock strata there are four.

First, *limerock*, the common *compact limerock* of the west ; as to the depth and extent of this rock, I am unable to speak with precision. It passes under the slate rock in the banks of the river below Shippingsport, but whether it rises again I do not know. It contains a great variety of petrifactions. The minerals which I have collected from it, are few and common; the principal are *quartz crystals*, *calc-spar*, and *sulphuret* of *iron*. Several springs issue through it, most of which contain a considerable quantity of *oxide* of *iron*, held in solution by means of *carbonic acid*. This has induced many persons to ascribe valuable medical properties to these springs.

When newly exposed to the air, this rock continually gives out an agreeable bituminous odor, occasioned by petroleum or Seneca oil, which is found filling the cavities. In some rare and small places, this rock is composed of small sixsided cells, resembling honey comb, generally covered with the bituminous oil above mentioned.*

It is this rock which forms the rapids of the Ohio. The stratum descends towards the west; the edge of it projecting above the surrounding country would form an obstruction to the river, which would continue to rise, until it ran over at the lowest place, and then in regaining its former level it would form a rapid. Instead of continuing in its course, south west, it would run down in the direction in which the stratum descends; or at least it would tend that way, and gradually adapt its course to it.

A variety of this limerock forms, when calcined in the usual way, a cement, which has the property of setting very hard under water; hence the name *water limerock* has been given to it. A thin layer of a coarse grained limerock, probably oolite or roestone, lies immediately on it. It forms a small island opposite to Shippingsport, called Rock island, and is quarried from the lock pits at the lower end of the canal. Its color is bluish-grey; fracture conchoidal; adheres slightly to the tongue; emits an argillaceous odor when breathed upon; and it effervesces with acids. When calcined, it is of a buff color, and does not slack with water, like common lime; but is ground for use in a steam mill, erected for the purpose. It is used in the construction of the locks and other mason work on the canal.

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* Mr. Lapham very properly objects to the popular impression, that this rock contains petrified honey comb; these imbedded masses are evidently the variety of madrepore, called by Mr. Say, (see Vol. 1 of this Journal, page 384) Favosite; productions as truly marine as any that are now formed in the existing oceans.—*Ed.*

The second rock is a black bituminous slate. It overlies the limerock above described, and forms the banks of the river, as far down as I have been (ten miles); and is seen in the bottom and banks of the numerous creeks, which enter the river from the north. This rock is said to be the same as that found at Pittsburg overlying the coal; it is therefore expected that coal will be found under it here. But boring has been tried near New Albany, three hundred feet deep, without finding either coal or salt. A spring that comes through this slate rock, near where the boring was made, contains a considerable quantity of *sulphuretted hydrogen gas*, and this gas is continually rising through the water of the spring. The smell of this gas is perceived at some distance from the spring. I have seen no petrifactions in the slate rock. It sometimes contains small masses of *sulphuret* of *iron*, disseminated through it. The limerock above mentioned, with occasional patches of this slate, is the rock to be excavated in the construction of the canal.

The third rock in order, is the sand rock. It is of a yellowish, and sometimes a blue color. It has a compact texture, and a laminated structure. It forms the hilly country west of the rapids, called the *Knobs;* and from one of these hills, the stone for the face of the lock walls is quarried. It contains but few petrifactions. The minerals are *quartz crystals* of a yellowish color, *calcspar* and sulphate of magnesia; this salt, in a state of efflorescence, may be seen coating some of the stone brought here for the locks. This sandrock is, in some of the highest knobs, overlayed by another limerock. At the quarry this limerock is about twenty feet thick. This makes the fourth rock, which I have mentioned.

The alluvion about the canal is chiefly blue and yellow clay, mixed with fine sand and gravel. It contains half decayed logs, bones of quadrupeds, &c. and occasionally primitive masses—all of which seem to indicate that the river had once run near where the canal now does.

Should you think any part of this communication worthy of a place in the American Journal of Science, it is at your service.

Besides the drawings of the river, &c. I send a geological profile from Louisville to the knobs, a profile of the canal, and a plan of the locks.

Shippingsport, Nov. 10, 1827.

Art. XV.—*Conclusion of the Notice and Analysis of Professor* Daubeny's *work on Active and Extinct Volcanos, from Vol.* 13, *page* 310.

Remarks on Volcanic Phenomena.

From page 355 to 436, Professor Daubeny has given a very candid, able, and perspicuous statement of his course of reasoning upon volcanic phenomena. It is compatible with our limits to state and quote only the outlines, and we will blend with the article, a few additional hints, such as the present state of science appears to us to warrant.

Theories suggested anterior to the discovery of Galvanism and the Metals of the fixed Alkalies, and Earths.

It is necessary, we apprehend, to occupy very little time, either in reciting or discussing these obsolete theories. We wish, however, not to treat them, or their authors, with contempt; for they were, perhaps, the best that the then existing state of science presented.

"According to the first and most antient of these, volcanos were attributed to the combustion of certain inflammables, similar to those which exist near the surface of the earth, such, for instance, as sulphur, beds of coal, and the like; and, in order to account for the spontaneous inflammation of these substances, an appeal was often made to an experiment of Lemery's, which went to prove, that mixtures of sulphur and iron, sunk in the ground, and exposed to the influence of humidity, would give out sufficient heat to pass gradually into a state of combustion, and to set fire to any bodies that were near."

Brieslak supposed, that volcanos are produced by petroleum, collected in subterranean caverns, and kindled in some unknown way. Brieslak has shewn, that petroleum is very abundant in the globe; a conclusion which has been still further extended by the researches of Hon. George Knox. (See Vol. 12, page 147 of this Journal.) It appears also, that petroleum is found, abundantly, in the vicinity of volcanos, and that it is exhaled during their eruptions. The uniform presence of sulphur also, in volcanos, and its copious exhalation, during their state of activity, seem to countenance the general idea, that they may arise from the burning of combustibles.

There are many reasons why this theory, however plausible, appears untenable.

1. The quantity of any of the ordinary combustibles, which could be supposed to be present in any one place, would be totally inadequate to the effect. Reasoning, analogically, from our knowledge of other parts of the world—what supply of coal, bitumen, or sulphur could be adequate to sustain the fires of Vesuvius, or of Etna, of Hecla, of Cotopaxi, of Teneriffe, of Sumboa, or of Kirauea! The most powerful beds of coal are but a few yards in thickness, and a few miles in extent. A few capital operations of any principal volcano would soon destroy the greatest existing bed of combustibles, and instead of continuing from age to age, as many of them do, all would soon be exhausted by the intenseness of their own energy, and the consumption of their inadequate magazines of fuel.

2. There are many volcanic countries, (indeed most are of this description) where the geological structure and associations are such, as to forbid the existence of coal, the only combustible, sufficiently abundant to countenance such a theory. We should look in vain for many active volcanos, in countries of the coal formation, or of the anthracite series. Although volcanic fires, occasionally force a passage through any and every species of formation, there is reason to believe, that they are deep seated—probably even in the primitive rocks, and in granite itself, where, of course, there is no coal and little sulphur.

3. When also (in the language of our author,) "we examine more narrowly into the analogies between the *effects* of volcanic fires, and those which we know to result from the combustion of either of these materials, we are soon brought to confess the inadequacy of such an hypothesis to account for the facts before us. What resemblance, for example, do the porcelain-jaspers and other pseudo-volcanic rocks, as they are improperly termed, which we observe in coal mines, that have been for centuries in a state of inflammation, bear to the lavas and the ejected masses of a genuine volcano; or where do we observe from them the same evolution of aeriform fluids, and of streams of melted materials which are so characteristic of the latter?"

4. The fermentation of pyrites and the combustion of sulphur and bitumen and coal, although they do, without doubt produce certain effects, and sometimes those that are considerable, still these causes are totally inadequate to account for

the prodigious extent, inconceivable energy, and indefinite continuance, and successive reproduction, of volcanic phenomena.

It is plainly impossible, that such results should take their origin from a few comparatively puny beds of common combustibles, and we must obviously seek for other causes more extensive and more powerful; and which are not limited in their range, their energy, or their capability of reproduction.

5. Gay Lussac* urged, with much force, against the theory of burning combustibles being the cause of volcanic action, that the atmosphere cannot possibly penetrate to those seats of volcanic power, when there is brought into action a pressure capable of raising a column of melted lava, three times as heavy as water, to the elevation of one mile or several miles. The objection seems unanswerable, as far as the atmosphere is concerned: although we may suppose, that the combustion is sustained by water, provided there are combustibles capable of decomposing that fluid, which would not be the fact, with either of the combustibles named, except coal, and that only at the temperature of intense ignition, which must not only be produced, but must also be sustained in some other way, as the affusion of water upon ignited coal, unless there is also a copious supply of air, soon puts an end to the combustion.

Earthquakes, &c.

Professor Daubeny, in settling "what appearances are to be considered as establishing the existence of volcanic action," states, that "some are unwilling to admit earthquakes, as any probable indication of subterranean fire, whilst others not only include them, but go so far as to class hot springs, gaseous exhalations, and the eruptions of mud and petroleum amongst volcanic phenomena."

Our author reasons with candor and moderation, as to the question, whether earthquakes and volcanos depend upon the same cause. On this point, however, we humbly conceive, that there can scarcely be any ground for hesitation.

Volcanic eruptions are invariably preceded, and accompanied by earthquakes, and when the volcano discharges its contents, the earthquakes immediately relent, and ultimately cease. It is plain, therefore, that those causes which produce

*Annales de Chimie and de Physique, v. xxii. p. 415.

volcanos do also produce earthquakes. But, it will be asked may not earthquakes be produced by other causes? To this inquiry we must answer, that we know not of any other causes that are sufficient to produce earthquakes, except those which modern science has assigned as the causes of volcanos, and, as these are, agreeably to the Newtonian rule, "*both true and sufficient*," we are bound to admit them, at least till other and more probable causes can be suggested.

"When we observe two volcanic districts, both subject to earthquakes, which are ascertained to have a connection with the volcanic action going on, and find that an intermediate country, in which there are no traces of the operation of fire, is agitated by subterraneous convulsions, similar in kind, but stronger in degree than those which occur in the more immediate vicinity of the volcanos; have we not reason to conclude, that the same action extends throughout the whole of the above space, and that it is *this* which produces in the intermediate country the effects alluded to, which are only the more alarming from the absence of any natural outlet, from which elastic vapours might escape?

"Now in proof of the former of these positions, it may be scarcely necessary to do more than appeal to the case of Etna or Vesuvius, which rarely return to a state of activity, after a long interval of comparative quiescence, without some antecedent earthquake, which ceases so soon as the mountain has established for itself a vent.* Such was the case before the celebrated erup-

* Humboldt gives us the following series of phœnomena, which presented themselves on the American Hemisphere between the years 1796 and 97, as well as between 1811 and 1812.

1796.—September 27. Eruption in the West India Islands; volcano of Guadaloupe in activity.
———-November——The volcano of Pasto begins to emit smoke.
———-December 14. Destruction of Cumana by earthquake.
1797.—February 4. Destruction of Riobamba by earthquake.
1811.—January 30. Appearance of Sabrina Island in the Azores. It increases particularly on the 15th of June.
———-May————Beginning of the earthquakes in the Island of St. Vincent, which lasted till May, 1812.
———-December 16. Beginning of the commotions in the valley of the Mississippi and Ohio, which lasted till 1813.
———-December——Earthquake at Caraccas.
1812.—March 26. Destruction of Caraccas; earthquakes which continued till 1813.
——-April 30. Eruption of the volcano in St. Vincent's; and the same day subterranean noises at Caraccas, and on the banks of the Apure. Pers. Narr. Vol. IV.

See also Gemellarro on the Meteorological Phœnomena of Mount Etna, extracted in the Journal of Science, Vol. 14, 1813.

tion of 79 in Campania, and in that of Etna in 1537, where, says Fazzello, noises were heard, and shocks experienced, over the most distant parts of Sicily. In such cases no one would doubt the connection between the volcano and the earthquake."

Teneriffe, furnished with the volcanic vent of Teyde, enjoys comparative immunity, while the neighboring islands are dreadfully agitated. If it be objected, that earthquakes are too extensive to have their effects attributed to the same cause with volcanos, we may reply, that volcanic movements generally accompany or succeed them, although it may be in remote countries, and the earthquakes of one country are often connected with those of another.

"During the earthquake at Lisbon, in 1755, almost all the springs and lakes in Britain and in every part of Europe, were violently agitated; many of them throwing up mud and sand, and emitting a fetid odor. The morning of the earthquake, the hot springs at Toplitz, in Bohemia, suddenly ceased to flow for a minute, and then burst forth with prodigious violence, throwing up turbid water, the temperature of which was higher than before. The hot wells at Bristol, were colored red, and rendered unfit for use for some months afterwards. Even the distant waters of lake Ontario, in North America, were violently agitated at the time. After the earthquake at Lisbon, Europe, Asia, Africa, and America were, for some time, violently agitated by subterranean explosions. Etna, which had been in a state of profound repose for eighty years, broke out with great activity, and some of the most tremendous earthquakes and volcanic eruptions recorded in history were witnessed in Mexico." (Bakewell's Geology.) It was at this time, (September 19, 1759,) that the mountain Jorullo, and the attending hornitos, already described, broke forth.

" During the earthquake at Lisbon, nearly all Europe, and a great part of Africa, felt the shock, more or less severely; its effects were sensible even across the Atlantic." Vibrations that are not perceived on the surface, are sometimes experienced in mines. "During the earthquake at Lisbon, the miners felt the rocks move, and heard noises, which were scarcely perceived by those above; and Humbolt says, that he has seen workmen hasten from the mines in Marienburg, in Saxony, alarmed by agitations of the earth, that were not felt on the surface." (Bakewell's Geology.) We will quote Mr. Bakewell, still further, as to the phenomena of earthquakes.

"Earthquakes are almost always preceded by an uncommon agitation of the waters of the ocean, and of lakes. Springs send forth torrents of mud, accompanied with a disagreeable stench. The air is generally calm, but the cattle discover much alarm, and seem to be instinctively aware of approaching calamity. A deep rumbling noise, like that of carriages over a rough pavement,—a rushing sound like wind,—or a tremendous explosion like the discharge of artillery, immediately precede the shock, which suddenly heaves the ground upwards, or tosses it from side to side, with violent and successive vibrations. The shock seldom lasts longer than a minute; but it is frequently succeeded by others of greater or less violence, which continue to agitate the surface of the earth for a considerable time. During these shocks, large chasms and openings are made in the ground through which smoke and flames are seen to issue: these sometimes break out where no chasms can be perceived. More frequently stones, or torrents of water, are ejected from these openings. In violent earthquakes the chasms are so extensive that large cities have in a moment sunk down and forever disappeared, leaving a lake of water in the place. Such was the fate of Euphemia in Calabria, in 1638, as described by Kircher, who was approaching the place when the agitation of the ocean obliged him to land at Lopizicum: 'Here (says he) scenes of ruin every where appeared around me; but my attention was quickly turned from more remote to contiguous danger, by a deep rumbling sound, which every moment grew louder. The place where we stood shook most dreadfully; after some time, the violent paroxysm ceasing, I stood up, and turning mine eyes to look for Euphemia, saw only a frightful black cloud. We waited till it had passed away, when nothing but a dismal and putrid lake was to be seen where the city once stood.'"

To account for the extent to which the vibration of the solid substance of the earth will communicate both shocks and sounds, Mons. Gay Lussac ("Annales de Chimie," &c. Tome xxii, page 429,) remarks, that a vibration of the earth is similar to that of the air; that it is a powerful undulation, produced in the mass of the earth, by some commotion, and that it is propagated, with the same celerity as sound. If we are surprised at the immense extent, to which the shock, the sound, and the ravages of an earthquake are perceived, we may be instructed by considering, that the shock produced by the head of a pin, at one end of a long beam, is distinctly perceived at the other, in consequence of a vibration of all its parts. The movement of a carriage upon the pavements shakes vast buildings, and is communicated through great masses of matter, as in the deep quarries under Paris. M. Gay Lussac enquires, therefore, whether it is astonishing, that a violent commotion, in the bowels of the earth, should cause it to tremble through a radius of many hundred leagues. This philosopher concludes, that earthquakes are the result of the communication of a commotion through the mass of the earth, so independent of subterranean caverns, (which some have supposed favorable to the propagation of the sound and motion) that these effects will be propagated the more extensively, the more homogeneous the materials of the earth are.

Our knowledge of elastic agents justifies us in concluding, that steam and gases, in a word, æriform agents, as the immediate moving power, are the causes of volcanic eruptions, and of earthquakes. When evolved rapidly and suddenly,—that is, in very great quantities, in a given short time, and endowed with great elastic power by heat, they have, without doubt, sufficient energy to rend mountains, to raise floods of fiery lava—to project stones to great heights in the atmosphere—to rock alpine ridges, on their foundations, to heave the ocean into unwonted undulations—to shake continents, and the solid globe itself, to its very centre. The effects of gunpowder, of fulminating preparations, and of imprisoned steam, when suddenly liberated, (now so fafamiliar to mankind,) fully justify us in attributing to elastic agents, all that we have done in this statement.

This subject has been fully illustrated by Mr. Scrope, in his Considerations on Volcanos, of which we gave an abstract in Vol. 13, page 100, which renders it unnecessary to repeat the arguments there urged.

Most hot springs have their origin from volcanic action.—Many that are not connected with active volcanic regions arise from basaltic rocks, and their composition is observed to be similar to that of the waters of volcanic districts, especially in their containing soda or the mineral alkali. It is possible that some hot springs—as, for instance, those of Bath and Bristol, may be derived from the fermentation of pyrites, or from other chemical agencies, generating heat, and that the permanency of the temperature may arise from the great depth, at which the chemical action, giving origin to the heat, is sustained.

Professor Daubeny is not disposed to attribute the occasional eruptions of mud and petroleum, to the *immediate* action of volcanos—but to the accumulation of sulphur, petroleum, and other inflammable materials, produced perhaps by primeval volcanos, existing even (it may have been) under the ancient oceans, before the now existing volcanos began their operations. He alludes, particularly, to the mud volcanos of Maculaba, in Sicily, which are detached from Etna, and appear to depend on the combustion of sulphur.

There can be no doubt that Water is a great agent in producing Volcanos.

Mons. Arago enumerates one hundred and sixty three active volcanos, nearly all of which are situated near to the sea, "in islands and maritime tracts."

The apparent exceptions are few, and generally when examined, they will not prove to be real exceptions.

If there are, as is stated, but not fully confirmed, one or two volcanos in the centre of Tartary, they may communicate with the lakes of that country, some of which are saline.

Jorullo, in Mexico, is one hundred and twenty miles from the ocean—but Colima, on the Pacific, and Tuxtla, on the Atlantic, may be regarded as the wings of a vast subterranean gallery, by which the waters of either ocean, may, ultimately, communicate with Jorullo, and we may presume, that a similar state of things exists with respect to the various mountain groups of Guatimala, Columbia and Chili.

It does not appear to us important to insist, that the communication supposed, should, in every case, be with salt water. It is true, that muriate of soda is frequently sublimed in volcanos, and we may generally attribute this to the proximity of, or at least communication with salt water. But those great agencies, for which water is necessary in volcanos, depend, not upon the foreign ingredients it may chance to contain, but upon its action in its own proper character, either fluid or aeriform, and upon the agency of its elements. It would, therefore, in our view, not militate, seriously, against the reasoning founded upon the supposed presence of water, if volcanos should break out, or be discovered in the midst of our greatest continents. We are always at liberty to suppose a communication with water, when we have so much evidence of its existence in the bowels of the earth, in caverns, and internal lakes and springs, and rivers, besides the vast stores which we see on the surface.

As to the extinct volcanos of France and other countries, as neither history nor tradition reaches to the period of their activity, although the evidence of their existence is unquestionable, we may, with good reason, refer them to the period, when the countries in which they are situated, were *sub-marine*, or, when water existed abundantly, on the surface, in natural hollows, forming lakes and inland seas, more or less extensive. But, it must be allowed, that water at the bottom of the ocean, existing under an enormous pressure of we know not how many miles of fluid, would be much more prone to reach the seat of igneous agency through those natural chinks and fissures by which the earth is, more or less, intersected, and therefore, this is an additional reason to prove, that the oceanic waters are principally active in producing volcanos.

It does not follow, that the volcano, which is fed by the waters of the ocean, must, of course, be submarine; it may break out through the communication, by which the water was admitted, or elsewhere, under the sea or the land, according to circumstances, depending upon the strength, nature, and connexions of the superincumbent strata.

"The most constant and essential phenomenon of an active volcano, is the evolution of certain æriform fluids, which, forcing themselves a passage through the incumbent strata, carry up with them, whatever comes within the sphere of their violence, thus giving rise to ejections of stones, of ashes, and of water." p. 371.

What are the gases and aeriform bodies emitted by volcanos? Our author ascertained, that, at Solfaterra, there is sulphuretted hydrogen, and at Volcano, sulphurous acid; but both are not found at the same place, as they mutually decompose each other, precipitating the sulphur of both, and forming water from the union of the hydrogen of the one and the oxygen of the other. Etna, as our author found, was full of sulphurous acid, but the vapor collected and examined, proved to be principally water, with a trace of muriatic acid.

It is probable, however, that during an eruption, muriatic acid is evolved in great quantity, forming white clouds in the air, and the muriates of soda and ammonia are found abundantly in volcanic matters; the former, Monticelli obtained from lava in the proportion of nine per cent. simply by washing, and the latter is sometimes so abundant as to form an article of commerce.

Sulphureous vapors are justly regarded as characteristic of a true volcano, and they have been observed in Bourbon, Java, the Sandwich islands, Kamschatka, &c.

The Rio di Vinegro, or vinegar river, mentioned by Humboldt, flows from the extinct volcano of Puracè, near Popayan. The waters are fatal to fish, and the spray irritates the eyes of observers. In a litre of this water (2.113 pints) there were found, sulphuric acid 16.68 grains, muriatic acid 2.84, alumine 3.7, lime 2.47, and traces of iron. The crater emitted sulphurous acid abundantly, and there was a deposit of very pure sulphur, eighteen inches thick. A lake within the crater proved to be a saturated solution of sulphuretted hydrogen, from whose reaction with the sulphurous acid, it is probable the sulphur arose.

There is a similar river in mount Idienne, in Java, of which the following account is contained in Vol. 1, of this Journal, page 58. Great quantities of very pure sulphur, are obtained in the crater of a large and now nearly extinct volcano, about sixty miles from the town of Batavia. It is in the crater that the famous lake of sulphuric acid exists, and from which it flows in a river down the mountain, and through the country below. In the dry season it is absorbed by the sands, but at other times, another river, called the white river, unites with this, some miles below its origin; this river, turbid with suspended white clay, is salutary to men and animals; fishes live in it, and vegetation is nourished by its waters; but, after the junction, it becomes clear; the acid dissolves the earthy particles, which discolored it, and it now becomes fatal to living beings—kills the fish, destroys the vegetation, and corrodes the stones in its channel. This river is called Songi Pouti. Analysis, by Vauquelin, shewed, that sulphuric acid was most abundant in this water; it contained also, muriatic acid, and small portions of sulphates of iron, alumine, and lime, and a little sulphur.—Tillock's Phil. Mag. vol. xlii, page 182. Annales du Museè, Tome xviii, page 425; the latter quoted by Daubeny.

Carbonic acid gas is given out by volcanos, chiefly when nearly extinct; but, it has not been observed, when they are in vigorous action. Professor Daubeny suggests, that in such circumstances, it may be decomposed by potassium, and that its origin is probably from limestone strata, to which the heat gradually penetrates.

Nitrogen gas is said to have been detected at Vesuvius, and in some other volcanos; the existence of ammoniacal salts implies that of nitrogen, which may arise from the decomposition of atmospherical air, by combustibles and metals, even at a considerable distance from the fire.

It is proved then, that the gases known to be given out by volcanos, are "muriatic acid, sulphurous acid, sulphuretted hydrogen, carbonic acid, and nitrogen," with an enormous quantity of aqueous vapor, whose condensation produces torrents of rain. We can scarcely doubt, that ammonia and hydrogen must also be present, although pure hydrogen has not been detected. It would of course unite with sulphur, if raised with its hot vapor; atmospherical air, or decomposed water, would produce sulphurous acid, and these two gases producing mutual decomposition, we should observe only that one which was in excess.

Muriatic acid impairs the inflammability of hydrogen, and might thus prevent its burning.

The muriatic acid is probably derived from muriate of soda, ignited with hot silex and alumine, and mixed with steam, in which case its alkali would unite with the earths, and its acid would be exhaled.

Professor Daubeny founds his explanation of the causes of volcanos, upon the very interesting discovery of Sir Humphrey Davy, "that the solid constituents of our globe all contain some inflammable principle, and owe their present condition to the union of this principle with oxygen," and he thinks it by no means improbable, "that at a certain depth, beneath the surface, at which atmospheric air is either wholly or partially excluded, those substances may still exist in their pure unoxidized state."

As they do not exist, and cannot, at the surface of the ground, we cannot expect any analogous phenomena to happen under our observation, and we are, therefore, at liberty to reason strictly with reference to the known action of the substances in question.

Water having access to them, would be decomposed, great heat would be generated, sufficient to melt the rocks and the stony matter, formed by the oxidizement of the metalloids, immense quantities of gas and of steam would be evolved, and all the mechanical effects so familiar in volcanic eruptions and earthquakes, would occur.

The composition of the lava of Catania, near Etna, as ascertained by Dr. Kennedy, is,		That of Santa Vennera, Piedmont, west of Etna, is,
Silex,	51.	50.75
Alumina,	19.	18.5
Lime,	9.5	10.
Ox. Iron,	14.5	14.25
Soda,	4.	4.
Muriatic Acid,	1.	1.
	100.	100.

The author has reviewed the structure and mineralogical and chemical composition of the volcanic masses, in order to shew the correspondence of facts, with the theoretical views which he has adopted, and it must be allowed, that he has so far made out his case, that there appears to be nothing connected with volcanos, which militates against the supposition of their origin from metalloids, acted on by water.

There is good evidence that "volcanos have universally broken out amongst the older formations, or those most near to the nucleus, whatever it may be, of the globe." The lavas themselves appear to be the materials of primitive rocks, altered by fire, and the accidentally imbedded fragments are portions of primitive rocks. It seems to be irresistibly inferred, that the seat of volcanic action is deep, because the immense masses ejected from such mountains as Vesuvius and Etna do not exhaust them—because the materials are raised to a vast height, as at Teneriffe and Cotopaxi, and because the mountains are not shattered by the tremendous explosions, which would blow up any superficial strata into the air.

"Let us suppose, (says our author,) that the nucleus of the earth at a depth of *three or four miles*, either consists of, or contains as a constituent part, combinations of the alkaline and earthy metalloids, as well as of iron and the more common metals, with sulphur and possibly with carbon. These sulphurets are gradually undergoing decomposition, wherever they come into contact with air and water, but, defended by the crust of the globe, just as a mass of potassium is by a coat of its own oxide when preserved in a dry place, the action goes on too slowly to produce any striking effect, unless the latter of these agents be present in sufficient quantity. Hence under our continents, the elastic fluids generated by this process are compressed by the superincumbent mass of rock, until they enter probably into new combinations, or diffuse themselves through the solid strata.

"But under the sea, where the pressure of an enormous column of water assists in forcing that fluid through the minutest crevices in the rock, the action must go on more rapidly, and the effects consequently be of a more striking nature.

"These effects however will take place in the middle of the sea less generally than on the coast, because the pressure of the ocean itself opposes an impediment; and it will in general not be constant, but intermittent, because the heat generated by the process itself will have a tendency to close the aperture by which the water entered, first, by injecting the fluid lava into the fissure, and secondly, by causing a general expansion of the rock; nor will the water again find admission, until, owing to the cessation of the process, the rock becomes cool, and consequently again contracts to its original dimensions.

"Now the first effect of the action of water upon the alkaline and earthy metalloids will be the production of a large volume of hydrogen gas, which, if air be present, will combine with oxygen and return to the state of water, if it be *absent*, will probably combine with the sulphur, both being at the high temperature favorable to their union. In the former case nitrogen gas will be given off, in the latter sulphuretted hydrogen.

"But in case of the presence of oxygen, the sulphur will also become inflamed, and give rise to the production of sulphurous acid, which will predominate among the gaseous exhalations emitted from the mouth of the volcano, provided sufficient quantity of air be present to combine with the hydrogen and re-convert it into water. So soon however as the oxygen is consumed, the hydrogen, no longer entering into combustion, unites with the heated sulphur, and escapes in the form of sulphuretted hydrogen, which, towards the latter period of the eruption, will predominate over the sulphurous acid, because it continues to be formed long after the want of oxygen has put a stop to the production of sulphurous acid. Now it is well known, that these two gases mutually decompose each other, and therefore cannot exist at the same time, so that the appearance of sulphuretted hydrogen from the mouth of the volcano may indicate, if not the entire absence of sulphurous acid at the place at which the process takes place, at least that its formation is stopped by the consumption of oxygen, or is going on with less energy than heretofore.

"The very circumstance of the reproduction of water by the mutual decomposition of these two gases, might be the means of keeping up the action in a languid manner for an indefinite period. The slowness with which lava cools would cause it to give out for a considerable time sufficient heat to the adjoining strata, to place the sulphur at the temperature necessary to cause its combination with oxygen; hence a certain portion of sulphurous acid would be continually emitted, which however would be soon decomposed by the hepatic gas present. The water resulting from this process would percolate into the recesses of the rock, act upon any portions of the alkaline and earthy metalloids that might have escaped the original action, and give birth to a fresh volume of hydrogen gas, ready in its turn to dissolve a new portion of sulphur, and thereby to contribute to the repetition of the same phenomena.

"The separation of muriatic acid from the common salt present in sea water is explained, on the common principles of chemistry, by the superior affinity exerted by the base for the siliceous or aluminous earth than for the acid, and the sublimation of iron in the state of *fer oligiste*, rather than of peroxide, may result from the deoxydizing property of the sulphuretted hydrogen at the same time disengaged. The carbonic acid given off may be derived either from the carbonaceous matters that have entered into combustion, a view of the subject which is perhaps favored by the phenomena of the pietra mala, or from the action of the high temperature upon the carbonates of lime and magnesia, existing in the strata above the seat of the volcanic action. I have already remarked, that this latter gas is chiefly found in volcanos that have become extinct, or have been long in activity, where time appears to have been given for the heat to extend itself beyond the immediate sphere of the volcanic action.

"In short, on the supposition of salt water and air being brought in contact with the sulphurets of the metals and earthy metalloids, all the known phenomena of volcanos may be deduced in the order in which they appear to occur: in the first place, so long as air was present, an evolution of large volumes of muriatic, sulphurous, and nitrogen gases, together with aqueous vapor, would take place; at a later period, when the oxygen was expended, sulphuretted hydrogen and carbonic acid, with a smaller quantity of muriatic acid, would appear; lastly, when all the other effects had subsided, aqueous vapor and carbonic acid might continue to be evolved."

The discussions which occupy the greater part of the last forty pages of Professor Daubeny's work must be studied in detail, in order to be intelligible, and they cannot be so in any event, except to geologists of considerable attainments. They relate chiefly to the following topics, namely,

1. To the analogies between volcanic and trap rocks.

2. The reason of the difference in their mechanical texture, and the circumstances under which the trap rocks were formed.

3. The reason of their greater compactness, their stony aspect being attributed to the slowness with which they cooled.

4. Why submarine lavas have cooled slowly.

5. The character of the volcanic products, formed while the ocean was retiring.

6. The character of tertiary volcanic products.

7. That of modern volcanic products forming streams and not beds.

8. The character of lavas, of the second class, with the formation of tuffs, which the author is unwilling to attribute to mud eruptions, but refers them to water, although not to diluvial action.

9. The rocks formed or ejected through the medium of dykes, with the changes produced by dykes on the rocks which they traverse.

10. The difference between trap rocks and the products of modern volcanos, and the cause of the columnar structure common among trap rocks.

11. Arguments for and against the igneous formation of granite and other rocks.

12. Evidences of a central heat.

13. Local causes of heat in mines.

14. Final causes of volcanos, and the evidence of their existence from the beginning.

It will be at once obvious, to those who are conversant with geology, that each of these topics is a fruitful text, from which extended and interesting discussions may be derived; those discussions, however appropriate to geological lectures and treatises, would be misplaced in a *Journal* of Science.

We will, therefore, close our citations and analysis, by the concluding remarks of the author, to whom we have been indebted for so much entertainment and instruction, and of whose work we have made a free use, believing it both decorous and useful so to do, in a country so remote from that where it originated, and in which it is as yet but little known.

"For my own part, however seductive it may be to the imagination to explain on some one broad principle the phenomena of our globe, and to lay down the great ends which volcanos are calculated to serve in the economy of nature, I think it more consistent with sound philosophy to limit myself, to those effects which have obviously been produced by their action, and to those final causes of their existence, which may be presumed from phenomena which we ourselves witness.

"The former of these inquiries has already been insisted upon, and the occurrence of basalts in every class of rocks, under circumstances which establish igneous action, indicates that volcanos have existed almost from the commencement of our globe.

"With respect to the latter point, I shall only remark, that whatever may have been the end, for the sake of which the accumulation of inflammable materials in the interior of our globe was ordained, their existence there, under circumstances which admitted of their undergoing from time to time inflammation, rendered the production of volcanos not only a natural consequence, but even an useful provision.

"They are the chimneys, or rather the safety valves, by which the elastic matters are permitted to discharge themselves, without causing too great a strain upon the superficial strata.

"Where they do not exist, they give place to a visitation of a much more destructive nature; for those who have experienced a volcano and an earthquake will readily testify, that the consequences of the former are *by no* (beyond?) comparison lighter than those of the latter.

"The same country is indeed often exposed to this double calamity, but that the existence of the volcano is even there a source of good, appears from the fact, that the most terrible effects are felt at a certain distance from the orifice, although the focus of the action is probably not far removed from the latter.

"The agitations, which took place during six years at Lancerote, likewise shew, how much more destructive the effects of subterranean fire appear to be, where no permanent vent is established.

"Thus far we have proceeded on solid grounds,—but if we are willing to push the enquiry farther, and to speculate on the other ends which volcanos may be intended to answer, it may perhaps not be too bold an hypothesis, when we consider their general distribution, to imagine that they are among the means which nature employs, for increasing the extent of dry land in proportion to that of the ocean.

"That such is the tendency of the processes daily taking place, appears from various considerations, and from none more remarkably than from the formation of coral reefs, a cause of increase to the quantity of dry land, with which the destroying agencies that are also at work have nothing to compete.

"In speaking of the Canary islands I observed, that volcanic processes seem much more frequently to have elevated, than to have submerged, tracts of country; and if we consider, that coral reefs are mostly founded on shoals caused by volcanic matter that has been thrown up, a sort of consistency will appear in this instance to exist in the arrangements of nature, which leads to the belief, that fire and water are both working together to a common end, and that end, the preparation of a larger portion of the earth's surface for the reception of the higher classes of animals.

"There may be something fanciful in what I am now going to suggest, with regard to another end which volcanos may be conjectured to fulfil; yet if there be any truth in the idea, that the pressure of the ocean would be constantly forcing a certain portion of its waters through fissures into the interior of the earth, it would seem that there ought to be some compensating process, by which the ratio between the sea and land might be preserved unaltered.

"This would perhaps be afforded by the action of volcanos, which restores to the surface just as much water as has been admitted to the spots at which the process is going on; for though the first effect of the action is to decompose that fluid into its constituents, yet the immediate consequence is, as we have seen, the disengagement of a large volume of sulphuretted hydrogen and sulphurous acid gases; so that by the action either of the latter fluid, or of atmospheric air upon the former, the whole of the hydrogen of the water, sooner or later, becomes re-united with oxygen. This indeed is *one* cause of the quantity of steam given out from the craters of all burning mountains.

"The products of the volcanic action also, though, from the individual mischief they occasion, they can hardly be viewed by the inhabitants of the country overspread by them in any other light, than as serious present calamities, do not nevertheless deserve to be considered as permanent or unmixed evils.

"It is true, that there is something gloomy and depressing in the contemplation of a volcanic mountain, when we consider the cities it has overwhelmed, the fields it has reduced to desolation.

"Yet if we do not adopt the notion once so prevalent with respect to the speedy dissolution of the globe, if we take up the more pleasing, as well as, I conceive, the more probable opinion, that a world, which required so many ages to prepare it for the accommodation of its present inhabitants, is destined for many ages more to afford them a suitable abode; there is then something consolatory in the reflection, that the very lava, which for so long a period has spread the most hopeless sterility over the ground it traverses, in process of time crumbles into the richest of soils; and that, if we take the case of the neighborhood of Naples as the volcanic district with which we are best acquainted, the experience of what has happened before justifies a belief, that the inflammable materials which supply the fires of Vesuvius will ultimately be expended, and that the mountain may at some future period return to the fertile condition, which Martial describes as belonging to it, when its heights were covered with vineyards, and the very spots surrounding the actual crater were considered the favorite resort of the Gods.

> " His est pampineis viridis Vesuvius umbris,
> Sparserat hic madidos nobilis uva lacus.
> Hæc loca, quam Nysæ colles, plus Bacchus amavit,
> Hoc nuper Satyri monte dedere choros,
> Hæc Veneris sedes. Lacedæmone gratior illi,
> Hic locus Herculeo nomine clarus erat."

Conclusion.—Theory of Volcanos.

In concluding this long account of volcanic phenomena, and of their possible and probable causes, we may be permitted to observe—

That having been for the last ten or twelve years, in the habit of applying the remarkable discovery of the metallic bases of the fixed alkalis and earths, to the explanation of volcanic phenomena, we have been led to embrace nearly all the opinions of our author on this head, with some additional views, which may perhaps be admitted, until something better shall be suggested.

The act of creative energy, admitted alike by religion and philosophy, necessarily implies the production of all the elements of which our physical universe is composed. How far these elements were originally united in binary, ternary, or still more complex combinations, we cannot possibly know. The revelation of this fact, not being necessary to our moral direction, has been withheld by the Creator, and we know only—that "In the beginning God created the heavens and the earth." As to the actual condition of the elements, at that primeval period, science may fairly enquire, and is justified in reasoning within the limits prescribed by our moral condition and intellectual powers.

In the present state of chemical science, our elementary bodies are divided, very nearly, between the two classes, combustible and metals, which really form but one class, and those agents, which from their acting with peculiar energy upon the combustibles and metals, and altering their properties, are called by some, supporters of combustion ;—they are oxygen and chlorine, and some add iodine, and an imaginary body called fluorine.

If we extend the idea of combustion, as several authors are disposed to do, to all cases of intense chemical action, especially if attended with the extrication of light and heat, we shall include the agency of the combustibles and metals upon each other, as well as upon the proper supporters of combustion. For our present purpose, it is quite immaterial which view is embraced.

If we suppose that the first condition of the created elements of our planet, was, in a state of freedom; the globe being a mass of uncombined combustibles and metals; when the waters, the atmosphere and chlorine, and iodine and perhaps hydrogen were suddenly added; it will be obvious from what we now know of the properties, of these elements, that the collision would awaken dormant energies, whose first operation would be a general and intense ignition, and a combustion of the whole surface of the planet. Potassium, sodium and phosphorus would first blaze, and would immediately communicate the heat necessary to bring on the action between the other metals and combustibles in relation to the oxygen and chlorine, and in relation to each other. Thus, a general conflagration would be the very first step in chemical action, and life not having yet dawned on the planet—this conflagration would be the step most admirably fitted to prepare the globe for the living beings by which it was to be peopled.

Thus, would be formed the alkalies, the earths and stones and rocks,—the metallic oxids properly so called—the sulphurets and phosphurets of the metals—the carburet of iron—the acids, including the muriatic, and ultimately the salts, and chlorides, alkaline, earthy and metallic, and many other compounds resulting either from a primary or secondary action.

In such circumstances, there would also be great commotion—steam, vapors and gases would be suddenly evolved in vast quantities, and with explosive violence; the imponderable agents, heat, light, electricity, and magnetism, and attraction, in various forms, would be active, in an inconceivable degree, and the recently oxidated crust of the earth would be torn with violence, producing fissures and caverns dislocations and contortions, and obliquity of strata; and it would every where bear marks of an energy then general, but now only local, and occasional. It is however obvious, that this intense action would set bounds to itself; and that the chemical combinations would cease, when the crust of incombustible matter thus formed, had become sufficiently thick and firm, to protect the metals and combustibles, from the water and the air, and other active agents.

As we are not giving a theory of the earth, but merely stating the conditions of a problem, we forbear to descant upon many obvious collateral topics, or to pursue the various rock formations, through the vicissitudes which might have attended them.* We do not even undertake to say, that we believe that such events as we have endeavored to describe, did actually happen; we say only, that their existence is consistent with the known properties of the chemical elements, and with the physical laws of our planet. Supposing that such was the actual progress of things, it is obvious that the oxidated crust of the globe, would still cover a nucleus consisting of metallic and inflammable matter. Of course, whenever air and water, or saline and acid fluids, might chance to penetrate to this internal magazine, the same violent action which we have already supposed to have happened upon the surface, would recur, and the confinement and pressure of the incumbent strata, increasing the effects a thousand fold, would necessarily produce the phenomena of earthquakes and volcanos.

Still, it is equally obvious, that every recurrence of such events, must oxidize the earth deeper and deeper, and if the point should ever be attained, when water or air ceased to reach the inflammable nucleus, the phenomena must cease, and every approximation towards this point would render them less frequent.

Does this correspond with the actual history of these events? Are they now less frequent, than in the early ages of our planet? The answer to this question must depend so much upon the theoretical views entertained of the formation of granite, and of the other primitive rocks, that it may be impossible, at present, to bring it to a decision.

Whatever we may think of the hypothesis now detailed, and which we suppose to coincide substantially with the views of our author, may we not suppose, with sufficient pro-

* The present hypothesis does not exclude the subsequent action of water, in dissolving chemically, or disintegrating mechanically, the crust of the globe.

bability, that those Voltaic powers which we *know* to exist—whose action we can command, and whose effects, having been first observed, within the memory of the present generation, now fill us with astonishment, are constantly active in producing the phenomena of earthquakes and volcanos.

Arrangements of metals and fluids are the common means by which we evolve this wonderful power, in our laboratories; and it would seem that nothing more than juxta position, in a certain order, is necessary to the effect. Even substances apparently dry and inert, with respect to each other, will produce a permanent, and in proportion to the means employed, a powerful effect; as in the columns of De Luc and Zamboni. It would seem indeed, that metals and fluids are not *necessary* to the effect. Arrangements of almost any substances that are of different natures, will cause the evolution of this power. Whoever has witnessed the overwhelming brilliancy and intense energy of the great galvanic combinations, especially of the deflagrator of Dr. Hare, and considers how very trifling, in extent, are our largest arrangements of apparatus, compared with those natural arrangements of earths, salts, metals and fluids, which we know to exist in the earth, in circumstances similar to those, which, in our laboratories, are effectual in causing this power to appear, will not be slow to believe, that it may be in the earth, perpetually evolved and perpetually renewed; and now mitigated, suppressed or revived, according to circumstances influencing the particular state of things at particular places.

In our laboratories, we see intense light, irresistible heat, magnetism in great energy, and above all, a decomposing power, which commands every element and every proximate principle, in every compound.

Sir Humphrey Davy, after discovering that the supporters of combustion and the acids, were all evolved at the positive pole, and the combustibles and metals, and their oxidated products, at the negative—proved, that even the firmest rocks and stones could not resist this power, their immediate principles and elements being seperated by its energy. The decomposition of the alkalies, earths, and other metallic oxids being a direct and now familiar effect of Voltaic energy—their metals being set at liberty, and being combustible both in air and water—elastic agents produced by this power, and rarefied by heat, being also attendant on these decompositions, it would seem that the first principles are fully established by experiment, and that nothing is hypothetical, but the application to the phenomena of earthquakes and volcanos.

It appears an important recommendation of the present view, that causes as here provided which admit of indefinite continuance, and of unlimited renovation. There appears no reason why, on the whole, the phenomena should cease, as long as the earth exists. It has therefore the great Newtonian requisites of a good theory; *its principles are true*, and *it is sufficient*.

It has this additional advantage—it embraces all that is possible in former theories. Coal, lignite, sulphur and petroleum, and fermenting pyrites, will all conspire with the great operations, at which we have so briefly hinted. Burnt substances will return again to their combustible condition, and combustibles will burn anew, in unlimited succession. Heat, light, electricity, magnetism, decompositions and recompositions without number,—the evolution of elastic fluids in boundless quantities, and all the violent mechanical effects, which their action is known to produce; these are among the known and familiar effects of this power, and all the materials, necessary to render it active, are existing in the earth, on a scale of immense extent. These suggestions might be fortified by many particulars. At present they are thrown out, as leading, although not entirely original thoughts, and in concluding we can only say with Horace,

Si quid novisti rectius istis
Candidus imperti; si non his utere mecum.

Art. XVI.—*Notice of the late Aurora Borealis, in a letter from Mr.* Benjamin D. Silliman, *to the Editor, dated New York, October 20th*, 1827; *also in letters from Dr.* Holyoke, *Professor* Cleaveland, *and others, and in notices selected from the newspapers.*

Dear Sir—I have taken pains to collect some facts, in relation to the beautiful phenomenon (connected, as is supposed with the Boreal Lights,) which was visible on the night of the 28th of August, 1827—and now transmit the substance of them to you, that if deemed important, it may be preserved in the American Journal of Science. They may perhaps prove valuable, in connexion with similar phenomena which may be hereafter observed.

This aurora borealis was generally seen in the northern states, in most portions of which there were no material variations in its appearance, while farther south, it assumed a less uniform character. In this city, it was first observed at about half past nine, P. M., at which time the light, excepting as regards its whitish hue, resembled that produced by a fire at some distance, and to such a cause it was, for some time, attributed by many. The light soon however became more intense, and its outline more distinctly defined, gradually assuming a columnar shape, and extending from about N. N. W. to a point in the opposite horizon, about E. N. E. In about ten or fifteen minutes from the time that I first observed it, waves of light, in detached masses, but all in the line of the luminous arch, began to flow from the eastern toward the western part of its course, until the whole were blended, and the heavens were adorned with the beautiful arch, extending from the terminations which I have above named, to a point about fifteen degrees north of the zenith. The greatest breadth of the arch at its centre, was about nine or ten degrees, tapering from that point to the western extremity, (where the light was much brighter,) almost to a point. The eastern segment was, at no time, so distinct as the opposite, but was rendered very beautiful from the constant passage of the waves of apparently illuminated vapor, the lines of which were at right angles with the line of the arch, and extending from north to south, toward the western part, and in an opposite direction to the course of the wind. The whole arch moved with a gradual and pretty uniform motion, toward the south, and passed the zenith at about three quarters past ten, presenting to the eye, throughout its whole length, a broad, bright band of wavy light, studded with stars, which were seen distinctly through it. As it passed the zenith, towards the south, its eastern limb became less distinct, breaking up into columns of great brightness, with dark spaces between them, and diminishing in lustre and magnitude until they disappeared. In the mean time, the western segment became more exact in its outline, and was as well defined, as a pencil of rays passed through a prism into a dark room. The color was a bright white, and slowly faded, until about two hours from the time of its first appearance, when it was no longer visible. The Aurora Borealis had, for several evenings, been unusually brilliant, and the atmosphere, was at this time, cool and very clear. On Tuesday evening, during the continuance of the arch, the light of the common Aurora was not very brilliant, but after its disappearance, was unusually splendid and vivid. A great bank of light lay almost permanently in the northern horizon, sometimes surmounted by, and sometimes resting upon, a dark cloud, which was visible during the whole time. Occasionally, broad flashes of the Aurora would illuminate the cloud, shaded by its denser spots, and presenting an appearance similar to that of a black thunder cloud penetrated by vivid lightning. This dark cloud was visible, and in the same situation, at sea, as will be seen by the following extract from the log book of the British ship Dalhousie Castle, captain Walton, from Liverpool for this port, published in some of the papers.

" *Tuesday*, *August* 28*th*, 1827.—As daylight closed, the moon had a remarkably red aspect, the sky was clear, and stars brilliant. At 9, 30, a dark cloud was rising to the northward, and soon afterwards strong perpendicular rays of light were seen from the N. E. to N. N. W.—these rays rose in shape of a cone, or to a point, the lower part resembling much the tail of a comet, becoming now and then more or less bright. This continued till 10 o'clock, (in which interval the moon had sunk below the horizon,) when a far stronger ray of light appeared in the N. W. in width about eight or nine degrees, and which ascended to thirty five degrees. After remaining stationary a short time, it ascended till it reached the zenith, and afterwards formed an arc. This continued till about 11, 30, when the upper part inclining to the southward, gradually died away. The dark cloud remained stationary all this time, from fifteen to twenty degrees high, and till midnight, and the strong light from N. E. to N. N. W. continued till after one, A. M.—the intermediate space between the lower part of the cloud and horizon filled with a dense haze. On the 27th, we experienced squally weather with rain and bright lightning. The whole of the 28th was fine weather with light breezes. On the 29th fine weather with light breezes. No appearance during the evening or night of the light.

[The situation of the ship at 10, P. M. was lat, 42° 12′ N. lon. 63° 9′ W.]

At Auburn, in this state, the appearance of the arch was similar to what I have above described, excepting that it continued distinct as a whole but about fifteen minutes. The thermometer at that place stood at 54°, and the barometer at 29.68.

At Canandaigua it was seen and described as above, the dark cloud stretching from east to north after its disappearance and the coruscations of the Aurora shooting up with unexampled splendor to the zenith, and illuminating with a flitting light the whole northern half of the firmament.

At Rochester and at Utica its appearance was the same; and at the latter place reports were distinctly heard, producing a sharp, snapping noise, like the discharge of an electric battery.

At Troy, two luminous spots were observed, one in the east, and the other in the west, and from these two the columns of light rose and met one another a little north of the zenith. The flowing of the light from east to west was constant, and is described as resembling the peculiar action of the angle worm as it puts itself in motion.

An intelligent gentleman who was at the time in St. Lawrence county, informs me, that the reports were heard during the existence of the arch, but that afterwards, while the coruscations of the aurora were so splendid, the report was very distinct and loud, and of the character of those heard at Utica.

On the east end of Long Island, at Sag Harbor, and other places, the phenomenon of the arch was visible, with the difference, that its brighest point was at the zenith, where it appeared much agitated.

At Portsmouth, Keene, and Charlestown, in New Hampshire, its appearance is described as having been in all respects, similar to that at this place.

In Lower Canada, at Quebec and Montreal, it was even more splendid than with us. The coruscations of the aurora are represented to have been awfully grand, on the evening of Monday, the 27th, extending in broad columns from the north to the east, and shooting up to and even past the zenith. A gentleman travelling on the St. Lawrence at the time, between Montreal and Quebec, mentions, that the moon had gone down, but so bright and permanent were the flashes of the aurora, that objects about the vessel and upon the shore were as distinctly visible as though the moon had been shining without a cloud. During this time, the southern part of the firmament was illuminated with streams and clouds of light, which lasted for about two hours, with a constant and tremulous agitation. A letter from a gentleman in Quebec, to the editor of the Commercial Advertiser of this city, in speaking of the arch of Tuesday evening, says:—

"During the whole time this phenomenon was seen, the northern part of the hemisphere continued calm, developing the vivid displays of the Aurora Borealis, which are sometimes seen in the high latitudes, and described in the Encyclopedia; but the rising of the light from the south, was to me perfectly novel. It was also remarkable that occasionally the flakes of light would shoot across the heavens in a large angular direction, from between the N. W. and N. E., so as to unite with the exhalations which continually arose from the southward, and a perceptible impetus was given to the rapidity of the circular motions, while the additional light was almost immediately concealed behind the dense clouds, which in the south gradually accumulated."

In Massachusetts, its appearance at Boston, Salem, Newburyport, Williamstown, and elesewhere was not materially different, from that at this city. The same was the fact at Providence, Taunton, Pawtucket, &c.

In New Haven, Con. it presented the same appearance, and was accompanied by reports, which increased in frequency, and distinctness, with the dartings of the Aurora. These reports were noticed by some gentlemen of the Faculty of Yale College, who were making observations upon the phenomena at the time.

At Philadelphia the bow appeared as in this city, the same was the fact at Norfolk.

At Baltimore the arch was not as distinct and perfectly formed as here, but resembled rather a line of comets, which soon disappeared.

I perceive by the English papers, that the coruscations of the Aurora have been singularly splendid during the present season in that country, the following is extracted from a Scotch paper dated (I believe,) some time in the month of August, and notices, as will be seen, a similar occurrence to that in this country, of the 28th of the same month.

From the Perth (Scotland) Courier.

"One of the most brilliant and picturesque appearances of the Aurora Borealis ever seen in this quarter, exhibited itself on the evening of Monday last. The coruscations were very rapid and transparent, and overspread nearly the whole northern hemisphere. Some of the flashes were almost vertical, and latterly they resembled in clearness and motion the undulations of a bright flame. At one time the meteors formed themselves into a narrow belt, crossing the heavens from east to west."

Phenomena similar to this have been observed heretofore. The London Philosophical Magazine, describes three—one of which occurred on the 11th September, 1814, the second on the 24th of September, 1816, the third on the 17th of October, 1819. The circumstances attending them, were generally similar to that of August last.

In the second volume of the memoirs of the American Academy of Arts and Sciences, an account of a similar phenomenon which occurred on the 27th of March, 1781, is given by Caleb Gannet, Esq. F. A. A. It differed from the last only as to the point from which it arose, which was the east instead of N. W.

Captain Parry, on his third voyage for the discovery of a northwest passage, made a number of interesting observations of the aurora, while at Port Bowen, lat. 73°, 15′, between October, 1824, and March, 1825. On his return voyage in September, 1825, the light of the aurora was for several nights so strong and permanent, as to throw the shadow of objects on the deck. His journal says,

"The next brilliant display, however, of this beautiful phenomenon which we now witnessed, and which far surpassed any thing of the kind observed at Port Bowen, occurred on the night of the 24th of September, in latitude 58 1-2 degrees, longitude 44 1-2 degrees. It first appeared in a (true) east direction, in detached masses, like luminous clouds of yellow sulphur colored light, about three degrees above the horizon. When this appearance had continued for about an hour, it began, at 9, P. M. to spread upwards, and gradually extended itself into a narrow band of light, passing through the zenith, and again downwards to the western horizon. Soon after this, the streams of light seemed no longer to emanate from the eastward, but from a fixed point about one degree above the horizon, on a true west bearing. From this point, as from the narrow point of a funnel, streams of light resembling brightly illuminated vapor or smoke, appeared to be incessantly issuing, increasing in breadth as they proceeded, and darting with inconceivable velocity, such as the eye could scarcely keep pace with, upwards towards the zenith, and in the same easterly direction, which the former arch had taken."

The journal mentions that the general color of the light, was yellow, with an occasional orange and greenish tinge, and that the intensity of the light, while it lasted, which was for about three quarters of an hour, was not inferior to that of the moon when full.

Whether the phenomena of the aurora borealis are attributable to electricity, or to the reflection, and refraction of the sun's rays, appears to be at this day, as questionable as ever. A writer in the London Philosophical Magazine and Journal, objects to the doctrine that they are electrical phenomena, and asks if they be such—

"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 color 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?"

Considering these questions as unanswerable, the writer accounts for the phenomena as follows.

"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, which 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."

Upon this ground, the author thinks there will be no difficulty in accounting for the phenomena, and for their annual and diurnal times of appearance. He accounts for the motion of the streamers, upon the supposition, that the bodies of ice, by which they are probably reflected are in motion, and says,

"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."

Upon this supposition with regard to the aurora generally, the luminous arches are accounted for as follows.

"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 no where 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."

Whether this reasoning be correct or otherwise, is left for others to decide. The following extracts of letters on the subject, with which I have been favored, by the venerable E. A. Holyoke, M. D. LL. D. of Salem, Mass. whose years now number more than a century,* furnish interesting descriptions of these phenomena which occurred in old times, and mention facts which would rather favor the theory that they are attributable to electricity.

Extract of a letter from Dr. Holyoke, dated Salem, Sept. 19, 1827.

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About fifty or sixty years ago, I observed early in the evening, an unusual and remarkable luminous band, or stripe in the firmament, extending from about the N. N.W. point of the horizon, through the zenith, to the opposite E. S.E. point. The color was that of a white cloud. It continued station-

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* It is scarcely necessary to remark, except possibly to some of our readers in Europe, that Dr. Holyoke has been during a large part of *his centurial term*, distinguished as an eminent physician and friend of useful knowledge.—*Ed.*

ary for one or two hours, if I remember right, without the least alteration of place or color.

The second which I saw, was some ten or fifteen years after the first. It occurred on Wednesday evening of the third week in July, but in what year I know not. It seemed to occupy the same place in the heavens as the former; and I think it began to show itself early in the evening, before the twilight had fully shut in. The color similar to, but rather brighter than that of the first, and I well remember that its form was exactly like that of the area contained between two meridians, placed three or four degrees distant from each other; the greatest breadth being in the zenith and terminating in the horizon, as meridians do at the poles, and its edges perfectly defined. It continued stationary all the evening. I would observe, that I do not recollect any light in the north accompanying either of these appearances, and if there had been any such, I think I should have remarked it.

The phenomenon, of the 28th of August last, I did not see till thirty minutes after ten, and at that time the highest part of the luminous band, I estimated to be eight or ten degrees south of the zenith; the sides of the band nearly parallel; the color of its light more like that of the moon and much more brilliant than that of the two above mentioned. I think it is remarkable that all these phenomena should occupy the same region in the heavens.

But these appearances are not to be compared in point of beauty and magnificence, with some forms of the Aurora Borealis, of which it has been my good fortune to have been twice an admiring spectator. It is impossible for me to give you an adequate description of them, but as what I have said may have excited your curiosity, I will endeavor to describe what I saw as nearly as I can. Imagine then, all that region of the northern heavens between the N. W. and E. N.E. covered with a sheet of light consisting of the four least refrangible rays, (for I saw no trace of the blue, and the green rays were very pale,) resting on, or proceeding from a black cloud in the horizon; and this extensive surface all alive by the constant agitation of columns of different colored rays, starting upwards, vibrating, dancing, changing, coruscating every moment, till they arrived at the zenith, or rather four or five degrees south of it. There the columns which had risen perpendicularly, assumed a horizontal direction, and a gyratory motion, and put on the appearance of flames reverberated from the top of an oven, all in constant motion, sometimes the whole rapidly revolving in a spiral, forming altogether a scene exceedingly beautiful, magnificent and sublime, of which it is not in my power to give a perfect description.

The light of this aurora was so bright as to obscure that of the moon, then in the S.E. about two or three hours high, and about as many days after the full. I viewed this phenomenon for half an hour or more, which left such an impression on my mind, as I think I never shall forget. This exhibition, as I may call it, occurred about the year 1754 or 1755.

The second time I saw the like appearance was about the years ——. It very much resembled that above described, though the second was I think, a little more south, than the first, and abounded more in red rays. I have some faint notion, that during the first exhibition, I heard the noise attending the rapid motions of the columns, though I cannot speak with any certainty, but I certainly have more than once, heard such rushings, during the vibrations of the aurora, as plainly, though not so audibly, as ever I did that of a rocket, which though fainter, it very much resembled.

I recollect also, that once during an appearance of an aurora, I examined its effect upon the magnetic needle, and found it much agitated, more especially when there was a more than ordinary vibration of the meteor, but to what extent, or to what number of degrees, I cannot say, but certainly enough to determine, that the needle was much affected by the auroræ. * * * * * *

Extract of another Letter from Dr. Holyoke, dated Salem, Sept. 26, 1827.

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Since my last, of the 19th instant, I luckily fell in company with a friend, Ichabod Tucker, Esq. a clerk of our supreme court, and a respectable character, who informed me, that while he lived in Connecticut, near New Haven, in the month November or December, 1781, or in January, 1782, he saw an exhibition of an aurora borealis, exactly similar to that second, which I gave you a description of, only that he took no notice of the absence of the blue colored rays. This he saw while walking about two miles, in a N. E. direction, so that he had half an hours time to view it, which he did with great trepidation, being then about fourteen years old, and having never seen an Aurora. But by his account, he heard the noise attending the shootings and vibrations of the columns, more loud, and more frequent than I ever had, or had heard of, for he heard not only this rushing noise, which I as well as three or four of my other acquaintances have repeatedly done, but loud claps or snaps, of which he was so perfectly assured, that he told me, he should not hesitate to confirm by his oath, if necessary.* Query.—Does not this serve to confirm the notion, that these auroræ are modifications of electricity, or that at least, these dartings, and shootings, are an electrical effect? I think that these appearances, and the effect they have upon the magnetical needle, amount to demonstration, that the needle is affected by these auroræ. I once observed myself, a very evident agitation, especially upon a brisk shooting of the meteors. The needle I made use of, was a very short and light one. If the noise attending these vibrations were thus audible, you will agree with me, that the aurora could not have been so far distant, as some of the European writers upon the subject, suppose they commonly are.—Since I wrote you, I have been informed by a gentleman in my neighborhood, who saw the second band, which I described as having occurred on Wednesday, the third week in July, without mentioning the year; I can now certify, that it happened in the year 1769.

We add the following parts of letters to the Editor and some extracts from the Phil. Mag. &c. for November last.

From Professor Cleaveland.

Brunswick, Oct. 6, 1827.

My Dear Sir—The Aurora Borealis was so extensive on the nights of the 27th and 28th of August, and the phenomena have been so frequently described, that I shall mention those circumstances only, which were peculiarly interesting. On the evening of Tuesday, the 28th, about half past eleven, a luminous bow or arch, extended from N.W. to S.E. its highest point being about 40° above the northern horizon. Below the bow, all was dark, with the exception of a few stars.

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* He tells me in further conversation on the subject, that the claps, or snaps which he heard, were most like the flapping of a vessels sails, when thrown up in the wind.

From *that part* of the bow contained between the N. E. and E. numerous waves of light proceeded in *rapid* succession to the zenith, where they soon disappeared, and were *instantly* succeeded by others, perfected similar. Their waves of light arose, *successively*, from *various parts* of the *afore mentioned portion* of the bow, and their *apparent* length, parallel to the horizon, varied from one to two yards. In some respects, they much resembled those luminous flashes, which appear, when a *charged* Leyden jar is placed under the receiver of an Air pump, in a darkened room, and discharged by gradually removing the pressure of the atmosphere. The *general appearance* of these waves of light, while rapidly passing from this bow, to the zenith, reminded me of that beautiful display of light in Hare's calorimotor, when the gas is on fire, and the plates a little elevated. These interesting phenomena continued about half an hour.

On the evening of September 25th, about eight o'clock, there was another exhibition of light, which we must call an Aurora *Australis.**—A broad, well defined bow, or arch of light extended from S. E. to nearly N. W., its highest point being about 35° above the *southern horizon.* The light of this bow was dense, and very bright, especially near the south eastern limit. From various points of the convex side of the bow, columns of light arose, and proceeded towards the zenith.—During these appearances in the *south*, the sky in the north, and north east was free from light, excepting that about midway between the horizon and zenith, there were a few feeble columns of light, which appeared to be insulated in the starry surface of the heavens. The light soon became much more diffuse, and extended, and so continued through the whole night.

From Mr. Benjamin Lincoln, two Letters.

Boston, Sept. 20, 1827.

Dear Sir—In compliance with your request, I send you some account of the Aurora, as it appeared on the evening of the 28th of August—I being then on the bay of Fundy, in about lat. 45°, N. long. 66°, W.

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* You will not understand by this expression, *Aurora Australis*, that I intended to refer the light to the south pole, but only to say, that the luminous bow was nearer the *southern* horizon, than the zenith.

The wind blew fresh from the south west, the air was unusually cold and piercing, and many small dark clouds were flying towards the N. E. According to the best of my recollection, the aurora was first observed about 8 o'clock, at which time a small arch in the north, was feebly lighted, the light at first remaining quite uniform and steady. It gradually extended towards the east and west, rising higher, growing more brilliant and flickering, with occasional vivid flashes, from the north which reached the zenith, and at times a play of feeble colors, till between ten and eleven o'clock, when my attention was first fixed exclusively upon the aurora. At that time, the whole arch from east through north, to N. W. was brilliantly illuminated, the brightest spot all the time being in the north, and the next brightest nearly in the east. Several bright *streams* of light, following each other in quick succession, issued from the north, passed the zenith, and reached to within 30° of the horizon in the point south. At the same time, bright flashes came from the east passed towards the N. W. meeting and apparently crossing the light from the north.

It should be borne in mind, that the aurora was very active throughout the whole of the arch before mentioned, to wit, from east to north west—these flashes from the north, and from the east were distinguished from the rest by their greater brilliancy. After this the light gradually diminished, and I left the deck without seeing the end of this interesting phenomenon. Yours most respectfully,

BENJAMIN LINCOLN.

Prof. Silliman.

Boston, Nov. 19th, 1827.

Dear Sir—Since my last, I have heard of a fact which seems to me strongly to support the theory that the aurora borealis is an electrical phenomenon. I hope this may reach you in season, to be introduced into your paper on the Aurora, should you think it a fact worth consideration. It was communicated to me, by Mr. Edmund Baylies, now of this city; a gentleman, in the accuracy of whose observations, we may place implicit confidence.

"In the year 1817," says Mr. Baylies, "on the nights of the 15th, and 16th of March, on the road from Stockholm, to Tornea, I noticed with much interest, and attention, the appearance and conduct of the Aurora Borealis. As these were noted down at the moment, I will give you an extract from my journal, relative thereto. 'Wind at N. W. clear and pleasant. The last two nights, enlivened by the aurora borealis. From *time* to *time*, a mist appeared to *form* for 30°, along the horizon, emitting rays of the most brilliant hues, till the whole heavens in that direction, beamed with light, clear and pale, as is frequently seen reflected by the sun, just after day-break.' "

Mr. Baylies states further, that this mist extended from the horizon towards the zenith about ten or fifteen degrees —and that the flashes of light, which beamed from it, seemed to exhaust it—that it grew paler and thinner, and the light in the same proportion faded away, till both nearly disappeared—then the mist formed again, and again emitted this light. "This continued during the whole, or greater part of the nights observed." Yours respectfully,

BENJAMIN LINCOLN.

To Professor Silliman.

From Dr. Pliny Hayes.

Canandaigua, Nov. 19th, 1827.

Dear Sir—Understanding that you intend to notice, in your very valuable Journal, the extraordinary appearance of the Aurora Borealis, seen sometime since, I send you a few notes which I took at the time, in addition to those published in the Ontario Repository of September 5th, which I am informed you have in your possession.

The account published in the Repository, was condensed as much as possible, and some particulars probably omitted.

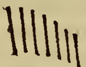
About the time that the arch broke up into columns, it seemed to be stationary, or rather to move back towards the north. Soon after it moved again to the south, apparently with a more rapid motion than ever, until it disappeared.

When I first saw the arch in the north, its centre appeared to be a few degrees east of north.

The divergent extremities of the waves of light, were towards the north.

There was no wind and the evening was very cold. The earth was unusually dry, even for the season.

The next day, (29th,) the sky was overcast with a sheet of horizontal clouds, apparently not very high, and dense enough to exclude the rays of the sun. Weather cool. In the evening the stars were partially visible. The 30th, the sun shone. The clouds were light, somewhat scattered, and remarkably comoid—the temperature warm. The 31st, also warm. In the forenoon, clouds were visible, consisting of bars of whitish vapor, very regularly disposed, forming the mackerel back sky. About noon, a smart shower.

On Sunday evening, September 9th, at 8 o'clock, I walked out, and saw a considerable light in the north, rounded into a semi-eliptical form. It extended probably through ninety degrees of the horizon. It was not very well defined, but was rather darker in the centre near the horizon. In about five minutes, I saw, almost directly overhead, a light cloud hanging in the clear sky, apparently lower than clouds generally are, which I immediately recognized, as a fragment of the aurora. It moved gently to the west, and as it moved became more and more distinct, and better defined, putting on gradually the appearance of beams of light, having a southern inclination. Suddenly they became very straight, and well defined on their north side, as if I then saw all their northern sides in a line. Proceeding still west, and probably a little south, they seemed to lengthen, and descend towards the western horizon. Looking at them in this direction, I judged their deviation from a perpendicular, to the horizon to be from fifteen to eighteen degress. Proceeding still farther west, they grew gradually shorter, and began to open, and soon had the appearance of five or six columns, of about the same height, the northernmost standing near the horizon, and the rest a little higher and higher, forming a part of an arch; thus 

About the time, this disappeared, some scattered fragments of a more considerable arch, appeared a little north of the zenith. It soon became more distinct, and the part east of the meridian, although rather faint, was well formed. It seemed to consist of bars of light lying in this manner:

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The movement westward, and the wheeling motion were distinct, but not sufficiently so to enable me to estimate the rate of motion. It gradually approached and passed the zenith, becoming narrower, and of a more uniform breadth. When it had passed the zenith a little, it seemed to have collected itself into two rolls forming a double arch, extending nearly across from one horizon to the other. The northern roll, was smaller than the southern ; but it was impossible to say, which (if either) was the highest. They were not very distinctly separate, but were considerably or very much blended together, except about the middle of the arch. It became more obscure, and broke up into fragments more or less distinct. The western motion of these was perceptible, and by looking at one when about 20 or 25 degrees south of the zenith, I estimated its motion at four degrees in thirty two seconds. About this time, the moon rose among a few clouds in the east.

Frequently, jets or columns, some apparently pretty near, darted up from the northern light, inclining constantly to the west, and becoming more distinctly narrow and straight.

The light in the north now (half past eight) seemed to be rising higher, and becoming more distinctly an arch. Its height from the northern horizon, I estimated at 16°. It was now pretty still; but presently bright jets began to start up all along its course. These continued to play very brilliantly for about half an hour. They commonly rose suddenly, in bright clusters, sending some of the beams frequently as high as twenty-five or thirty degrees—and varying their appearance continually, being sometimes cloudy or obscure, and at others very bright and narrow. The coruscations, which had been little observed before, now became almost constant, and very beautiful. They seemed to consist of broad flashes of light, extending a great distance, or perhaps the whole breadth of the northern light, rising up very rapidly, and succeeding each other very closely, or as well as I could judge, at intervals of about half a second.

The northern light rose no higher. The jets continued, but were less frequent, and less tall and bright. The coruscations were still very perceptible, at 11 o'clock, when I retired.

The bases of the jets were sometimes below the horizon, sometimes a few degress above it, particularly in the north. The evening was cool, but not cold, as on the 28th August. The sky was at first clear. Some small clouds were seen in the east before the moon rose, and these gradually approached us. At first, no motion of the air could be discovered; but in the latter part of the evening a breeze came up from the south east. The light of the moon, which was very bright, seemed to have no effect upon the northern light, except perhaps, to render it a little less luminous.

I endeavored to ascertain the direction of the centre of the arch, as nearly as possible; but this was difficult, particularly as my horizon was not level, but inclined to the east. Judging, however, from the direction of the jets, it was about one degree east of the north star, which was then nearly two degress east of the pole, making the declination about three degrees. At this point the jets appeared to be erect, but declined more and more from the centre as they appeared further from it.

(*From the Paris Constitutionel.*)

"The learned Mr. Arago had the goodness to communicate to us the following note:—

"The phenomenon which appeared on Tuesday the 25th, in the atmosphere was an Aurora Borealis. It announced itself as early as eight o'clock in the evening, by a very perceptible disturbance of the horizontal needle's diurnal variations. At half past nine this disturbance was enormous; but at that time luminous spots showed themselves here and there, between the west, north west, and north north east. A few minutes afterwards, a luminous arch formed, which lasted only a few moments. Its culminating point coincided nearly with the magnetical meridian. At eleven o'clock, the phenomenon was already considerably lessened. During the whole duration of its appearance, the horizontal magnetical needle, and even the dipping needle changed their direction so frequently as scarce to allow the time requisite for noting the observations. No Aurora Borealis has been visible at Paris these twenty years."

(*From the Journal des Debats.*)

"On the 8th September, a very beautiful Aurora Borealis was observed in the north west, from every part of Denmark, which is said to indicate an early rigorous winter.

"The day before yesterday (Sept. 28th,) towards 11 o'clock at night, all the northern part of the sky appeared in a blaze. It was supposed that a vast fire had broken out, and that the flames were devouring part of the metropolis. The reflection was as strong, and the reddened atmosphere as fiery, as on the occasion of the great fire breaking out at the theatre of L'Ambigue

Comique. Several parties of firemen were running their fire engines, when it was ascertained that the fiery appearances affected only the celestial regions. The light continued for sevall hours."

Aurora Borealis.

Gosport Observatory, Sept, 26, 1827.

"At nine o'clock last evening a bright yellow light appeared in the N. W. quarter, behind a low stationary *cirrostratus* cloud, and gradually extended from N. to W. N. W.: it continued to increase in altitude and width, and at ten had a brighter appearance than the strongest crepuscule that appears in this latitude in a clear sky, about the time of the summer solstice; but neither lucid columns of light nor coruscations yet presented themselves. At half past ten the aurora had formed itself into a tolerably well defined arc of intense light, whose base extended from N. to W. and at a quarter before eleven, perpendicular lucid columns and vivid coruscations of this subtile fluid appeared in quick succession. So brilliant was the aurora at eleven, that the streamers reached eight or nine degrees higher than *Polaris*, and their apparent base was nearly horizontal with the star *Beta* in Ursa Major. At this time the coruscations, which appeared to spring up from a much greater northerly distance than the columns were, reached to the constellation Cassiopeia, which was nearly in the zenith. Soon after eleven, a column of light six degrees in width gradually rose from the position of the before mentioned star, and when it had reached an altitude of seventy degrees, it changed from a light yellow to a blood-red color, which with the more elevated and vivid flashes that frequently reached twenty degrees south of the zenith, gave the aurora an awfully grand appearance, which it would be difficult to paint or express. This wide column remained perfect upwards of an hour, alternately waving and increasing in brilliancy, and ultimately passed through the gradation of colors, which is sometimes seen in the clouds near the horizon at sunset, as lake, purple, light crimson, &c.; it became apparently stationary in the N. E. by E. point, and its eastern red edge was very well defined in the dark blue sky. Two more columns of light nearly similar in color and width, soon afterwards sprang up, one in due north, the other in N. W. and passed the zenith several degrees to the southward: these three large variegated columns presented a very grand appearance.

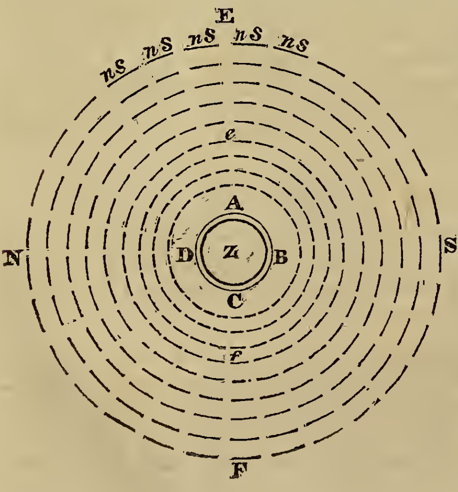
"At half past eleven, the aurora suddenly changed to light red; and from about this time till twelve o'clock the apex of the arc of light was within four or five degrees of the polar star; consequently the hemisphere from N. E. by E. to S. W.

by W. was so brilliantly illuminated as to appear like the reflection of a great conflagration, whilst the white coruscations which flashed through the atmosphere quicker than sheet lightning in sultry summer evenings, formed whole but irregularly shaped arches from these points of the horizon through the zenith nearly. At one A. M. lofty perpendicular columns emanated from the aurora in the western point; and at this time the northern hemisphere was filled with long and short streamers varying in width and brilliancy, and often terminating in very pointed forms. The coruscations from the N. E. and W. frequently met each other in the zenith, and enlightened the scattered portions of *cirrostratus* even to within thirty degrees of the southern horizon; and from the clouds being stationary, it is probable that the atmosphere was serene and undisturbed in their vicinity. Soon after 2 A. M. the aurora grew faint and gradually disappeared. The lustre of the stars of the first, second, and third magnitude was very little diminished in any part of the heavens where the vivid flashes of the aurora intervened. The diffusion of the coruscations through the atmosphere caused twelve accensions or meteors to appear at intervals in different quarters, but most of them were to the northward; and it also had the effect of increasing the temperatue of the external air near the ground half a degree between the hours of observation, notwithstanding the wind blew fresh from the south. This was the finest aurora borealis that has been observed here during the last seventeen years. In sixteen hours after its disappearance, heavy rain and a gale of wind came on from S. E. (to which quarter the coruscations mostly tended;) the common result here of the diffusion of a superabundance of electrical fluid in the lower atmosphere. An aurora borealis of extraordinary beauty is reported to have been seen all over Denmark in the night of the 8th instant, while the moon shone in full splendour."

The following remarks connected with this subject, are extracted from a paper by Prof. Hansteen, upon the influence of distant polar lights on the magnetic needle, translated and republished in the Philosophical Magazine and Annals of Philosophy, for November, 1827.

"The properties of the polar lights seem to be inexplicable, if we assume that they are produced by electric currents in the atmosphere. It seems indisputable that the direction of the rays of the aurora, like that of the *dipping-needle*, is determined by the attractive and repulsive powers of the terrestrial magnetism. The phenomenon of light seems to arise when the intensity of the terrestrial magnetism has risen to an unusual height, and this intensity seems to be considerably weakened during the development of the polar light. But we have not known hitherto any such elastic fluids in the magnet, by the union of which, phænomena of light appear, as in the two opposite electricities. It is therefore still to be discovered what kind of substance it is which seems at once to partake of the properties of electricity and magnetism.

In the *Magazine for Naturvidenskaberne*, vol. ii. pp. 98, 99, I have advanced the following hypothesis, as an attempt towards an explanation of the electro-magnetic phenomena. In the completed galvanic circuit, the conductor is traversed in an opposite direction by the opposite electricities. Every positive elementary particle strives to combine with a negative one; thus united in pairs they neutralize each other, and their *electric* power disappears. But in this neutral state they perhaps appear as elastic fluid *elementary magnets*, which so surround the surface of the polar wire that all north poles are turned on one side, and all south poles on another; and the axis of every elementary magnet is the tangent of the circular section of the conducting wire. Owing to the constantly aggregating quantity of electricity from both ends of the wire, and the expansive nature of electricity, these elementary magnets are forced out of the surface of the wire with a velocity equal perhaps to that of light itself. As long, therefore, as the circuit is uninterrupted, the wire is surrounded by a cylindrical atmosphere of neutralized molecules combined in pairs, each pair of which has a magnetic north pole and south pole, and a neutral point.



Let ABCD represent a section of a conducting wire turning towards the zinc pole of a galvanic apparatus. The neutralized electric pairs of molecules NS flow from all points of the circle ABCD towards the direction of the radii ZE, ZF &c., (like the circular waves round a stone dropt into the water,) in a manner that on imagining ones self to be in the point Z, all the magnetic north poles N will lie to the left, and all the south poles S to the the right. By this means an innumerable quantity of circular elastic fluid magnets is formed round the conducting wire, in which magnets every point may be considered as the neutral, every north pole being immediately touched by a south pole, which impedes its free action. One might obtain such a circular magnet without free poles by forming a connected steel ring, touching it at the same time in several points of the circumference with the south poles of different magnets, and then moving these poles round the ring from right to left. This steel ring would then have no perceptible poles; but if it were any where broken in two, the surface of the fracture on the left hand would appear as a free south pole, and that on the right hand as a north pole. In this manner it may be easily explained, why the intensity decreases in the ratio of the simple distances from the axis of the conductor: for if the radius ZE is double the size of *Ze*, the same quantity of electricity which first filled the circle *ef*, must afterwards fill the doubly large circle ESF, and consequently the intensity must decrease in the same proportion as the distance increases. Hence it may also be easily explained why the electro-magnetic action freely penetrates the conducting bodies as well as the non conducting. For the un-neutralized electric molecules excite in every body instantaneously the opposite state, and are therefore attached to the body; but those that are neutralized cannot do it, and have therefore a perfectly free passage. According to this hypothesis, magnetism would be nothing but neutralized electricity. It is therefore possible that the aurora consists of such neutralized pairs of molecules which here, as in the completed electric circuit, obey the laws of attraction and repulsion of the magnet. I present this as a simple hypothesis, and confess that there still remain various obscurities not easily to be solved. But it is not to be expected that in such an obscure and difficult subject, the truth should be discovered in a first attempt."

We had selected from the newspapers, a number of interesting and valuable statements respecting the appearance of the Aurora Borealis,* at different *places*, but we are obliged to omit them in order to make room for original communications on other subjects. Possibly some of them may be inserted, (should there be room) among the miscellanies.

* Particularly that from the New Haven Journal, and from a Canandaigua Paper.—*Ed.*

Art. XVII.—*Contributions towards the Botany of the States of Illinois and Missouri; by* Lewis C. Beck, M. D.

(Continued from Vol. XI, p. 182.)

ICOSANDRIA. MONOGYNIA.

Cactus opuntia. *Lin.*

Hab. Sandy banks of the Illinois river, near Fort Clark, frequent.

Prunus pennsylvanica. *Ait.*

Hab. Barrens, near St. Louis—May.

Obs. Lower surface of the leaves somewhat pubescent, their shape usually oblong-oval. Pedicels about an inch long, smooth. This species can be readily distinguished from P. americana. *Marshall.* (P. nigra. *Ait?*) by the serratures of the leaves which in the latter are very sharp,—almost spinose.

Lythrum alatum. *Pursh.*

Hab. Marshes, four miles west of St. Louis—June.

Obs. *Stem* two to three feet high, winged. *Leaves* closely sessile, sub-cordate, ovate-oblong, opposite, and alternate. *Flowers* hexandrous, solitary, longer than the leaves, sessile or on very minute pedicels.

ICOSANDRIA. DI—PENTAGYNIA.

Agrimonia eupatoria. *Lin.*

Hab. Prairies near St. Louis, frequent—July.

Agrimonia suaveolens. *Pursh.*

Hab. Borders of marshes near St. Louis—July.

Obs. *Stem* one and a half to two feet high, densely covered with long brownish hairs. *Leaves* interruptedly pinnate; *leafets* thirteen to fifteen, with smaller ones interposed, terminal one sessile, all more or less hairy beneath. *Flowers* small, and nearly sessile.

Cratægus crus-galli. *Ait.*

Hab. Prairies near St. Louis—April.

Cratægus coccinea. *Lin.?*

Hab. Alluvions of the Illinois—April. The confusion which attends this genus leaves me in doubt concerning this plant.

Spiræa opulifolia. *Lin.*

HAB. Bank of the Mississippi near St. Louis—May.

Spiræa aruncus.

β americana. *Pursh.*

HAB. Banks of the Merrimack river, Missouri—June.

OBS. *Stem* three to four feet high. *Flowers* small, hermaphrodite. *Leaves* triply pinnate; *leafets* ovate, acuminate, pubescent on the under surface.

Gillenia stipulacea. *Nutt.*

HAB. Hills near Potosi, Missouri—June.

ICOSANDRIA. POLYGYNIA.

Rosa parviflora. *Ehrh.*

Rosa carolina. *Lin.*

Both species are common on the prairies near St. Louis, and flower in June.

Rosa rubifolia. *Brown in Hort. Kew.*

Fruit subglobose and with the *peduncles* glandular-hispid. *Stem* smooth. *Prickles* solitary, short, uncinate. *Leaves* petioled, ternate; *leafets* ovate, acute, serrate, glabrous above, white-downy beneath. *Calyx* with ovate, acute or acuminate segments, which are covered with viscid hairs. *Flowers* corymbose. *Petals* large, cuneate, white, pink and red.

OBS. A very branching shrub, from six to eight feet high, common on the prairies near St. Louis. I have sometimes seen the bushes assume a conical form, and completely covered with flowers. The color of the petals when they are first unfolded is white, this in a few days is changed to pink, and before the end of the flowering season this last is again changed to a deep red. Hence Mr. Bradbury who considered it a new species proposed the name of *mutabilis*. But it is undoubtedly R. rubifolia. It flowers from June to August.

Rubus trivialis. *Lin.*

Rubus villosus. *Ait.*

Both species are common on the barrens, near St. Louis—May.

Geum album. *Willd.*

Geum virginianum. *Lin.*

Both found on the banks of the Mississippi, near St. Louis —June.

Potentilla argentea. *Lin.*
Potentilla simplex. *Mich.*
Potentilla canadensis. *Lin.*
Potentilla norwegica. *Lin.*

Hab. Prairies near St. Louis—April and May.

Potentilla supina. *Lin.*

Obs. *Stem* decumbent, dichotomous, pubescent. *Leaves* pinnate; *leafets* three to five pairs, with a terminal one, somewhat oval, incisely dentate, a little hairy. *Peduncles* solitary, an inch or more in length, with a single flower. *Petals* about as long as the calyx.

Hab. Inundated banks of the Mississippi at St. Louis and also near Herculaneum—May—June.

Fragaria virginiana. *Lin.*

Hab. On the prairies of Illinois and Missouri, frequent—April. Fruit smaller than in more northern latitudes.

POLYANDRIA. MONOGYNIA.

Helianthemum canadense. *Mich.*

Hab. Sandy prairies near St. Louis—June.

Meconopsis petiolata. *De Cand.*
Stylophorum petiolatum. Nutt.

Hab. Banks of creeks, Illinois and Indiana—May.

Sanguinaria canadensis. *Lin.*

Hab. Banks of the Illinois river, from its mouth to Fort Clark, frequent—March—April.

Podophyllum peltatum. *Lin.*

Hab. Shady situations near St. Louis—April.

POLYANDRIA. DI—PENTAGYNIA.

Delphinium tricome. *Mich.*

Obs. *Stem* ten to twelve inches high. *Leaves* five-parted; lobes three-cleft, linear. *Spur* a little longer than the flower, which is bluish-white.

Hab. Prairies near St. Louis and Fort Clark, on the Illinois—April.

Aquilegia canadensis. *Lin.*

Hab. Rocky banks of the Mississippi and Illinois—April.

Hypericum maculatum. *Walt.*
HAB. Prairies near St. Louis—June.

Hypericum perforatum. *Lin.*
Hypericum parviflorum. *Lin.*
HAB. Both common on the prairies near St. Louis—July.

Hypericum rosmarinifolium. *Ell.*
OBS. *Stem*, terete, somewhate angled, colored. *Leaves* opposite, linear-lanceolate, shining, paler on the under surface, obtuse, but terminated by a short mucronate point, margin revolute and somewhat undulated. *Flowers*, numerous, in a dichotomous terminal corymb. *Styles* three, generally united.

A shrub from three to four feet hight, found on the low grounds near St. Louis.

POLYANDRIA. POLYGYNIA.

Porcelia triloba. *Pursh.*
HAB. Banks of the Illinois, and Mississippi, frequent—April.

Clematis virginiana. *Lin.*
HAB. High grounds near the mouth of the Missouri—July.

Clematis reticulata. *Walt.*
HAB. Banks of the Riv. des Pères, near St. Louis. My specimens agree with the very accurate description of this species, given by Dr. Elliott, in his sketch of the Botany of South Carolina, and Georgia. Its coriaceous and distinctly reticulated leaves sufficiently distinguish it from the allied species.

Anemone terella. *Pursh.*
HAB. Low prairies on the Illinois—March.

Anemone virginiana. *Lin.*
HAB. Shady situations on the banks of the Merrimack, and Missouri rivers—May.

Anemone pennsylvanica. *Lin.*
Anemone thalictroides. *Lin.*
Both common in various parts of Illinois, and Missouri—June.

Hydrastis canadensis. *Lin.*
HAB. Banks of the Illinois river—April.

Caltha palustris. *Lin.*

Hab. Swamps in Illinois, and Missouri—April.

Hepatica triloba. *Wild.*

Hab. Banks of the Illinois and Mississippi, common—March.

Ranunculus fluviatilis. *Lin.*

Hab. Ponds near Herculaneum, Missouri—May—June.

Ranunculus abortivus. *Lin.*
Ranunculus fascicularis. *Muhl.*

Hab. Inundated banks of the Mississippi and Illinois—April.

Ranunculus ——— N. S.?

R. foliis omnibus radicalibus, pubescentibus, petiolatis, 3—5 sectis; scapo villoso, unifloro, foliis longiore; calyce persistente; petalis oblongo-ovatis.

Obs. *Root*, fibrous and fasciculated. *Leaves* all radical, of the length of the scape, sometimes whitish pubescent on the under surfaces. *Scape* one flowered, villous. Plant from one half to two inches high. It closely resembles R. collinus of Robert Brown, as described in De Candolle's Prodromus; but I have not the means of comparison.

Hab. Wet Prairies near Fort Clark, on the Illinois—April.

Brasenia peltata. *Willd.*

Hab. Ponds four miles west of St. Louis—June.

DIDYNAMIA. GYMNOSPERMIA.

Teucrium canadense. *Lin.*

Hab. Prairies near St. Louis—June, July. My western specimens undoubtedly belong to this species, the leaves being ovate-lanceolate, but the bracts are very little longer than the calyx. This species, however, is most probably not distinct from the T. virginicum.

Mentha canadensis. *Lin.*

Hab. Banks of the Mississippi, June. Identical with M. borealis of *Michaux*.

Isanthus cœruleus. *Mich.*

Hab. Prairies near St. Louis—August.

Hyssopus nepetoides. *Willd.*

HAB. Banks of the Mississippi, at St. Louis—June.

Stachys aspera. *Mich.*

HAB. Alluvions of the Mississippi—July.

OBS. Plant nearly smooth except the angles of the stem, which are retrosely-hispid.

Pycnanthemum linifolium. *Pursh.*

HAB. Prairies near St. Louis—July.

Pycnanthemum pilosum. *Nutt.*

P. foliis sessilibus, lanceolatis, subtus tomentosis, obsolete dentatis; capitulis magnis, terminalibus; bracteis lanceolato-ovatis, cano-tomentosis.

Stem eighteen to twenty inches high, pilose, sparingly branched at the summit. *Leaves* lanceolate, pilose on the under side, prominently veined, obscurely denticulate. *Bracts* of the length of the calyx, which is also whitish pubescent. *Heads* larger than in P. *lanceolatum.*

HAB. Prairies and barrens. St. Louis—June.

Dracocephalum virginianum. *Lin.*

HAB. Prairies near St. Louis—July. Entirely resembling the specimens, from the shores of lakes Erie, and Ontario.

Prunella pennsylvanica. *Willd.*

HAB. Prairies, Illinois and Missouri, frequent—June.

Scutellaria lateriflora. *Lin.*

HAB. Banks of the Mississippi, at St. Louis—July.

Scutellaria parvula. *Mich.?*

OBS. *Stem* simple, four to six inches high, pubescent above, and on the veins beneath, lower ones petioled and subcordate. *Flowers* solitary, or in pairs, axillary, small. S. *ambigua. β missouriensis Torrey in Lyc. Ann.?*

Scutellaria versicolor. *Nutt.*

HAB. Prairies near St. Louis—July.

Scutellaria canescens. *Nutt.*

HAB. In similar situations with the last—July.

DIDYNAMIA. ANGIOSPERMIA.

Phryma leptospermia. *Lin.*

Hab. Alluvions of the Mississippi, opposite to St. Louis —July.

Verbena hastata. *Lin.*

Hab. Road sides in prairies—June.

Verbena urticifolia. *Lin.*

Hab. In similar situations—July.

Verbena angustifolia. *Mich.*

Hab. Prairies near St. Louis, also in the mine district—June.

Verbena stricta. *Vent.*

Hab. Barrens near St. Louis—July.

Obs. My specimens agree with the descriptions of this species, except that the leaves are oval or ovate, and not obovate.

Verbena lanceolata.

V. erecta, hirsuta; foliis lanceolatis, acutiusculis, basi attenuatis, subsessilibus, inciso-serratis; spica terminale, stricta, imbricata; bracteis lanceolatis, calyce superantibus.

Stem simple, two to three feet high, stifly erect, hairy. *Leaves* three to four inches long, about an inch in breadth, crowded together, somewhat acute, coriaceous, much attenuated at base, subsessile. *Spike* simple, terminal, dense flowered, imbricate. *Flowers* small, blue. *Bracts* narrow-lanceolate, acute, longer than the calyx. Resembles V. Stricta in habit.

Hab. Near St. Louis—July.

Verbena Aubletia. *Jacq.*

Hab. Rocky banks of the Mississippi at St. Louis—May.

Verbena bracteosa. *Mich.?*

V. decumbens hirsutus; foliis laciniatis, inferioribus petiolatis; bracteis linearibus, longissimis, patentibus.

Obs. I am somewhat in doubt concerning this plant. Its general resemblance to V. aubletia, induced me to think that it was V. pennatifida of Nuttall, (*Jour Amer. Acad.* vol. II. p. 123;) but the teeth of the calyx, are not setaceous as in that species. The flowers are small, closely aggregated together in a terminal spike and almost concealed by the long hirsute bracts.

Hab. Beaten grounds near St. Louis—June.

Bignonia radicans. *Lin.*

Hab. Low banks of the Mississippi, two miles above St. Louis, twining about trees—June.

Ruellia strepens. *Lin.*

Hab. Banks of the Mississippi—May.

Ruellia ciliosa. *Pursh.*

Obs. *Stem* erect, hairy. *Leaves* sessile, ovate, with long whitish hairs on the margin and nerves. Teeth of the *calyx* about a third as long as the tube of the corolla.

Hab. With the last.

Buchnera Americana. *Lin.*

Hab. Prairies near St. Louis—July.

Collinsia verna. *Nutt.*

Hab. Wet Prairies of Illinois and Indiana, frequent—May.

Gerardia tenuifolia. *Vahl.*

Hab. Banks of the Missouri near St. Charles—June.

Gerardia quercifolia. *Pursh.?*

Obs. *Leaves* all sinuate-pinnatifid; teeth of the *calyx* longer and narrower than in the eastern specimens.

Hab. Prairies, St. Louis—July.

Pedicularis gladiata. *Mich.*

Hab. Barrens near St. Louis—April.

Pedicularis canadensis. *Lin.*

Hab. With the last, and also on sandy prairies in Illinois—April.

Mimulus ringens. *Lin.*

Hab. Inundated banks of the Mississippi, common—June.

Martynia proboscidea. *Willd.*

Hab. Rocky banks of the Mississippi at St. Louis.

Euchroma coccinea. *Nutt.*

Hab. Wet prairies west of St. Louis, frequent—May.

Orobanche uniflora. *Lin.*

Hab. Roots of trees on the banks of the Illinois, rare—April.

Pentstemon pubescens. *Lin.*

Hab. Prairies, St. Louis—April and May.

Pentstemon Nuttallii.*

P. glaberrima; foliis coriaceis, ovato-lanceolatis, denticulatis, subamplexicaulibus; floribus paniculatis; calycis foliolis ovatis acuminatis; filamento sterili apice barbato; antheris glabris.

Stem two to three feet high, round, very smooth, almost polished, stifly erect, simple. *Leaves* three to five inches long, varying from ovate to lanceolate, acuminate, coriaceous somewhat glaucous, subclasping. *Flowers* panicled; *peduncles* opposite, three to five flowered. *Sterile filament* densely bearded on the under side about half its length. *Anthers* smooth, as in P. pubescens. Leafets of the *calyx* ovate or oval, with a long acuminate point. Distinguished from P. erianthera of *Nuttall*, by its smooth anthers.

TETRADYNAMIA SILICULOSA.

Draba caroliniana. *Walt.*

Hab. Sides of mounds near St. Louis—May.

Draba arabisans. *Mich.*

Obs. *Stem* three to four inches high, leafy. *Leaves* lanceolate-ovate, sparingly dentate.

Hab. In similar situations with the last.

Capsella bursa-pastoris. *De Cand.*

Hab. On the prairies in Illinois and Missouri, common—April.

Lepidium virginicum. *Lin.*

Hab. Mounds near St. Louis—June.

TETRADYNAMIA SILIQUOSA.

Dentaria laciniata. *Lin.*

Hab. Wet prairies on the Illinois, near Fort Clark—April.

Cardamine virginica. *Lin.*

Hab. Banks of small streams near St. Louis.

Sisymbrium canescens. *Nutt.*

Hab. Banks of the Mississippi, at St. Louis. Two other plants apparently belonging to this genus, I am unable to determine for the want of perfect specimens.

Arabis rhomboidea. *Pers.*
Arabis falcata. *Mich.*

Hab. Both found on the rocky banks of the Mississippi.

MONADELPHIA PENTANDRIA.

Lobelia pallida. *Muhl.*
Lobelia claytoniana. *Mich.*
HAB. Prairies, Missouri.

Passiflora lutea. *Lin.*
Twining about trees two miles west of St. Louis, Miss. Agreeing in every respect with specimens from Georgia.

MONADELPHIA DECANDRIA.

Geranium maculatum. *Lin.*
HAB. Wet prairies on the Illinois—April.

Geranium carolinianum. *Lin.*
HAB. Road sides near St. Louis.

Schrankia uncinata. *Lin.*
HAB. Siliceous hills near Potosi, Missouri, common—June.

MONADELPHIA POLYANDRIA.

Sida spinosa. *Lin.*
Malva rotundifolia. *Lin.*
HAB. Both common on road sides and beaten grounds, near St. Louis.

(To be continued.)

ART. XVIII.—*Remarks on Mr. Barnes' Notice respecting Magnetic Polarity; by a* SURVEYOR.

TO PROFESSOR SILLIMAN.

IN the 12th volume of your valuable Journal I offered some remarks under the signature of a Surveyor, upon Prof. Eaton's proposed improvement in the manufacture of compass needles. These remarks were made I trust in a becoming spirit—dictated as they were by a desire to promote the great cause of truth, and to prevent at least the rash adoption of suggestions, which I conceived would be of injury to a respectable portion of the community. That I did not appear under my own proper name, was not that I feared responsibility, but because every purpose would be answered by the method which I employed. Besides, as the objections which I urged are to be found in every standard treatise on magnetism, I did not expect any credit for their mere repetition.

Under these circumstances I was somewhat surprised that Mr. Barnes, in the "Notice," published in your last number, should have pronounced with so much boldness in favor of Mr. Eaton's proposed improvement. Above all I was surprised that he should have attributed my remarks to improper motives, when I venture to assert that no part of them will warrant such an inference.

After the positive declaration with which the 'notice' is prefaced, I was prepared to find a detail of conclusive arguments, or accurate experiments in its support. But strange as it may appear, there is not a single fact or experiment relating to the main question in dispute; viz.—Whether *tipping* the ends of a compass needle with brass, does or does not affect its directive force? We have, it is true the author's assertion, "that the fitful variation of the compass is caused by the magnetism of the card," for which Mr. Eaton has proposed a "simple and efficient remedy." Whether this assertion is a sufficient answer to my former remarks, is not for me to determine. The proposed improvement and the objections to it are now fully before the public, and I shall cheerfully abide their decision. In the mean time, however, I can hardly suppose that Mr. Patten will risk the reputation which he has acquired as an artist, by sending forth instruments, which to say the least, carry with them the evidence of imperfection.

I cannot omit the present opportunity, of making a few observations upon the remaining part of Mr. Barnes' paper; and although *he* has so freely pronounced upon the *motives* which actuated me, I shall be content with inquiring into the *merits* of the experiments and results which he has offered.

We are told by Mr. Barnes that "Mr. S. Dodge of the western High School of Rochester, took the (iron ?*) window bar which lay near it," (the compass needle,) "and placing it perpendicularly found that the *lower* end was a north pole. He inverted the bar, and was surprised to find the *same* result, that is the poles were *instantly changed by in-*

* This word and its annexed (?) were inserted by the EDITOR.

verting the bar." The experiments were repeated by Mr. Barnes with the same results.

Now surprising as these results may have appeared to these gentlemen, they were first made known about the year 1600, and have been distinctly stated in almost every work on magnetism since that time. Mr. Barnes indeed appears to have been, in part, aware of this, as he says—"Dr. Gilbert has mentioned the fact that opposite ends of an iron bar equally affect the magnet, and in the same way, and he accounts for the fact, by supposing that the earth magnetizes the bar instantaneously." But still the whole subject is to him a mystery, as is evident from the following questions, which he gravely propounds—viz. "Is then the common remark, in the books, that a bar becomes magnetic by long standing in a vertical position strictly true? And will not any such bar instantly change its polarity by being inverted?"

In answer to these questions, I would remark, that the difference depends wholly upon the kind of bar employed. A bar of hard iron or steel, like a bar of soft iron, when held in a vertical position, becomes magnetized by the influence of the earth. But in the bar of soft iron, the magnetism is impressed instantaneously;—in the bar of hard iron or steel, time is necessary for its development. In the bar of soft iron, the magnetism is transient; in the bar of hard iron, it is permanent. In the bar of soft iron, therefore, a change of position produces an instantaneous change in polarity;—in the bar of hard iron, a change of poles would require the same time that was necessary to render it magnetic. If Mr. Barnes is still in doubt upon these points I would refer him to *Biot's Traitè Prècis*, third edition, vol. 2d, pp. 8th and 9th. *Cavallo's Philosophy*, second American edition, vol. 2d, pp. 279 and 280, and indeed to almost any work in which magnetism is treated of.

The "Notice" is chiefly made up of experiments to ascertain what is denominated the "*neutral* point, or medium between polarities directly opposite." From the manner in which their result is announced, I should infer that the author was not aware, that several years since, Mr. Barlow in his researches upon the method of correcting the local variation of a ship's compass, ascertained the fact—that in every mass of iron there is a *plane of no attraction*—a plane, in which a compass being placed, *the iron has no effect upon* *the needle.* It was also satisfactorily settled by the experiment of Mr. Barlow and others, that this plane cuts the horizon in a line due east and west, and to which it inclines at an angle, which in all parts of the earth, is the *complement of the dip.* Now supposing Mr. Barnes' experiments to have been conducted with perfect accuracy, and allowing, what is very questionable, that they are susceptible of perfect accuracy—he has only ascertained a fact which any person might have learned by a bare inspection of the dipping needle. For as has been remarked, this line of no attraction, or the "neutral point" as it is denominated in the "Notice," is in all cases the complement of the dip. Whether Mr. Barnes is correct in stating the dip at New York to be 67½ degress, (which is the complement of 22½,) observers in that city, will either confirm or correct.

It is not intended by any thing that has been said to underate in the slightest degree, the importance of experiment, for I am well aware that a single new fact thus ascertained, is of more importance to the cause of science, than a score of crude speculations. Yet it is difficult to determine how much credit will be awarded to an experimenter who announces a result as "curious and interesting," without a knowledge of what has previously been done by others.

A Surveyor.

Art. XIX.—*A Chemical Analysis of the Pittsburgh Mineral Spring; by* William Meade, M. D.

TO THE EDITOR.

Sir—A mineral spring having been lately discovered on the estate of J. S. Scully, Esq. near Pittsburgh, in the state of Pennsylvania, which had attracted considerable attention, I was favored by the proprietor with a few bottles of the water carefully put up, with a request that I would make a Chemical Analysis of it, with some observations on its medicinal qualities. The result of this analysis, I now take the liberty of sending to you, together with some extracts from the remarks which I have made on the general properties of a class of mineral waters, which are ranked as chalybeates, and which are not uncommon in this country, though not generally known, or their valuable properties fully appreciated. If you think the subject of any interest to the public, or that such an inquiry is within the limits of those branches of science, to which your useful Journal is appropriated, this communication is perfectly at your service.

I am sir, very respectfully yours,

W. Meade.

The Pittsburgh Mineral Spring is pleasantly situated on the farm of John S. Scully, Esq. in St. Clair township, Alleghany county, four miles south west of the city of Pittsburgh, and two miles south of the Ohio river. It issues from the fissures of a rock, on the side of a small hill, and discharges about a gallon of water per minute, which is conveyed through a tunnel into a reservoir, from which it is pumped to supply the bath house. The water in the spring, when undisturbed for a few hours, is covered with a thin white pellicle, which after some time assumes an iridescent appearance. It then falls to the bottom, and is renewed, if the water be not disturbed, as may be more particularly observed every morning.

When the water is first taken from the spring, its appearance in a glass is perfectly clear; its taste is lively and rather pungent, with a peculiar ferruginous flavour, and an odour which has some resemblance to the scouring of a gun barrel, and which is easily recognized as arising from an impregnation of sulphuretted hydrogen gas.

If the water is allowed to remain for some hours in a glass, it loses, in some degree, its transparency, as well as its lively and pungent taste; numerous air bubbles are extracted from it, and a light deposit takes place on the inside of the glass, which renders it pellucid. Vessels which are constantly used become lined with an ochry incrustation which is with difficulty removed, and the bottom and sides of the well, as well as those substances over which the water flows, contain a sediment of the same nature.

The temperature of the spring is nearly the same at all seasons of the year. In the month of August, when the atmosphere was as high as 85 of Fahrenheit, the temperature of the water was only 54.

The specific gravity of the water differs little from the purest water. When compared with distilled water it is as 1002 to 1000.

Having made these preliminary remarks on the external qualities of the spring, I proceed to an experimental inquiry into its chemical properties.

SECTION I.

Examination of the contents of the water by tests and reagents.

Exper. 1. *Litmus paper* when dipped into the water fresh from the spring has its color immediately changed from blue to red, but this color is fugacious; nor will the water when boiled produce any such effect, a decisive proof that this change was produced by the presence of uncombined carbonic acid gas, and not by a fixed acid.

2. *Paper stained with tumeric* is not changed in color by this water, nor could it well be expected as the carbonic acid gas would repress the effect of this test.

3. *Lime water* produces an immediate turbidness and precipitation when added to this water, yet a variety of circumstances are to be attended to in the application of this test. The usual directions which are given are that the lime water shall be added to it in equal quantity. This, however if the mineral water is saturated with carbonic acid, as in the case of the Ballston water, is too much, and if the water contains but little carbonic acid, it is not sufficient to decompose the same water; in order therefore to ensure a complete and permanent precipitation of the lime, it requires four cubic inches of the water of this spring to decompose three cubic inches of lime water. It is evident, therefore, that the greater the quantity of carbonic acid gas, which is contained in a mineral water, the less of that water is required to produce the requisite change, so that by observing this rule, an experienced chemist can form a tolerable accurate judgment of the quantity of carbonic acid contained in any mineral water.

4. *Tincture of galls*, when poured into a glass of this water strikes an immediate purple color, which after standing for some time, increases in intensity, but no such change takes place if the water has been previously boiled.

5. *Prussiat of potash.*—This test produces an immediate change in the color of the water; it first becomes green, and after standing for some hours assumes a blue color.

6. *Nitrat of silver.*—When a few drops of this test are added to a glass of this water, a dense white flocculent precipitate is thrown down, which after some time changes to a light purple color.

7. *Acetate of lead*, throws down an immediate dense white precipitate, the color of which is rendered a shade darker when allowed to stand in the glass for a few hours. This precipitate is partly dissolved when a few drops of nitric acid are poured on it, which shows that a small quantity of sulphuric, as well as muriatic acid, is present; muriat of lead being soluble, while the sulphate is perfectly insoluble in any acid.

8. *Muriat of Barytes*, produces a white cloud when permitted to stand for some time, a precipitate falls which is not soluble in nitric acid.

9. *Oxalat of Ammonia*, produces a slight turbidness but scarcely any precipitate.

10. *Liquid or pure ammonia*, has no effect on the water either when fresh from the spring or when concentrated by boiling.

11. *Carbonat of potash*, does not disturb the transparency of the water.

12. *Sulphuric acid.*—This acid produces no change.

SECTION II.

Inferences to be drawn from the above experiments.

If it was only required to determine the quality of this water, and the nature of the ingredients, these experiments would be nearly sufficient; but no chemical investigation will be deemed satisfactory at present which does not exhibit the exact proportions of the different ingredients. Before however we proceed farther in the investigation, the use of tests and reagents become an important guide; by their means future experiments may be conducted with more precision, and when we proceed to evaporation, much time and labour are spared in looking for those substances which we had previously ascertained by reagents not to be present. Thus having discovered iron by experiments 4 and 5 and that it is held in solution by carbonic acid, it was in vain to look for any metallic salt, and we have only to determine the quantity of iron which is thus suspended.

Experiments 1 and 3 have shown the presence of a considerable quantity of carbonic acid gas.

Experiments 1 and 4 show that the iron is held in solution by this gas.

Experiments 6 and 7 demonstrate the presence of muriate acid combined with a base.

Experiments 8 and 9 shew the presence of a small quantity of sulphuric acid and of lime.

It now remains to confirm these, by evaporation and more direct experiments, as well as to determine the quantity of each substance in a given quantity of water.

SECTION III.

Examination of the gaseous contents.

As many of the most important qualities of mineral waters arise from the gas with which they are impregnated, there is no part of their analysis which requires more attention. In order to determine the quantity of this gas I proceeded in the manner which I have pointed out in my essay on the mineral waters of Ballston and Saratoga, and which I have uniformly found successful. A plate of the instrument which I used on those occasions will be found in the publication alluded to. It consists of a tin vessel, calculated to hold one quart of water. A covering was soldered on it, and no opening left except one at the top, to which was adapted a small tube about half an inch long, and one third of an inch in diameter. A graduated decanter was connected with this which was filled with hot water. Heat was then applied to the tin vessel when the gas which was extricated from one quart of water was collected in the glass vessel graduated into cubic inches. I found that the whole of the gas which was extricated from one quart of the water amounted to eighteen cubic inches, which, when passed through lime water, was entirely taken up by it, so that it consisted entirely of carbonic acid gas. Some surprise may be excited at finding so small a quantity of carbonic acid in this water, when we compare it with the waters of Saratoga and Ballston, but let it be recollected that they have no resemblance; and if we refer to the analysis of the most celebrated chalybeates in Europe, and even in this country, none of them are stated to contain more, and few of them so much. It is even probable that if this water were examined when immediately taken from the spring, it would be found to contain more of this gas.

SECTION IV.

Examination of the contents of the Pittsburgh Mineral Spring by Evaporation.

The experiments which have already been detailed throw great light on the qualities of this water, and enable the experienced chemist to decide upon the nature, but not on the quantity of the different substances with which it is impregnated. To make an accurate estimate of these I proceeded to evaporate one quart of water in a glazed China vessel, placed in a sand bath over a furnace. Heat was gradually applied, but never allowed to exceed 180 or 200 of Fahrenheit, when the gas began to arise, the water became slightly turbid, and a light pellicle appeared on its surface, which gradually subsided to the bottom of the vessel; and when the water was evaporated to dryness, the whole of the residuum or solid contents which was collected, amounted to 4 grains. This powder when exposed to the atmosphere for several days, showed no signs of deliquescence, nor was it sensibly increased in weight. In order to determine the component parts of these four grains, I proceeded in the following manner. I poured over it, in a small phial bottle, about half an ounce of alcohol of the specific gravity .827 and shook it repeatedly for twenty four hours; then filtered it carefully, when I found that it had lost in weight only half a grain, which was the whole that the alcohol had taken up. The residue now reduced to three and a half grains, was treated with an ounce of pure distilled water, and having left it sufficiently long to complete the solution of whatever was soluble in pure water, I again filtered it carefully, and dried the residuum which was now reduced to one and a half grains.

Only this residuum which resisted the action of alcohol and of distilled water, remained to be examined, and, as from former experiments I had satisfied myself that it must consist principally of the iron and earths contained in the water, I re-dissolved it in dilute marine acid which took up the whole of it, except half a grain of white powder, which remained on the filter, and which not being soluble in dilute marine acid was found to be gypsum or sulphate or lime.

We have now three solutions which we shall examine in the following order:—

First—That which was taken up by the alcohol and consisted of only half a grain. This could be only muriate of lime or muriate of magnesia. Having converted it into an aqueous solution by previous evaporation, and subsequent dilution in a small quantity of distilled water, I found that it was precipitated by pure ammonia, and shewed the presence of marine acid by the addition of nitrate of silver. Thus we have decided the presence of muriate of magnesia, half a grain.

Second—It will be perceived that the distilled water had taken up two grains of the residuum, from the solution in alcohol. To ascertain the properties of this, I evaporated this aqueous solution over a lamp in a glass vessel. When the evaporation was nearly finished saline cubic crystals appeared, which on examination, were found to be wholly muriate of soda, or common salt.

The third and last solution in marine acid, which consisted of one grain, was diluted with distilled water, and as I had no reason to doubt it contained the whole of the iron with which the water was impregnated, I added a few drops of succinat of ammonia which immediately threw down a brown precipitate. When the whole of it was precipitated the solution was filtered, and after the residuum had been exposed to a red heat it was weighed and examined, when it was found to consist of one grain of oxide of iron.

The Analysis of the Pittsburgh Mineral Spring having been thus completed, I shall here recapitulate the whole of its contents as it appeared to me from experiments, as follows:—

Muriate of soda - - -	2	
Muriate of magnesia - - -		1-2
Oxide of iron - - -	1	
Sulphate of lime - - -		1-2
Total	4	

Quantity of carbonic acid gas in one quart of water eighteen cubic inches.

SECTION V.

General Remarks on the sensible properties of the Pittsburgh Mineral Spring, and of its comparative qualities as resembling those most celebrated in Europe and America.

When we take a view of the component parts of this mineral water, as they appear by analysis, we must perceive that it is an uncommonly pure water, possessing all the qualities of a strong chalybeate. Those who are not accustomed to examine waters of this description, may at first feel some surprise at not finding it to contain a greater quantity of solid contents, but when we refer to the analysis of similar springs both in Europe and America, as performed by the most distinguished chemists in each country, we shall find that the Pittsburgh spring possesses qualities equal to any of them, and to many is greatly superior. As an instance in point, I shall take for example, in the first place, the waters of Tunbridge, in England, one of the most celebrated and established chalybeates of that country, on which many treatises have been written, and much discussion taken place with respect to its medical qualities. According to the analysis of the celebrated Doct. Babington, the Tunbridge water contains only one grain of oxide of iron in a gallon of water, while the Pittsburgh spring contains four times as much, viz: one grain in a quart. It also contains only ten cubic inches of carbonic acid gas in one gallon of water, while the Pittsburgh spring contains eighteen inches in a quart. On the whole its solid contents do not amount to more than one fourth of the quantity we find in the Pittsburgh spring; and yet this mineral spring is as much frequented as any in England, and is known to possess most valuable medicinal properties in those diseases to which it is applicable. But we shall refer to various mineral springs in this country of established reputation, where extensive buildings have been erected, and which are frequented with great advantage, by invalids from all parts of the union. In doing so I shall select those whose qualities are precisely similar, and whose virtues are to be attributed chiefly to their chalybeate qualities.

The mineral water of Schooley's mountain, in the state of New Jersey, is perhaps one of those which has for many years sustained the greatest reputation as a chalybeate. Having visited it myself, I have had an opportunity of observing its powerful medicinal qualities as a chalybeate, but for an accurate and able analysis of it, I must refer to an essay of Professor M'Neven, of New York, where it will be found that the whole contents of one gallon of the water are only about eight grains; two grains of which consist of oxide of iron—and that one quart contains nineteen cubic inches of carbonic acid gas. Here then we have a mineral water of acknowledged reputation which does not contain much more than one fourth the quantity either of iron or saline solid contents, which we find in the Pittsburgh spring, and as nearly as possible the same quantity of carbonic acid gas. I could refer to many other springs of the same nature, in this country, possessing the same properties, but scarcely one have I ever examined, possessing them in the same degree; among others, the Yellow Springs, in Pennsylvania, where beautiful buildings are erected, and accommodations of every kind are prepared for the invalid; yet, having myself made an analysis of this water with great care, I found that it had no claim to rank as a chalybeate of a superior order. In fact, all those mineral springs which are impregnated with iron, held in solution by the carbonic acid gas, in whatever country they are situated, are properly called chalybeates, and are endowed with nearly the same medicinal properties. What these are I shall now proceed to point out.

SECTION VI.

On the medicinal qualities of the waters of the Pittsburgh Mineral Spring, with observations on the effect of such waters on the system.

The operation of the chalybeate waters, perhaps the most important class of natural medicines, has greatly occupied the attention of practical physicians. Much refinement has been introduced into the subject, which it is my intention to avoid, as my main object is to point out the principal effects which such waters produce on the system, and the diseases to which they are more particularly applicable. Let me however premise, that though the principal virtues in those waters are derived from their chalybeate impregnation, yet certain differences will arise, which modify or alter their operation. These may be traced either to the presence of an active neutral salt or to a large excess of carbonic acid.

I cannot exemplify this better, than by referring to the waters of Ballston and Saratoga, all of which contain iron in greater or less quantity, but containing also, as most of them do, a considerable quantity of a neutral salt, the effects of the iron as a tonic are counteracted, by the purgative quality of this salt, which totally alters their medicinal qualities, and renders the use of them inexpedient in many diseases, where a purely chalybeate water would have the most beneficial effects.

In taking the Pittsburgh water as an example of a numerous class of natural springs, properly called chalybeate, I shall first make some observations on the effect of iron on the system, and then shew that in the state in which it is found in such waters, it is particularly calculated for the cure of such diseases as preparations of iron are found beneficial in.

The effects of iron on the system are sufficiently numerous in the animal economy; it stimulates the fibres of the stomach and abdominal viscera; it augments the tone of all the muscular fibres; strengthens the nerves and gives the whole weakened system remarkable energy; it increases the strength of the pulse, and from its use, the pale emaciated countenance assumes a healthy florid color.

With regard to the various preparations of iron, those which seem best calculated for the purpose, are such as are most certainly conveyed into the blood, and most easily converted into oxide. Of these, iron dissolved by carbonic acid and held in solution in a mineral water, seems by far preferable, and with respect to quantity, experience has shewn us that small doses of iron produce better effects than large ones, particularly when persevered in, as should always be the case for a considerable length of time. This observation is particularly made by the celebrated Doctor Cullen, and should always be attended to. Mineral waters, he remarks, often produce cures which we in vain attempt to perform by the combinations of iron in our shops, even although those waters contain nothing but iron; this is manifestly owing to the weakness of the dose, in proof of which we find that the strongly impregnated waters seldom answer so well as those which we commonly reject.

The Chalybeate water at Pittsburgh I can venture to recommend for all purposes for which Chalybeates in general are given, and though the quantity of iron is small, yet it is equal to that contained in some of the most celebrated German mineral waters, and greater than in many of those which are most esteemed and frequented in this country. The mineral spirit or fixed air by which the metal is held in solution should by no means pass unnoticed, as it is an agent possessing no small powers over the human frame, and if properly employed becomes one of the most useful remedies. To this principle most mineral waters owe their activity; it is this agent which holds many of their most powerful ingredients in solution, and enables them to pervade the remotest recesses of the human frame.

With these observations on the effect of chalybeates on the system, we are prepared to enter into the medicinal qualities of the Pittsburgh spring.

The first effect of those waters, and which is easily and distinctly remarked in the water at Pittsburgh, is decidedly of a stimulant kind. Soon after taking a few glasses of it, the pulse is increased in strength, the patient if previously chilly and pale, feels a glow occasioned by the increased circulation, and by persevering in the use of the water for a few days, the appetite becomes greatly increased, and the general spirits and health improved ; these effects are more striking in some than others. It is not uncommon however on beginning a course of this water, for the patient to experience nausea, vomiting, and pain about the region of the stomach, or else a heaviness of the head, slight vertigo, and sense of fullness over the whole body. Sometimes these are so troublesome as to shew that it was not adapted to the nature of the complaint, and to forbid the use of it, but in general these symptoms soon disappear after a little use, and particularly when an increase of any of the natural excretions, such as the urine, or fæces, is established.

Such chalybeates as the Pittsburgh water, produce no certain action on the bowels, nor if we attend to the nature of their contents as they appear by analysis, could it be expected, when the bowels are foul and loaded with bilious sordes. The water often purges pretty briskly at first, but this is a very desirable circumstance, and its operation in this way soon ceases, when the intestines are restored to their proper state. The secretion which this mineral water most commonly excites is that of urine, and this is generally in the greatest quantity, when the water best agrees with the habit of the patient.

The general operation of such waters is to increase the power of the secretory system in a gradual and uniform manner, and at the same time to impart vigor to all the functions. It is therefore chiefly in chronic disorders and those which are attended with great laxity and debility of the solids, that such waters as we speak of are found to be peculiarly useful.

Chalybeates, such as this, are of eminent service in an impaired or capricious appetite, weakness of the assimilatory organs, irregular digestion, flatulent distention, and an occasional vomiting of viscid mucus. These are the usual symptoms of a disease called dyspepsia, which is of frequent occurrence in this country, and which often baffles the aid of medicine in any other form but that of a natural chalybeate combined with exercise and a proper regulation of diet. But in recommending this water as a powerful tonic, I wish it to be perfectly understood that it should be used only in those cases where all traces of active inflammation have subsided, such as complaints of the biliary organs of the alimentary canal, or any of the viscera, arising principally from intemperance or from climate, and frequently accompanied with jaundice. It is by being employed injudiciously in these cases and before the inflammatory diathesis is removed, that such chalybeates have often disappointed the sanguine expectations of those who have resorted to the use of them.

Neither the design nor the limits of this essay will permit the taking of a more extensive view of the various diseases for which chalybeate waters may be considered as valuable remedies. Enough has been already said to recommend such mineral waters to those who are afflicted with complaints for which tonics, and particularly combinations of iron, are preferable to many of our common medicines. I have as yet but slightly alluded to one quality which this mineral spring at Pittsburgh has been observed to possess. It has been already stated in the Analysis, that a slight impregnation of sulphur, in the form of sulphuretted hydrogen, is present in this spring. It is true, that subsisting as it does only as a gas in the water, the effect of the sulphur as a medicine, may not be very apparent, but still such waters possess some medicinal qualities, and if highly impregnated with it, are valuable remedies in Herpetic and other cutaneous disorders, assisted by the frequent use of the warm bath, which, at watering places is always to be found as a necessary and suitable appendage to such establishments.

Art. XX.—*On the Combinations of Chromium; by* Augustus A. Hayes.

In the published accounts of the combinations of this metal, much discordance exists, and the processes recommended for procuring the oxides, are not only ineligible, but fallacious. The memoir of Vauquelin, contains nearly all that is known on this interesting subject, notwithstanding the time which has elapsed, since the discovery of the metal. The following additional observations, connected with its chemical history, are submitted by the writer.

Protoxide of Chromium.—This oxide is of a dark green color, when in fragments it possesses considerable lustre, it is soluble in the strong acids, and forms with them green solutions; it is less fusible than platina. When mixed with three parts of nitre and exposed to heat, it is acidified and forms chromic acid, which, uniting to a part of the potash present, forms bichromate of potash. When heated nearly to redness it becomes suddenly ignited, and presents the *appearance* of combustion; an effect first observed by M. Berzelius, and by him referred to internal change of form, consequent to rapid contraction. This interesting character is exhibited, when we place a few grains of the dry oxide in a platina spoon, gently press it, so as to distribute it equally over the surface and cause it to slightly cohere, and subsequently heat it by the blow pipe flame; the oxide is partly dispersed by the sudden action. If considerable quantities of the oxide be heated in a capsule, the ignition commences at the surface in contact with the disk, and sufficient heat is developed, to continue the action throughout the mass. The color is usually changed to a light green, and long ignition renders it nearly grass green. It is obtained by heating the hydrate to 400° F. A light green, insoluble oxide is obtained in prismatic fragments, by heating tartrate of chromium to redness.

Protohydrate of Chromium.—This compound is of a greenish black color, brittle, and the fracture exhibits a vitreous lustre. It is soluble in strong and diluted acids. When recently prepared, it is soluble in a solution of pure potash, which, when saturated, is of a dark green color; the oxide precipitates as the solution of potash, absorbs carbonic acid from the atmosphere. Ammonia in solution, does not dissolve oxide of chromium, either when moist or dry;—hydrate of chromium may be *suspended* in ammonia, but after a few days it precipitates, when the mixture is kept in closed vessels. It is readily obtained by washing the *orange* colored chromate of lead of commerce, in a large quantity of distilled water; collecting and drying the powder, and mixing it with oil, so as to form a paste; placing the paste in a covered crucible, and exposing it to a red heat for twenty minutes;—agitating it occasionally, to collect the reduced lead into a globule. On withdrawing and cooling the crucible, a dark green oxide, mixed with small globules of lead, and a button of reduced lead are obtained. The former separated from the lead by washing, and mixed with three parts of nitre, and exposed in a crucible for half an hour to a full red heat, gives on cooling, a yellow salt—which is to be dissolved in water, and neutralized by adding sulphuric acid, until turmeric paper browned by ammonia, is restored to its former color, by the solution—a small quantity of ammonia added will precipitate any alumina, and the filtered solution, mixed with a quantity of sulphuric acid, equivalent to one half the nitre employed, and heated to 212° F., will afford a rich green precipitate, on adding pure ammonia, containing, after washing with water, nothing but protoxide of chromium and water. It is essential to the perfection of this process, that the nitre should be decomposed into a nitrite, and chromate, by the temperature to which it is exposed; but the native mixture of oxides of chromium, and iron, may be employed as a substitute, for the bichromate of lead.

Deutoxide of Chromium.—Its color is brownish black, in fragments, its lustre shining. In cold muriatic acid, it dissolves and forms a greenish brown solution; when the solution is heated, chlorine is evolved, and protomuriate of chromium remains. Nitric acid when warm, dissolves it, and forms with it a brown solution; the acid may be dissipated by exposure to a temperature sufficient to volatilize it; the oxide remains unchanged. Sulphuric acid dissolves it, and when the solution is heated, it becomes a protosulphate. It may be obtained, by evaporating a solution of chromate of chromium to dryness on a vapor bath; it then presents the above characters. It however contains water, which may be expelled by an increased temperature, but the oxide is rendered insoluble. When heated, in a retort connected with a pneumatic apparatus, oxygen is given off at a temperature below 400° Fahrenheit. "The oxide obtained by exposing nitrate of chromium to heat, until vapor of nitrous gas ceases,"—yields nitric acid, when treated with lime and water. An unknown weight of the moist oxide, yielded chromic acid 8.17 grains, protoxide of chromium 4.07 grains:—it probably contains one prime of each.

Peroxide of Chromium, or Chromic Acid.—When dry, its color is yellowish brown; its solution when somewhat diluted is yellow with a shade of brown; the solution has an acid and astringent taste;—it bleaches litmus and blue paper;—it does not afford crystals by evaporation, but is reduced to a yellowish brown crust, which is slightly deliquescent. It unites to alkalies and oxides, and forms salts. At a temperature below the boiling point of mercury, it fuses with bubbling, and is partially decomposed; at a red heat, it becomes the protoxide. It may be obtained by dropping muriatic acid into a mixture of chromate of silver and distilled water, until the red brown color of the chromate is reduced to white with a tinge of red; filtering, and cautiously adding a few drops of muriatic acid, till a white precipitate ceases to be formed. When large quantities are required, the bichromate of lead may be added to strong muriatic acid, and the mixture placed on a *warm* sand bath for a few hours, occasionally stirring the mass. Water may then be added and filtered from the chloride of lead, and the filtered fluid used instead of the muriatic acid, in decomposing the chromate of silver;—in either process a solution of pure chromic acid is obtained. This acid possesses the property of coloring salts which crystalize in its solution.

Protoxide of Chromium and Acids.—*Nitrate of Chromium.*—Nitric acid dissolves protoxide of chromium, and affords a solution, which, when concentrated, is of a dark green color when viewed by reflected light, but by transmitted light, thick portions of the fluid appear of a dark red; by lamp light, the solution transmits red light. By evaporation it does not afford crystals, either when neutral or acid; but is reduced to a syrup, and ultimately, to a dry and brilliant gum like mass, which often splits into long prismatic masses; its color is dark green both by reflected and transmitted light. Its solution has a sweet and astringent taste, resembling the salts of lead. When heated on a vapor bath for some hours, it is rendered partly insoluble, water boiled on it gives a brown solution containing nitric acid. At a temperature below redness it is decomposed, and becomes a very bulky green oxide.

Hydrosulphuric acid, does not decompose solutions containing protoxide of chromium, nor does oxide of chromium dissolve in its solution.

Muriate of Chromium.—When dry, this salt exists in the state of a transparent green powder; its solution is dark green, and of a sweet astringent taste; it does not yield crystals. If heated to 212° this salt exhibits some greenish grey spots; at 300°, no acid is disengaged. When dried at 212° it is slightly deliquescent. At a red heat it swells, becomes greenish gray, and is ultimately decomposed.

Sulphate of Chromium.—Diluted sulphuric acid dissolves oxide of chromium, and forms a neutral green solution of an astringent taste,—it is uncrystalizable. When dry, its fragments are blue, green and transparent; mixed with charcoal and heated in a closed crusible, it affords a green powder, which, with muriatic acid gives an evanescent odour of hydro sulphuric acid; the acid is merely tinged with green. When nitrate and sulphate of potash exist in the solution, by evaporating and cooling, the nitrate crystalizes in very oblique octohedrons, or double 4 sided pyramids with rhombic bases,—of an apple green color. 50.20 grains of sulphate of chromium, dried at 212° F., dissolved in water, and added to an excess of a solution of muriate of baryta,—gave 65.70 grains dry sulphate of baryta $=22.27$ sulphuric acid. The filtered solution, treated with a solution of sulphate of soda and again filtered, decomposed by carbonate of ammonia,—gave 15.98 grains dry oxide. $22.27+15.98+11.95$ water in the salt$=50.20$. And 22.27 : 15.98 : : 40 : 28.70.

Phosphate of Chromium.—Phosphate of soda, added to nitrate of chromium, occasions a precipitate of phosphate of chromium; while moist, its color is light green, by drying it becomes darker and after being heated red hot, it is blueish black; its powder is greenish brown, and it is soluble in hot muriatic acid. In phosphoric acid it remains suspended for some days, but finally subsides.

Carbonate of Chromium, is a black shining powder, soluble with effervescence in hot nitric acid. When heated to redness it is decomposed, the oxide becomes ignited, and remains of a dark green color. Obtained in the state of an hydrate, its color is light blue ;—in this state it is slightly soluble in a solution of carbonic acid. It is obtained by adding carbonate of ammonia, to a solution of nitrate or muriate of chromium.

Ferroprussiate of Chromium, is a light blue, insoluble powder ; procured by adding ferroprussiate of potash, to muriate of chromium.

Borate of Chromium, is a light green insoluble powder, which falls when we add borate of ammonia, to muriate of chromium. Borate of ammonia, forms a precipitate in very dilute solutions of chromium.

Oxalate of Chromium, is obtained by adding oxalate of ammonia, to a solution of protoxide of chromium ; it is a pale green insoluble powder. In the proximate analysis of vegetables,—muriate of chromium is a valuable reagent, for separating the oxalic, from the tartaric, and citric acids.

Succinate of Chromium, is a pale green powder, soluble in dilute acetic acid, insoluble in water.

Acetate of Chromium.—Oxide of chromium dissolves in acetic acid and forms a salt possessing in general the character of the nitrate, except, that it is less readily decomposed by precipitants.

Tartrate of Chromium.—Tartaric acid dissolves moist oxide of chromium, and forms a neutral green solution ; when evaporated in a hemispherical capsule, it dries on the sides like varnish ; before the water is entirely dissipated, the dry portion splits into small prisms, exhibiting a *pectinated* appearance ; these prisms are usually kept in motion by the vapor. When dry this salt is greenish and black ; it is decomposed at a red heat. It may be employed to furnish oxide of chromium.

Citrate of Chromium.—Moist oxide of chromium is soluble in citric acid, the solution when concentrated is *plum* blue. Like the tartrate, it cracks into prismatic portions; they are however generally much smaller; it is readily decomposed by heat, and affords the protoxide.

Other salts have been formed, but they are either nearly insoluble, or uncrystalizable. In its combinations with acids, protoxide of chromium, presents some of the characters of alumina; but it does not like that earth, form triple salts,—at least so far as I have investigated its compounds.

II. *On the combinations of chromic acids, with bases.*—These compounds are so well known, that it is not necessary for me to enter into details;—I shall therefore add only a few remarks on their colors, and the processes of obtaining them.

Chromate of Potash.—Its crystals are minute prisms of five and six sides; its color is lemon yellow; it is very soluble in water. It is obtained by neutralizing a solution of the bichromate; by subsequent evaporation and rest, the crystals are deposited.

Bichromate of Potash.—When crystalized without the presence of other salts, it presents rhombic tables, truncated on their obtuse, lateral edges; its color is pure *orange*-red; —crystalized in an acid solution, its color is red brown. Hydrosulphric acid gas, decomposes this salt, and gives a precipitate of oxide of chromium, *mixed* with sulphur.

Chromate of Ammonia.—The crystals are minute prisms, which are aggregated so as to present thin plates, resembling the form of the index used in writing; its color is yellow, and its lustre is metallic. It is formed by neutralizing chromic acids, by ammonia. It is a beautiful salt.

Bichromate of Ammonia.—The crystals are rhombic prisms; color, red-brown; less soluble than the chromate. When heated on platina foil, at a temperature below redness they are decomposed, with the evolution of light and a slight detonation; oxide of chromium remains.

Chromate of Iron.—When a solution of proto sulphate of iron, is added to a solution of chromate of potash, the chromic acid of the chromate is decomposed, its oxygen unites to the protoxide of iron forming the peroxide; a part of which cannot be retained by the acid, and therefore is precipitated with the oxide of chromium; another portion of the oxide of iron, is thrown down by the potash disengaged from the chromate. Iron does not dissolve in chromic acid, even when its affinity is aided by attaching it to a slip of platina; —heated with the acid, it decomposes it.

Chromate of Copper.—It is uncrystalizable. When moist, its color is *chesnut* brown, when dried at 212° F. it is black. It is soluble in ammonia, and affords a rich, dark green solution; by evaporating the ammonia, it separates unaltered. It may be formed, by adding chromate of potash, to sulphate or acetate of copper.

Chromate of Lead.—Its crystals are acicular prisms, often grouped so as to form radiated masses; the color of the crystals is pure orange yellow, and they present a rich silky lustre. When in the form of scales, this salt is of a dull scarlet color; when moist the color is a bright scarlet; and when in powder its color when dry, is scarlet. It is converted into the bichromate by nitric acid, and subsequently dissolved; pure alkalies dissolve it, and leave it unchanged, when neutralized by acids. Its crystals are obtained, by dissolving oxide of lead in a solution of pure soda; adding a solution of chromate of potash, and placing the mixed solution,—contained in a conical or hemispherical vessel,—in a jar, at the bottom of which, carbonic acid is slowly eliminated from chips of marble, by sulphuric acid. As the soda absorbs the acid, beautiful groups of radiated crystals appear.* It is readily obtained, by fusing nitre on bichromate of lead, at a low temperature, dissolving the nitre and washing the powder. In this way it might be prepared by our manufacturing chemists, and introduced into use as a pigment.

Bichromate of Lead.—In the form of powder, its color at ordinary temperatures, is yellow and orange yellow; it is soluble in nitric acid; decomposed by muriatic acid, and also

* Mr. Faraday, first published the fact, that chromate of lead might be crystalized, or rather, he first observed crystals, which had been deposited from an alkaline solution, and it is due to this accurate observer, for me to state, that his observation led me to make experiments on this salt.

by an excess of sulphuric acid. When heated, its color changes to *dark orange-red*, scarlet, and finally to *red* brown ; on cooling it returns to its former color ; this change takes place under water, and is common to several of the chromates. It is obtained, by adding a solution of bichromate of potash, to a solution of nitrate of lead,—a *yellow* powder falls, which, by washing becomes *orange yellow.*

Chromate of Silver.—In the form of powder, its color is *red* brown ; it is instantly decomposed by chlorides and muriatic acid. Sulphates also decompose it ; it is soluble in ammonia, and when the solution is exposed to the air; long pointed filaments, formed by the aggregation of acicular prisms, are deposited. When a dilute solution contained in a conical glass, is partly neutralized, by a few drops of nitric acid introduced at the bottom, the crystals form in a few hours,—they are often one inch in length.* It may be obtained, by double decomposition.

Bichromate of Silver.—Its crystals are rhombic tables, and scales of an indeterminate form ; color red, with a tinge of brown ; decomposed by chlorides, sulphates, and muriatic and sulphuric acids; soluble in warm nitric acid, and is deposited as the solution cools, in the form of rhombic tables. It is obtained by dissolving chromate of silver in nitric acid ; or by adding oxide of silver to chromic acid. It is this salt which forms the *ruby red crystals*, described in our elementary works, as crystals of chromic acid. When a slip of silver is dipped into chromic acid, it is instantly acted upon, and crystals of the bichromate are formed. This effect is sooner produced if a drop of sulphuric acid, be added to the solution. If an arc, composed of iron and silver, be used with this solution, the *silver* is negative, with respect to the iron ;—but a galvanoscope of sixteen turns of wire, when made the medium of communication, does not indicate the existence of a current.

Chromate of Mercury.—It exists in the form of a powder; its color is dull yellow. It is partly decomposed by hot nitric acid. Muriatic acid dissolves it, and forms bichloride of

* Mr. Teschemacher, has noticed the production and crystalization of this salt, in the mixed solution of chromate and nitrate of potash ;—this salt is *insoluble* in an alkaline solution containing potash, and the crystals observed by him, were *probably* the bichromate of silver.

mercury and muriate of chromium. Chromic acid converts it into the bichromate. It is obtained, by boiling a solution of ammonia, on bichromate of mercury; decanting, washing the black powder, consisting of chromate, and oxide of mercury, and heating it on a vapor bath for twelve hours; the oxide is reduced, and the mercury may be separated by washing;—or acetic acid may be employed to remove the oxide, from the black powder while moist.

Bichromate of Mercury.—This salt may be obtained in small scales; it usually exists in the form of a powder; its color is a beautiful scarlet. It is slightly soluble in nitric acid; muriatic acid converts it into chloride, and bichloride of mercury, and chromic acid. Ammonia, instantly converts it into chromate and oxide of mercury. 56 parts of this salt, were heated with a solution of ammonia; the black powder which resulted, was washed, and exposed to a temperature sufficiently high to volatilize the mercury;—the oxide of chromium which remained, weighed 4.864 parts. The fluid which was decanted from the powder, was evaporated, and the salt which remained was heated; 4.927 parts of the oxide of chromium were obtained. It may be obtained in the form of scales, by adding mercury to chromic acid; or by heating mercury, in an acid solution of chromate and nitrate of potash. By adding chromate of potash, to acid proto-nitrate of mercury, and washing the resulting precipitate in hot water, it is obtained in powder.

Chromate of Chromium.—Chromic acid, dissolves moist oxide of chromium, and forms with it a neutral solution, of a yellowish brown color; it does not afford crystals, but it sometimes affords small prismatic fragments. Its powder is brownish black, and shining. It may be repeatedly evaporated to dryness, and redissolved in water,—if not exposed to a temperature above 212° F.—without decomposition. With nitrate of lead, it gives a yellow precipitate. With ammonia, a dark green precipitate. When exposed to a temperature equal to 212° F. for a long time, it is rendered insoluble in water.

Windsor, Vt. 9th January, 1828.

Art. XXI.—*Geological Nomenclature, Classes of Rocks, &c.; by* Prof. Amos Eaton.

In the first part of the Erie Canal survey, I attempted a Geological Nomenclature, so far as the rocks described in that survey required one. The facts upon which it was founded, were all collected more than four years ago. Since it was published, I have reviewed the whole line several times, and have traced the strata laterally to a considerable extent. Several gentlemen, who are familiar with such investigations, have devoted much time and attention to the same subject, and have favored me with their results.*

Before entering upon the subjects which exclusively appertain to the second part, I shall introduce some facts in support of the Geological Nomenclature proposed in the preceding synopsis. I published a tabular view in the 2d No. of the 13th vol. of the American Journal of Science, with a view to elicit criticisms. Fortunately I succeeded beyond my expectations, Prof. Parker Cleaveland favored me with one hundred and three very judicious queries. Dr. Steele of Saratoga presented facts and a suit of specimens, which totally changed my former views of the oolitic formation. Through the politeness of several others, my views were corrected on numerous points.

But the characters and order of superposition, are so manifest in this district, that an attentive observer, of but ordinary pretensions, could scarcely fall into very great mistakes, especially in the secondary formation.

I take for my starting points, the *Highlands* on the Hudson River, a *traverse* across *Rensselaer County*, from the west line of Massachusetts to the Hudson, and the *Genessee Falls.*

The Highlands being cut down to their base, in a transverse direction by the Hudson, we cannot conceive of a better exhibition of primitive rocks. The central part is here occupied by slaty granite (gneiss) embracing alternating

* Mr. G. W. Clinton and Dr. I. Eights, have furnished very important facts. Profs. Beck, Henry, Rafinesque, Patten, and Benedict, have communicated whatever fell in their way from time to time. More than twenty other scientific gentlemen have occasionally contributed useful materials. I should add, that on account of a temporary indisposition, Mr. Clinton assisted in collating localities, and in preparing materials for this nomenclature.

layers of crystalline granite, often twenty or thirty feet in breadth. On the south-east side, at Fort Washington, the slaty granite passes into mica slate. On the north-west side, it meets the granitic hornblende rock, which passes into the gneisseoid variety. This last rock, terminates the Highlands up the river, with the lofty mountain, usually called Butter-hill. A similar succession of rocks follows the mica slate, and terminates the Highlands down the river.

On following the Highland range about one hundred miles in a north easterly direction, to its junction with the Green Mountains, where it appears on our geological profile under the name of Savoy, we see it pass westerly under the *granular quartz*, and that under the *granular limestone.* There is however an intervening range of granular quartz and limestone, between the main primitive range and the Saddle Mountain range ; or rather these rocks seem to be separated to a great distance north and south. As this does not derange the general order of succession (for alternations are found every where) we here actually see the very arrangements of rocks as set down in the Synopsis, with the exception of mica slate. As there is no mica slate on the west side of the primitive range, we look elsewhere for evidence of its relative position.*

On the south-east side of the slaty granite in the Highlands, we find mica slate, before the hornblende rocks commence. In Saratoga county, in the McComb range, the slaty granite passes into mica slate. On the east side of the Green Mountain range, the mica slate and hornblende rock alternate several times. Between Worcester and Boston, there is certainly some mica slate ; and the hornblende rock, is the last primitive rock towards Boston. On the whole, leaving out the supposed mica slate, west of the Green Mountain range, we have no good reason for admitting the hornblende rock between the granite and mica slate.

This statement presents my reasons in short, for the arrangement of our primitive rocks. Next we see the granular limestone pass directly under the argillite, which is on the east boundary of Rensselaer county, our next starting point.

I shall not detain the reader with any apologies for former

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* In the first part of the Canal survey, I was misled on this subject by high authority, but I have now fully investigated the subject. *There is no mica slate in Berkshire County, on the west side of the Green Mountain range.*

mistakes, as he will feel no interest in such apologies. I now state, that I have traversed the transition range from Massachusetts line to Hudson river, in fifteen places, since the first part of this survey was published, for the purpose of ascertaining the true superposition of rocks in this most complicated and difficult geological theatre.

The argillite, under which the granular limestone passes near Massachusetts line, is certainly the very same continous rock, which forms the Cohoes falls, and the bed and banks of the Hudson from Baker's falls to Newburgh, near the Highlands. All the intervening rocks lie in a kind of inclined trough in the argillite. *We have no primitive argillite in our district, if organic remains form the characteristic distinction.* Neither do I believe there is such a rock as primitive argillite on this globe. This is Bakewell's opinion ; and though I have often changed mine, I now believe he is correct, and that the bassetting edges of the same rocks present a more primitive appearance in all cases ; and that this fact has led geologists into ruinous errors.

First graywacke, sparry limerock, calciferous sandrock, and metalliferous limerock may be seen in regular order of superposition, between Massachusetts line and Hudson river. West of Cohoes Falls the same rocks occur, and at Alexander's bridge the second graywacke overlies the whole.

We now pass over the second and third occurrence of the same rocks on our geological profile, and recommence with the same calciferous sandrock west of Little Falls. Here we find the metalliferous limerock, and second graywacke so perfectly characterized, that mere inspection is conclusive. The graywacke passes directly under the millstone grit in fair view in Starch Factory Creek, Meyer's Creek, and Steel's Creek.*

Here too we see the millstone grit pass under the saliferous rock. This may be seen eighty miles in a lateral direction towards lake Ontario. The bassetts of this rock, of the saliferous and of the ferriferous, may all be seen in this order of superposition all the way to lake Ontario.

We may now go to our next starting point, Genessee Falls. Here we see the saliferous rock. Ferriferous lias, and geodiferous, lying upon each other as distinctly as a

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* Places set down on the geological profile will be referred to without any farther description.

pile of books. We see the same between Niagara Falls and Lewiston, one hundred miles west. At Black Rock we see the geodiferous rock pass under the cornitiferous. This latter we see pass under the pyritiferous at the same place; and this continued along the south shore of lake Erie, also by way of Ithaca to Catskill mountains.

Thus we demonstrate by actual inspection, the true order of superposition. Nothing is left for conjecture or hypothesis.

On pursuing the lateral extension of strata, we arrive at certainty in regard to several important localities. We have traced the cornitiferous limerock of Black Rock at lake Erie to Bethlehem caverns, in Albany county, and thence through Greene into Ulster county. We find that all the most elevated part of Catskill and Allegany mountains is the third graywacke of the south shore of lake Erie. Also that the old red sandstone of Werner is not a general stratum. It often forms extensive beds in the third graywacke, and is also found in the second graywacke in some places. Conybeare seems to favor the opinion that old red sandstone is not a general stratum. I think our district furnishes ample evidence of its being merely in beds. The red sandstone of Connecticut river and under the palisadoes of the Hudson, is certainly the saliferous rock of Conybeare; and the conglomerate is his breccia. See introduction to Phillips and Conybeare, p. 15.

As the proposed nomenclature depends entirely upon facts for its support, I shall make particular reference to those localities which are most accessible to stage lines, packets, and places of public resort. With this brief view I shall close that part which is expressly devoted to nomenclature. But I shall make numerous applications to this subject when I treat of facts which belong more exclusively to the second part of the canal survey.

CLASSES OF ROCKS.*

I. Primitive Rocks.

1. *Granite.*

At West Point we find as extensive layers of crystalline granite, as at any place which I have visited. Here it always

* These localities were all searched out and examined under the direction and at the expense of the Hon. Stephen Van Rensselaer, during the last seven years.

alternates with the slaty subdivision (gneiss.) It is the same at Chesterfield, Goshen, Southampton, Russel, Spenser, &c. in Massachusetts. Also in Haddam, Litchfield, Norfolk, &c. in Connecticut. These and numerous other localities seem to authorize the adoption of the opinion of De Witt Clinton, L. L. D. Professor Nuttall, and several Europeans, who prefer including the granite and gneiss of Werner under the general name granite. Varieties. *Sandy*, at Little Falls. *Porphyritic*, in Johnstown, Montgomery county, N. Y., Litchfield, Connecticut, Chester, Massachusetts. *Graphic*, in Litchfield, Connecticut, Southampton mines. Contents. *Steatite*, in Savoy. *Diallage* and *plumbago*, Lake George. *Magnetic iron ore*, Crown Point, lake Champlain. *Schorl*, every where.

2. *Mica Slate.*

Varieties. *Compact*, on the Boston stage road between Worthington and Chesterfield, and between Shrewsbury and Northborough, Massachusetts. *Fissile*, Fort Montgomery in the Highlands, Conway, Massachusetts. Contents. *Staurotide*, Litchfield and Goshen, Connecticut. *Sappare*, Chesterfield, Massachusetts, Chatham, Connecticut. *Garnet*, every where.

3. *Hornblende Rock.*

Divisions. *Slate*, east part of Becket, Mass., Butterhill, in the Highlands. *Granitic*, Dalton, Mass., Highlands, adjoining the granite. Varieties. *Gneisseoid*, Dalton, Mass., Butterhill, Highlands. *Porphyritic*, Conway, Plainfield, Buckland, Mass. *Sienitic*, Chip Hill, Johnstown, N. Y. and near Boston, Mass. Contents. *Granite*, in veins, Belchertown, Mass. *Actynolite*, Cummington, Mass. *Augite*, Lake George, N. Y.

4. *Talcose Slate.*

It is always slaty. Divisions. *Compact*, east side of Saddle Mountain Range. *Fissile*, on the west side of the same range. Variety. It is highly colored with chlorite in the east part of Savoy. Contents. *Chlorite*, in beds in Savoy and Florida, Mass. Octahedral crystals of iron ore, near Williams College, Mass.

5. *Granular Quartz.*

Divisions. *Compact*, adjoining the east side of Saddle Mountain Range. *Sandy*, on the west side adjoining the granular limestone. Varieties. *Translucent*, Snowy Mountains in Wallingford, Vt. *Yellowish*, most common. *Ferruginous*, Bennington, Vt. Pittsfield, Mass. Contents. *Haematite*, in Dalton, Mass. three miles south of the village. *Manganese*, in Bennington, Vt.

6. *Granular Limestone.*

Divisions. *Compact*, Stockbridge, Mass. *Sandy*, west side of Pittsfield, Mass., on the Albany stage road. Varieties. *Statuary Marble*, Stockbridge, Mass. *Dolomite*, Barrington and Sheffield, Mass. Milford, Conn. Contents. *Tremolite*, Canaan, Conn. *Serpentine* and chromate of iron, Milford, Conn.

II. Transition Rocks.

7. *Argillite.*

Divisions. *Clay Slate*, Williamstown Mountain Range,—the bed and banks of the Hudson. *Wacke Slate*, overlying the clay slate, most of the way from Massachusetts line to three miles west of Cohoes Falls in New York. As this slate takes the same inclination with the clay slate, and differs widely from the horizontal (or 1st) graywacke, and as their meeting can never be ascertained, I have presumed to join them. Varieties. *Chloritic.* Both of the divisions are often colored green by the chlorite in Rensselaer county. *Roof Slate.* That which splits freely into roofing slate, Hoosick, Chatham, N. Y. Water Gap of the Delaware River, Pa. *Glazed Slate*, banks and bed of the Hudson from Fort Miller to near Newburgh, Water Gap of the Delaware. *Chloritic*, *red* and *purple*, varieties frequently occur near its junction with the primitive rocks. Contents. *Silicious Slate*, nearly black, and of different shades of green, in the glazed variety at Troy and a few miles below Albany, in extensive beds. *Basanite*, in the glazed slate, near Troy and Albany. *Anthracite*, in small quantities, near Troy. *Striated quartz*, in the cleavages of the glazed variety, in a kind of sheet, connected with an unascertained green, hard, substance, resembling serpentine. Mrs. Griffith's account of Disbrow's method of boring for water, presents facts which seem to make the argillite the great repository of carbonated waters. The borings at Ballston and Albany, about forty miles apart, are made in the same layers of argillite; and carbonated water is found in both places.

8. *First Graywacke.*

Subdivisions. *Compact*, overlying the inclined wacke slate in a horizontal position, from Canada to near the Highlands. *Rubble*, on the compact; very perfect in the middle of Rensselaer county, also two miles south of Albany. Variety. *Chloritic*, in the highest part of Rensselaer county. Contents. *Milky quartz*, in the eastern part of Rensselaer county. *Calcareous spar* and *anthracite* along the east side of the Hudson from Fort Miller to opposite Newburgh.

9. *Sparry Limerock.*

Subdivisions. *Compact*, about New Lebanon Springs. *Slaty*, three miles south of the springs on the Hudson turnpike. Variety. *Checquered rock*, on the Little Hoosick, and near New Lebanon Springs. Contents. *Chlorite* and *Calc. spar*, every where.

10. *Calciferous Sandrock.*

Subdivisions. *Compact*, Flint Hill. *Geodiferous*, at Flat Creek, west of the Noses. Varieties. *Oolitic*, near Saratoga Springs. *Sparry*, at Flat Creek. *Quartzose*, on the north side of the Mohawk, opposite Flat Creek. Contents. *Concentric concretions*, near Saratoga Springs. *Sulphate of barytes* and *anthracite*, on the West Canada Creek, six miles above its mouth, also at Little Falls. *Semi-opal*, connected with the quartzose variety. *Brown spar* and *Hornstone*, at Flint Hill.

11. *Metalliferous Limerock.*

Subdivisions. *Compact*, on East Canada Creek, Otsquaga Creek, and west of Little Falls. *Shelly*, Trenton Falls, north of Utica, Glen's Falls, twenty miles north of Saratoga Springs. Variety. *Birdseye marble*, is the compact, to which, when polished, the vertical encrinites give a birdseye appearance.

12. Second *Graywacke.*

Subdivisions. *Compact*, at Alexander's Bridge. *Rubble*, on the top of the hill west of Schenectady, three miles. Varieties. *Grindstone*, in Blenheim, Scoharrie county, N. Y. and in Nova Scotia. *Honeslate*, in Rensselaerville, Albany county. *Red sandy*, (old red sandstone ?) in Stephentown, Rensselaer county, N. Y. near Dr. Elmore's. Contents. *Anthracite*, near Alexander's bridge. *Manganese* Blenheim ; also in Hillsdale, Columbia county, N. Y. This manganese is connected with an argillaceous iron ore, resembling bog iron ore.

III. Secondary Rocks.

13. *Millstone Grit.*

From Little Falls to lake Ontario, between Little and Big Salmon rivers, this rock bassetts and is in fair view. Both divisions occur near each other, and often in the same layer,—the under side being always the sandy and the upper the conglomerate. Coal mines in Europe are in connexion with this rock, but have not as yet been found in this connexion in our country.

14. *Saliferous Rock.*

Its bassetting edges lie directly on the millstone grit. Both divisions, and all the varieties, but the conglomerate, may be seen at Genesee Falls and in the banks of the Niagara river; also at Oak Orchard Creek. The conglomerate and sandy varieties are seen on Connecticut river, and at New Haven under the basalt; also on the Hudson above New York under the pallisadoes. Salt springs are found in it every where west of Rome; but none have been discovered under the basalt of this country.

15. *Ferriferous Rock.*

It reposes on the saliferous rock every where west of Little Falls. The sandy division lies over the slate, and a layer of red argillaceous iron ore, about a foot or a foot and a half in thickness, lies between them; or alternates with the layers of one or both. The slaty division is generally green or blue, and very soft. The sandy division is harsh, coarse, and often conglomerate at the top. The softest variety of the iron ore is called reddle, and is used as a paint.

16. *Lias.*

This general stratum does not agree in all respects with European specimens which have been received in this country; besides, no oolite has ever been discovered in connexion with it. But it has so many characters in common with the lias, that I venture to extend this name to it. Subdivisions. *Califerous slate* forms the south ridge along the Erie canal from Oneida to near Rochester; also the lower part of Lockport Hill. *Calciferous grit* overlies the slate in grit-like blocks. It is used in the construction of locks and aqueducts at Jordan and other places. It abounds in shells. Varieties. *Conchoidal.* This variety breaks into conchoidal or lenticular forms. It appears in the bed and on the banks of the canal in Minden, where it contains petrifactions resembling the chiton. *Argillaceous.* This is common throughout. *Shell grit* occurs near, or at the upper surface of the stratum. Contents. *Gypsum*, *water cement*, and the *vermicular limestone* are found in beds in this rock and in no other. All may be seen at Manlius Centre, along the south bank of the canal. *Shell limestone* is common in this stratum. One of the best localities is between the lower Genesee Fall and the one next above it, on the west side.

17. *Geodiferous Limerock.*

Subdivisions. *Swinestone* is found in the bed and banks of the Erie canal near Genesee river, and extending one mile east. The canal at Lockport is cut through this rock to the depth of nearly thirty feet for two miles. It forms the upper part of Niagara Falls to the depth of seventy feet. The *sandy division* overlies the swinestone, is less fetid, somewhat stratified, and contains quartzose grains. Its characters are well exhibited at Black Rock, immediately under the cornitiferous limerock. Varieties. The *Fetid* can scarcely be considered a distinct variety. The darker the color, the more fetid the odor. Contents. The geodes contain *sulphate of strontian*, *granular gypsum*, *laminated selenite*, *anhydrous gypsum*, *fluor spar* in limpid cubes, *arragonite*, *dog-tooth spar*, *brown spar*, and *waxy blende*. *Galena* has been found in small masses imbedded in this rock, and *Bitumen* has been observed in exudations upon its surface.

18. *Cornitiferous Limerock.*

Subdivisions. The lower or *compact* side contains layers of hornstone, generally in pairs, often of great extent. The upper, or *shelly* side, contains irregular masses of hornstone, often somewhat nodular. Black Rock affords an excellent locality of the *compact*, and Auburn, behind the state prison, presents a most perfect locality of the *shelly*.

19. *Third Graywacke.*

I propose placing all this vast formation under one general name for the present, on account of the difficulties and perplexities which would result from any other method. It embraces what have been described by eminent geologists under graywacke, old red sandstone, breccia, pyritous shale, and pyritous grit. A writer in the American Journal of Science, vol. 4, p. 249, calls most of it sandstone. By referring it to the Erie canal line, where nature seems to have presented her works in the most uniform and simple dress, we find that all those variable layers are above the cornitiferous limerock. This rock may be traced from lake Erie, in fair view, until it bassetts from under the Helderberg and Catskill Mountains: Therefore the pyritiferous rock (pyritous shale and grit of England) which bounds the south shore of lake Erie, is the same in the order of superposition, as the vast pile constituting the Catskill and Allegany Mountains. Professor Henry and H. H. Eaton have traced the lake Erie rocks to the Catskill Mountains; and Mr. N. Goodsell has traced them to the Olean coal mines in Pennsylvania, under the direction of the Rochester canal company.

Subdivisions. *Pyritiferous slate.* On the shores of lake Erie this is the perfect pyritous shale of Whitby in England. A pupil of mine, Dr. Witherell, has collected and sent to this school every variety of the Whitby rock, with specimens of the bituminous shale, coal, and most of the petrifactions contained in it. They agree in character, perfectly with this rock. The same bituminous shale, the same pyritous petrifactions, and the same kind of coal, are found here. The coal is in small quantities until we pass the Pennsylvania line; but it appears in thin layers for many miles along the east shore of Cayuga Lake. This variety retains its characters very perfectly in some parts of the Catskill Mountains near its base. In the Helderberg, sixteen miles S. W. from Albany, the pyrites is quite as abundant as at lake Erie. *Pyritiferous grit.* Under this subdivision I include for the present, all the siliceous rocks of this general stratum; such as the old red sandstone, gray sandstone, Rubblestone, conglomerate or breccia, red wacke, argillaceous wacke, and the proper compact graywacke. It may be asked, why not consider each of these as a general stratum? Every geologist, who will visit Catskill Mountain, and ascend it by way of the lake turnpike to the mountain House, and return by way of the clove turnpike, will perceive all the objections to such a method. He will see all these varieties with the exception of the conglomerate, passing into each other, in the same continuous horizontal layers. The conglomerate caps the Round Hill south of the Lakes. The most perfect old red sandstone of Werner occupies more than one hundred feet of the base of the mountain at the mouth of the clove; and further north, becomes redwacke, and the most perfect compact graywacke. Old red sandstone has always been a perplexing subject to me. I was greatly relieved when Conybeare gave the opinions of the geologists of the continent against its admission into the system. I most cordially accept the suggestion that it ought to be struck from the list of general strata, and treated as a variety of the second and third graywackes. The *calcareous grit* is a doubtful variety. It may be a bed of cornitiferous limerock. It appears a mile or two east of the village of Bern, on the Helderberg. Contents. *Grindstone* is very perfect in Blenheim in Scoharie county, and was wrought to good advantage during the last war. The Nova Scotia grindstones in our markets often have graywacke attached to them. *Fibrous Barytes* of Scoharie county, called Scoharrite, is found in a soft variety of this rock.

IV. Superincumbent Rocks.

20. *Basalt.*

That this class of rocks is of volcanic origin, and that it contains real basalt, I believe is no longer disputed. Every variety, and every imbedded and every disseminated mineral may be seen at Deerfield and at Mount Holyoke in Massachusetts,—at New Haven in Connecticut, and at the Palisadoes on the river Hudson.

CLASSES OF DETRITUS.

V. Alluvial Detritus.

21. *Anti Diluvion.*

Subdivisions. *Plastic clay* is found near Crown Point, on the west side of lake Champlain; also in Newark, New Jersey, &c. I have seen it in beds in Rensselaer and Albany counties. I should have considered it in all the localities I have visited as in beds or veins, had I adopted my own observations as authority. But it has been treated as an extensive stratum by several accurate geologists. See American Journal of Science, vol. 7, pp. 31, 32, 44. *Marly clay* (London clay) is one of the most universal of all visible strata. It is the common clay of all North America. Lieut. A. B. Eaton, of the U. S. army, traced it from the mouth of the Ohio to New Orleans, mostly covered with bagshot sand. No particular localities need be pointed out. It always effervesces with acids when dry. It always contains muriate of lime; consequently all wells dug in it yield hard waters. Sulphate of magnesia is not uncommon in it; and in some localities it contains small quantities of muriate of soda. We have one such locality near the Rensselaer school, on the bank of the Hudson. *Bagshot sand and Crag* are next in extent to the marly clay, and generally overlie it. The sand and crag often pass into each other, and often alternate. If they are ever to be treated as distinct, probably the crag would be considered as uppermost; for I have never seen the sand uppermost, after ever so many alternations. The hard-pan of agriculturists is the most perfect crag. Varieties. *Brick earth* is very perfect in marly clay, on the canal west of Lockport. *Hard-pan* extends over vast districts of the elevated parts of New England, and New York. Contents. *Puddingstone* abounds in crag and sand west of Schenectady, and west of Little Falls, along the Erie Canal. *Buhrstone* is found in the marly clay of Georgia. *Bog-ore* is found in the bagshot sand from near lake Champlain to Coxackie, along the west line of the Hudson—about eighty miles. *Indurated marl* is every where in marly clay, in the form of rings and pins. *Shell marle* is found overlying and imbedded in crag, bagshot sand, and marly clay; particularly along the canal between Rome and the Genesee river.

22. *Diluvion.*

No discoveries have yet furnished materials for a subdivision of this general stratum. There is even some difficulty in distinguishing it from post-diluvion. The negative character, that it never contains any works of art, is not a sufficient distinction. But, that the pebbles are not separated from the light sediment is a pretty good characteristic. When it is so situated that it could not have been brought into its present situation by any existing cause, its character is unquestionable; such as the Erie Canal line from Little Falls to near the Genesee river. This great diluvial trough of one hundred and sixty miles in extent, could not have been scooped out and filled by any existing cause. But the Detritus on which Troy, N. Y. is built, might have been produced by the Hudson: Yet, as the constituents resemble those of the great diluvial trough in every particular, we feel a confidence in the opinion that it is diluvial. In both localities, though eighty miles apart, the Hemlock tree, (Pinus canadensis) with its roots, trunk, branches and green leaves, is the chief vegetable. In both localities we find much quicksand, masses of clay, gravel, &c. which are much alike. These remarks will apply to numerous other localities, which I have examined. This subject will be resumed in its proper place.*

23. *Ultimate Diluvion.*

I believe nothing had been published on this subject until I made a communication to the American Journal of Science, vol. 12, p. 17, unless DeLuc and Jameson intended the word *Geest* for this stratum. Their definition, however, would seem to embrace surperficial analluvial also. Since that time the subject has occupied the attention of many accurate observers. Prof. Cleaveland has observed it in the state of Maine, and it has been recognized by several geologists in most of the ancient elevated forests of Massachusetts, Connecticut, New York, and Pennsylvania. It is always some shade of yellow, and gray, or rather a light dirty orange. It is best characterized when reposing on the hard-pan variety of crag. It is from three to nine inches thick in most localities. When thicker we can generally find evidence of its having been accumulated by the last settling of water into basins, or depressions of the surface of the crag.

24. *Post-Diluvion.*

In the beds of large rivers this may be distinguished from diluvion by an undeviating character. *The coarse pebbles are always higher up the river than the fine sediment.* For

* Reference would be made to the Alluvial detritus of New York, and Long Island, but neither Mrs. Griffith's, nor Dr. De Kays' excellent essays seem to be sufficiently particular to establish its character.

example, pebbles reposing in argillite, from ten to forty feet in depth, form the bed of the Hudson from the head of tide water at Troy, to near Albany. Seven miles below, sediment more or less fine is seen in the bottom of the river. Dr. Hayden of Baltimore, has given numerous localities of this kind, without any other object than that of giving us simple matter of fact.

Works of art are found in this formation, which distinguishes it from diluvion. It is a curious fact that no works of art are found in the diluvion. It seems to prove, that durable works of art were not common before the deluge; and that pasturage was the chief employment of the antediluvians.

VI. Analluvial Detritus.

25. *Stratified Analluvion.*

Whole rocks sometimes become soft detritus, without being removed from their original position. At Montezuma, on the Erie canal, Comfort Tyler, Esq. dug a well, one hundred and eighteen feet deep. He perforated the diluvial trough, then the lias and ferriferous stratum, and entered several feet into the saliferous rock, where he found strong salt water. These rocks were all in a state of disintegration, and retained all their original contents, and all their characters excepting induration. I have traced this kind of formation southwardly to Cayuga lake, and up the lake to Spring mills, a distance of about fifteen miles. This is in exact conformity with a general principle which seems to have been overlooked. *All rocks are found to be harder and to present a more primitive aspect, as we approach their elevated and bassetting edges.* This character is well illustrated by the lias, ferriferous and saliferous rocks just mentioned. Also by the third graywacke of Lake Erie, in its approach to Cattskill Mountain; and by the argillite and first graywacke as they approach the primitive rocks of the Green Mountain range.

26. *Superficial Analluvion.*

All rocks are subject to disintegration on their exposed surfaces. The common disintegrating agents, water and variation of temperature, are perpetually reducing the upper surfaces of rocks to the state of soils adapted to the production of vegetables. As this detritus is not necessarily washed from the place of its original production, it may be called *analluvial detritus:* As it is formed at the exposed surfaces of all rocks, it may be denominated *superficial.*

It always depends for its character upon the nature of the rock whose disintegration produced it. The most distinct subdivisions are *granulated soil* and *clay loam.* It presents a granulated appearance when it originates from granite, granular quartz, the graywackes, millstone grit, &c. It is of a loamy, and more or less clayey appearance, when hornblende rocks, argillite, argillaceous graywacke, &c. have furnished it by their disintegration.*

REMARKS.

1. *The upper part of every general rock-stratum, is either more fissile or more loose and siliceous, than the under part.* This affords a natural character for making the two-fold divisions adopted in this nomenclature.

2. *The upper surface of every general rock-stratum in our district, is destitute of a superimposed rocky covering, for a great distance.* This affords a very natural guide for the limit of general strata.

(To be continued.)

Art. XXII.—*Account of the Welland Canal, Upper Canada; by* William Hamilton Merritt, Esq. Superintendant.

This canal is intended to connect Lakes Erie and Ontario, and thereby remove the natural barrier caused by the wonderful and well known falls of Niagara; it exceeds in magnitude any other yet constructed in America, excepting the short cut from the Chesapeake to Delaware Bay, and in the extent of the surface of its waters it exceeds any in the world.

By reference to the map of the Niagara peninsula, hereunto affixed, it will be seen that from the mouth of Grand river on Lake Erie, it continues up that stream by a towing path one hundred and twenty eight chains, thence up Broad creek seventy chains, thence by a thorough cut through an extensive marsh ten miles, thence down Mill creek two and

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* The figures given with the preceding synopsis, are intended as an imitation of the half-artificial figures of Linnæus, representing his botanical classes. More than half a century has demonstrated the great utility of his plan in fixing a kind of standard in the mind of the learner.

a half miles, until it intersects the river Welland, into which it descends by a ship lock of eight feet lift, thence a towing path or track way is constructed ten miles,* and thence the canal runs in a northerly direction to Lake Ontario, winding up a ravine about sixty six chains with from eight to twelve feet cutting. This part is finished and filled with water, together with a guard gate to control the admission of the waters of Lake Erie. Thence commences the deep cut, (as it is termed,) or dividing ridge, and a most formidable work it assuredly is. It commences with an almost abrupt height, of thirty feet above the canal bottom, then gradually rises to fifty six feet six inches in a distance of one hundred and six chains, then gradually descends in a distance of twenty eight chains to thirty feet, when it as abruptly breaks off in another ravine. The entire distance through this cut is one mile fifty four chains, averaging about forty four feet cutting; to the depth of from twelve to eighteen feet from the surface, it is composed of clay with a small mixture of sand, and below this, a tenacious blue clay.

This cut was commenced in Sept. 1825; it contained one million four hundred seventy seven thousand seven hundred cubic yards, and at the close of this last season, there remained to be removed, only three hundred seventy thousand yards. The bottom is removed from each end of the cut with scows, and the earth is deposited in the Welland river and in a large reservoir below bottom level at the other end. Between these points, the earth is removed with carts, wagons and machinery; being drawn to the top, where it is deposited on the bank, on either side. The machine in most general use, is a common wagon wheel, fixed on an upright post, about seven feet from the ground on the top of the bank; a rope, with a hook on each end reaching from the bottom of the canal to the top, is fixed round this wheel which hooks on the back of the descending cart and to the tongue of the one below, so that the return team assists in pulling up the loaded one, thereby, in effect, reducing the ascent to a perfect level, as the loads are drawn up with more ease than they are removed on the level to discharge.

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* This part of the canal, was placed under contract in October last; a number of men are now employed on the Marsh, which has to be excavated from ten to sixteen feet deep throughout. The contracts stipulate for its being finished, 1st Oct. 1828.

From the termination of the deep cut, to that part where the mountain descends (or lock No. 1, as it is called, although it is properly No. 2,) the distance is four miles and twenty three chains. The land is undulating, and composed alternately of ridges and ravines, running from east to west, at right angles with the Canal; the ravines are generally below bottom level, and by throwing an embankment on the west side of the Canal, they afford large and spacious reservoirs, embracing in all about two miles in length. The cutting through these ridges is light, except one at the brow of the mountain, which, in a distance of twenty chains, averages near twenty feet. This part of the Canal is finished, except ten thousand cubic yards of excavation, which will be removed in April next; there are three small culverts of masonry on this summit, one with a span of five feet, the others of three feet each; four twin bridges will cross the Canal, the butments of which will be forty feet apart; the guard lock, and the one between the Grand and Welland rivers will be forty feet in width and one hundred and twenty five in length, so that any steam boat may approach this point by either route, that is, from lake Erie by the Niagara river and the Welland, or from lake Erie by the Grand river.

From lock No. 1, the Canal continues in a ravine fifty three chains, gradually descending by four locks of twenty two feet width—thence for one mile and fifty five chains it curves round the brow or break of the mountain to the left, and again to the right, for the purpose of extending the distance to admit a pound between each lock, and maintain the same gradual and convenient descent. There are seventeen locks in this distance, and sixty thousand yards of rock excavation, which is all removed, and is all that was met with between the lakes; the excavation is nearly all finished, and the locks in a forward state.

From this, the Canal enters another ravine to St. Catharines, a distance of two and a half miles, in which there are twelve locks of twenty two feet width; the banks are high, and the same easy descent is maintained throughout—the work on this part is likewise nearly all finished—this may be termed the mountain descent, as in a distance of four miles and seventy two and a half chains, from lock No. 1, there are thirty two locks, with a declination of three hundred and twenty two feet—their dimensions are one hundred feet length and twenty two feet width in the pool, calculated to pass vessels of one hundred and twenty five tons burden.

From this to lake Ontario, a distance of five miles, the Canal continues most of the way in the bed of the main branch of the twelve mile creek ; there are three locks in this space (including the one at the harbour,) thirty two feet wide and one hundred and twenty five feet long, for the purpose of admitting steam boats from lake Ontario. A large and commodious harbor is constructed at this place, by throwing an embankment seventeen chains long, between two high ridges and raising the water five feet, which covers an area of three hundred acres, capable of containing all the vessels or lumber which may be required for ages to come—the entrance is protected by two piers extending into the lake, one two hundred, the other three hundred and fifty yards.

This Canal is made by a company, incorporated by an act of the Provincial Parliament of Upper Canada, with a capital of eight hundred thousand dollars. The legislature of Upper Canada have authorized a subscription of two hundred thousand dollars, and have lent the company one hundred thousand dollars—and the government of Lower Canada has subscribed one hundred thousand dollars; the remainder is owned by individuals. The British government has likewise given one ninth of the amount of its cost, on condition that their stores pass free of toll, besides a donation of thirteen thousand acres of crown lands between the Grand and Welland rivers, through which the Canal passes.

That part of the line from the river Welland to Ontario is nearly finished, excepting the residue of the deep cut, which, although it is rather less than one fourth of the whole amount originally to be excavated, is still an arduous work. There has been expended, including the purchase of land, mills, machinery, &c. about seven hundred thousand dollars, and it is supposed it will require the full amount of capital to finish it, exclusive of the loan from government.

Its general dimensions are eight feet depth of water, and twenty six feet width at bottom, with a slope of two to one, which gives a surface of water of fifty eight feet.

The company's affairs are managed by a board of directors, elected annually, consisting of a President, Vice President, and five Directors, which situations are now filled by the undermentioned gentlemen:

The Hon. John Henry Dunn, Receiver General of the Province, President.

Henry J. Boulton, Esq. Solicitor General, Vice President.

The Hon. Col. Wells, J. B. Robinson, Esq. Attorney General, D'Arcy Boulton, jun. Esq., George Keefer, Esq., and John Clark, Esq., Directors.

The immediate superintendance of the business is under the management of an agent,* and a secretary, who are appointed by the board. Alfred Barrett, of the state of New-York is principal engineer.

The first idea of all Canals is suggested by the direction of natural water courses, but in no instance have we ever seen the route of any Canal more plainly laid down than through this peninsula.

It affords geological information respecting this portion of the country, which we have never seen noticed. The lowest point between Lewiston and the Genesee river is at Lockport, where the mountain ridge rises thirty two feet above the level of lake Erie, extending, with a gradual descent seven miles to the Tonewanta creek, three miles of which is hard limestone rock, and caused by far the greatest expenditure on any part of the Erie Canal.

At this place the dividing ridge is situated near the river Welland, from which the water descends both into the Welland and lake Ontario—in the ravines formed by those waters is the location for this Canal—this ridge or barrier is only one mile and fifty four chains in length, and appears the only formidable obstacle in the whole line. From this the mountain takes a dip and at the brow three miles distant, at the falls of the twelve mile creek, it is from forty to fifty feet below the level of lake Erie, the mountain again gradually rising on each side from twenty to thirty feet above the level, as at Lockport—the streams from all the mountain above Burlington bay running eastward, and from the falls and near the Niagara river westward, although it contains no rock, neither is any met with until after a descent of eighty feet, in winding round the face of the mountain.

The Welland River is a large stream peculiarly adapted for an extensive navigation, being from twelve to eighteen feet in depth, and from three to four chains in width. It divides the peninsula discharging into the Niagara river two and a half miles above the falls, and extends with almost a dead level from thirty to forty miles into the country. The

* The gentleman who is named at the head of this article now occupies that situation.—*Editor.*

company have power to construct a towing path on the Niagara river, from Fort Erie to the Welland, and thence up ten miles, until it intersects the canal by which vessels may enter, or return without any obstruction from lake Erie, by passing the ship lock now constructed at Black Rock.

The other entrance by the mouth of the Grand river, has been already described, and the advantages expected from this connexion will be mentioned hereafter.—In either case Lake Erie will serve as a feeder, which by coming in at one end of the canal will always afford an equal and abundant supply of water, and the same supply may be made use of on each level to any extent for hydraulic purposes, which will form a productive branch of revenue, as there are no mill seats on the peninsula except the Falls of Niagara.

The natural advantages which the route possesses, can be more fully understood by the following abstract of distances.

	Natural		Artificial	
	M.	C.	M.	C.
From lake Erie to the marsh on Grand river and broad creek, - -	2	38		
Entire cut through the marsh and mill creek, - - - - -			12	40
To River Welland, - -	10			
	12	38	12	40
From River Welland to Lake Ontario including reservoirs and ravines, -	11	26	6	15
Total,	23	64	18	55

The wide surface afforded by these ravines and reservoirs will make the canal appear more like a large river than an artificial navigation.

Another remarkable feature in this navigation is, that by throwing a dam over and constructing a lock in the Welland river below the entrance of the canal, and raising the locks two feet, the water may be raised throughout the canal to a depth of ten feet, with very little additional expense; the towing path is now raised four feet above the surface in situations where excavation is necessary, with a view to this extension, whenever it may be found desirable.

We have been thus minute in describing the geographical situation of this canal through the Peninsula and its progress and prospects, as it has seldom been noticed, and its utility is likely to be tested by actual experiment before it will be fairly before the public.

The extent of waters or countries which it will connect, can be realized only by looking at a map or chart of North America. Lake Erie is the natural outlet of St. Clair, Michigan, Huron and Superior, bordering on a country containing two hundred and six thousand square miles, besides the state and valley of Ohio, a part of which may fairly be included, as it will be connected with lake Erie by the Ohio canal, extending to the mouth of the Scioto river three hundred and fifty miles, which is two thousand miles from New Orleans and only nine hundred and eighty from New York by the Ohio and Erie canals, the produce from which will cost only one dollar per cwt.

The next question to be determined is, when property is once afloat on lake Erie, where will be its destination, as it must pass either through the Welland or Erie canal. For ourselves we consider all reasoning on this subject superfluous, for any person who fairly comprehends the extent of country lying on and above lake Erie, must be morally certain, that it will afford ample business for at least two channels.

The projectors of this canal maintain, that property can be conveyed to New York market, cheaper through the Welland, than the western part of the Erie canal, which opinion is supported by the following numerical calculation.

Distance from Buffalo to Syracuse, where the Oswego canal intersects the Erie, two hundred miles, which at $1\frac{1}{2}$ cent per ton per mile for toll is - - \$3

200 miles transportation $1\frac{1}{2}$ cent per mile	3	—\$6
add $1\frac{1}{2}$ cent per mile for additional toll up - -		3
		\$9

Distance from river Welland to Ontario $16\frac{1}{2}$ miles,			
Oswego to Syracuse - -	32		
	$48\frac{1}{2}$—\$1 45		
Same price as the Erie,			
add 25 miles for Grand River, - -		75	
From Welland canal harbour to Oswego		1	—3 20
Add additional $1\frac{1}{2}$ cent for 73 miles up - -			1 10
which gives a gain in descending of \$2 80 per			\$4 30
ton, and ascending - -	4 70		

Besides which the following reasons are assigned. *First*, the principal expense in transportation by vessels, consists of port charges, loading and discharging—and as vessels will pass through this canal without breaking bulk, the distance from Welland canal harbor to Oswego, one hundred and twenty miles, will be a mere continuation of voyage. *Second*, the peculiar formation of lake Erie which contracts to a very narrow space below Port Albino, and the prevalence of westerly winds, together with the current of the Niagara river, cause an accumulation of ice to take place every winter, which prevents the approach of vessels to Buffalo or Fort Erie, from three to five weeks, after the lake at the mouth of Grand river and above it is open. Every merchant is anxious to push his commodities to market on the first opening of the navigation, and the facility afforded by the Grand river in removing this natural and formidable obstruction is important.

It appears that the United States possess as great an extent of lake, as sea coast, and as the opposite side of those waters in the Upper province of Canada presents an equal extent—every philanthropist must dwell with pleasing anticipation, on the cheering prospects which are now opening to the citizens of this most extensive and heretofore secluded region.

It is a matter of little consequence to the grower in what part of the world, his produce is consumed, so long as he has to depend on a foreign market for a demand, or by what channel it reaches that market; his interest consists in the value of the articles at home, and any measure or any improvement which tends either to facilitate this foreign intercourse, or to lessen the expense of transportation, adds so much direct wealth to the grower, and consequently to the country.

The British government has established free ports at Kingston, Montreal and Quebec, where our merchants may deposit their commodities for exportation. We learn that an application will be made to Congress this present session, to make Buffalo and Oswego on lakes Erie and Ontario, free ports to enable the inhabitants of Canada to export their commodities by the port of New York on similar conditions—this will afford facilities to exports, and open a salutary and desirable competition.

A Steam Boat canal is likewise in contemplation from Prescott to Montreal, a distance of one hundred and thirty two miles, and from the short distance through which a canal is necessary, only about sixty miles with one hundred and ninety six feet lockage, we have no doubt it will be accomplished in a few years. In this manner lake Erie will be connected with the Ocean by canals of only seventy six miles in length—sixteen to Ontario, and sixty on the St. Lawrence, which will render this extensive lake coast a sea coast, to all intents and purposes.

It remains to be seen, whether produce can be shipped at once from thence to a foreign market, by the gulf of St. Lawrence on better terms, than by the Erie canal to New York where the market generally is preferred.

DESCRIPTION OF MACHINERY.

The facility with which the earth is removed in deep cutting, by means of the improved machine invented by Oliver Phelps, must be obvious upon the slightest inspection of the accompanying plan, and must necessarily supercede the use of any other method hitherto made use of for this purpose, both on account of the increase of power, and the simplicity and cheapness of its construction, which consists of nothing more than a common wagon wheel, with the addition of a rim for the purpose of fastening on the rope by which the carts are drawn up. This wheel is so placed, on an axle or upright piece firmly supported by a brace fastened in a piece of timber bedded in the earth, and two posts framed together and so placed as to keep the wheel steady, with two shives fixed to the sides to keep the rope in its place. A road is constructed in the side of the bank, in an oblong direction, forming an angle of about fifteen degrees from the top where this machinery is placed, to the bottom of the canal. The great advantage derived from this method is that no power is lost, for the empty team descending assists the one ascending—thereby reducing the ascent to a level. Six teams may be attached to each machine, and work without the least inconvenience or interruption.

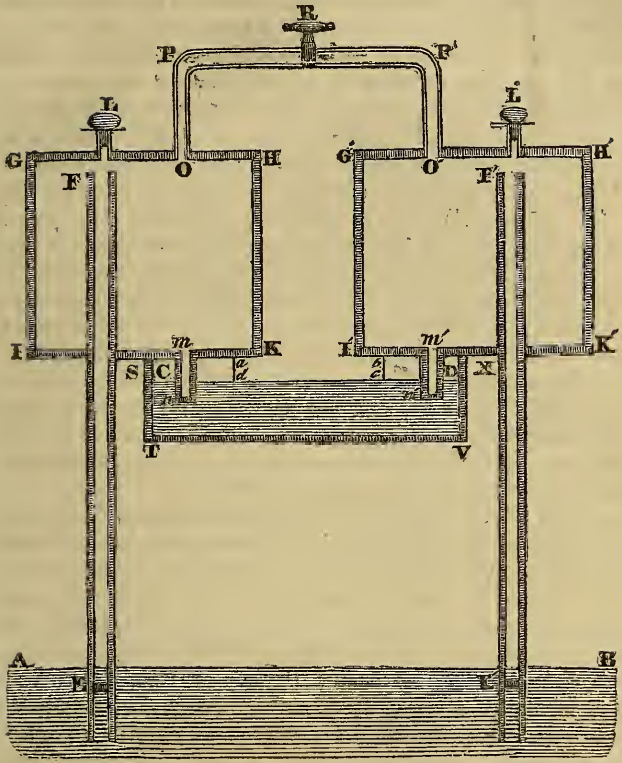
George Keefer, Jun.

REMARKS BY THE EDITOR.

Having been gratified, during the late autumn, by a visit to the deep cut on the Welland Canal, we were, in common with our whole party, forcibly struck with the simplicity and efficiency of the machinery here described. Horses and oxen were driven rapidly down the inclined roads on the bank of the canal, dragging after them their empty wagons, and at the same time drawing rapidly up the loaded vehicles, which were guided by teams, soon to descend again, after depositing their loads. The unloading was an affair of only a few seconds. The body of the wagon being fixed on an axis, running longitudinally, was easily made to lose its balance, when the load dropped out by the turning of the body, while the wheels remained undisturbed, and in a twinkling, the empty machine was again running rapidly down the hill and drawing up its reluctant counterpart. The bottom of the canal was also a scene of great life and industry—hundreds of men and of animals were busily employed in the most active industry. The vast beds of tough tenacious and regularly stratified clay, presented decisive evidence of being a great diluvial deposit. We did not, however, learn that any organized bodies had been found in it.

From captain Basil Hall, R. N. F. R. S. to whose good offices we are indebted for this account of the Welland Canal, we received a printed copy of the regulations adopted for the government of the laborers and workmen. Their moral tendency is excellent, and being every way judicious, we understand they proved effectual for the promoting of order, industry and good morals.

ART. XXIII.—*Long's Steam-Pump.*



Lieut. G. W. Long, of the U. S. army, has lately obtained a patent for an apparatus invented by him, which he denominates a Steam-Pump, and which, when known to the public will probably find many useful applications.

The annexed figure represents a section of this apparatus. It will be seen to consist of two symmetrical parts. EF is *the barrel* or *suction pipe* having a valve opening upwards at E. GHIK is the *receiver.* OP is a *steam-pipe,* having a valve at R so constructed that steam may be admitted to one receiver, and cut off from the other, at the same instant. The steam is supplied from a boiler, which is not represented in the figure. MN is *the discharging tube*, and has a valve at N opening downwards, which is kept closed by the pressure of a small quantity of water in *the reservoir* STVX. A small aperture *a b c d* is made in the side of the reservoir, by which the water may be conducted away.

The mode of operation will be easily understood. The barrels EF are first filled with water through the tubes L, which are then securely stopped. The reservoir is filled with water up to the level CD, high enough to close the valves N. By turning the valve R, steam is admitted into the receiver IH, and the air which this contains is expelled through the valve N. As soon as this is effected, the valve R is again turned, so as to cut off the steam from IH, and admit it into I'H'. The air is then expelled from this receiver through the valve N', while the steam contained in IH is condensed by contact with the upper part of the pipe EF. A vacuum being thus formed, the water rises through the suction pipe EF and fills the receiver. The valve R is now turned again;—steam is admitted at O, and the water in IH is discharged into the reservoir by the valve N, while the steam in I'H' condenses and that receiver becomes full of water. Thus each receiver is alternately filled and emptied.

A method of regulating the admission of steam, independently of manual assistance, has also been invented by Lieut. Long, which may be considered as completing the apparatus.

As the water is raised in the barrel EF by atmospheric pressure, and it should ascend with a certain velocity, the height to which water will be elevated when the greatest effect is produced will be about twenty or twenty five feet. With receivers of a capacity of sixteen cubic feet, one being emptied every ten seconds, six thousand pounds of water might be raised to this height in a minute: an effect about equal to that of a four horse power.

The apparatus evidently requires no great strength of material or nicety of construction. Its first cost will therefore be small. But few of its parts are liable to get out of order, and those may be easily repaired or replaced. The pressure of the steam need exceed that of the atmosphere but little, and the quantity of it necessary exceeds that of the water to be raised only by an allowance for wastage occasioned principally by condensation, while in contact with the discharging water and the sides of the receiver. The amount of this loss, it may not be easy to estimate exactly without the actual experiment; but if the discharging orifice be made large, it will not, perhaps, be so great as to balance the advantages of the invention. H. H. G.

Art. XXIV.—*An account of a Water Spout, seen off the coast of Florida, in the spring of* 1826; *by* Benjamin Lincoln, M. D., Boston.

April 5th.—At 6 o'clock, A. M. an order was heard from the deck to get ready the gun on the weather quarter, and bring the muskets from the cabin. Recollecting what region we were then in, my first thought was of an engagement with a piratical cruiser, but on going upon deck it appeared that our enemy was a water spout; bearing north, distant, according to the captain's estimation, about two miles, and coming down upon us before a whole-sail breeze. One musket was fired at it, but it had nearly effected a retreat before we got ready for action. I had just time to see it and it disappeared.

In the course of a few minutes another appeared, which was said by the officers of the vessel to be much more distinct than any one they had ever seen before.

I observed it attentively, but neglected to note the time, except at its commencement and at the end of a third water spout which appeared after the second and principal one had passed away. This omission renders it impossible to give the *duration* of its different stages with any good degree of exactness.

The wind came from the land, blowing a whole-sail breeze. The thermometer stood at 72°. A black cloud, from which the spout proceeded, extended along from east to west; its lower edge very distinctly defined, even, parallel to the surface of the water, and elevated 25° or 30° above the horizon. No other cloud was visible in that quarter, but a haziness covered the whole heavens.

A small, black and perfectly defined cone (fig. 1. A.) darted from the lower edge of the cloud and pointed perpendicularly to the water, which at the same moment was seen flying upwards like spray on the rocks (fig. 1. B.) It was distinctly noticed that the cloud grew blacker near the cone, appearing to be gathered in from all quarters and condensed at this point.

After the lapse of two or three minutes, the cone instantaneously extended itself to about twice its first length (fig. 2. A.) and the water was thrown up higher (fig. 2. B.) This continued a few minutes;—then the apex of the cone suddenly disappeared, leaving the truncated end jagged, (fig. 3. A.)

from which little scirrhi were continually darting and disappearing, the water remaining the same as before. This appearance continued two or three minutes, after which the cone gradually elongated itself, assumed the cylindrical shape (except near its junction with the rest of the cloud) and descended almost to the surface of the water (Fig. 4.) The time occupied by the descent was about two seconds.

N. B.—All the changes thus far mentioned, were instantaneous, except the *descent*, which was gradual.

As the spout descended, the agitation of the water increased, boiling up on each side above the end of the spout, *but not coming in contact with it.* The spout was slightly curved, the convexity of the curve being towards the point whence the wind came. It appeared to be hollow, light in the middle, and black, like the cloud at its sides. A waving, ascending motion was distinctly seen in the middle, more distinctly near the water than near the cloud. This the sailors with one accord pronounced to be *water, going up the spout!*

This appearance lasted fifteen minutes or more, the spout remaining entire and unchanged. Then it began to fade, and suddenly a section from the lower end disappeared, leaving the same scirrhous jagged extremity before mentioned. One section after another disappeared in this way, the spout continuing to grow paler, the waving motion *growing more distinct and slow*, and the agitation of the water subsiding till the whole disappeared.

By this time the wind had freshened considerably and the cloud had spread over a great part of the heavens.

In a few minutes after, another cone appeared, exactly like the first in all respects, and the same appearance was exhibited in the water under it. This remained a short time and then disappeared.

From the appearance of the first cone, till the disappearance of the last, was three fourths of an hour.

The wind continued to increase, and the cloud to gather blackness and spread in every direction, till it enveloped the whole heavens. Next came a most vivid flash of lightning, with a most tremendous peal of thunder. It seemed as if heaven and earth had exploded at once—and in an instant all was calm—the sails hung loose—not a breath of wind could be felt. Rain now began to fall not in drops, but in torrents, and the wind came in gusts from every point of the compass.

It continued to rain and blow in this way about fifteen minutes, after which it ceased raining, the wind settled in its former direction, the sky became clear, and we went on our way.

Fig. 1.

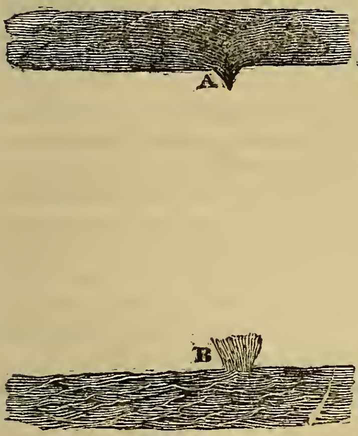


Fig. 2.

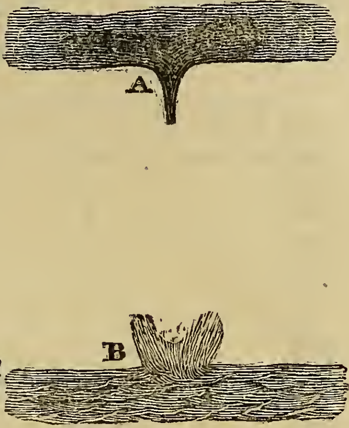


Fig. 3.

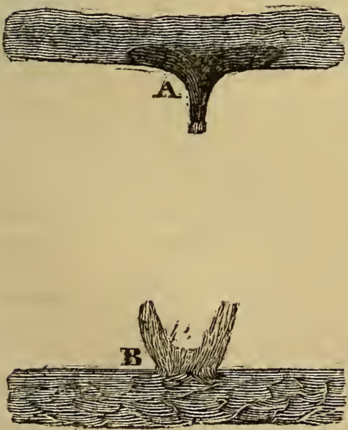
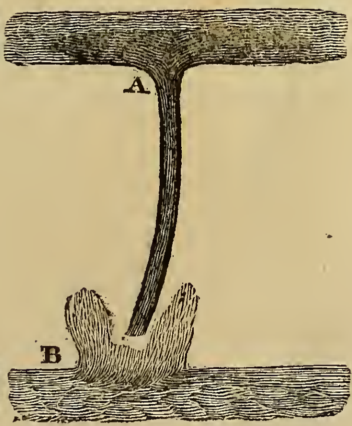


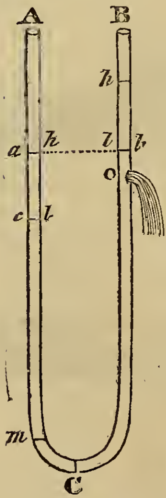
Fig. 4.



Art. XXV.—*On the Cause of Fresh Water Springs, Fountains, &c.; by* Joseph Du Commun.

In the Harmony Gazette, November 21, 1827, there is a *Nut for the philosophers*, picked, it is said from the National Gazette. I have endeavored to crack it, and I now present you with the kernel, leaving to your taste to determine whether it is palatable.

The questions proposed are two in number, 1st, Why the fresh water issuing from the depth of two hundred and twenty feet, by boring in solid rock near the city of New Brunswick, rises from eight to fourteen feet above the surface of the Raritan river? and 2d, Why the quantity of water corresponds exactly and continually with the rising and falling of the tide?



If we take an inverted glass syphon ACB and pour water into it, the two sides will be filled in part, and the water will rise in each side to the same height, say *a* and *b*.

If instead of water, we introduce mercury in the branch A and rain water in the branch B, one inch of mercury at *m* will support above thirteen inches of water in the branch B.

And lastly, if in the branch A we have a fluid denser than common water, as salt water for instance, the column of fresh water will be supported in the branch B, at the height *b*, by a column of the salt water inferior to it in height, in the inverse ratio of their densities, say to the height *c* only.

But now, cannot the branch B, of our syphon represent the subterranean stream winding through the crevices of the rocks, until it reaches, at some depth or other, the great oceanic reservoir, and cannot the column of salt water in the branch A represent, in like manner, the height and pressure of the salt water of the ocean?

If so, it explains why the fresh water, in boring by the sea shore, is raised and flows above the level of the sea water; thus, one of the two given questions seems to be solved.

The answer to the second may be deduced from the same principle.

Let us suppose that a hole has been opened in the branch B, a little below *l b* the level of the water at ebb; the water will then flow with a velocity that may be represented by 1, but at high tide the water might be supported at the height *h*, if the opening in the tube did not permit it to flow out, and it then must flow with the same velocity as if pressed under a column of fluid of that elevation. The quantity of water so running may be as 3, 4, 5, &c. according to the height of the tide; and finally, it must continually and exactly follow its oscillations.

Such is our solution for the two problems proposed.

To these considerations several might be added, for example: Knowing the proportional densities of the fresh water and the sea water, and the difference of the two levels, to determine at what depth the subterranean stream empties itself in the ocean. If we calculate the particular case here given, we shall find, the density of fresh water being represented by 1000, that of sea water by 1029 (Dr. Murray,) the difference of the levels being fifteen feet, we shall find, I say that the depth at which they join under ground must be five hundred feet.

Thence it follows, that if the junction of the two different kinds of water should take place at five thousand feet, or one mile, below the surface, the fresh water should rise at one hundred and fifty feet; if at fifty thousand feet, or ten miles, as one thousand five hundred feet, &c. This I think may account for the springs on high ground, and even at the top of insulated mountains.

Proceeding on, and drawing conclusions from the above principle, if admitted, it explains why there are during winter, places in our rivers, and each year the same, called air holes, where the water is very transparent, and will never freeze.

It seems that streams, rivulets and rivers under ground, are as numerous as on the surface of the earth, that they join together to form main streams, and that they are all directed towards the sea, where they empty at various depths, we may suppose also that there are lakes various in extent, and then we shall be compelled to admit, that the tide must not have a more apparent effect on the springs that are opened at remote, or elevated points of the surface, than the tide of the Ocean has on the Mediterranean and Black sea, although in open commuication with them.

And to conclude, it might throw some light on that phenomenon related by voyagers, of spaces of several miles in extent, in the open sea, where they have met with water perfectly fresh and soft; supposing these places to be above the mouth of one of these immense and subterraneous rivers, the water of which, being lighter, would ascend to the surface and spread to a great distance, until tide, wind, wave and current have mixed it with the salt water of the sea.

West-Point, *Dec.* 20*th*, 1827.

INTELLIGENCE AND MISCELLANIES.

I. Domestic.

1. *Meteorological Report for the year* 1827.

From the Register of the Connecticut Academy of Arts and Sciences, kept at New Haven—by Denison Olmsted, Professor of Mathematics and Natural Philosophy in Yale College, and Secretary of the Academy.

[Printed by permission of the Academy.]

In the following paper, it is proposed to lay before the Academy, the *results* of the meteorological register for the year 1827, kept by their order, with the hope and expectation, that similar reports will be continued from year to year, forming a series from which, taken in connexion with the meteorological observations already in the possession of the Academy, ample materials will be furnished for ascertaining the true character of our climate, by comparing it with the climates of other countries.

Table I.---*Shewing the state of the Thermometer and Barometer at sunrise, at* 2 *o'clock P. M., and at* 10 *P. M. for every month in the year, being the mean of daily observations.*

	THERMOMETER.				BAROMETER.			
	sunrise	2P.M.	10P.M.	mean	sunrise	2P.M.	10P.M	mean
January,	17.00	28.93	20.32	22.08	30.04	29.98	30.02	30.01
February,	25.90	35.30	28.30	29.80	30.03	29.98	30.02	30.01
March,	32.00	43.30	35.40	36.90	30.07	30.00	30.08	30.05
April,	42.50	57.00	45.60	48.36	29.96	29.93	29.93	29.94
May,	46.40	64.45	54.00	54.95	29.82	29.83	29.90	29.85
June,	56.23	73.80	61.83	63.95	30.09	30.08	30.06	30.08
July,	62.84	77.06	67.22	69.04	30.10	30.11	30.08	30.10
August,	61.10	75.72	65.79	67.54	30.11	30.11	30.10	30.11
September,	57.23	70.46	61.08	62.92	30.11	30.11	30.11	30.11
October,	51.64	60.93	54.82	55.80	30.03	30.00	30.00	30.00
November,	32.25	40.66	34.68	35.86	29.95	29.92	29.94	29.94
December,	31.30	39.00	32.00	34.10	30.18	30.16	30.17	30.17
Mean,	43.03	55.55	46.75	48.42	30.04	30.01	30.03	30.03

REMARKS.—I. THE THERMOMETER.

1. *Mean temperature of the year* as deduced from the three daily observations, 48.42; but taking the mean from observations at sunrise and at two o'clock, which may be regarded as the maximum and minimum, it is - 49.29

2. *Means for the three separate observations,*

for sunrise,	43.03
2 P. M.	55.55
10 P. M.	46.75

3. *Means for the several seasons,*

for the winter months	28.66
spring, do.	46.70
summer, do.	62.65
autumn, do.	51.53

4. *Maximum for the year,*

	occurred August 6th, and was	93.00
Minimum	January 21st - -	−7.00
Whole annual range of temperature	- -	100.00

The maxima and minima for the several months,

January,	Maximum	45	Minimum	−7	Range	52
February,	"	49	"	−2	"	51
March,	"	63	"	14	"	49
April,	"	73.5	"	33	"	40.5
May,	"	78	"	35	"	43
June,	"	83.5	"	42	"	41.5
July,	"	88	"	55	"	33
August,	"	93	"	50	"	43
September,	"	80	"	45	"	35
October,	"	71	"	33	"	38
November,	"	60	"	18	"	42
December,	"	55	"	8	"	47

Hence, the greatest monthly range of temperature occurred in March, and was 49 degrees; and the least occurred in July, and was 33 degrees.

5. *Hottest month*, July, - - - - 69.04
Coldest do. January, - - - - 22.08

Whence, it appears that our hottest and coldest months, differ from each other only 47 degrees, although the extremes of temperature are 100 degrees asunder.

It appears also that during this year, the mean as deduced from the maximum and minimum for the year, coincides very nearly with the mean as deduced from all the daily maxima and minima; the former being 50°, and the latter 49.29.

II. The Barometer.

1. *Mean height of the barometer for the year,* 30.03
2. *Means for the three separate observations,*

for sunrise,	30.04
2 P. M.	30.01
10 P. M.	30.03

These results differ so little as not to favor the hypothesis of a regular diurnal variation.

3. *Means for the several seasons,* for winter, 30.06

spring,	30.01
summer,	30.09
autumn,	30.01

It appears, therefore, that the mean height of the barometer during the several seasons, has been nearly equal.

4. *Maximum for the year,* - - - 30.62

It occurred in March and April. In March the wind was N. W. and sky clear; in April, wind N., sky likewise clear.

Minimum for the year, - - - 29.02

Range, do. - - - - 1.60

The entire range appears to be, therefore, extremely small. The minimum was observed on the night of April 24th, and was distinguished by a violent gale of wind accompanied by heavy rain.

Other periods of unusual depression of the barometer were as follows:—

Jan. 1. Barometer 29.04—a gale, with a violent snow storm.

Nov. 13. " 29.20—a gale which lasted all night, and blew down the chimnies of the College Chapel. The only instance of so low a state of the barometer which was not attended with a gale, was on the 28th of December, when the mercury stood at 29.23. The wind was high but not violent.

Maxima and Minima of the respective months.

January,	Maximum	30.45	Minimum	29.04	Range	1.41
February,	"	30.58	"	29.40	"	1.18
March,	"	30.62	"	29.44	"	1.18
April,	"	30.62	"	29.02	"	1.60
May,	"	30.05	"	29.60	"	0.45
June,	"	30.39	"	29.72	"	0.67
July,	"	30.30	"	29.89	"	0.41
August,	"	30.40	"	29.77	"	0.63
September,	"	30.50	"	29.80	"	0.70
October,	"	30.42	"	29.41	"	1.01
November,	"	30.58	"	29.20	"	1.38
December,	"	30.56	"	29.23	"	1.33

Whence, the greatest monthly range took place in April and was 1.60: the least occurred in July, and was 0.41. It appears also that during the summer months, including May and September, the variation was much less than during the other parts of the year.

TABLE II.—*Shewing the state of the winds, being such as prevailed at the times of recording the thermometrical and barometrical observations.*

	WINDS.				
	Northerly.	Southerly.	Variable.	N. W.	N. E.
January,	18	3	10	7	4
February,	11	4	13	7	1
March,	11	5	15	6	1
April,	13	7	10	6	6
May,	5	14	12	3	1
June,	7	8	15	6	0
July,	9	11	10	8	0
August,	12	7	12	5	4
September,	19	2	9	12	2
October,	14	8	9	12	1
November,	22	2	6	18	0
December,	21	3	7	8	4
	162	74	128	98	24

REMARKS.

1. Northerly winds constitute of the whole, 44 per cent.
2. Southerly do. 20 do.
3. Variable do. 36 do.
4. Northwest, which bring our fairest weather, 27 do.
5. Northeast, which usually bring foul weather, 7 do.

6. The wind has usually remained for only a short time either directly east or west. Westerly winds have been accompanied with fine weather; easterly winds, almost uniformly with clouds, fog, or rain.

7. Our longest snow storms have commenced with the wind between N. and N. E. settling finally at N. E.

8. The ratios for the several seasons are as follows:—

Winter months,	Northerly	50	Southerly	10	Variable	30
Spring, "	"	29	"	26	"	38
Summer, "	"	28	"	26	"	37
Autumn, "	"	53	"	12	"	24

Whence, it appears that notherly winds prevail most in autumn, and southerly most in spring and summer; and that in spring the winds are most variable, and in autumn least variable.

TABLE III.—*Shewing the state of the weather at the times of the daily observations.*

	WEATHER.			
	Clear.	Broken.	Cloudy.	Stormy.
January,	16	10	5	11
February,	15	8	5	8
March,	14	9	8	8
April,	13	6	11	10
May,	18	8	5	5
June,	17	11	2	10
July,	16	14	1	9
August,	14	14	3	10
September,	19	6	5	5
October,	15	7	9	10
November,	15	5	10	9
December,	4	12	15	8
	176	110	79	103

N. B. Under the head of *stormy* are included all those days on which there fell either rain or snow.

REMARKS.

1. Clear days, - - - - 48 per cent.
   Cloudy in part, - - - - 30 do.
   Cloudy entire, - - - - 22 do.
   Falling weather, - - - - 28 do.
2. Months most *cloudy*—April, November, and December.
   do. most *fair*—May, June, and September.
   do. most *stormy*—January, April, and August.

3. The year came in with a violent snow storm. The winter was distinguished for steady cold weather, the mean for *January* being only 22 degrees, and for *February* only 28 degrees. A bed of snow unusually compact and indestructible, afforded uncommonly fine sleighing from about the 20th of December to nearly the 20th of February, and remains of this body of snow were to be seen till about the last of *March*.

The advantages of an uninterrupted covering of snow as a protection to the earth, were obvious as soon as it had disappeared, the ground being free from frost, and fitted to receive the full benefits of the returning sun. Light showers and mild weather prevailed in *April*—the elms were putting out rapidly on the 4th, and the peach trees were in full bloom on the 24th. The first week in *May* was rather colder, and slight frosts occurred as late as the 14th; but they did no serious injury to fruit. The thermometer, at the time of the latest frost, was no lower than 40, shewing that frosts may happen, when the temperature of the air, at the ordinary elevation of the thermometer above the ground, is 8 degrees above the freezing point, the surface of the ground being so much colder than the air a few feet above it. The same remark applies to the first frosts of autumn. They occur as soon as the mercury has descended to 40.

The early part of *June* was cold, but the month was generally pleasant, the temperature ranging from 42 to 83.5 degrees, and the mean as deduced from the daily maxima and minima, only 65 degrees. Strawberries were ripe on the 4th, and North Haven peas were in market on the 5th. Haymaking commenced about the same time.

July was distinguished by a great number of copious showers of rain. Although a good proportion of clear weather prevailed, yet the entire quantity of rain was 4.83 inches. The thermometer ranged from 55 to 88 degrees, the mean deduced as before, being about 70 degrees. During the second week in July, our citizens were entertained by three evening rainbows of uncommon beauty.

August had a larger proportion of rainy weather, although the sun was entirely obscured for only three days. Ten days were more or less rainy, and the amount of rain for this month, was greater than for any other, being 6.41 inches. But the occurrence which rendered August more particularly memorable, was *the great Auroral arch*, which was seen on the evening of the 28th, between the hours of nine and eleven. An account of this phenomenon, written at the time for one of the city papers, is herewith submitted to the Academy. It may be worthy of remark, that an unusually rainy season accompanied and followed these Auroral appearances. Indeed the quantity of rain which has fallen since the first of August, has been 27.46 at the rate 66 inches or $5\frac{1}{2}$ feet a year —a quantity quite unprecedented at this place. The hottest day of the year occurred on the 6th of this month, being 93 degrees; but the mean was 68° and was a little less than that of July, which, as has been already stated, was 70 degrees.

The earlier part of *September* was dry and clear; but on the 14th a series of cloudy days commenced, which continued for the most part to the end of the year. On the 19th, after a drought, there fell a very copious rain, amounting in the course of four days to 5.4 inches. The temperature ranged from 45 to 80 degrees.

October was also a rainy month. On the 25th, the occurrence of hail with a few flakes of snow, afforded the first indications of the approach of winter. Autumnal fruits, particularly apples, were very fine and abundant.

The evening of the 2d of *November*, presented a lunar halo greatly distinguished for its brightness and variety of colors. A little snow fell on the 8th, which was all that occurred during the month. As in the three preceding months, the amount of rain was unusually great, being 6.18 inches. The month was cold and unpleasant; and it is worthy of remark that neither this month, nor the month preceding or following, afforded any example of that succession of warm, pleasant days, usually called the *Indian summer*—a period which was before thought never to fail.

During the month of *December*, snow has fallen at three different times, but so little in quantity as to have afforded scarcely any foundation for sleighing; indeed, the ground has for the most part remained bare. About half the month has been decidedly cloudy, and only four days have been entirely clear.

Table IV.—Rain.—*Shewing the amount of Rain for every month in the year.*

January, -	2.21	July, - -	4.83
February, -	3.60	August, - -	6.41
March, -	2.57	September, - -	5.40
April, - -	3.70	October, - - -	6.01
May, - -	4.34	November, - -	6.18
June, - -	2.67	December, - -	3.46
	19.09		32.29

1. Amount for the first six months,	19.09
2. Do. for the last do. do.	32.29
3. Total, - - - -	51.38

Hence it appears, that nearly twice as much rain fell during the latter as during the former half of the year; and that the whole amount is probably unprecedented.

2. *Native Iron? slightly arseniuretted.*—The substance described below, was brought to me two or three weeks since, by Mr. Philo Baldwin,* who stated that it was from Bedford county, Pennsylvania, in which county we believe Mr. B. lives.

Perceiving that it was a singular modification of iron, and different from any thing I was acquainted with,—it was, at my request, submitted by Mr. S. to chemical examination.

My impressions are, that it is a new variety of native iron, and that it differs from that substance only by containing a little arsenic, with a little plumbago. Measures will be taken to obtain a greater supply, as it is stated to be abundant, and will at least form an interesting addition to our cabinets.

We take this opportunity to say, that a notice of facts relating to the native iron of Canaan, which is unavoidably postponed, will appear in the next No.—*B. S.*

Chemical examination.—The fragment weighed, I should judge, two or three ounces, and although it had sustained considerable injury, it evidently formed a distinct crystal. By observing a symmetrical modification which this crystal had undergone, in the truncation of two of its alternate obtuse solid angles, I was able easily to ascertain, that it belonged to the class of rhombic prisms, but whether the prism was right or oblique, I could not determine. The natural planes were not sufficiently even, to allow of the determination of their angles with perfect accuracy: neither were the results, from numerous cleavage planes, uniform enough for this purpose; although in the latter case the reflective goniometer was used with the utmost convenience. The inclination of the primary planes may be regarded as an approximation to 121° and 59°, and those of the secondary (intersecting the base parallel to its greater diagonal) to the primary 146°. With the cleavage crystals the following angles were obtained, 120°, 121°, and 122°—a diversity very remarkable, as the cleavages appeared to the eye quite perfect and the planes highly uniform.

The cleavage parallel to the lateral planes is effected without much difficulty, whilst no terminal one is visible; it break-

* Mr. Baldwin went to Newtown, Connecticut, where he formerly resided, and was to return in a week to learn the nature of the mineral, but has not yet called, which prevents me from stating the exact locality.—*B. S.*

ing in that direction with great difficulty, and presenting an uneven and sub-hackly fracture. The external planes of the crystals before being broken, were dull and nearly black, owing to a thin coating of brown oxide of iron; but fresh cleavages presented a fine metallic lustre, and a color between silver white and steel grey. It breaks with the greatest difficulty, and small masses often flatten under the blow of the hammer, like pure iron. Its hardness is almost that of ordinary steel. Specific gravity, in distilled water at 60° F. 7.337. It is highly magnetic with polarity, so distinct as to take up iron filings. Before the blowpipe it melts.

Fragments of the size of a pea, brought within the exterior flame of the compound blowpipe, emitted a very slight vapour, in which the well known odour of arsenic was detected; and immediately on coming within the inner cone of flame, they burnt with intense energy, and with a most brilliant light, throwing out a profusion of scintillations, after the manner of pure iron, or more like a burning watch spring. No odour of sulphur was perceived in these trials. In order, however, to make myself sure of the absence of sulphur, I resorted to the following experiment. A portion of the metal was dissolved in dilute nitric acid: the solution was supersaturated with potash and boiled in the alkaline liquor; the precipitate was separated, and the supernatant fluid neutralized by nitric acid, to which was afterwards added nitrate of lead; the precipitate was separated, and found to be perfectly soluble in dilute nitric acid, thus evincing the absence of sulphate of lead, which must have formed part of the precipitate, provided sulphur had existed in the mineral under examination.

After having examined in the usual modes, for silver, gold and other metals, and not discovering any to be present,* I dissolved fifty grains in nitric acid, with a view to ascertain merely the proportion of iron present. After the solution appeared to be effected, I observed a number of little black flakes floating in the liquid, which resisted the action of the acid. These being separated by the filter, were examined and found to be plumbago, which, under somewhat similar circumstances, though less disguised, and more abundant,

* After the iron had all been removed from the nitric solution by ammonia, and the fluid boiled, hydro-sulphuret of ammonia gave no cloudiness, thus evincing the absence of nickel.

was found in the native iron of Canaan. They weighed 0.2 grs. and from other trials, appear to exist in the mineral pretty constantly in this proportion. The nitric solution was precipitated by ammonia, and the residuum after drying indicated 48.7 grs. of metallic iron.

I afterwards repeated my examination with greater care in the following manner. Twenty five grs. were dissolved in dilute nitric acid. This solution was boiled for some time with an excess of soda, and deposited 35 grs. of the peroxide of iron. The supernatant liquor with the washings of the precipitate being evaporated and neutralized by nitric acid, was decomposed by nitrate of lead, and afforded a precipitate weighing 1.5 grs. which, upon burning charcoal gave the smell of arsenic, and was entirely soluble in nitric acid, and therefore consisted wholly of arseniate of lead. The result of my trial, then, would be as follows, after deducting the weight of the plumbago—for 24.9 of the mineral.

Iron, - - - - -	24.263
Arsenic, - - - -	389
	24.652
Loss, - - - - -	248
	24.9

Which gives *per hundred* of the mineral, free from the plumbago.

Iron, - - - - -	97.44
Arsenic, - - - - -	1.56
	99
Loss, - - - - -	1
	100

This therefore cannot but be regarded as a singular substance, especially as it affords us an instance of the remarkable effect produced by a small proportion of arsenic in disguising the natural properties of iron. Whether it coincides with the species described by Mohs under the name of axotomous arsenical pyrites, (to which opinion I am rather inclined from its crystalline character and specific gravity,) or whether it constitutes a distinct species in mineralogy, I will not at present venture to assert. When an additional supply of this substance shall be furnished us for examination, and the means of comparing it with some genuine specimens of the above mentioned species shall occur, it will be very easy to decide upon this point. CHARLES U. SHEPARD.

Yale College, March 4th, 1828.

3. *Note, from R. Harlan, M. D. on the Examination of the large bones disinterred at the mouth of the Mississippi River, and exhibited in the city of Baltimore, January 22d*, 1828.—These bones have excited much curiosity in this country, and have even been noticed in some European publications: they have been referred, by different individuals, to the fossil remains of some extinct animals, and it has been proposed to construct upon them a new fossil genus to be designated "MEGISTOSAURUS." (Greatest of all lizards.)

In a verbal communication, which I had occasion to make to the Academy of Natural Sciences, some months since, before I had an opportunity of examining these remnants, I offered it as my opinion, (judging from the descriptions which I had received concerning this subject, from persons unacquainted with natural history,) that they were the remains of some large Cetaceous animal.

On a late visit to Baltimore, I enjoyed the opportunity of a particular examination of these specimens, and was gratified to learn, that the opinions which I had previously formed were correct.

On the first view, it was very easy to perceive that the bones were not *fossil*, but that they were portions of the skeleton of the recent spermaceti whale, "*Physeter macrocephalus*." Indeed the situation, or geological relations of these bones would preclude the possibility of their being fossil.

The remains of three different individuals were distinguishable, and the following parts were noticed.—The largest portion consists of the superior maxillary bone of the left side—the total length of which, measured in the direction of its curvature exteriorly, is seventeen feet three inches, the greatest breadth thirteen inches; there are belonging to the same animal seven dorsal vertebræ, six lumbar, and five caudal, with two ribs, all in a perfect state of preservation.

The os humeri, radius and ulna, have belonged to another whale of much smaller dimensions. A cervical vertebra and the lower jaw of a very young whale-calf were also observed. The teeth, several in number, from the lower jaw of the large individual, were detached and slightly broken at their bases; the largest measures six inches in length and six and a half in circumference.

The long process of bone, or "*horn*" as it has been called by several observers, is a mutilated portion of some of the facial bones, erroneously attached to a process on the upper and outer side of the large bone.

On comparing the large bone, with the same portion in the specimen of the head of a similar animal in the cabinet of the Acad. of Nat. Sc. Philadelphia, known to have been thirty feet in length, (and to have yielded eighteen or twenty barrels of oil,)—and on taking the comparative measurements, the animal whose remains we are discussing, is demonstrated to have been about fifty three feet in length.

The average size of the common spermaceti whale is from forty to sixty feet; they inhabit the polar regions principally, but are sometimes found in the temperate regions. The *Physeter trumpo* (Desne.) which according to Linnæus and Cuvier, is only a variety of the P. macrocephalus, is an inhabitant of the coast of Bermuda and of North America.

The skeleton of the head of the P. macrocephalus is figured by Baron Cuvier, Oss. foss. vol. 5. pt. 1. pl. 34.

P. S.—I have lately discovered the remains of a huge *Megatherium*, in New Jersey, nine miles south east of Philadelphia, in a marl pit, on the farm of I. Tod, Esq. of Phila. some account of which, I propose shortly to publish.

4. *Teeth of the Mastodon.*—Among the numerous published accounts of places in which remains of the Mastodon have been found, we believe that few have been named in the eastern states.*

We have now the pleasure of stating a fact of that kind. During the excavation of the Farmington canal near the village of Cheshire in Connecticut, about thirteen miles north from New Haven, there were found, the last summer, three or four large molar teeth of the mammoth. Being buried in diluvial gravel, where there had probably never been any putrescent matter, they were almost in the condition of

* Since writing this memorandum we are reminded that some remains of the Mammoth were found in Sharon, Connecticut, a good many years ago.

recent teeth in a state of extreme dryness;* they had belonged to an old animal, for the enamel and the processes were much worn and brightly polished by grinding; the enamel was of a brilliant white and very firm, but the proper osseous structure beneath, although white as snow, was so porous and tender, that the least force was sufficient to crush it to powder. It had a distinct columnar structure and a smell like dry magnesia. The extreme dryness of the teeth, was probably the reason why they were easily crushed, in a frolic, in which some jolly Hibernian Canal diggers threw one of their number upon the grinders and they broke to pieces. Some research was made, but no other bones were found as the operations of the canal in this quarter did not require deep digging.

New York Times, July 25, 1827.

Mammoth.—In excavating the Morris Canal, near Schooley's Mountain, N. J., on the 20th inst. the skeleton of a mammoth was found, about three feet beneath the surface, in a remarkable state of preservation. It is stated to be enormously large, and that one of the tusks weighs one hundred and fifty pounds. (?) Mr. Peter C. Bowne, who has purchased the skeleton, says, that the grinders look remarkably fresh, though they may have lain buried a thousand years. The following description of these bodies is given in the Democratic Press:—

The inferior maxillary or lower jaw bone, measured between the outer extremities of the condiloid processes, or at the back part of the jaw bone, three feet six inches, from the anterior to the posterior part of the bone, three feet eight inches. The foramen, which serves for the passage of the artery, vein and nerve from which the teeth, &c. receive their supply, is two inches in diameter, which would admit the blood vessels, (though not one tenth as large as some other,) to have been larger than the largest blood vessel in a horse. The teeth are entire; the enamel on them is sound and perfect, and of a shining bright, blue veined, marble color. The dimensions of one of them taken on the grinding surface, were three and a half inches wide, and seven long, and it weighed four pounds. The tusk measured two feet in circumference, and seven in length, and from appearances, we should suppose it to have been of a much greater length.

* We are told, however, that the place was moist.

One of the vertebræ, measured seven and a half inches across the body, and between the extremities of the transverse processes fifteen inches. The scapula or shoulder blade measured three feet in length, and two in breadth; articulating surface ten inches in diameter—thigh bone two feet ten inches in length, twenty inches in circumference; its round head received into the acetabulum or socket of the hip joint, in circumference, measured two feet six inches. Articulating surface of the fore knee joint measured in circumference three feet six inches. Examined this 20th of July, 1827. THOS. P. STEWART.

5. *Life Preservers—Cloth impervious to air and water, &c.*—We are informed, that after a great variety of experiments, Dr. Comstock of Hartford, has found a composition* which will render cloth and leather, and other substances impervious to water. Colored cloth, as silk or cotton does not show the water-proof composition on the one side when it is placed on the other, so that cloaks, or other articles of dress look equally well after being made water-proof. Shoes, boots and other articles have been in use more than a year, and still retain their imperviousness. Several canal engineers have pantaloons made with feet of this cloth, by which they are enabled to wade in the water for hours or for the whole day, without getting wet.

This cloth, being impervious to air as well as water, has been employed for the construction of "Life preservers," for those who may be exposed to the hazard of drowning. The life preserver consists of a bag of the water-proof cloth put together with the water-proof composition, and consequently without sewing, by which it is rendered air tight, and so strong as to bear the pressure of two or three hundred pounds when blown up, without bursting.† This bag is about one foot wide, and long enough to reach around the body of the wearer, and is tied with strings in front. It is furnished with straps, which keep it firmly fixed under the arms, and a stop cock by which it is blown up after it is put on. It may be put on and worn under the clothes, and in time of danger blown up in one minute. It contains air enough to keep a person suspended in the water, full head

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* Of which caoutchouc is understood to be the basis.—*Ed.*

† Two persons have often tried the experiment of sitting on one of them at the same time.

and shoulders above that element. Chlorine destroys the peculiar smell.

Dr. C. is making preparations to manufacture this cloth, for dresses, life preservers, &c. on a large scale. He has secured a patent from government, and expects the ensuing year to supply the Steam Boats of the Ohio, and Mississippi with the life securing machines.

6. *Vermont Manganese.*—A few tons may be obtained of Mr. Isaac Doolittle, Bennington iron works. If this be of the same quality as some received a few years since from that place, at the laboratory of Yale College, it may be recommended with confidence, as that affords very pure oxigen gas.—Editor.

7. *Geological Notice.*—T. Dwight Eaton, a son of Prof. Eaton, will collect and deliver suits of geological specimens, correctly labelled, including all the general strata and varieties named in the synopsis published in this number of the journal, on the following conditions. Specimens all to be two inches across in both directions, and of a suitable thickness. If he receives twenty responsible subscribers, (before the first day of next August,) at $25 per suit, regularly cased. If thirty subscribers, at $20. If fifty, at $15. If seventy, at $12,50. If one hundred, at $10. Subscriptions are to be by letter, post paid, directed to T. Dwight Eaton, Troy, N. Y. with directions whether to be delivered at Albany, Boston, New Haven, New York, Philadelphia, or Washington. The boxes of specimens will be delivered at the above places, the first day of next December, if encouraged, and a letter sent to each subscriber, giving notice where to send the money in payment, and to receive the specimens. Each box will contain seventy-five specimens, and a colored synopsis of the Nomenclature.

8. *Proceedings of the Lyceum of Natural History, N. York.*

(Continued from Vol. XIII. p. 381.)

April 1827.—Dr. Van Rensselaer read a paper on the larva of an insect passed through the urethra of a female, with several analogous cases. (See this Jour. vol. 13. p. 229.)

Dr. Mitchill presented a parasitic animal, about twelve inches long, found in the liver of a cod—the organ being perfectly sound. The same gentleman presented specimens of *vegetable milk*, from the vicinity of Rio Chico, S. America.

Mr. J. Cozzens offered a suite of geological specimens from Rhode Island.

Dr. Swift presented specimens of *bituminous coal* from Tioga Co. N. Y. This coal, which, since the message of Gov. Clinton to the legislature of New York in January last, has attracted much notice, is an important discovery, and will prove highly valuable in domestic economy. It contains about 65 carbon, 30 bitumen, and between 4 and 5 of earthy impurities—not differing essentially from the best Liverpool coal. (See vol. xiii, pp. 32 and 381 of this Jour.)

Mr. Seth Hunt presented specimens illustrating the geology of Alabama.

A valuable collection of *dried plants* was received through the Cor. Sec., from Dr. Steüdel of Wurtemburgh, in Germany.

Mr. Barnes read a paper on *magnetic polarity*, detailing some interesting experiments. (See this Jour. vol. 13. p. 70.)

Mr. Cooper presented a suite of *lavas* from Vesuvius—and a collection of *volcanic products* from France, Italy and Germany, with specimens of the building stones anciently employed in Italy and Egypt.

May.—Prof I. A. Smith read a detailed account of the anatomy of the *Proteus of the Lakes;* with remarks on the Syren Intermedia. (See An. Lyc. vol. 2. p. 259.)

Dr. Van Rensselaer read a paper on *Oolite*, as found in Alabama. It seems to correspond with the lowest division of Oolite, as described by Conybeare and Philips, and known in England as " *coral rag*"—Its equivolent on the continent of Europe is known as the " *Stonesfield formation.*"

Mr. Gale presented minerals from Massachusetts—and Mr. Cozzens a suite of Lavas from St. Helena ; and radiated asbestos, serpentine and granite from this island in place.

Maj. Delafield presented fossil organic remains from lake Huron, and the western portion of the state of New York. Also five specimens of *Alcyonium* from Warminster, (England,) exhibiting a striking similarity to the alcyonium lately found in the green sand near Annapolis.

Dr. Mitchill read a description of a new species of fish, presented by him at a former meeting, which he proposed to call "*Diodon carinatus.*" (See Ann. of the Lyc. vol 2. p. 264.) He read also a paper detailing some experiments made with a fluid, prepared for the destruction of injurious insects inhabiting trees as caterpillars, &c. The same gentleman exhibited a skull from Chili, exhibiting the peculiar artificial flattening of the occiput.

A collection of *Alpine plants* from the valley of Chamouny, was received from Dr. N. Niles—and *minerals* from Mr. Davis of Westfield, Mass.

June.—A collection of minerals, reptiles and insects, was received from Dr. Porter, of Plainfield, Mass.

Dr. Mitchill read a paper, containing some additional remarks on the *solanum laurentii*, with drawings. This potatoe, which Dr. M. calls St. Lorenzo potatoe, has been placed under Solanum, as S. montanum, by Ruis and Pavon, (Flora Peruv:*) and as S. tuberosurn minus, by Feuillêe, (Obs.) who observed its habitat. Dr. Hooker places it as Witheringia Montana, Mountain Witheringia, or St. Lorenzo potatoe. The specimens of Dr. M. were brought from the Mountains of St. Lorenzo island, in Callao Bay. They are found on the Maine also.

Dr. Van Rensselaer presented serpentine, amianthus, and granite, found, *in situ*, on the island of New York. Also some primitive rocks in a state of decomposition, from the same island.

This locality of serpentine, which hitherto seems to have escaped general observation, is only three miles from the city, and covers an extent of perhaps forty acres, near to the Hudson River. Serpentine bowlders have been repeatedly found on the eastern parts of the island, and were probably carried from the present locality. Observation has not yet determined whether this is an extensive bed—or whether it is connected with the Hoboken and Staten Island range of serpentine, in a line with which it lies: and of which it probably forms a part. The rock, if properly quarried, would, in all probability, yield a stone valuable for economical purposes, in building, fencing, &c.

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* A splendid copy of which has lately been presented to our library.

Dr. Mitchill read a paper on *superfœtation.* He read also an account, (with drawings,) of a moluscous animal from the Pacific, not hitherto described, and which he names *Quadripennis Pictus.*

Mr. McAuley, of Herkimer, presented a suite of specimens illustrating the mineralogy and geology of the valley of the Mohawk.

Capt. Sloat, U. S. N. presented *Asterias Helianthus* from Chili, fossil casts from Gallipagos Islands, a series of *volcanic minerals* from the island of Juan Fernandez, and *minerals* and *fossils* from Antigua.

Capt. Leconte presented *Testudo reticulata* from Georgia.

July.—Mr. Cooper read a paper on the habitat of the *schizea pusella.* (See An. of the Lyc. vol. ii. p. 266.)

Mr. Barnes offered some remarks on the *Proteus of the Lakes*, and presented specimens of steatite containing crystallized bitter spar, from Marlborough, Vermont.

Dr. Mitchill read a paper on a *fossil skull*, from Folly landing, Accomac county, Virginia.

The corresponding secretary read a letter from Mr. Thos. Dixon, accompanying a *splendid collection of minerals*, from Cumberland and Derbyshire, England.

Capt. Sloat, U. S. N. presented "Certaine testimonies concerning King Arthure, and his conquests of the north regions, taken out of the histories of the kings of Brittaine, written by Galfridus monamutensis, newly printed at Hedleberg, 1587." This copy was obtained at Pitcairne's Island, where it had been saved from the English frigate Bounty, Capt. Bligh.

An abstract was read of "a memoir on the posterior members of *ophidian reptiles*," by Prof. Mayer.

Prof. J. A. Smith read a paper on the *Syren Intermedia.*

Mr. Cooper read a paper on the osteology of the *megatherium*, from Georgia. (See An. of the Lyc. vol. ii. p. 207.)

Dr. De Kay read "observations on a *fossil skull*, in the cabinet of the Lyceum, belonging to the *genus Bos*, from the banks of the Mississippi." (See An. of the Lyc. vol. ii. p. 280.)

August.—A report was read on the *fossil skull* found in Accomac county, Virginia. (See An. of the Lyc. vol. ii. p. 271.)

Dr. Goldfuss' work "on the petrifactions in the Museum of the University of Bonn," was received.

The corresponding secretary read a letter from the Belfast Natural History Society, accompanying a *cask of minerals* from the Giants Causeway.

Two *boxes of insects*, beautifully prepared, were received from Dr. Duval, of Geneva, in Switzerland.

Dr. Mitchill presented mineral specimens from the state of New York, and several *fossil echini*, in chalk, from England.

Dr. Torrey read notes on inflammable mineral substances, including a report on the *amber* found in excavating the Delaware and Chesapeake Canal.

9. *Pressure of water at great depths in the ocean.*

Extract of a letter to the Editor, from Prof. Lardner Vanuxem, dated Ship Virginia, of New York, for La Vera Cruz, January 11, 1828. Latitude 28° 56, Longitude 73° 16.

Dear Sir—I wish to call your attention to two experiments made this day, which may not only interest yourself, but likewise some of the readers of your valuable journal.

Doubtless you are well aware of the numerous popular experiments, which have been made at sea, by lowering *empty* bottles well *corked*, to the depth of one hundred or more fathoms; such bottles, be the mode in which the corks have been secured, what it may, do invariably, as the experimenters have stated, come up full of water; one instance however was related to me, in which a portion of air still remained, or in other words, the bottle was not quite filled with water. In most instances the corks were thrust into the inside; in some, no change was observable. Experiments have been likewise made by well corking a bottle of fresh water, and lowering it into the sea, and on examination, the fresh water was found to be replaced by salt water.

Being convinced that the presence of water in these popular experiments, arose from the corks being forced into the bottles by the pressure of the water in some instances, and from the permeability of most corks if not all of them, to water when so greatly compressed in others; I was determined before I went to sea, to prepare a bottle which would prove the correctness of the opinion just stated.

I had the top of the mouth of a strong porter bottle ground, so as to fit a thick piece of glass equally well ground; the two surfaces being made as parallel to each other as could be obtained by grinding, as well as by rubbing the one upon the other. (The surfaces were not polished as ought to have been done, to produce the most perfect contact possible.) A cork was first put into the bottle, using great force, and the top then covered with tallow, likewise the ground part of the bottle; and upon the two, the piece of glass was placed, then closely pressed to the bottle, and there properly secured by strong strings; grooves having been cut into the piece of glass, so as to secure it to the neck of the bottle.

The bottle was then fixed securely to a *sounding line*, to which also a second bottle, prepared in the ordinary manner, was attached. This bottle was provided with a good cork, much larger than the mouth of the bottle, for it projected considerably over it; great force having been used, to make it enter.

The log with its bottles, was then cast into the sea, (there being a calm,) and one hundred and ten fathoms of line let out. After being down a few minutes, the line was drawn in, and the bottles examined. The bottle secured in the common way was full of water, the cork having been driven in, being in the lower part of the neck of the bottle. The other bottle exhibited no visible change, all things remaining as they were before being put into the ocean, with the exception of about a dozen drops of water, which must have passed, from the circumstances related, between the piece of glass, and the mouth of the bottle, penetrating the tallow and the cork.

That water should find its way through cork, when subjected to a pressure of six hundred and sixty perpendicular feet of water, does not appear extraordinary, when we reflect that many kinds of wood are permeable to mercury, when acted upon by a pressure, not so great as that of our atmosphere, as in the common experiment of the air pump; mercury being placed on *a piece of wood*, (its fibres being vertical,) covering the top of the receiver.

The instances related of bottles containing fresh water having their contents replaced by salt water, are owing to the same principle as the replacing of the *air of the bottles* by sea water; for fresh water being of less density than salt water, it would pass out, to make way for a denser fluid, or the same kind of fluid, made denser by saline substances. It is my intention to repeat this experiment during the next calm, should one occur.

The most simple mode of trying the experiment which I made, would have been with a bottle whose mouth was hermetically sealed. The want of time before I left New York, prevented me from having one prepared.

Note.—Professor Vanuxem, when these experiments were made, was on his way to the city of Mexico, where he will reside for two years. He may be addressed through Behrman & Muller, La Vera Cruz.—*Ed.*

10. *Effects of friction on board of Ships of War.*

Extract of a letter from Lt. James Glynn, of the U. S. Navy, in answer to certain enquiries by the Editor.

New Haven, Conn. Nov. 16, 1827.

Sir—On board of our national ships of war, where *despatch* in performing any evolution is a consideration second to safety only, it not unfrequently occurs that the pullies are destroyed by the friction of the sheave, or wheel on the pin, or axle, about which it revolves; or against the shell or case that contains it. In one instance I have known fire produced in this way to break out into a full distinct blaze. On this occasion, I think iron was in contact with iron, the temperature of the air was agreeable, and the pully or tackle had been in active operation for perhaps half an hour, when a heavy boat was attached to it for the purpose of being hoisted on board, and a velocity of revolution given to a wheel of four or five inches diameter, equal to what might be communicated by the seamens *running* fore and aft the deck, with the chord of the pully in their hands. The effect was so unexpected, as to put at an imminent risk, both property and lives.

Similar, and nearly allied to this is the fact, that on board of large vessels, anchoring in high winds, the friction of the cable round the bitts, (windlass of the merchant vessels,) is sometime so great as to render a resort to water necessary to prevent the bitts from taking fire. I have seen but one instance of this kind, but have heard of many.*

11. *Valuable collection in Geology and Mineralogy.*—We learn that G. W. Featherstonhaugh, Esq. has recently introduced into this country an extensive and various collection of fossils and of minerals.

A considerable part of them belonged to the cabinet of Mr. Parkinson, which has been sold.

Mr. Featherstonhaugh has obtained fine specimens of the Icthyosaurus; fossil fish very perfect; fossil plants of great beauty and variety, and many rare fossils. Indeed, he has brought, as we are informed, a most complete collection of fossils from all the European beds, from the first appearance of organic remains in the lowest deposits, to the highest conditions of zoological existence in the superior strata of the tertiary; also a complete series of fossils from Tilgate Forest, to illustrate all Mr. Mantell's superb works; these specimens were obtained principally from Mr. Mantell himself. That wonderful animal, the Iguanadon, a reptile about eighty feet long and twelve feet high, with teeth like the Iguana, was found in those beds of Tilgate, and described by Mr. Mantell. There is also a fine series of all the chalk fossils found to the present day, as well as of the singular and various appearances presented by flints. The organic remains from the lias, both in Yorkshire and Lyme in Dorsetshire, will be found highly interesting to the friends of geology. Mr. F. has also the crinoidal family, to illustrate the famous work of Mr. Miller of Bristol, ecrinites and pentacrinites—with a complete series of the apio-crinites. But what will be extremely interesting here, is the capital series of osseus remains of the varieties of animals found in diluvial deposits in the various caves; a branch of geology illustrated and brought to light by the genius and eloquence of that extraordinary person, Dr. Buckland. Mr. F. travelled a great deal with Dr. Buckland; they visited in company the celebrated cave at Torguay, from whence Mr. F. brought the bones of eleven different animals: all

* Recently, the axletree of an ox cart, heavily laden, took fire when passing in the streets of New Haven, and required water to extinguish it.—*Ed.*

the circumstances of this cave confirm Professor Buckland's opinions, as expresed in the Reliquæ Diluvianæ, of which we gave an analysis and review in vol. 8, of this Journal. On various occasions we have urged the prosecution of similar inquiries here, and we repeat that we should be glad to see the attention of our geologists roused to the importance of this subject, as we have numberless caves to explore—and bones we must find, or draw some curious conclusions from their absence. Professor Eaton has given some valuable information on this subject, (vol. 12, p. 19, of this Journal) from which it would appear that hyenas never existed in this country, but much remains to be done to complete the investigation.

We understand that Mr. Featherstonhaugh's collection of minerals is a well selected one, and that he has most of the rare specimens up to the present day.

12. *American Porcelain.*—We have great pleasure in congratulating our fellow citizens, on the complete success which has attended the effort to establish a manufactory of porcelain, in the city of Philadelphia.

From the manufactory of Messrs. Tucker & Hulme, we have received specimens in the state of biscuit, baked—of the ware, baked and glazed—and of the ware, gilded and painted, the sight of which must afford pleasure to every friend of American arts, and especially of an art so difficult, and which is scarcely a century old even in Europe, although practised for many centuries in China and Japan.

The porcelain of Philadelphia is very beautiful, in all the principal particulars—in symmetry of modelling—in purity of whiteness—in the characterestic translucence, in smoothness and lustre, and in the delicacy and richness of the gilding and enamel painting. That it *rivals* the finest productions of Sèvres itself, it is not necessary to assert; but it certainly gives every assurance, that if properly supported, it will not fail to meet every demand of utility and taste, which this great and growing country may present.

We pretend not to judge of the political and commercial circumstances which may influence the success of this manufactory; the art now stands forth in this country, in all the attractions of utility and beauty, and we sincerely hope that it may prove as lucrative to the proprietors of the establishment, as their productions are honorable to their skill and enterprise. It appears from Mr. Carpenter's memoir in the early part of this number, that the raw material is very abundant, at no great distance from Philadelphia, and it is well known that it is found in many parts of the United States.

13. *Meteor of a green color.*

Communicated by Mr. B. D. Silliman, in a letter dated N. York, March 1, 1828.

On the night of the 11th of February, between 11 and 12 o'clock, as I was crossing the East river, between this city and Long Island, I observed a beautiful meteor which was visible for about the space of two seconds. Its course was from a point perhaps 5° below the zenith, toward the horizon in a N. E. direction. It described an arc of perhaps 20°— when it apparently exploded but without any report that I could hear. Its color was a singularly pure *grass green*, of a light shade; the trail which it left was of the same color, and so were the scintillations which accompanied its apparent explosion. The latter were distinct, like those accompanying the bursting of a rocket, but by no means so numerous. Two gentlemen who were in the boat with me at the time, also saw it.

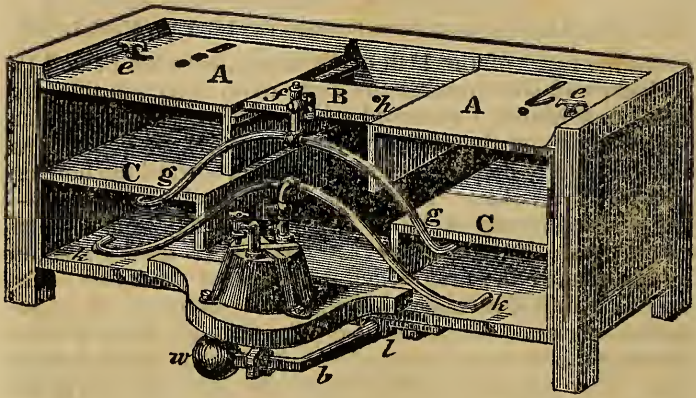
14. *Southern Review.*—We have received the first number in time only to glance over its pages. The subjects treated of in this number are sufficiently various.

Classical learning, agriculture, mathematics, craniology, mineralogy, history, political economy, and the Colonization Society, are among the topics presented to our consideration; and the discussions to which they give rise, afford abundant evidence of talents and learning. The writers are not satisfied to merely intimate what they think; they declare their opinions boldly and the reasons of them. Though we may not adopt as our own, all the sentiments of this review, yet we wish the work success, and promise ourselves both entertainment and instruction in its perusal.

15. *Asbestos.*—Joseph Morehouse, New Milford, Conn. has three or four hundred weight of asbestos, and can obtain any quantity of it, should it be wanted for experiments in the arts, or other purposes. It is found in the quarries of primitive white granular limestone, which abound in that region. (See vol. 2, p. 222, of this Journal.)

16. *Engraving and description of the Hydro-Pneumatic Cistern, used in the Laboratory of the University of Pennsylvania; by* R. Hare, M. D. *Professor of Chemistry.*

Fig. 1.



This engraving is intended to convey an idea of my Hydro-Pneumatic Cistern. It is constructed upon the principle of one contrived by Professor Silliman and myself, when we operated together in 1803, and which we have used under various modifications, since that time.

The figure, here given, is such as would be presented to the eye, were the front of the cistern removed.

A A, are two shelves formed by two inverted chests, which are used as cells to contain gas: B is a sliding shelf, over a deep place between the shelves A A, which is called the well of the cistern.

Fig. 2.

Fig. 2 affords a view of the lower side of the sliding shelf, in the wood of which it will be seen that there are two excavations, converging into two holes, one of which is seen at *h*, fig. 1. This shelf is loaded with an ingot of lead at L, to prevent it from floating in the water of the cistern.

Besides the chests above mentioned, there are two others, C C, near the bottom of the cistern, but not so close as to prevent the water from passing freely into and out of them.

In front of the cistern may be seen an inverted brass kettle, held firmly to a wooden plank by straps and iron screws. This kettle covers a circular hole in the plank. The hole is somewhat less in diameter than the kettle inside, so as to leave a bearing for the brim of the latter. Between the brim of the kettle and the margin of the hole, cut in the plank, the margin of a disk of sole leather is included, at about half an inch from its circumference all round, in such a manner as to form an air tight juncture. The leather is perforated at the centre, and is pressed between the summits of two perforated leaden hemispheres, by a rod of iron which passes through the perforations in them, and in the leather. The compression is effected by means of a screw and nut, and a shoulder on the iron rod. The rod thus fastened to the leather disk, is connected with the bent lever, *b*, *l*, which is carried under the cistern, and being bent at right angles, is flattened so as to form a treadle. When the treadle is forced down by the foot, the arm connected with the rod rises, and causes the leather to be bulged up into the kettle; when the pressure of the foot ceases, the weight, *w*, suspended from the lever, causes the descent of the rod, and the leather is bulged downwards, so as to cause air to enter the kettle, and to be expelled from it, successively.

Into the bore of the cock, which extends from the upper surface of the kettle to the arched pipe, *k k*, there is a valve opening outwards. Within the pipe in the form of an elbow on top of the kettle in front of this cock, there is a valve opening inwards: it is through the valve last mentioned, that the ingress of air takes place, while the egress is effected through the other.

In order to put this apparatus into operation, the kettle,* cistern and upper air cells must be filled with water, until it is about an inch deep on the shelves, A A, the lower air cells remaining full of air. Bell glasses, or other vessels, being plunged in the well, filled with water, and inverted and placed, while full, over one of the holes, *h*, on the sliding shelf, B, are afterwards easily filled with any gas; for any gaseous fluid escaping from a retort beak, or from a tube, will be easily caught in the cavity, excavated in the wood of the lower

* It is requisite to the operation of the bellows, that the kettle be filled with water first, otherwise the air remaining in it, will, by its elasticity, diminish the effect.

side of the shelf, and thence rising through the hole, into the inverted vessel, will occupy it to the exclusion of the water.

Having filled one vessel with gas, it may be transferred to another, filled with water, and inverted upon the shelf, B, by depressing the brim of the vessel containing the gas, under the shelf, and then inclining it so as to allow the gas to escape gradually into the cavity under the shelf, whence it rises into the other vessel, as already described.

When the air cells under the shelves, A A, are to be filled with gas, a flexible leaden pipe, passing from a vessel containing the generating materials, is curved into a hook, and placed so that the orifice may be within the cell. As the gas enters the cell, the water must of course be displaced from it, and would in consequence overflow the cistern, were not the cock, *f*, opened.

This cock communicates with the bore of the arched pipe, *g g*, to which it is soldered. The orifices of this pipe enter severally the chests, C C, so that their cavities communicate with each other and with the cock, *f*. Hence by opening this cock, the air may be allowed to escape from those chests in such quantities, as to compensate the gas introduced into the upper air cells.

The gas, contained in the cells, is easily transferred to any vessel, by bringing it over a hole, which communicates with the cell, through one of the cocks, *e e*, in the shelves, A A.

The vessels may be previously filled with water and inverted, but in the case of oxigen gas, if an open neck bell glass, or a tall cylindrical vessel, open at both ends, be placed over the hole, and a jet of the gas allowed to enter it, the atmospheric air being lighter, is driven out before the entering gas. It may be easily ascertained when the vessel is full of oxigen, by the greater brightness of a taper flame held over the upper orifice.

As the escape of gas from the cells, permits the subsidence of the water into them, it is necessary to countervail the deficiency thus produced, by the action of the bellows pump, formed as already mentioned, by the kettle and its appurtenances, in duly replenishing the chests, C C, with air.

17. *Improved Scale of Chemical Equivalents.*—Professors Lewis C. Beck and Joseph Henry, have published an "improved scale of chemical equivalents" founded upon the well known scale of Dr. Wollaston, which has contributed

so much "to facilitate the general study and practice of chemistry."

It is stated that, "the present scale differs from the original one, in the assumption of hydrogen as the radix or unity, and that two principal advantages arise from assuming this substance as the unit."

"1. We avoid fractitional quantities, and the whole scale, when the slider is properly placed, becomes a table of atomic weights."

"2. These atomic numbers exhibit for the most part, in reference to hydrogen, the specific gravity of gases and other chemical substances, supposed to be in an æriform state, and also the combining ratios of their weights under the same volume."

This scale is executed with much neatness, and we are happy to find that so excellent an invention will now be made so extensively known, in this county.

We have had no opportunity to use this improved scale, but doubt not that it will be found accurate.—*Ed.*

II. Foreign.

1. *Recent discovery of Fossil Bones in the eastern part of France, by* Prof. Buckland.—The cave of Osselles has long been an object of curiosity, on account of its extent, and the brilliant stalactites with which it is decorated. Prof. Buckland while on a visit to this cave, perceived that it presented all the characters of the caves of Franconia, which are so abundant in fossil bones. He noticed a spot where he thought he could perceive the bones very near to the surface, and by the aid of a hammer, he had the satisfaction to find his conjecture verified. The prefect of Doubs, took all the interest in this natural curiosity, which it merited, and the thorough research which he caused to be effected, proved that this cave is no less abundant in these interesting reliquiae, than those of Franconia.

A portion of these bones has been forwarded to Paris, and examined by M. Cuvier of which he says, "what has surprised us is, not that they belong to the *ursus spelaeus*, which naturalists call the cave bear, because they have been found only in caves similar to that of Osselles, *but*, *that they all belong to this species*."

Thus by an exception wholly peculiar, this cave does not contain with the bones of the bear, any remains belonging, either to tigers or hyenas, or to the herbivorous animals, the cotemporaries of these ancient races, and whose ordinary presence in these caves has been explained by the voracity of the hyenas, who are supposed to have dragged them thither to devour them.

M. Cuvier supposes that these bones belonged to animals which have lived and died peacebly in this retreat. Their state of preservation does not allow the idea that they could have been collected together by currents of water, or in any other manner. They were amassed by the occupation of the cave, for a long series of years by this animal, and afterwards buried by the sand, brought thither by some great inundation.—*Bull. Univ. Sept.* 1827.

2. *Analysis of the massive Cinnamon Stone.*—M. Laugier has found the massive cinnamon stone of Ceylon to be composed of

Silex,	-	38	Alumine,	-	19
Lime,	-	33	Ox. Iron,	-	7

He regards it as a silicate of lime and alumine, with an accidental portion of iron.—*Ibid.*

3. *Mines of Gold and Platina in the Ural Mountains.*—Nïjnoï-Tagil is a foundery situated forty leagues to the north of Jékatérinenbourg. The annual product of this place is one hundred and fifty thousand quintals of iron, twelve thousand of copper, fifty pounds of gold, and eighteen of platina. They are taken from a mountain of four or five hundred feet in elevation, composed of magnetic iron, near the borders of the river Tagil. Three other founderies exist upon the borders of the Outka: the river upon which these substances are transported to St. Petersburgh. Primitive clay slate exists here, with numerous veins of quartz in the direction of north and south, and inclining towards the east. The crest of the Ural consists of serpentine, near the middle of which at the western foot of the mountain Pugnia, immediately under the soil, in the decomposing and efflorescing talcose slate, is found a great quaintity of platina, accompained by gold, and rarely by native lead. At the north east on the contrary, the platina is found connected with a blue limestone in a decomposed green porphyry. At Kuschva (seven leagues to the north of the first place) is found a quantity of sodalite, in a mountain also of magnet-

ic iron; it is compact, and crystallized in dodecahedrons, but more often in trapezohedrons, and accompanied by pyroxene. Upon the west side of the mountain, occurs an amygdaloidal stone, consisting entirely of massive garnet, with almond shaped masses of calcareous spar, and cavities containing crystals of scapolite.

At three leagues distance is the little river Vitjie, which flows upon a bed of ophite and serpentine. These rocks are decomposed to many feet in depth. There have been obtained from them nearly ten quintals of native gold. This metal is found at Nerviansky in quartzy veins traversing the talcose slate and accompanied by iron pyrites, converted partly into ochre. For more than seventy leagues, in extent of the Ural chain, magnesia, in the form of bitter spar, is distinctly predominant in the metallic deposits, either in veins or beds; sometimes in the place of the quartz, the quantity of gold not being diminished. The mines of copper appear in the neighborhood of beds of primitive limestone, between these and the argillaceous schist, or the talcose slate, or else in the diorite. At Preobasjenskoï there is a considerable quantity of crystals of chromate of lead, of different modifications not in the hills of sandstone, as has been understood, but in the talcose rocks, in a talc slate, which often assumes a granular aspect, by its mixture with grains of quartz, and by the excess of magnesian limestone. Sandstone is not found in the Ural, at least to the north of Jékatérinenbourg. In general, in this chain of granite extending two hundred leagues, there are but few spots where search is made for the precious stones, such as the amethysts, the topazes, the beryls, &c.—*Ibid.*

4. *Sapphire in the Emery of Naxos.*—Fragments of emery from Naxos were ground between two plates of tempered steel, and the powder was washed with oil. The first powder which was precipitated having been examined with a very powerful magnifying glass, was found to contain perfectly regular crystals of sapphire.—*Ibid.*

5. *A new combustible gas.*—In the philosophical transactions for 1827, Dr. Thomson describes a gas which may be obtained by slightly heating together in a flask $1\frac{1}{2}$ oz. muriatic acid, half an oz. nitric acid of commerce, and half an oz. of pyroxylic spirit, all by measure, and collecting it in glass jars over mercury. It burns with a lively bluish white

flame—is absorbed by water and oil of turpentine, but not by acids or alkalies—and is composed of

1 atom hydrogen,	- -	0.125	
1 atom carbon,	- -	.750	
$1\frac{1}{2}$ atom chlorine,	- -	6.750	7.625

Dr. Thomson, in his "*First Principles of Chemistry*," pointed out a remarkable property of the compound of one atom carbon, and one atom hydrogen, denominated carbo-hydrogen, which forms a variety of gases, differing from each other in the number of integrant particles of carbo-hydrogen which a single volume of the gas or vapour contains. The new combustible gas, called by its discoverer, *sesqui-chloride of carbo-hydrogen*, (abstracting the chlorine) contains only one integrant particle of carbo-hydrogen in a volume ; olefiant gas contains two ; the oil gas vapour three ; sulphuric ether vapour (abstracting the water) four ; while the vapour of naptha contains six integrant particles. The existence of the simple carbo-hydrogen, was merely hypothetical, till the discovery of the present gas has given us an example of its actual existence. Thus the only doubtful part of this reasoning has been shown to be correct. This circumstance gives an importance to its discovery, to which it would not otherwise be entitled.

The same volume of the Phil. Trans. also embraces a very important article upon the compounds of chromium, and a detail of some experiments upon gold by the same gentleman.

6. *Voyage to the Eastern Seas—in* 1816, *&c. by Capt.* Basil Hall, R. N. F. R. S.—At the last moment, before closing the present number, we have found time, hastily to peruse this very interesting volume. We feel much obliged to its respectable author—now on a visit to this country—for permitting the publication of a revised edition, for the benefit of the young people of America, and doubt not that it will afford them as much pleasure and instruction, as it had before imparted, to those of England. It is however a work in which the mature and the young—the parent and child can equally participate. It is replete with interesting and valuable information ; it is disinguished by sterling good sense —acute observation—fine graphic descriptions of scenery and manners—an elevated moral bearing, and great felicity of expression. We rarely read so good a book of travels, and we trust that the publishers will find encouragement to prosecute their design of reprinting captain Hall's travels in South America.

We have now neither time nor space to analyse the volume before us. Indeed, most of its topics are not particularly appropriate to this work, although it would not be difficult to occupy some of our pages very profitably by citing from it, facts relating to science, and to various topics of useful knowledge. We shall however confine our citations to a single passage, relating to the coral reefs, and the little animals by which they are formed.

"The examination of a coral reef during the different stages of one tide is particularly interesting. When the sea has left it for some time it becomes dry, and appears to be a compact rock, exceedingly hard and ragged; but no sooner does the tide rise again and the waves begin to wash over it, than millions of coral worms protrude themselves from holes on the surface which were before quite invisible. These animals are of a great variety of shapes and sizes, and in such prodigious numbers, that in a short time the whole surface of the rock appears to be alive and in motion. The most common of the worms at Loo-Choo was in the form of a star, with arms from four to six inches long, which it moved about with a rapid motion in all directions, probably in search of food. Others were so sluggish that they were often mistaken for pieces of the rock; these were generally of a dark color, and from four to five inches long, and two or three round. When the rock was broken from a spot near the level of high water, it was found to be a hard solid stone, but if any part of it were detached at a level to which the tide reached every day, it was discovered to be full of worms of all different lengths and colors, some being as fine as thread and several feet long, generally of a very bright yellow, and sometimes of a blue color; while others resembled snails, and some were not unlike lobsters or prawns in shape, but soft, and not above two inches long.

"The growth of coral ceases when the worm which creates it is no longer exposed to the washing of the tide. Thus a reef rises in the form of a gigantic cauliflower, till its top has gained the level of the highest tides, above which the worm has no power to carry its operations, and the reef, consequently, no longer extends itself upwards. The surrounding parts, however, advance in succession till they reach the surface, where they also must stop. Thus, as the level of the highest tide is the eventual limit to every part of the reef, a horizontal field comes to be formed coincident with that plane, and perpendicular on all sides. The reef, however, continually increases, and being prevented from going higher, must extend itself laterally in all directions; and this growth being probably as rapid at the upper edge as it is lower down, the steepness of the face of the reef is preserved; and it is this circumstance which renders this species of rocks so dangerous in navigation. In the first place, they are seldom seen above the water; and in the next, their sides are so abrupt that a ship's bows may strike against the rock before any change of soundings, indicates the approach of danger."

But, the most remarkable topic, which this volume presents, relates rather to moral than to physical causes. The inhabitants of the Loo-Choo islands, who occupy a principal place in the book, seem like a different race of beings from the rest of mankind. Destitute of arms and strangers to war—without money, and ignorant of its use—not tempted by gold and silver, which they regard with indifference; highly acute and intelligent, but amiable and gentle, even to the extreme of kindness—bestowing on strangers, provisions, both animal and vegetable, and all the bounties of their fruitful islands, without recompense, although pressed upon them in every form;—refusing even presents, except at last, a few articles, by way of remembrance; comfortable and happy in the midst of a country cultivated with skill and care–and under a government apparently regal, but mild and patriarchal, and in a state of society, exhibiting the most perfect good order—affectionate to their children, who, in their turn, are dutiful to their parents—hospitable and convivial, but jealous to the extreme, of having their territory occupied and examined by strangers, and *absolutely excluding them from even the sight of their females*, and thus evincing their wise and exalted estimation of their own domestic purity and peace! No wonder that the description of such a people excited the incredulity of the acute Napoleon!* We could scarcely admit their existence, upon authority less respectable than that of Capt. Hall.

The Loo-Chooans have, it would seem, an order of priests although treated with little respect, and a few traces of religious ceremonies.

We had thought, that the character of the Pelew Islanders, as exhibited many years since, by the historian of Capt. Wilson's disastrous voyage, sufficiently surprising; but the Loo-Chooans appear quite without a parallel, either among civilized or barbarous, among christian or pagan nations, and it must remain for future travellers to explain this strange anomaly in the human character.—*Ed.*

* During an interview which Captain Hall, on his return from the east, had with the ex-emperor at St. Helena, in August 1817.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Notice of the Tockoa and Tallulah Falls in Georgia;** *by* A. Foster.

Communicated for this Journal.

In a southern excursion during the autumn of 1827, I visited the Table Mountain in Pendleton, S. C. and the Tockoa and Tallulah Falls in Habersham, Ga. Those only who have visited and contemplated this interesting section of our country can justly appreciate the beauty and magnificence, and the wildness and sublimity of the natural scenery around the southern termination of the Blue Ridge.

It is not now in my power to gratify the curiosity of my northern friends, by describing every thing that delighted or astonished our little party of travellers. But to the admirer of his creator's works, never yet in their native richness and variety, described by the geographer, sketched by the artist or sung by the poet, permit a traveller to recommend an excursion, along the western and mountainous border of North and South Carolina and Georgia. If you have imagined southern scenery to be tame and uniform, your disappointment, like my own, will be most gratifying and complete. A brief sketch of the two principal Falls is all that will at this time be attempted.

Tockoa Fall, is in a small creek of the same name, just before it runs into the Tugaloo, one hundred and fifty miles

* *To the Editor*—This sketch was written for the gratification of my northern friends. If they are pleased to learn that the section of our country so faintly described in this sketch, presents scenery of the richest and most interesting description, and if any of our travellers should be induced to visit the places, and should find, as they must find, that "the half has not been told," they will not regret, that I have communicated the annexed notice to your scientific Journal.

above Augusta. The perpendicular fall is one hundred and eighty six feet, measured by a line. It is surrounded by no wild scenery. The rivulet disturbed by no rapids, moves with a gentle current, and drops without warning into a beautiful basin below, expanding into fine rain before it reaches the bottom; and the breeze which always plays there, spreads a thick spray around, and ornaments the falling water, the rock and the shrubbery, with rainbows. A carriage road is within a stone's throw of the fall, and our party rode to the base and to the summit of the precipice.

Two beech trees grow near the base which are so closely covered with names down into the very ground, that he who will carve his own, must intrude upon a present occupant. Old and venerable names have been obliterated to give a conspicuous position to some young aspirant for immortality. These beeches, said a lady of our party, are the political world in miniature.

The Tockoa produces a sensation rather of the beautiful than the sublime—it pleases, but does not terrify—it satisfies, but does not overwhelm the expectation. It is a fine preparation for the tremendous scenery which awaits the traveller sixteen miles northward.

The rapids of Tallulah* are in Georgia, ten miles above the union of the Tallulah and Chatooga rivers which form the Tugaloo, five miles from South Carolina, and about twenty miles from the line of North Carolina. The river, which is forty yards wide above the rapids, is forced, for a mile and a fourth through a range of mountains, into a channel scarcely twenty feet broad. The mountain receives the water into a broad basin, surrounded by solid rock one hundred feet in height. Here the stream pauses in anticipation of the awful gulf,—then rushes down a cataract forty feet,—then hurrying through a narrow winding passage, dashing from side to side against the precipice, and repeatedly turning at right angles, is precipitated one hundred feet—and in a moment after fifty feet more—and then making many short turns, it rushes down three or four falls of twenty and ten feet. The sum of the fall in the distance of a mile is estimated at three hundred and fifty feet.

The rapids, however splendid, apart from the sublimity with which they are surrounded, are only an appendage to

* Entered Turroree on most maps, but the old deeds spell it Tallulah, and this is its pronunciation by the inhabitants in its vicinity.

the stupendous banks of solid rock, descending almost perpendicularly to the water on both sides of the river, and varying in the distance of a mile, from seven hundred to one thousand feet in height, so that the stream literally passes that distance *through* the mountain, or rather through the high lands that connect two mountains.*

The visitor approaches from the west, finds an easy descent for the last mile, and drives his carriage to the very edge of the gulf. No unusual appearances of pointed rocks or broken lands admonish him that the Rapids are near, till suddenly he sees the opening abyss. He advances cautiously, from tree to tree, till he looks down upon the water. Instantly, his mind surrenders itself to the overwhelming sensation of awe and amazement. He neither speaks nor smiles—and even a jest or smile from a friend is painful to his feelings; which, particularly with the ladies, (as at the Niagara Falls,) are often relieved by weeping. Some of our company, hurrying down to the brink without giving the mind time to collect itself, experienced dizziness and faintness, and were compelled to *crawl* back.

Here are no artificial embellishments. The scenery wears the artless robe of nature's wildness. The romantic variety, magnificence and sublimity of Jehovah's works are untouched by human hands. The Rapids are in the bosom of a forest, in which are seen burrows of foxes, and dens of rattlesnakes, and in which are heard the howling of wolves, and the screaming of eagles,—there the wild deer bound gracefully through the small bushes, and pass the trees rifted by lightning.†

In front of the spectator, the perpendicular face of the rock on the opposite shore, presenting an endless variety of

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* I regret to give these numbers by estimation, but the heights and distances have never been accurately measured. I offer the general estimation of visitors as stated by our guide who resides near the place. The only description of these Rapids that has ever been published is from the pen of Mr. Hillhouse of Georgia, and published in Niles' Register Oct. 1819, which accurately describes the scenery, and its effects upon the spectator. His account however of the heights of the banks is too small by more than one half. I have, since visiting the Rapids, looked from the base and from the top of the Table Rock, the perpendicular of which measured by a line from the surface of the lake, to the celebrated cedar bush is seven hundred and thirty four feet. This view confirmed my opinion, that the present estimation of the height of the banks at the Rapids is near the true one.

† A deer bounded along, and a pine near us was splintered with lightning while we were viewing the Rapids.

figures and colors,—brown, white, azure and purple—overhanging, receding, angular and square surfaces,—figures in bass-relief ornamented with shrubbery—small rivulets falling in graceful cascades down the precipice—the opening abyss, lined with massive rock—the foaming, roaring water, at the bottom encircled by rainbows, all seen at one view, produce sensations unutterable. The feeling once enjoyed you desire to recall, but it can be recalled only by placing yourself again upon the spot. Nor does the scenery lose its power by long and minute examination. I lingered about the Rapids three days, and the effect was rather heightened by new discoveries, than weakened by familiarity.

The most magnificent general view is from a part of the precipice which projects over the abyss twenty feet, and which is gained by a descent of fifteen feet. This is half way between the commencement and termination of the rapids, near the highest part of the mountain through which they pass, not less than one thousand feet above the water, and affords the best view of the second and third falls, one of which is almost under the projection. Our company had just gained this site, sufficiently agitated with our situation, when instantly a peal of thunder burst over us, and the rain descended upon us. The young ladies took shelter under a projecting bank, from which one step might have precipitated them one thousand feet into the foaming river,—the rest of the party crowded under a single umbrella upon the point of the overhanging rock. The rock-house formerly the entrance of the Indian's paradise, but now the eagle's habitation,. was before us—the earth in front and on either hand opened wide and deep—over us roared the thunder—under us, at about the same distance, were seen and heard the pouring and dashing of the cataracts—"heavens red artillery" played around—and the wind swept by, with great violence. At this moment, a large pine near us was rifted by the lightning, and its trunk entirely splintered to the ground. Echo answered echo from side to side, rumbling long and loud, through the caverns of the broken mountain. We all trembled, and looked at each other in silence. The ladies sustained the shock with unexpected equanimity, and kept their places. In half an hour the cloud passed over—the wind slept—the sun casting its brilliant rainbows round the falls, spread over the wilderness a mild and enchanting serenity, and we pursued our discoveries with augmented interest.

This however was the most sublime and awful hour of my life. Perhaps few have ever been favored with a display more magnificently impressive of the power and presence of Omnipotence. Heaven and earth seemed to display their most terrific operations, and conspired to make us feel our own feebleness.

The Rock House is an entrance apparently ten feet square, leading into the perpendicular face of the rock, too far down the side to be accessible. We were informed by the guide, of an Indian tradition, that this is the door of paradise. They had frequently traced their lost companions to this spot, and could never hear of them again; since which, no Indian has been known to hunt alone near the Rapids of Tallulah. At present the less superstitious eagle finds this a safe retreat to rear her young.

There are three places of descent to the bed of the river; two of these meet at the same place, and the other leads to the bottom of the upper fall. The other falls have been approached very seldom, and only by fording up the stream. Both descents cannot easily be performed the same day; the upper one to the fall, is the most interesting. To look out at the opening of this deep gulf pays the excessive fatigue of the lower descent, but the view from several positions above, produces the most enchanting effect of grandeur and sublimity.

At these Rapids, I very forcibly felt the influence by which the primitive worshippers selected grand and terrible scenes as the most favorable places to hold converse with the Deity. The mountain's top—the deep valley—the base of the waterfall—and the mouth of the grotto were selected by the rude inhabitants of untaught nations as the dwelling place of a presiding divinity.

I left this place with an unsatisfied curiosity, convinced that a year might have been consumed in examining every object interesting to a scientific traveller.

In preferring the Rapids to the Table Mountain, as I decidedly do, in common with many of superior taste in scenery, I would object to no part of the admiration so justly and so largely bestowed on the latter. Each presents scenes like no other in the United States; the one is so perfectly unlike the other, and both are so remarkable, that a visit to the one, in no respect, supercedes the propriety of seeing the other.

The effect from the top of the Table Rock is one unmixed overwhelming sensation of the sublime. As the spectator walks along the edge of the sloping precipice for a third of a mile, his mind demands time for expansion to receive the full influence of its new situation. This is accomplished by fixing the attention upon each object separately,—the falls of Slicking before him—the plantations below him—the mountains around him and the broad bosom of the forest spreading every way:—but the effect of the precipice under him prevails over all other emotions. As the spectator walks half a mile under the precipice, the height of which is at this distance about seven hundred and thirty feet, and the base of which contains a narrow path, midway between the summit and base of the mountain, a variety of emotions is enjoyed too complex to be definitely described. Objects pleasing, novel, beautiful and sublime, are every moment demanding his attention. On the summit his countenance is grave, his words few, and his imagination strongly excited. At the base his countenance is lighted up, and his conversation animated and brilliant. For his visit to the summit he feels rewarded, and his mind has expanded. With his visit to the base he is more than satisfied; he is delighted; his feelings have been kindled—the company are endeared to him, and on retiring he says, "no day of my life has passed more agreeably or more profitably." The best judges, however, unanimously express a preference for the Rapids of Tallulah. As at the Table Mountain, so also *two days at least* should be devoted to the Rapids.

Mud Creek Fall is twenty five miles north of Tallulah. I did not visit it, but was informed that the whole fall of this cataract is two hundred and eighty feet; that it is in a large creek, and the effect eminently interesting.

The Currihee Mountain, one mile from the Tockoa Fall, affords a rich reward for the toil of gaining its summit. On the north is a view of the Blue Ridge, surpassed in its prospect of "mountains piled on mountains," perhaps by no other site in the United States. On the south, Georgia and South Carolina, with the exception of a few plantations on the Tugaloo, present one unbroken forest as far as the sight extends. As you traverse this forest you will sometimes see splendid situations insulated from the rest of the world, in the fertile vallies, surrounded by the conveniences, the elegancies, and the domestic refinements of social life. The fertility of the soil, the salubrity of the climate, the vicinity of boat navigation, in a word, every natural advantage unites to persuade us that cultivated plantations, elegant and happy homes, and spires of churches, may one day be seen from the Currihee as they are now from the top of Mount Holyoke.*

REMARKS.

The mountain rock through which the Tallulah passes, is of a dark grey, sometimes approaching a blue color. The first bed of rocks, descending perhaps one hundred and fifty feet, is irregularly broken into masses of all forms and sizes; then succeed others with long parallel seams, dipping in a regular line with the fall of the river. These rest upon a third class of rocks, solid and of a light grey which form the bed of the stream. The Indians say that no fish, (not even the smallest minnow,) are found above the Rapids.

Springs impregnated with lime and iron are found in the vicinity. Alum and a hill containing a mineral resembling coal, are situated below the Rapids.

A few white pine and hemlock trees grow upon the Rapids. They are the only trees of the kind which I have seen in South Carolina or Georgia, and gentlemen from both these states were of our party who had never before seen the species. None of our company had seen the spruce pine in these states. We noticed eight species of oaks—white, red, black, spanish, post, black-jack, chestnut, and live oak.

Art. II.—*Miscellaneous Notices of Mineral Localities, with Geological Remarks; by* Prof. Edward Hitchcock.

During the summer and autumn of 1827, I visited a number of the well known localities of minerals in Massachusetts and Connecticut; and if the following remarks, in the form of a diary, are of any value, they are offered for a place in the Journal of Science. I was accompanied in most of my excursions, by my assistant in chemistry, Mr. Lucius F. Clark, to whose zealous assistance I am much indebted.

July.—Visited the most important localities in Chesterfield. The green tourmaline and rubellite still hold out in great abundance. The vein has been laid open ten or

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* Near Northampton, Mass.

twelve feet in length, in the granite, and is really one of the richest objects that can be presented to a mineralogist. I found Mr. Clark, the proprietor, very accommodating, and reasonable in his charges for minerals. He will pack boxes for gentlemen at a distance, who may request it.

Locality of Sappare.—This is about one mile north of the meeting house, on land of Mr. Searle. The mineral has hitherto been found only in veins in bowlders of mica slate, lying in a cornfield. These bowlders are large, and without doubt were derived from the rock beneath. Several varieties of sappare are found, from the coarsest and most unsightly, to the finest crystals. No specimens, however, can now be obtained so rich as were found several years ago: yet recently, they have opened a vein or two that furnish very good specimens. Mr. Searle usually keeps a supply on hand to furnish travellers.

Zoisite occurs at the same locality in grey flattened prisms, in limpid quartz.

Anthophyllite is found abundantly in the same place, in mica slate, and is well characterized. Other remarks concerning this mineral will be added when I come to speak of Blandford.

Any person who wishes to visit the most interesting mineral localities in the vicinity of Chesterfield, with the greatest expedition, will do well to pursue the following route. If he goes from Northampton, he will first proceed to Williamsburgh, were he will find argentine in abundance, plumose mica, &c. He will need a guide to find the deposits of these minerals: and Dr. Collins, the physician of the place, will be able to direct him. Proceeding to Chesterfield, he will visit first the sappare locality, and take the nearest route from thence to Mr. Clarke's vein of green tourmaline, in the north western part of the town. From this place, he can go directly to the congregational meeting house in Cummington, where he will find abundance of carbonate of manganese, and perhaps also cummingtonite. Col. Bryant of that place, will be able to direct the traveller to the proper spot. From Cummington he can go to Goshen meeting house, where the physician, Dr. Wright, will direct him to the most interesting locality of spodumene, siliceous feldspar, beryl, rose mica, indicolite, &c. on what is called the Week's farm in the north west part of the town. Going back to the centre of the town, and proceeding on the road to Ashfield, a mile or two, he will meet with another locality of spodumene. If he takes his departure from Greenfield, or Deerfield, the mineralogist may proceed to Goshen, by the way of Ashfield, and then to Williamsburgh, on the route already mentioned, through Cummington and Chesterfield: and if he chooses, he can proceed directly from the argentine at Williamsburgh, to the Southampton lead mine, which is six or eight miles from Northampton. He will find it for his interest to provide himself with conveniences for packing his minerals before he sets out; as he will not find at any locality, except Mr. Clark's, materials for this purpose.

August.—Went in search of a locality of sulphuret of molybdena, in Shutesbury, described in vol. 1. p. 238, of this Journal, as occuring in that town, on land of William Eaton. Could not find any such person, nor ascertain that he ever owned any land in that place; though he was recollected. Ascertained at length that the spot was on land of Mr. Pratt, in the extreme northern part of the town, close by a common chalybeate spring, more than half a mile from any house. The ore is found in a granite rock which forms a bed, or vein, in mica slate. But it was impossible to obtain more than two or three specimens of any value. Possibly by considerable blasting, good specimens might be found; but unless the mineralogist goes prepared for this business, I would not recommend him to visit this locality. Good specimens of black schorl, however, occur not far from the spot, and the geologist will be much interested by the enormous veins and beds of granite existing in the same field.

About a mile west of this place, is a large pond. On its southern shore, is a beach made up chiefly of the most beautiful white sand I ever saw. This appears to have proceeded from the disintegration of granite. Growing out of this sand, I observed many plants rarely seen in this vicinity; such as the xyris caroliniana, lobelia dortmanna, eriocaulon pellucidum, beautiful patches of galega virginica, proserpinaca palustris, and a species of utricularia, rooting in the dry sand and almost destitute of utriculi. The novelty of this spot afforded some consolation for our disappointment at the vein of molybdena.

Actynolite Schist of Macculloch.—On our return, we found this rock, well characterized, in the centre of Shutesbury, directly opposite the mineral spring, which is somewhat celebrated in this region. It consists of schistose actynolite, or of actynolite and quartz, with the addition sometimes of mica. It forms beds in gneiss; which is exactly the situation in which Dr. M. found it. If actynolite be considered a mere variety of hornblende, then ought this rock to be regarded as a variety of hornblende slate. It has not before, I believe been indentified in this country.

August.—Visited the place in South Hadley, where some agents of Mr. Disbrow had been boring for coal. They had selected a spot on the bank of a small stream, a few feet above the water, near which were seen alternating strata of shale and sandstone; and in the sandstone were thin masses of very fine bituminous coal, having almost the brilliancy of jet. The workmen had abandoned the exploration, though their instruments and the pyramidal edifice they had erected over the spot still remained. No one whom I saw, was able to communicate many circumstances of interest relating to the work. They penetrated, I believe, nearly one hundred and forty feet, and it was said, passed through one or two beds of coal several inches thick. When they had penetrated about sixty feet, they opened a vein of water, and it rose to the top and continued to pour over the surface with considerable force, in a stream two or three inches in diameter. I passed the spot several weeks afterwards, when the house was removed, and a tube inserted into the opening, through which the water was issuing as rapidly and abundantly as at first. The spot is more than two miles north of the village of South Hadley, almost at the foot of Mount Holyoke.

Mount Holyoke.—On the south side of the most northern foot path leading to the top of this pinnacle, about two hundred feet below the summit, I have lately found the sandstone of the coal formation cropping out most distinctly beneath the greenstone. Such instances are quite rare in the northern part of the trap ranges of the Connecticut.

September 4.—Southampton. The well known vein of galena in this town, appears also, about half a mile north of the principal adit, and has been explored to a considerable depth. It is seen on the north side of the road, on a steep hill about half a mile east of Kingsley's tavern. This spot is a good locality of yellow foliated blende and radiated quartz, and better specimens may here be found than at the principal adit. Mica slate here appears to form the walls of the vein.

Westhampton.—Noticed a bowlder of granite, so intersected by veins of the same rock, as to exhibit granite of four successive epochs: that is to say, the original bowlder must have been first formed; a vein, intersecting it was the second formation; a second vein, cutting off the first, was a third formation; and a third vein, cutting off the second was a fourth formation.

Norwich.—Went in search of the locality of beryl and plumose mica, described in Robinson's catalogue of Minerals, as "half a mile west from Pitcher's bridge, near a mass of white rocks, to be seen from the bridge." No such white rocks can be seen west of the bridge; but a conspicuous protruding mass of granite appears on the hill directly north. Concluding this to be the spot, we went to it: but neither in it, nor near it, could we find more than one or two crystals of beryl. But the prismatic mica is very abundant and fine: Schorl also, in immense quantities, exists in the rock, and very many of the prisms are terminated by three sided pyramids, and I noticed a few nine sided prisms. Some of the crystals are four inches in diameter. Plumose mica also occurs at the same place though sparingly.

September 5.—Having cause to suspect that beryls were found in several of the granite beds and veins in the vicinity, we proceeded up the river, (a branch of the Westfield,) until we came to the last house on the road, where lived one of those persons who profess to have a *natural taste* for mineralogy, and to be acquainted with several most valuable metallic veins in the vicinity, whose situation they will not disclose. He undertook to conduct us to a locality of beryls; and after leading us up a hill half a mile in length, we came to a spot, near the north line of Norwich, which was really interesting.* The rocks in all this region are mica slate, with irregular protruding masses and veins of granite; and in this latter rock we not unfrequently found beryls, but they were neither very fine, nor abundant. The best had been dug out; as some of the inhabitants in the vicinity had ascertained that they were of some value. Other interesting minerals, however, were found, which repaid us for the fatigue of the excursion.

Black schorl, in immense crystals, three or four inches in diameter.

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* Large patches of ground in the fields around this spot were red with immense quantities of that curious moss the *Funaria hygrometrica.*

Siliceous feldspar, a new variety as to color; it being dark grey, or blue. In other respects, it agrees exactly with that from Chesterfield, Goshen, &c.

Spodumene, in large laminated masses, of a pearly white color. Upon examining a few specimens after my return, I find one of them to be a six sided prism, without terminations; and a second exhibited distinctly three of the sides of such a prism. I was suspicious that this might be one of the crystalline forms of this mineral; but perhaps it is the result of cleavage.

The mica slate of these mountains forms good whetstones; and a quarry is opened half a mile south of the locality above described. Near this quarry is a ledge of that variety of granite which I have described as *pseudomorphous*, in vol. 6, of this Journal; and the plates of mica are of enormous size, even from fifteen to eighteen inches across; although it was hardly possible to get out any specimens of this size, I found also near this spot, one or two very fine specimens of black schorl; the crystals one or two inches long, and completely covering the convex surface of a mass of mica slate, a foot long, and ten inches wide.

In going from Norwich to Blandford, I passed through the east part of Chester; but had not time to search for the many interesting minerals discovered in that place by Dr. Emmons. I observed, however, both in Chester and in Blandford, sappare in abundance, disseminated extensively in mica slate. In Blandford it is accompanied by wine colored staurotide.

On an island in a branch of Westfield river, near what is called Chester village, one of the inhabitants informed me, an hundred days work, had been performed a few years since, in search of Capt. Kidd's* money. The digging was accompanied with the superstitious observances common on such occasions. They were greatly discouraged in one part of the process by the intrusion of my informant, who by speaking to them, when they were observing the most profound silence, broke the charm, and the treasure they supposed just within their reach, was thus irrecoverably lost. They did all in their power, by gestures, to prevent the fatal word from being spoken; but they could not make themselves understood. At another time they were greatly encouraged to proceed, by finding an iron pot, containing

* A celebrated Buccaneer.

some bits of copper, which had been secretly deposited there, the day previous, by some boys who had discovered the place of their operations. It is astonishing how widely these foolish whims concerning Kidd's money are disseminated among the ignorant in New England.

We visited Blandford with a view to find the locality of anthophyllite, announced some time since by Mr. Shepard. But we found no one there who could direct us to it. Upon searching, however, we found the mineral, at first about twenty rods southeast of the village, on the road to East Granville, and afterwards more perfect specimens, about a mile south of the village, on the same road. It differed, however, so much in appearance from the mineral discovered by Mr. Shepard, that I was led to doubt its identity, and also whether it was anthophyllite. And this doubt was still further increased, on subjecting a filament to the action of the blowpipe, by which it was slightly, though with some difficulty, fused. In other respects it corresponds very well with the descriptions of anthophyllite in the books; its structure being foliated, its fracture uneven, its color some shade of brown, and the aggregation of its fibres, or prisms, somewhat radiated. Not having a specimen of Norwegian anthophyllite for comparison, I gave some specimens to Mr. Shepard, the results of whose examination are contained in the following letter, which I think renders it nearly certain, that the mineral in question is anthophyllite. The specimens from Blandford and Chesterfield are so nearly alike, that the one can hardly be distinguished from the other.

Yale College, Jan. 2, 1828.

My dear sir—In compliance with your desire, I have compared the substance which you supposed might be anthophyllite with a genuine specimen from Norway. It possessed the same crystallographical characters, affording by the reflecting goniometer, angles of 125° 30' and 54° 30'. Before the blowpipe their appearance was the same, although I was able to fuse them both without difficulty upon the edges, into a glass colored by iron, contrary to the characters given in this respect in the books, which assert that, alone, before the blowpipe, the anthophyllite is unalterable.

The determination of this substance has led me to re-examine a mineral from the same neighborhood, of which I gave some account in the Boston Journal, under the name of anthophyllite. I find myself to have been in an error as to my examination of its crystalline form and some other characters. At present I regard this mineral as constituting a new species, of which I propose at a future day to give a particular account. Yours very truly,

C. U. Shepard.

Sept. 6.—The view from Blandford meeting house, is most commanding and extensive. We could see several points of interest in the valley of the Connecticut, and in all other directions the horizon was very distant.

From Norwich to West Granville we passed nearly in the direction of the rock strata. The prevailing rock is mica slate, sometimes passing into talcose slate, and in Granville, alternating with hornblende slate, containing numerous small crystals of hornblende. These slate rocks were frequently intersected by granite veins and protruding masses. Some of these were interesting to the geologist; but I have not now time to enter into any details. If life and leisure be granted me to collect together a sufficient number of facts, relating to the granite of New England, to justify any generalizations, I shall offer the result to your journal. I will here only remark, that rarely, if ever, do I meet with a granite bed in the strict sense of that term; but in nearly every instance, a little careful examination shows that the granite mass continues precisely parallel with the including strata, only a short distance, and then crosses the strata more or less obliquely.

In West Granville, one or two miles south east of the meeting house, occurs a bed of very good soapstone. We saw a specimen, but did not visit the spot.

From Granville we proceeded westerly across the strata to Tolland, the next town. Mica slate was the prevailing rock for about two miles, when we came to a region containing immense quantities of hornblende rock, scattered in large and small bowlders over the surface. In most instances, the hornblende was nearly pure, occurring in laminated masses, very much larger than I have seen elsewhere. I noticed some of them from twelve to fifteen inches in length, and one inch and a half broad. Not unfrequently there was nearly an equal admixture of feldspar, constituting a magnificent sienite; some of which, was beautifully porphyritic. This hornblende is black, and easily fuses before the blowpipe—a proof that it is not augite. I have no question that these varieties of rock exist, in place, in the east part of Tolland, and occupy a space a mile or two in breadth. I regretted that I could not spend more time in its examination, or carry with me more than an imperfect suite of specimens. West of Tolland meeting house we found mica slate, gneiss and granite; and we meet with these occasionally as far west as New Marlborough; though after descending the mountain, three miles west of Tolland, we fell in with numberless bowlders of granular quartz. But the geology of this region has been so ably described by Prof. Dewey, in the 8th vol. of this Journal, that it is unnecessary for me to go into details.

Sept. 6th, *Canaan*, *Connecticut*.—This is an interesting region, both to the geologist and mineralogist. We were attracted thither, principally by the hope of discovering the spot from which the native iron was obtained, that was recently announced in this journal. We called upon Maj. Burrall, who, in search of the iron which he formerly obtained from this mountain, had recently visited it again, in company with his son, Mr. Wm. Burrall, a graduate of Yale College, and Dr. Reed. Maj. B. not being able to go with us to the spot, the two other gentlemen just named, conducted us. About two miles north of the meeting house, in the south parish in Canaan, is a precipitous mountain, nearly a thousand feet in height; and it was on its top, and near the western edge, that the native iron was found, not three years ago as stated in this journal, but as Maj. Burrall informed us, sixteen or seventeen years since. At the base of the mountain is limestone, succeeded by an aggregate of quartz and mica, which appears to be one of the varieties of Dr. Macculloch's quartz rock. The top of the mountain, however, is well characterized mica slate, containing small imperfect crystals of magnetic iron ore, sparingly disseminated. On the top of the mountain we came to a pond, perhaps sixty or eighty rods across, and on the south west margin of this pond, is the spot, where, as well as Maj. Burrall can recollect, he obtained the specimens in question. At this spot, he found his compass liable to so great a variation, that it was useless, and on examining the rocks for the cause, he found the specimens that have excited so much interest. Mr. Burrall junior took his father's compass with him, on our present excursion, and attempted to run over the same line which his father pointed out to him, as the one upon which he experienced so much difficulty. This line runs nearly east and west, just upon the southern margin of the pond, and we found that where it approaches the nearest to the pond, there was a variation of 30°, as shown by back objects. On setting the compass only two or three rods backwards or forwards, on the line, however, the variation almost entirely vanished. This showed us that the magnetic mass, that produced the variation, could not be far removed from the line, either north or south; for had it been at a considerable distance, the removal of the compass a few rods either east or west, could not materially have affected the variation; since the radius of a large circle, for a considerable number of degrees, differs so little from the secant. We removed the compass one or two rods to the north, and run a line parallel to that above named, so as even to enter a little distance into the pond, where the water is highest. Here the variation was even greater than upon the first line; so that the attracting mass must lie north of that first line. Probably it lies just in the edge of the pond; and I have no hesitation in saying, that a circle, described with a radius of two rods, upon the point where the greatest variation was noticed, would embrace the ferruginous mass that here disturbs the needle; nor is there much reason to doubt but that mass is native iron. And whoever has observed how large a mass of iron it requires to turn aside the needle of a compass, at the distance of one or two rods, will presume that the mass here deposited must be a large one. The spot I have been describing is covered with trees and thick underbrush, and the moss and rubbish almost entirely hide the rocks underneath. The bottom of the pond is sphagnous: and perhaps it might be necessary partially to drain it, which is not difficult. Whoever will be at the trouble and expense of removing the brush, moss and soil, at this spot, under the direction of Mr. Burrall, or Dr. Reed, will, I have little doubt, be abundantly rewarded by the discovery of a mass of native iron.

On seeing this pond, and considering this locality of native iron on its margin, the enquiry forces itself on the mind, may it not be the crater of an extinct volcano? But I could perceive not the least indication of any igneous action.

Maj. Burrall presented me with a small specimen of the native iron, whose characters correspond exactly to those given in the 12th vol. of this journal; but it furnishes no additional information.

Canaan furnishes several other interesting minerals, which have been noticed in the journals and mineralogical books. In the limestone, a large part of which is dolomite, between the mountain just described and the south meeting house, occurs abundance of crystallized white augite. The limestone is very liable to disintegration, and by a little search in the white soil above the rock, the augite may be found in a perfect state. Some of the crystals are six sided prisms, with two lateral planes broader than the others. These are terminated by four sided summits, whose faces correspond to the nearest faces of the prism. Sometimes the terminal edge of the summit is truncated. Sometimes in addition to this truncation, one, two, three or four of the solid angles of the summit are replaced by planes. This six sided prism is often converted into an eight sided one, by a slight truncation on its acute lateral edges. This truncation is sometimes so deep that the crystal becomes a perfect four sided prism, with slight truncations on all its angles.

In the same limestone exists abundance of very beautiful tremolite. If I mistake not, all the varieties of this mineral exist here; viz. the common, in flattened prisms; the fibrous, exceedingly delicate, resembling white silk; and the baikalite, in acicular radiating prisms.

Quartz Rock.

By consulting Professor Dewey's geological map of Berkshire county, we find that he has put down quartz rock in several places, and in Canaan among the rest. I understand him, however, in common with all American geologists, to embrace in his description, only that variety of this rock, which consists of granular and compact quartz alone. But if I mistake not, several other varieties of the quartz rock of Dr. Macculloch, occur in this country, and have been usually confounded with mica slate. I reckon among these, the high and precipitous mountain a few rods south east of the south meeting house in Canaan. It is composed of quartz and mica, the quartz predominating: and this is the character by which Dr. Macculloch distinguishes this rock from mica slate. It rarely has a schistose structure, but is rather indistinctly stratified. The quartz being white, the rock would easily be mistaken for granite, or gneiss: but I could discover in it no feldspar. This same rock I have observed in several other places, in connexion with the mica slate of the Hoosack and Green Mountains; though no where else, (as far as I recollect) constituting so large a mass. A variety of quartz rock, in which the ingredients are arranged in distinct layers, the quartz, being greatly in excess, constitutes strata of considerable extent, in Northfield, Vernon, Leverett, &c. along Connecticut river. Quartz rock of a similar character also constitutes a considerable part of the Blue Ridge in North Carolina; particularly the remarkable peak called Pilot Mountain. I doubt not but our geologists, by a little attention, might easily identify in our country all the varieties of this rock, described by the author above named, as existing in Europe. I ought perhaps to mention, that in a former volume of this Journal, I described the conglomerate quartz rock, as occuring both on the eastern and the western sides of the Hoosack Mountain. The variety of this conglomerate described by Prof. Dewey, as "cemented by fibrous brown hematite," and which the traveller not unfrequently meets with in New Marlborough and the north part of Canaan, is not mentioned by Macculloch and appears to be new.

Scapolite Rock.

In mineralogical treatises, scapolite is described as rather a rare mineral; but in this country it occurs in large quantities, especially at Bolton and Boxborough in Massachusetts. The locality in Canaan, however, exceeds in extent any thing before heard of. From the space it there occupies, I have no hesitation in denominating it a *rock*. About half a mile north east of the meeting house, it forms regular strata, at least two miles long, and from a quarter, to half a mile wide. It is associated with granular limestone; and on its western limits, is intimately mixed with that rock. It is the compact variety and has a splintery fracture. I noticed three varieties of this rock.

1. Compact scapolite.
2. Compact scapolite and limestone.
3. Compact scapolite and mica.

This rock is distinctly stratified, the strata varying from a few inches, to a foot or more, in thickness, and dipping to the east, at an angle between 45° and 60°. These strata are usually crossed, nearly at right angles, with another set of seams, dividing the rock into columnar masses. The external part of the rock is generally partially decomposed, to the depth of half an inch, or more. I had not time to examine all the relations of this rock, and should not, therefore, be surprised, if it should be found much more extensive than above stated. I was not without suspicion, at first, that it might be a variety of augite; but it melts, without difficulty, before the blowpipe, with intumescence, into a white enamel; whereas I was not able to fuse the augite, from the same locality.

As to the geological relations of this rock, I have no doubt that it is connected with a primary series, consisting of limestone, quartz rock, and mica slate. It is very tough, and being regular in its stratification, it is a good material for stone walls.

September 8th.—Visited the most extensive bed of iron ore in Salisbury, and the furnaces. Interesting as these objects are, they have been so minutely and repeatedly described, even in this Journal, that a repetition is unnecessary. At the old furnace, near the principal village, we found abundance of cadmia thrown aside, of which the superintendant very obligingly permitted us to take as much as we pleased.

September 10th.—In passing over the mica slate, gneiss and granite, occuring on the road from Canaan to Woodbury, we met with but little worth noticing, in regard to mineralogy and geology. Bowlders of limestone, containing tremolite, are not uncommon in Goshen and the north part of Litchfield. One mile south of Litchfield, I noticed tremolite in fetid quartz. In Litchfield (south farms,) and onwards to Bethlehem, are numerous bowlders of beautiful porphyritic granite, and occasionally porphyritic gneiss. The crystals of feldspar are uncommonly large. Bowlders of these same rocks exist in great quantities, a few miles northwest of N. Haven, in Woodbridge; but I have not noticed these rocks in place in Connecticut.

We stopped in Woodbury at the public house directly opposite, and only a few rods, from the well known locality of prehnite. We had been told that this locality was exhausted, but found it easy to obtain an abundance of very decent specimens. We were told that a better locality had been found on the east side of the hill; but after wandering in search of it for some time, we gave up the idea of finding it.

I was gratified to find the character of the greenstone in Woodbury so exactly like that along the Connecticut. I observed also in a stone wall, near the prehnite locality, a piece of sandstone precisely resembling a variety of this rock found in the coal formation on that river. And on proceeding southerly, to Southbury, I was agreeably surprised to find, not only a continuation of the greenstone, even to the banks of the Housatonic, but also several other varieties of the sandstones and shales of the coal formation, and also bituminous limestone. In fact, it is a real coal formation; whose northern limit is in Woodbury, and its southern on the banks of the Housatonic; and Dr. Smith of Southbury informed me, that explorations had been made in that place for coal. He mentioned also that an impression of scales, probably those of a fish, had been found in the bituminous limestone; and that in the greenstone occur chalcedony, agates, calcareous spar, &c.; also satin spar in the limestone. If I did not misunderstand him, a vein of sulphuret of arsenic was formerly explored in the southern part of the town; though the pit is now filled. He said likewise, that the rose quartz of this town, may still be obtained in abundance, though blasting is now requisite.

But the most interesting object Dr. Smith offered to our inspection, was a siliceous petrifaction of a trunk of a tree, eight or ten inches in diameter, found in Southbury. The man, who discovered it, mistook it for the unaltered stump of a tree; and on attempting to fix his axe in it, he so battered the instrument as almost to ruin it, upon which, he flew into passion, and fell to breaking this fine petrifaction to pieces. Dr. Smith however, obtained one piece, a few inches long, of the entire trunk, and it is rare to see a petrifaction exhibiting the back and solid part more perfectly. I think Dr. Smith told me it occurred in a swamp.

A strong desire to reach New Haven before the College commencement, induced us to break away from the mineral attractions, which the reader will see, were here presented to us. Yet no mineralogist would think of leaving Munroe unvisited, when in its vicinity. We therefore hurried forward to that place.

September 11*th*, *Munroe. Lane's Mine*—I suspect the gangue of this mine, which is quartz, constitutes an immense bed in gneiss, and not a vein: in one part of the exploration, the gneiss appears above the quartz, in contact with it, dipping a few degrees, to the northeast. It may possibly, however, be a bowlder. The mine is yet explored only ten or twelve feet deep.

The locality of topaz and chlorophane is three and a half miles south west of this mine. We did not visit it, for want of time. But Mr. Lane informed us, that both the minerals form a vein in limestone; one side of which vein, is chlorophane, and the other quartz containing topaz. The crystals of this latter mineral appear to be abundant, and some of them very fine; but in general, their great size seems to be at the expense of their delicacy. It occurs in foliated masses, as well as distinct crystals, whose lustre is about the same as that of feldspar, and as plates of mica are mixed with it, it might easily be mistaken for granite, had it not so great a specific gravity. I obtained a mass of this variety of the mineral of Mr. Lane, which was almost entirely topaz, and which weighted twenty six pounds! And yet, originally this was twice as large, and the whole was blasted from the vein, where, for aught I know, may be tons of it.

I have said that the topaz locality was three and a half miles from the mine; but I have found this mineral at the mine. The specimens were connected with the Wolfram, and were very decided in their characters. I regard this discovery as interesting, because it shows that topaz is disseminated in this region, more widely than had been supposed.

Carbonate of iron and delicate fibrous hornblende, as well as a remarkable variety in crystals, resembling hypersthene; also smoky and yellow quartz, and green feldspar, are found at Lane's mine. In another part of the town is found brown spar, associated with tripoli; I believe these minerals have not been noticed before.

I forget whether the fine crystals of black schorl, in the northwest part of this town, have been noticed among former localities. They are the best I have seen in this country. Often they are an inch or more in diameter, with perfect terminations, and the edges of the terminating faces beautifully truncated. Mr. Lane keeps duplicates of these, as well as all the other minerals of the place, on hand, for the accomodation of mineralogists. We obtained of him three or four hundred specimens, at a very reasonable rate. He is very zealous in exploring his mines, and possesses a very good tact at discriminating minerals.

Gypsum of Nova Scotia.

I recently examined a quantity of this rock brought from Nova Scotia, and there happened to be mixed with it several specimens of the rock in which it is contained. I have no hesitation in saying, that it is the red marle, or saliferous rock, so prolific in gypsum, in various parts of the world. If I am not mistaken therefore, the geological relations of the Nova Scotia gypsum are ascertained.*

In the selenite and compact gypsum from the same place, I found disseminated small masses of bituminous carbonate of lime, of a dark color, and resembling the fetid limestone sometimes found in the same situation.

Art. III.—*Notice of the Report on the Geology of North Carolina, conducted under the direction of the Board of Agriculture; by* Denison Olmsted, *Professor of Chemistry and Mineralogy in the University of North Carolina.* In two parts, pp. 141, 1824 and 1825.

(Communicated.)

It has not been owing to any doubts as to the value and merit of this publication, but to circumstances beyond our control, that we have so long delayed the execution of our resolution, made upon the first appearance of this work, to give the readers of this journal a detailed account of it. The valuable geological facts it contains, would be a sufficient reason for devoting to this purpose a few pages of a work, intended, like this journal, to be a record of the natural history of our country. But there is another reason that prompts us to this labor even at this late hour. It will be recollected that this geological survey of North Carolina was authorized by an act of its legislature, and to this day it remains a conspicuous and solitary† instance, in which any of our state governments have undertaken thoroughly to develope their mineral resources. It was attended, we are told, with an almost enthusiastic success; and certainly confers great honor upon its projector, and upon the intelligent representatives, who provided the means of carrying it into execution. It is a good example, therefore, to hold up before other legislatures, to induce them to adopt a similar course. The subject, it is well

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* In a letter from Mr. Frances Alger, of Boston who has examined the beds of this rock in N. S. he says, "the sulphate of lime and fibrous gypsum occur in red sandstone near its junction with greenstone."

† South Carolina has we learn engaged in a similar enterprize, under the direction of Professor Vanuxem.

known, is exciting considerable attention at this day; and in one of our largest states, intelligent and public spirited individuals have undertaken the work on a scale worthy of their distinguished character. From the very commendable spirit for internal improvements that is pervading all classes of the community, may we not hope, that ere long this subject will not be urged in vain upon the representatives of any state. What an accession would be made to our resources, and to a knowledge of our country, were a thorough examination to be instituted into our mineralogical, geological, and, even botanical riches! How worthy the genius of our governments to have an accurate geological map, with an accompanying report, accessible to all our citizens! Individual naturalists are indeed doing much towards the accomplishment of such a work: but the pleasure derived from scientific discovery is almost their only reward; and without patronage, they cannot for many decades of years accomplish the enterprize.

As the report of Prof. Olmsted was intended for the community at large, he has wisely avoided, as far as possible, technical phraseology. He has also dwelt most upon those substances which are of practical utility, and most of those facts, that would interest only the scientific man, he has thrown into the notes. The first part of the report gives an account of the country immediately west of Raleigh; the second part describes all that part of the state between Raleigh and the ocean; and to these two parts, there are added observations on the geology of the western section of the state. In this order was the state examined: But in the extracts we propose to make, we shall begin on the sea board and proceed westward, because this order will lead us in succession across the different geological formations; beginning with the tertiary, and passing across the secondary to the primary.

We call that part of the state tertiary, which is usually denominated alluvial; but with about as much propriety, in our opinion, as if one were to speak of granite as alluvial. This part of the state, extending westward from the ocean nearly one hundred and fifty miles, is called by the inhabitants the "Low Country." It consists of regular alternating beds of sand and clay, with occasional masses of sandstone and limestone abounding in marine organic remains. The regularity of its beds, and its different mode of formation, distinguish it decisively from the alluvial. Although a few years since this formation was thought to be quite uninteresting, it is now justly beginning to excite a great deal of attention. Professor Mitchell, the successor of Prof. Olmsted in the chemical and geological chair in the University of North Carolina, has however, given so excellent a view of this formation in No. 2, of the last volume of this Journal, that we need not dwell upon it. Though personally unacquainted with Prof. Mitchell, we feel constrained to express our gratification at the sound geological view that paper exhibits, and to congratulate the University, that its loss, in the resignation of Prof. Olmsted, is so well supplied. If he has not given a death blow to the prevalent hypothesis of the formation of the low country of the southern states by the action of the Gulf Stream, and the waves, we know not how sound argument could destroy it.

Notwithstanding the paper of Professor Mitchell, just alluded to, it will not be uninteresting to the geologist to read the following extract, relating to the organic remains of the tertiary formation of North Carolina, from the Report of Prof. Olmsted. For the reason already alluded to, he could not employ all the scientific designations which the geologist would wish.

Beaufort Canal.

The opening of the new canal between Clubfoot and Harlow creeks, forming a water communication between Newbern and the Ocean, by way of Beaufort, affords an opportunity to examine the upper strata of this district, and discloses to view a specimen of the curious fossil remains of animals with which this region is stored. These excavations expose a depth of sixteen feet, for a distance of three miles, through a tract that is nearly a dead level, and they penetrate through the following horizontal strata.

1. *A black mould*, such as is usually found in the eastern swamps, capable of producing corn and wheat in the greatest luxuriance.

2. *Potters clay*, of a yellowish brown color.

3. *A thin layer of sand*, full of sea shells and the remains of land animals, particularly of the Mammoth, or fossil Elephant. Along with a profusion of shells, in perfect preservation, there are not unfrequently thrown out, huge teeth, vertebræ, and skeletons, more or less entire, of a gigantic race of animals, which, no doubt, were buried here by that great catastrophe which also shut out the ocean far eastward of its original borders. The shells, when first thrown out, are generally unaltered; but

on exposure to the air, they speedily crumble to pieces. They are met with at different depths, from three to eight feet, and the marine deposits are chiefly in beds or ridges crossing the canal from east to west. Conch-shells, scollops and clams, are the most common varieties of shells, and they correspond both in kind and appearance with the marine aggregates accumulated on the sandy beach near cape Look-out. The clam shells, however, are frequently of a larger size than those met with at present.

4. *A soft deep blue clay*, which is sometimes in contact with the potter's clay, (number 2.) though it is frequently separated from it by the layer of sand, (number 3.) The inhabitants assert, that this blue mud corresponds in its character precisely with that which is now found in the bed of the adjacent ocean.

Shell Marl.

In ascending the Neuse towards Newbern, the banks generally appear low, but occasional bluffs present themselves, all of which I should have examined more minutely, had not the nature of my conveyance, (a public boat,) prevented. The most conspicuous bank, however, I had an opportunity of inspecting with some attention. It occurs at Johnson's Point, four and a half miles below Newbern, on the south side of the river. This contains an extensive deposit of marine shells, more or less decayed, and blended with clay, constituting that valuable species of manure, called shell marl. The bed occupies a space of about five feet above low water mark, and consists of a vast collection of marine substances, among which are scollops, oysters, clams, conchs, corals and madrepores. Immediately above the bed of shells, is a thin layer of clay, exhibiting prints of shells only, the shells themselves having apparently mouldered entirely away. Above the clay, the remainder of the bank, about fifteen feet, is occupied by sand.

The Report describes several varieties of limestone and stone marl in the low country. In an economical point of view, these are interesting, especially as it is probable one of the varieties will form the water proof cement. The oolitic limestone and stone marl are thus described.

Limestone of the Sarpony Hills.

In the eastern part of the county of Wayne, is a high ridge of land extending along the south side of the river for several miles, and dividing the waters of this river from those which pursue a longer course to the Cape Fear. These hills are covered with large round blocks of fine stone marl, beneath which, at the bed of the river, lies a formation of limestone, of the description called by mineralogists, *oolitic limestone*—different in its appearance from all the other beds which occur on this river. It crosses the river in a north east and south west direction, and affords every indication of being one of those general formations which traverse the whole state.

The most favorable view of these rocks occurs at Mr. Griswold's, on the bank of the river, nine miles below Waynesborough, where a bluff ninety feet high exposes them fully to inspection. Thirty five feet above the limestone, in the side of a hill, the blocks of marl, above mentioned, make their appearance. It is of a close texture, nearly or quite destitute of shells, and other organic remains, and does not, like the stone marl of Jones county, fall to pieces on exposure to the weather. It is of a lively grey color, and when first removed from the bed, it is so soft as to be easily cut with a knife or sawn into blocks; but on becoming quite dry, it grows hard and firm, and assumes every appearance of a most elegant building stone. Indeed, on comparing it with a specimen of the celebrated Bath stone, (which is used for the finest public buildings of the city of London) recently taken from Westminster Abbey by the Rev. Dr. Caldwell, the eye can hardly discern any difference between them, but the two appear equally well fitted in texture, color, and beauty, for the finest purposes of architecture. It is composed of sixty per cent. of lime and forty of a fine grey clay. It is therefore a true marl; but, as has been already remarked, not subject like that to decompose, but on the other hand, possessing the valuable property of hardening on exposure. Lying as it does on the very bank of the river, and therefore susceptible of easy transportation in boats, it is to be hoped that some edifice in the town of Newbern, will ere long display its uncommon excellencies as a building stone. Should it cross the other large rivers, as it probably does, it may be regarded as without a rival among the building stone hitherto discovered in this state.

In Lenoir county is found a fine white sand that would probably answer for common glass: and in Lincoln occurs abundance of white granular quartz, easily crumbling between the fingers. No manufactory of glass, however, has yet been established.

For more than a hundred miles along the banks of the Neuse, the pyrites of the clay is found in a decomposing state, and partially converted into copperas. No establishment, for its separation from the clay, as yet exists. In the same clay and associated sand, occur abundance of fine lignites.

The lignite is, in some instances, perfectly charred, exactly resembling charcoal; sometimes it is only partially charred, exhibiting the remains of trees very perfectly. We uncovered a trunk for five feet which was in a state of complete preservation, having the bark entire and unbroken. The diameter was twelve inches by six, and its figure therefore ellipsoidal, a circumstance which is common to all the lignite I have seen. This mass was horizontal, resting on its broader side, and coincident with the general range of strata (viz. north east and south west.) It burns readily on the fire. Fragments which are scattered over the surface become petrified, the vegetable matter being replaced by silex. In this collection were also fragments of fine chlorite slate, containing octahedral iron, than which nothing could be a greater stranger in this region.

The wells of the eastern district are thus noticed.

The *wells* of this region are a curiosity to a visitant from the hilly and mountainous districts. They are rarely if ever *walled*, but the compact clays which form the natural walls, give a sufficient firmness to the strata of sand and gravel which they enclose, to keep the sides from caving. During the wet season, the water is usually found in these wells at no greater depth than five or six feet. If means could be devised to penetrate to the depth of a hundred feet or more, it is probable that a much finer kind of water would be obtained, as is found to be the case in many similar formations of sand, clay and gravel, in other parts of the world.

Bog iron ore is not unfrequently met with in the eastern section of the state, and the brown hematite occurs abundantly near the dividing line between the lower and upper country; and the magnetic exists in large beds in the mica slate of the primary region. None of these, except the magnetic, are wrought to any extent. "In Lincoln," says the Report, "there are ten forges, and four furnaces, where, in the year 1823 were made about nine hundred tons of bar iron, and two hundred tons of castings." To encourage the working of these ores more exclusively, Prof. O. devotes a few pages to some judicious remarks upon the chemistry of the subject, and to the suggestion of more economical and effectual processes than are now employed.

One of the specimens of iron ore sent to Prof. Olmsted, from the slate formation, or gold region, proved to be native iron. Another was afterwards discovered that weighed twenty seven pounds, and a part of it was wrought by the blacksmiths, pp. 31 and 108.

In passing westward from the tertiary formation of North Carolina, we come to a belt of sandstone, of an average width of twelve miles, which Prof. O. denominates the Independent Coal Formation: and he is of opinion that it is a continuation of the Richmond coal basin, and that both of these belong to that deposit of sandstone, extending, according to Maclure, from Connecticut river to the Rappahannock. It crosses the state of North Carolina, but has not been examined farther south, though it undoubtedly extends into South Carolina. A single bed only of coal has been found in North Carolina, not far from the Gulf on Deep river. It is about a foot thick, is bituminous, and resembles the Richmond and Liverpool coal.

The sandstone of this formation furnishes valuable building stones. It is employed also for grindstones and whetstones. Underneath the coal formation, is found a bed of millstone grit, which is employed for millstones, which bring in market, from thirty to one hundred dollars a pair.

Very little limestone has been found in connection with this coal formation; though the geological relations of this rock in England would lead us to expect it immediately beneath the millstone grit.

Succeeding to the red sandstone, or coal formation, on the west, and forming a belt across the state wider than the sandstone, we find what Prof. O. denominates the Great Slate Formation, and Prof. Mitchell, the Ancient Transition Rocks. The following synopsis of this formation from the Report, will give the reader an idea of its geological and mineralogical contents.

1. Argillite—black, blue, green, lilac, porcelanite? Aluminous slate, light grey, yellow. 2. Chlorite—common, slaty. 3. Greenstone—unstratified, slaty, trap. 4. Porphyry—green, argillaceous, petro-siliceous. 5. Novaculite—olive green, oil green, straw yellow, passing into chlorite slate, passing into talc. 6. Petrosilex. 7. Hornstone—yellow, dark green, zoned. 8. Siliceous Slate. 9. Talc—fibrous, radiated, foliated, scaly, indurated. 10. Steatite—common soapstone, light flesh red. 11. Sienite. 12. Quartz—common, limpid, crystallized, milky, tabular, pseudomorphous, amethystine, granular. 13. Sulphate of Barytes—lamellar, compact, granular. 14. Carbonate of Lime. 15. Epidote—massive, crystallized. 16. Tremolite. 17. Augite—coccolite. 18. Hornblende—olive green, slaty.

19. Breccia—consists of rolled pebbles imbedded in a ferruginous greenstone; (Is not this the trap conglomerate of Macculloch?) or in argillite, imbedded in the slate. (Is not this graywacke?) 20. Serpentine—dark green, pale green, iron black. 21. Clays and Ochres—pipe clay, potter's clay, saponaceous, porcelain, red and yellow ochres. 22. Iron—specular, oxide, magnetic, pyrites, native, brown hematite, argillaceous, sulphate. 23. Manganese—black oxide, ferruginous oxide. 24. Copper—red oxide, green carbonate, pyritous. 25. Arsenic—arsenical pyrites. 26. Gold—in veins, stream gold.

From a suite of specimens from this formation, obligingly sent to us by Prof. Olmsted, we should be disposed to add to the above list, talcose slate and graywacke slate. It is well known, however, that the characters of these rocks, are not a little dubious.

We approve of the caution of Prof. Olmsted, in denominating this series of rocks the slate formation, rather than the transition formation. For he thus makes us acquainted with the rocks themselves, as they exist in the arrangement of nature; which is of far more importance than to ascertain where they should be placed in the system of Werner.

Some of the members of this slate formation deserve more particular notice.

It is in this formation alone that gold is found in veins, although the stream gold has been carried to some extent over other rocks. According to Mr. Rothe, in No. 2, of the last volume of this Journal, the veins of gold are found exclusively in the greenstone. As, however, the mode of its occurrence and every important circumstance relating to it, have been so well described, both in the memoir of Mr. Rothe just alluded to, and in another by Prof. Olmsted in a former number of this Journal, it is unnecessary, in this place, to enter into details.

Some of the porphyry of this slate formation is very fine and well characterized. It occurs in beds and huge bowlders.*

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* Cleopatra's Needles are stated in the Report, p. 26, to consist of porphyry. We have not examined the subject; but happen to have a specimen of well characterized *sienitic granite*, broken from Pompey's Pillar, by the missionary Fiske, with the following label attached, in his own hand writing. "From Pompey's Pillar, at Alexandria. Cleopatra's Needles are of the same kind of stone."

The novaculite deserves special attention. We give its description in the words of the Report.

The Hone, or whet-stone slate, (the Novaculite of Mineralogists) is by far the most interesting and important among this collection of rocks. In my examination of this region, I have made it an object to ascertain the localities, and the respective qualities and relative values of this substance. It is found in the greatest abundance in various parts of the slate formation, although the qualities of different beds are various. The most valuable bed that I have met with, is about seven miles west of Chapel-Hill. It is known by the name of M'Cauley's quarry. It has been opened on the summit of a hill, which forms one of three parallel ranges extending from north east to south west, and composed chiefly of a green slate, called chlorite. The hone slate occurs in distinct beds, which present on the top, when exposed to view, a more rounded exterior than the slate rocks usually do. Although many thousand hones have been taken from this spot by travellers and others, yet as the quarry has not been wrought for the market, the excavations have been carried to a very little depth, and are insufficient to enable one to judge fully of the extent of the bed. I think however, that there can be no doubt that its extent is quite adequate to the supply of the market. Being near the brow of the hill, and the bed being perpendicular to the horizon, a large surface on one side might very easily be exposed, and thus the quarrying would be greatly facilitated. Of those specimens which are found at the top of the ground, some are weather-worn and a great difference in quality prevails among those that are obtained from the same spot. The properties which characterize the best variety are the following:—

Color a soft olive green—general aspect, like horn—the thin edges, when held up to the light, transparent.

The olive green color and the transparent edges are, when they meet, almost sure indications of a good quality.

The best of these hones answer with great exactness to the description of the genuine Turkey hones, and I have do doubt that they are indentical with them. Some of the best specimens, when polished, present a clouded or chequered surface, with a high lustre, and possess no small degree of beauty. Mechanics, in the vicinity of the quarry, frequently supply themselves with masses of eight or ten pounds weight. One side being faced, it is used as a hone, and is generally valued in proportion to the time it has been in use, for thus it acquires smoothness and hardness. The quality is frequently much improved by becoming thoroughly soaked with oil, and it probably would be still farther improved by boiling in oil, a process which is said to be practised with the Turkey hones when they happen to be too soft.

The excellence of the hones obtained at M'Cauley's quarry, is attested by this fact, that our carpenters lay aside, for them, the best Turkey hones of the market. They combine two qualities that are particularly esteemed, namely, they *wear away* fast, and set a fine edge; that is, their grit is both fine and sharp. Some of them answer well for razors; but their principal use among us is for carpenters' tools. Their value has not yet been settled by actual trial; but several mercantile gentlemen whom I have consulted, have been of opinion, that if properly faced and shaped, their price would not be less than fifty cents per pound by wholesale.

M'Pherson's quarry, in Chatham five miles west of Woodin's ferry, on Haw River, is next in importance among the whet-stone quarries that I have visited. It is lighter colored than the preceding, softer, and has a still finer grit. There are several varieties in the same bed. Some are transparent when in thin pieces, and resemble horn; others are opaque and of a duller aspect. The former are better fitted for oil, the latter for water. The prevalent colors are a bluish and yellowish white. The grit of these stones is exceedingly fine, and probably razor hones of the best quality may be found amongst them. The bed is extensive: I have observed it crossing the Salisbury road, a little north of the quarry, where the quality is apparently the same.

On the same road in Randolph, near Deep River, there is found a bed of a similar kind, and also highly valued by the inhabitants.

In the immediate vicinity of Chapel-Hill are several excellent quarries of whet-stone slate. At Barbee's mill, two miles south of this village, is a hill containing a great quantity of this article. It is of a yellowish straw color and highly transparent.

A great number of other localities might be mentioned; but almost every inhabitant of the district now under consideration is acquainted with such beds as have been noticed, in his own vicinity.

The extent of these beds is commensurate with the great slate formation. I have noticed the genuine hone slate, at intervals, from Flat River, in the eastern part of Person to the Narrows of the Yadkin. They are, therefore, quite inexhaustible, and may become, with suitable enterprise, objects of traffic that will well reward the industrious. The great quantities of this article required to supply the market; the abundance and variety of our quarries; the facilities with which they may be wrought; and above all, their acknowledged excellence and superiority, conspire to invite our attention in no ordinary degree, to this object of enterprise.

Prof. O. pronounces the soapstone of Orange county to be the most elegant he has ever seen. In several places copper has been found in connection with it.

The granular sulphate of barytes, of Lincoln county, is extremely well characterized; and it very much resembles in appearance snow white granular carbonate of lime.

In crossing the strata of the slate formation now described, to the west, we fall in next, as might be anticipated, with older primary rocks, as mica slate, gneiss and granite. This zone of rocks runs across the state in a south western direction, and extends westward to the blue ridge. The Report denominates it the granitic district, using the term granitic in rather a loose and popular sense. The granite lies next to the slate formation: next succeeds the gneiss, and then the mica slate. Beyond this, and occupying about twenty five miles of the western part of the state, lies a formation of argillaceous slate, usually denominated transition.

A remarkable stratum of gneissoid rock occurs in this connection, which is thus described in the Report.

Columnar Gneiss? A remarkable structure in Surry, seven miles north of Rockford. It consists of cylindrical masses or columns lying northeast and southwest, and exhibiting a striking resemblance to logs of wood laid side by side. The columns are a foot each in diameter, and where they appear in the bed of a creek, they extend unbroken forty or fifty feet in length. They are seamed cross-wise at short intervals, and the fragments appear like billets of sawn wood. Indeed the whole bears a striking resemblance to petrified wood, the laminated structue being not unlike vegetable fibre. These cylinders rest on gneiss of tabular structure, which is susceptible of a division into very large parallelopipeds.—This singular formation is only about three miles broad. The texture is soft and the fragments are used for coarse whet-stones.

The different varieties of the granite of this district are thus described.

The vicinity of Salisbury affords an example of the best building granite. Four and a half miles north of the town is a specimen of this kind which is not surpassed by any that I have ever seen. It resembles that of Raleigh, which appears very advantageously in the new projections of the Capitol; but the Salisbury granite is even superior to that, being more free from veins of a harder, coarser kind of the same rock, and consequently more easily dressed than that of Raleigh. It very much resembles the Chlemsford granite, so much esteemed in Boston for architectural purposes, recently appropriated to a noble use in constructing the Bunker's Hill monument. It owes its softness to the intimate diffusion of the mica. The same kind of granite is found at Louisburg, Warrenton, and near Halifax.

Of the harder kinds of granite of coarse grain, which are not susceptible of being dressed, a good example occurs at Dunn's mountain, four miles east of Salisbury. The vast masses of hard granite (boulders) which are here piled one upon another on the summit of this hill, present a very striking and almost sublime appearance, in a district of country so generally level and sandy as the surrounding region. These globular masses rest on a base of the same kind of rock which, being full of seams, is easily divided into blocks or parallelopipeds of great regularity, of which a valuable use is made in the neighboring town. They are likewise employed for millstones.

In the counties of Stokes and Surry, and in several other places of the western district, there is found a kind of granite containing a large proportion of feldspar in a state of decomposition, which gives it a loose shelly texture. It is by the decomposition of this kind of granite, that the finest varieties of porcelain clay are formed; and accordingly, this is the region where we may expect white clays of the most valuable kind; and veins, of fine clay are not unfrequently observed in the foregoing rocks. White clays which result from the decomposition of feldspar, are suitable for the finest kinds of pottery. It is essential however, that they should burn white. Some white clays contain so much iron as to lose their whiteness on calcination. Among the varieties enumerated, that near the Pilot Mountain appears to be most worthy of attention.

The traveller, in going westward over the granite, meets with alternate ridges of granite and greenstone, the latter of which, Prof. O. supposes to constitute beds in the former. Very interesting veins of a rock kindred to the greenstone, and which the Report considers basalt, exist also in the granite. These constitute the celebrated natural walls of Rowan—regarded for a great number of years as artificial, as the work of some wonderful people, long since extinct. We well recollect what full credence we gave in our boyish days to this sapient suggestion, which we found in the geographies of those times; and how very wisely our learned pedagogue would descant upon the mighty people whose fortifications still remained. But alas, science threw a ray of light upon these structures, and the magic spell of the antiquary vanished in a moment, and these walls stood forth confessedly the work of God alone. They are nothing more than dykes or veins of trap rock in granite, having that columnar structure so common in the rocks of this family: and being moreover encrusted with a part of their own substance, partially decomposed, which the imagination of an antiquary might easily mistake for mortar. Although this rock agrees exactly in external characters and composition with the classic European basalt, yet most of the distinguished French geologists seem unwilling to pronounce them identical, from an apprehension that basalt always has a volcanic origin, and that no evidence of volcanic action exists in the United States. We are aware that there are several instances in geology, in which we are obliged to regard rocks as specifically distinct, although their external characters and composition are the same; because their origin was unquestionably different. But in the case under consideration, we think European geologists ought not to require that we should show them extinct craters of volcanos, before they will admit the igneous origin of our trap rocks. There may be other proofs of such an origin quite as conclusive as this; and if we are not deceived, they are as numerous and decisive in regard to all the members of the trap family in this country as in Europe. We should, therefore, have no hesitation in pronouncing the rock of the natural walls of Rowan to be genuine basalt: although it may be of a more remote era than that in Europe. We have seen no trap rock in our country, whose fracture resembles the basalt of the Giant's Causeway so closely as this. We subjoin Prof. O.'s description of some of these dykes.

Of the natural walls of Rowan, I made a particular examination of only two. The first is about four miles north of Salisbury, and is known by the name of Jacobs' wall. The dykes at this place, (of which their are several,) are narrow, running through a friable kind of granite. We uncovered one which exhibited the following characters.

Width—about eight inches, the sides being smooth planes, and separated from the granite by a thin crust of clay.

Dip—eastward at an angle of 78 1-2 degress.

Seamed—at right angles to the sides, dividing the whole into very regular prisms, each crossing the wall, and consequently of uniform length, but differing in diameter and in the number of sides. The ends of these prisms being in the same plane, and at right angles to their sides, form the sides of the wall; and since the wall dips eastward, at an angle 78 1-2 degrees, the individual columns of course dip westward at angle of 11 1-2.

Course of the wall (as near as we could judge without a compass) south thirty degrees east.

This dyke though smaller than that at Robley's, on the south Yadkin, (which is the one generally intended by the natural wall) is still more regular than that, and in every respect more interesting. The breadth being so small, and the prismatic columns lying so closely compacted, we found it easy to remove entire sections of the wall, several of which I had put up in boxes for the inspection of geologists abroad. Robley's wall however, has been extensively visited and is minutely described in several publications. The description of it given by Dr. Beckwith, in the 5th volume of the American Journal of Science, I found to be so accurate as not to require any further observations from me.

The mica slate of the granitic district is interesting on account of some valuable imbedded minerals. Among these are extensive beds and veins of iron ore, a general account of which we have already given. Here occur also beds of white primary limestone, with a coarse grain. It is in mica slate also, that the very extensive deposit of North Carolina plumbago exists. We see not why this bed will not become of great value when extensively wrought. An account of it is thus given in the Report.

Plumbago of Wake.

Locality and extent.—This great deposit of Black Lead lies a little westward of Raleigh, and is crossed by all the roads that lead to Hillsborough. On the road to Chapel-Hill, I have observed it in a gulley within two and a half miles of the capitol, which is, I believe, its nearest distance from Raleigh. On the same road it is seen again a little west of Mrs. Streeter's; and a short distance north of this place, on the Hillsborough road, is one of the largest beds that I have seen any where exposed to the surface. Its apparent width is about twenty feet. On the eastern road to Hillsborough, we fall in with the formation soon after passing Crabtree creek, three and a half miles from Raleigh. At this place is *Guthrie's mine*, where the principal excavations have been made, and where has been obtained the greater part hitherto exported.

The whole formation consists of a great number of parallel beds varying in width from a few inches to twenty feet. They lie in a singular variety of isinglass rock (*micaceous shistus*) usually of a bright cherry red, but sometimes of a silvery white color. These beds occur throughout a space not less than three fourths of a mile wide and ten miles long. To this extent I have myself observed it; but a land surveyor informed me that he had followed it eighteen miles, and found its bearing to be south ten degrees east. I have no reason however to suppose, that the limits of the plumbago, have been as yet accurately defined. I have never read of any mine of plumbago which can compare in extent with this, but have reason to believe that it is the largest mine on record.

The plumbago may be obtained in large masses unmixed with any foreign ingredients; but it is frequently more or less blended with the rock in which it lies. From this, however, on account of its softness and friability, the Plumbago may be easily separated by pulverising and washing; although, probably, a sufficient quantity of that which is pure may be obtained to supply the market. It would be favorable to the reputation of the ore, to have that which is offered for sale well assorted, according to the different qualities. This practice is strictly maintained at the celebrated mine in England.

From Prof. Olmsted's descriptions, and from an inspection of specimens in our possession, we are persuaded that an important part of what is denominated mica slate in the Report, is the quartz rock of Macculloch. Indeed, as Dr. M. calls all those aggregates of quartz and mica, quartz rock, in which the quartz predominates, we have no hesitation in saying that this is one of the most common rocks of our country. We could refer, if it were necessary, to several localities, and in almost all of them this rock occupies a place next higher, and therefore newer, in the series, than mica slate: indeed, it passes insensibly into mica slate, and our geologists have hitherto described it as such, except that small portion of it which consists of granular quartz alone.

The flexible sandstone of North Carolina appears to us to be a variety of quartz rock. But the most interesting spot where quartz rock occurs, is in the pinnacle of Pilot Mountain, and several adjacent eminences, whose description in the Report is too interesting to be omitted.

The Pilot and Sawratown Mountains.

In the first glimpse we catch of the Pilot in Rockingham, it resembles a magnificent temple with a superb cupola, not unlike the picture of St. Peter's at Rome. The uncommon symmetry of its structure is preserved on a much nearer view.

Nothing could exceed the regularity and beauty of its appearance, as it presented itself to President Caldwell, Professor Andrews, and myself, on a summer evening of 1823, while we were approaching it from the east a little before sunset. Its dark side being towards us, we could the more distinctly observe its finished outline, which was still illuminated. The figure now presented by its sloping sides and perpendicular summit, was that of a triangle, having a portion of its vertex removed and replaced by a parallelogram; while the trees and shrubbery that graced the outline, appeared like delicate fringe projected on the western sky. We took lodgings at the eastern base of the mountain, and waited for morning to make our ascent. The sun rose fair, and at an early hour, led by our host, we set forward for the pinnacle. The country around for a great extent, especially to the east and south, though undulating, is still so low compared with this eminence, that the latter seems almost to rise from an immense plain. In the immediate vicinity the land descends a little towards the mountain on every side, which therefore literally " swells from the vale."

Dr. Caldwell and Professor Andrews had provided themselves with a quadrant, and a mountain barometer, for taking elevations, while I was to examine the geology of the mountain. A small stream called Grassy creek which runs southerly being considered as the true base, at this point we began our observations. For more than half the distance from this spot the ascent is so gradual, that one may proceed on horseback, the acclivity being only about 20° until we reach the *Spring*, a post of rest and refreshment, which was very grateful to our party. The water was very cool and pure, its temperature being only 58°, (June 23d,) which may be regarded as the mean temperature of the place for the year. From this spot the ascent becomes more abrupt, (about twenty five degrees) and those who are unaccustomed to climbing mountains find it extremely fatiguing. We arrive at the pinnacle on the north side, where is the only pass that has hitherto been found to the summit. The form of the pinnacle is almost perfectly cylindrical, resembling an eminence in the western Islands of Scotland, called the Scuir of Egg, but is even much more regular than that, (see M'Culloch's western Islands, *plate* 5.) The perpendicular wall is two hundred feet in height; and many of the visitants, unaccustomed as they are to alpine scenery, are so affected by the bewildering aspect of the world below them, and so appalled at the idea of hanging on the sides of the cliff that frowns over their heads, that no persuasion can induce them to ascend the pinnacle. The path is indeed narrow and steep; but it appears when viewed from below, more formidable than it really is. In some places the ascent is nearly perpendicular; but convenient cavities and projections are found, by which the feet and hands may be made sure. The course winds along, westwardly, on the side of the cliff, and at length passing abruptly over its brow, we find ourselves on the level, or rather convex, summit.

We were two much engrossed by the scenes that expanded around us, to proceed with our professional tasks, but seated ourselves on the northwestern brow of the pinnacle to enjoy the sublimity of the prospect. The air was still, but a hollow roar ascended from the plain—the voice of the forest—and not less sublime than the roar of the ocean, which it seemed to emulate. More than three fourths of the horizon were distinctly in view. On the south and southwest spreads an interminable plain meeting the sky, with a few exceptions, like the ocean itself. On the west and north the Blue Ridge presents an outline of unrivalled grandeur; and the Sawratown mountains relieve the eye in the most agreeable manner, as it wanders over the undefined limits of the eastern horizon. On the southwest at distant intervals, are caught a few bright glimpses of the river Yadkin. But after a general survey of the landscape, we gladly turned our admiring gaze to the lofty mountains of the west, some of which displayed their dark summits above the white insulated clouds, that were rolling around them. As the day advanced, these clouds began to multiply on the sides of the Blue Ridge, covering its acclivities with chequered fields of sun and shade. A few of them occasionally wandered towards us over the clear blue sky, projecting their dark shadows on the earth, which coursed each other majestically over the sunny tops of the hills and forests. At length, here and there a cloud rose above the Blue Ridge, and distilled a copious shower of rain, as it moved along the mountain from west to east, the exact limits of which we could easily define, the sun still shining on all the regions around. Each successive cloud diverged farther and father to the east, until a shower, accompanied by lightning and thunder, was approaching the Pilot, and forced us to descend from the pinnacle and take shelter under one of its shelving rocks. Here we had leisure to exchange our expressions of delight and admiration; and some of the party who had viewed scenery in populous and cultivated regions that was more beautiful, still acknowledged, that they had never witnessed any that contained more of the elements of the true sublime. Serenity was shortly restored to the sky, and we proceeded with our respective tasks. The following are some of the results ascertained by President Caldwell and Professor Andrews.

1. Height of the Pilot Mountain from a base line near Grassy creek to the top of the trees, - 1551 feet.

2. Elevation of the pinnacle on the north side at the place of ascent, - - - - 205 feet.
3. Elevation of the same on the south side, - 250 "
4. Highest perpendicular rock on the south side, 214 "

The height of the Pilot Mountain and of its rocky castle, as indicated by the foregoing measurements, appears so inconsiderable when compared with the summits of the Alps and the Andes, that one accustomed to scale those aerial heights, would perhaps smile at the representation we have given, of the lofty emotions inspired by the view from this comparatively humble eminence ; but he would neglect the consideration that the Pilot stands alone, and does not lose its majesty among surrounding heights—that the neighbouring country for forty of fifty miles around is, with a few exceptions, comparatively a plain—that those who ascend this mountain, have just emerged from a region over which, for a great extent, the prospects are obstructed, and even the horizon concealed, by boundless forests—and finally that the Pilot Mountain is a most favorable post of observation for viewing the Blue Ridge, in its sublimest attitude, presenting to the eye at once a varied but unbroken chain of lofty eminences, that stretch over nearly one hundred and eighty degrees of the horizon.

While my companions were employed in these observations, I had begun an examination of the geological structure of the pinnacle. A foot path running close to its base conducts one, without the least obstruction, quite round the circle, and no opportunity could be more favorable for remarking the different kinds of rocks and their relative position. In the geology of the pinnacle, there is something quite remarkable and curious ; and the geologist will linger around its base with as much delight and admiration, as he gazes upon the landscape from its summit. The pinnacle is made up chiefly of mica slate and quartz; but each exhibits peculiar and interesting characters. Its rocky wall is full of rents from top to bottom, and it is also regularly stratified, the strata dipping easterly at an angle of only ten degress. By these parallel seams, the whole is divided into tabular masses. The most abundant rock, is a peculiar kind of mica slate or *grit rock*, composed of very fine granular quartz with flesh-red mica intimately disseminated. The texture is exquisitely fine, and the cohesion so loose that it may be frequently crumbled between the fingers into the finest white sand.

At a mill near the river Ararat, I saw a pair of millstones, said to have been quarried from an eminence on the northwest side of the Pilot. They consisted of quartz rock, somewhat resembling French burrh, and appeared to be of an excellent quality. Grindstones also are quarried from the grit rock of these mountains.

After feasting for a week on the native luxuries of the Pilot, we next passed a few miles eastward to the Sawratown mountains, which we ascended at the highest point of elevation, called Moore's mountain. This eminence though higher than the Pilot, is less difficult and perilous in the ascent, but is still sufficiently laborious. The view which its summit presents, is similar to the other; and if the outline of the Blue Ridge loses a little of its grandeur by a small increase of distance, the loss is more than compensated by the Pilot itself, which stamps on the landscape a most beautiful feature. The scenery that adorns the sides of Moore's Mountain, is also of a highly interesting character. On the ascent we are conducted to a cascade, which, though small, is eminently pleasing to the eye, presenting suddenly to the visiter, in a chasm between perpendicular rocks, sixty five feet in height, a narrow sheet of silvery foam, falling first down a precipice thirty feet, and then rolling down an inclined plain with peculiar grace and beauty. This water-fall is so hidden among inaccessible rocks, as to be known to very few persons, and remained without a name. But our party, learning that Mr. Schweinitz, the distinguished botanist, had recently penetrated to this spot in pursuing his favorite objects among the mountains, and had expressed a high admiration of its romantic scenery, we agreed with one consent to designate it afterwards by the name of *Schweinitz Falls.*

On our return we visited the celebrated grotto called the *Tory House.* The access to it on all sides is precipitous and difficult. Hence it was selected during the Revolutionary war by a number of tories, forming a party of maurauders, who, like Scottish Highlanders of former times, sallied forth now and then upon the neighbouring low-lands, and plundered the inhabitants. In this secluded spot, we discovered an arched entrance, through which we passed, and found ourselves in a vaulted cavern of very regular structure fifteen feet high, fifty feet long and twenty feet wide in the center, but converging towards the farther end. The arch is throughout remarkably well turned; hardly a knob or angular point appears to impair the smoothness of the surface. The rocks consist of angular pieces of quartz, so wedged as to fit each other with great precision, and of white mecaceous rocks nicely pared by the hand of nature to the same level.

We returned from our excursions with a full conviction, that if the summit of the Sawratown mountains had inspired us with emotions less sublime than that of the Pilot, yet it was only because we had there taken our first view of the landscape.

For measuring the elevation of Moore's mountain, a good station is obtained on the Banks of Dan River, which flows at its base. From such an observation Messrs. Caldwell and Andrews ascertained the height of this mountain to be one thousand eight hundred and thirty three feet, and consequently two hundred and eighty two feet greater than the highest point of the Pilot.

From different persons who had attended us in our rambles over these mountains, we had heard frequent mention made of the *pinnacles of the Dan*—remarkable eminences, where the head waters of the Roanoke find their way through the Blue Ridge. Every one who had visited this spot, described its scenery in terms that made us impatient to see it; and, though it is within the limits of Virginia, and therefore aside from the route which we had prescribed to ourselves, yet our curiosity was too much awakened to permit us to rest, and we set off for this region of wonders. A day's ride from Moore's mountain brought us to the base of the Blue Ridge; and having provided ourselves with guides, we set off early in the morning for the pinnacles of the Dan, and reached the top of the ridge long before the sun, (which shone gloriously on the conical mountains that form an interesting series a little eastward of the main ridge,) had removed the vale of night from the profound vallies that lay at our feet. I cannot, without wandering too far from the principal objects of this Report, attempt a description of the feelings with which we traversed this region of the clouds, where "Great Nature dwells in awful solitude." The ridge is so well defined in some places, that we were at one time within a stone's throw of the waters that empty into the Mississippi on the one side, and of those that empty into the Atlantic on the other. Of the former are the head waters of New River, and of the latter are the remotest fountains of the Yadkin and the Roanoke. The pinnacles of the Dan are sharp conical peaks, rising twelve or fifteen hundred feet above the bed of Dan river, and converging so nearly to a point, that one standing on the vertex may almost reach round the mountain with his cane. There are several of these sharp peaks which together constitute the "pinnacles." The mica slate rocks at their base project their perpendicular strata (called by the inhabitants *saw teeth*) into the stream, first on one side then on the other, forcing it in a zigzag course down the declivity, and maintaining an obstinate and angry conflict with its waters.

In the primary region of North Carolina are several mineral springs, two of which are described in the Report. From an analysis of the Catawba Springs, Prof. O. concludes that their chief mineral ingredient is sulphate of lime, (eighty-eight grains in a gallon,) with eight grains to the gallon of sulphate of magnesia. The Rockingham Springs appear to be more strongly impregnated. Some slight experiments showed them to contain sulphur, carbonic acid, and several salts of lime.

In the county of Rockingham, Prof. O. found a wedge shaped patch of what he calls a transition formation, coming in from Virginia among the primary rocks. We should judge it to be a coal formation, as it contains sandstone, shale, and coal. It is remarkable also for lignites.

But a more singular substance, which had been mistaken by the inhabitants for coal, is found at Col. Winston's, two miles east of Germanton. It consists of the remains of trees, sometimes lying scattered loosely over the ground in small billets, and sometimes presenting to view entire trunks, obeying the general direction and inclination of the rocky strata, affording another example of a subterranean forest similar to that found on the River Neuse, and before described under the name of Lignite, (see page 98.) These fragments and trunks of fossil wood appear in the road for a distance of a mile and a half east of Germanton, reaching to the foot of the hill on which that town is built, that is, to the very extremity of the transition formation itself. The fragments that are scattered over the surface are frequently so much altered by exposure, that they resemble common petrified wood; but those specimens which are taken fresh from their bed, are invested with bark perfectly reduced to coal, and of a shining black color. The ligneous structure is less apparent in the mass. In a blacksmith's forge they burn with a yellowish flame, slightly tinged with green, emitting the odour of gunpowder, and finally melt into a yellowish black glass.

The best view of the lignite is in the bed of a small river, near a saw-mill, where entire and very perfect trunks of trees are seen between the open layers of a coarse fragmented rock very much resembling granite. These trunks lie parallel with each other, and appear between the rocks formed, as though by compression, into flattened cylinders or ellipsoids, the diameters of the elliptical bases or ends being respectively twenty four and nine inches. The ends of large trunks exhibiting the same oval shape frequently project out of the banks. Here the formation terminates on the south, resting against a hill of mica slate, the strata of which and the transition rocks, dip in opposite directions, resting against each other and forming a roof.

We wish now to ask the intelligent legislator, who may cast his eye over this analysis, whether such a developement of internal resources as this Report exhibits, does not amply remunerate the state of North Carolina for the comparatively trifling expense of this survey; and whether so great success, attending the efforts of an individual, who was obliged at the same time to execute the duties of an arduous professorship, does not strongly recommend that this example be followed by the other states of the union? It ought to be remembered, that no state was supposed to be more destitute of mineral riches than this; so that a distinguished mineralogist, a few years since, said to a traveller passing that way, that, "he would find nothing there of any interest." Yet now, what portion of the union exceeds, or even equals that state, in its mineralogy? And we believe that similar disclosures would, to a greater or less extent, attend every similar effort conducted judiciously and perseveringly.

In conclusion, we take the opportunity to express our gratification, that although Prof. Olmsted is now removed to another, though a kindred sphere of action, he does not forget, as the pages of this Journal testify, those branches of science which for years he was called to teach, and which he cultivated so assiduously and successfully.

Art. IV.—*On the Nature of the Bleaching and Disinfecting Compounds, denominated Chlorides of Soda, Lime, &c.*; by Lewis C. Beck, M. D. Professor of Chemistry, &c. in the Vermont Academy of Medicine.

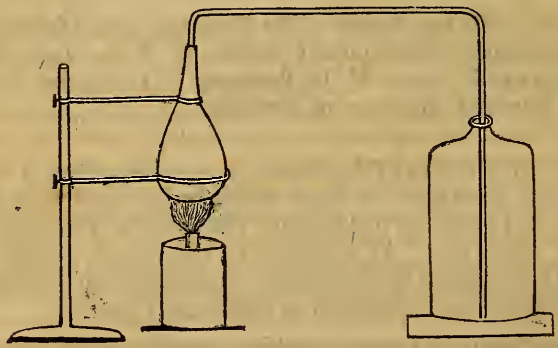
The chief design of the following communication is to enquire into the nature of those compounds which have been called, as I conceive improperly, *Chlorides* or *Chlorurets of Soda, Lime*, &c. As tributary to this object, I shall also notice the manner in which these compounds are obtained, and their mode of operation as disinfecting agents.

Preparation.—There is nothing peculiar in the preparation of the compounds under consideration. All that is necessary is to subject the hydrates or solutions of potassa, soda, lime, and indeed of any of the fixed alkalies or earths, to the action of a current of chlorine gas. If instead of these, we pass a stream of the gas through solutions of the carbonated alkalies, equally efficient compounds are produced;

and we shall hereafter see that other salts may also be employed for the same purpose.

The substance which has received the name of Labarraque's disinfecting liquid, is prepared according to his own formula, as follows: 2800 grains of crystalized carbonate of soda are dissolved in 1.28 pints of water; being put into a glass, two-thirds of the chlorine, evolved from a mixture of 967 grains of salt with 750 grains of oxide of manganese, when acted upon by 967 grains of oil of vitriol, previously diluted with 750 grains of water, are to be passed into it.*

This liquid may also be obtained in the manner proposed by M. Payen, which consists in the mutual decomposition of chloride of lime and carbonate of soda. But this method will seldom be employed, as all the valuable purposes of the article can be attained by the use of the compound of chlorine and lime alone. This is now so extensively employ- in the process of bleaching that there is little difficulty in obtaining it at any time. When it cannot be procured, however, solutions of lime or soda may be easily charged with chlorine gas, in the manner represented in the annexed cut.



Into the florence flask introduce manganese, common salt, and dilute sulphuric acid, in the proportions above mentioned;—taking care that it is not more than a third filled. The bottle may contain lime water, or solution of soda, or its

* I quote from Faraday's paper on Labarraque's liquid, in *Brande's Journal*, N. S. V. 2, p. 84; not having the original formula at hand.

carbonate; and should be kept at the temperature of 60° F. or below. Having now adjusted to the mouth of the flask, a bent tube, with one leg passing to the bottom of the vessel containing the solution, the heat of a lamp or of a few coals is to be applied to the flask. By this means chlorine is evolved and is absorbed by the solution. The heat should be continued till the evolution of chlorine has nearly ceased, which will generally be from fifteen to twenty minutes. The clear fluid is now to be decanted. It is the disinfecting liquor.

This disinfecting compound may, therefore, be obtained in either of the following ways: viz.

1. By dissolving in water the common bleaching powder, usually denominated chloride of lime.

2. By passing a stream of chlorine gas through solutions of lime, soda, &c.

3. By passing a stream of chlorine through a solution of carbonate of soda, or by adding chloride of lime to dissolved carbonate of soda.

Chemical constitution.—Upon this subject there has been, and still is, considerable dispute. I shall first advert briefly to some opinions which have been suggested, and then offer my own views.

M. Labarraque, to whom is due the discovery of the disinfecting nature of these compounds, does not appear to have understood their chemical composition, or the manner in which they act upon putrid matters. He, however, calls them chlorides or chlorurets of lime or soda (*chlorures d'oxide de calcium*, and *d'oxide de sodium.*) This name, though without much propriety, they have generally retained.

Dr. Granville, whose paper on this subject is published in a late number of Brande's Journal, gives it as his opinion that the solution of chloride of soda, so called, is a mixture of dry chloride of sodium and neutral chlorate of soda, with an excess of chlorine equal to twice the bulk of the water employed in preparing the liquid according to Labarraque's own formula. He infers that no such compound as chloride of soda exists in this liquid, and proposes for it the simple name of *disinfecting liquid of soda.*

In another part of his paper Dr. Granville undertakes to show that the singular properties of this liquid are owing solely to the chlorine, and in no way to the agency of the salts contained in it.

These views are controverted by Richard Phillips, who contends that admitting no such compound as chloride of soda exists, the explanation of Dr. Granville cannot apply in the case of chloride of lime. As a proof that the action of chloride of soda does not depend upon the mere gas which it holds in solution, he adduces the fact that it does not, even by ebullition lose its bleaching properties, and that it also retains its power, to a considerable extent, after evaporation to dryness. He also offers some other objections to the results of Dr. Granville's analysis, which it is not important to detail.*

Upon Dr. Granville's paper Mr. Faraday remarks—"Unfortunately Dr. Granville has mistaken M. Labarraque's direction, and by passing chlorine 'to complete saturation,' through the carbonate, instead of using the quantities directed, has failed in obtaining Labarraque's really curious and very important liquid; to which, in consequence, not one of his observations or experiments applies, although the latter are quite correct in themselves."†

Having mentioned these names it may be considered presumptuous in me to interfere in the controversy. But it is proper to remark, that the views I am about to offer were formed long before I was aware that the subject was undergoing discussion abroad, and were matured without particular reference to it. I claim attention to them only so far as they are supported by facts and experiments.

To arrive at correct conclusions concerning the nature of the substances under investigation, it is necessary that we should accurately examine all the circumstances which attend their formation, and the conditions which appear to be essential for this purpose.

The first point deserving of attention is, that chlorine will not combine with the oxides of the alkaline or earthy metals when *perfectly dry*. In the case of lime this has been abundantly proved by Dr. Ure. He states that he exposed dry lime in fine powder to a copious stream of chlorine for four days, but that even at the end of that time the powder had not sensibly increased in weight.‡ The same may be said of the oxides of the other above named metals: I believe it is

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* Philosophical Magazine and Annals, vol. 1, pp. 377, 378.
† Brande's Journal, New Series, vol. 2, p. 92.
‡ Chemical Dictionary, 2d edition.

an established law, that they are not susceptible of combination with chlorine at ordinary temperatures, when both are completely deprived of water. When these oxides are exposed to a high heat, chlorine effects their decomposition; —oxygen being disengaged, the chlorine combines with their metallic bases. But these compounds of chlorine and the metals do not possess any bleaching or disinfecting powers.

If instead of employing the dry oxides of sodium, calcium, &c. we take the hydrates of these oxides, or their solutions, and pass through these a stream of chlorine gas, their weight will in every case be increased, and we shall obtain compounds possessed of bleaching and disinfecting properties.

To what then shall we ascribe the difference in the results obtained? The presence of water is the only circumstance in which the cases are not parallel, and we must therefore look to this as influencing, in a great measure, the formation of these compounds.

Another fact worthy of notice, is, that chlorine, when perfectly dry, exerts no action upon vegetable colors, and probably not upon putrid substances, though I am not aware that the latter has been settled by experiment. But water at low temperatures, dissolves or absorbs chlorine in considerable quantity, and this solution has the property of discharging vegetable colors, and was indeed for a long time employed exclusively in the process of bleaching. This solution, if kept in well stopped bottles, will retain its powers for a great length of time; but if it is exposed to the air, or if its temperature is raised, chlorine is evolved and with it all the bleaching powers of the solution are lost.

Having premised these remarks, I shall first notice the combination of chlorine with solution of soda.

When a stream of chlorine gas is passed through a solution of soda, after the manner directed by M. Labarraque, the chlorine is absorbed, and as it is said, a chloride of soda is formed. But if additional quantities of chlorine are transmitted through the solution after variable periods of time, decompositions take place and new definite compounds are produced, which are permanent and can be obtained in a separate state by subsequent analysis. These changes consist in the decomposition of water, the formation of chloric and muriatic acids, and the combination of these with the soda, forming the chlorate and the muriate of that alkali. In whatever manner these changes are effected, the correctness of the results is sufficiently proved in the ordinary process of obtaining chlorate of soda.

If then chlorate and muriate of soda (when dry, chloride of sodium) result from the long continued action of a stream of chlorine in a solution of soda, the chloride of soda, if it existed at all, must have existed previous to the formation of these acids and their action upon the soda. But as we shall hereafter see, there is, previous to these decompositions, nothing in the compound which could not have been obtained by passing chlorine through water without the addition of soda; much less is there any evidence of a combination, in definite proportions between the chlorine and soda.

If now instead of the solution of soda we employ the carbonate of that alkali, nearly the same phenomena will be presented upon the introduction of chlorine. Following the formula of Labarraque, we shall obtain his disinfecting liquid, and that as Mr. R. Philips and Mr. Faraday have asserted, without the evolution of a particle of carbonic acid. If this is the fact, and the authority of these chemists is perhaps conclusive upon a matter so easy of proof, it follows that the carbonate of soda remains *entire* in the solution.

But when this process is long continued, decompositions take place, similar to those which have been previously mentioned. Chloric and muriatic acids are formed, and these combine with the soda, and as a necessary consequence carbonic acid is disengaged.

Desirous of ascertaining whether there was any thing peculiar in the solution of soda and the carbonate, I prepared a saturated solution of sulphate of soda, in water at 50° F. and passed through it from two to three volumes of chlorine. The solution assumed a yellowish color, and bleached indigo and turmeric powerfully. The same results were produced when I charged in like manner a solution of alum. In efficiency, so far as bleaching is concerned, I could discover no difference in the two last compounds and a like solution of carbonate of soda and chlorine.

Let us now pause for a moment, and bring into a narrow compass the facts which have been stated. It has been shown that these bleaching liquids may be formed:

1st By passing chlorine into a solution of soda.

2d. By passing chlorine into a solution of carbonate of soda.

3d. By passing chlorine into a solution of sulphate of soda; and that too in the case of the carbonate without the disengagement of a particle of carbonic acid, and in that of the sulphate without the separation of a drop of sulphuric acid. Now as these substances remain *entire* in the solution, if the properties of bleaching and disinfecting which appear to characterize the compounds under review, depend upon definite or chemical combinations of chlorine with the substances held in solution,—each of the above must be distinct chemical combinations, though possessing similar properties;—and it is probable that a new chemical compound would be formed every time chlorine is transmitted, through a different saline solution, and that too without having effected the least decomposition. This absurdity may be avoided by referring these properties to a cause which exists in each, and which is adequate to the explanation of all the phenomena, viz.—the absorption of chlorine by the water in each of these solutions.

I am now prepared to notice some seeming objections to this view of the subject.

It is asserted by Mr. Phillips that the chloride of soda, as he terms it, retains its bleaching property to a considerable extent after evaporation to dryness. But this does not form an objection to the view which I have taken, unless he means to apply the term *dryness* in an absolute sense. This, however, cannot be the meaning of the author, for I am satisfied that a temperature sufficiently elevated to drive off all the water, will at the same time expel the whole of the chlorine; except, indeed, so much as is contained in the stable compounds, chloride of sodium and chlorate of soda. This total discharge of chlorine, as we shall hereafter show, is effected by mere exposure to the air, or more speedily, by the agency of a stream of carbonic acid, and it would be strange if the application of heat necessary to drive off all the water should not produce the same effect. Yet we should not be surprised , if the evaporation was carefully conducted, that the residuum, when *apparently dry*, should still retain a small quantity of water, and that this last, holding in solution a portion of chlorine, should exert feeble bleaching and disinfecting powers.

It is stated by Mr. Faraday, that a portion of Labarraque's liquor, prepared by passing chlorine through solution of carbonate of soda, being boiled, gave out no chlorine ; " it seemed but little changed by the operation, having the same peculiar taste, and nearly the same bleaching power as before." From this he infers, that the chlorine is not in the ordinary state of solution, either in water or in a saline fluid; "for ebullition will freely carry off the chlorine under the latter circumstances."*

Two circumstances are worthy of notice in this experiment, viz. 1st. that no chlorine was given off during ebullition;—and 2d. that after the operation the solution retained bleaching powers.

The first of these may be accounted for by a fact stated in a subsequent part of Mr. Faraday's paper, which is, that by boiling this liquid a part of the chlorine acts upon the alkali, to form chloride and chlorate. We should therefore expect the disengagement of carbonic acid rather than of chlorine; but the evolution of chlorine or carbonic acid, or both, depends upon the time the boiling is continued.†

To ascertain whether the second was peculiar to Labarraque's liquid, I took portions of the solutions of sulphate of soda and sub sulphate of alumine and potash, charged with chlorine as before mentioned, and subjected them to heat in glass vessels. After having been heated for five, and boiled for three minutes, portions were taken out and tested with indigo, and they were found still to bleach, although not so powerfully as before. Even after five minutes rapid boiling, they still had an effect upon the above test.—In each of these cases, however, chlorine was given off during the ebullition; a fact arising as I conceive, not from any difference in the *state* of the chlorine, but in the nature of the salts held in solution.

I am not prepared at present to offer a satisfactory explanation of these phenomena; but it would appear from these and other experiments of a similar nature, that *any* saline substance held in solution by water, either by increasing its density or otherwise, tends to prevent or retard the escape of chlorine in a gaseous state. For it is freely admitted that ebullition will completely disengage the chlorine held in solution by pure water. It would be an interesting subject of

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* Faraday's paper as before referred to.

† When this liquid is boiled for a length of time, I am satisfied that chlorine is given off and that it loses much of its bleaching power, although it may be boiled so as not to evolve chlorine.

research to determine whether other gaseous bodies are similarly affected in such solutions.

Before leaving this part of the subject I shall notice one other peculiarity in which the mere watery solution of chlorine resembles those of the salts, which have been the subject of experiment.

It was ascertained by Mr. Faraday, that when a portion of Labarraque's liquor was evaporated by exposure to air, crystals were formed resembling those of carbonate of soda, but which did not possess the slightest bleaching power.

Upon exposing to air, a solution of sulphate of soda charged with chlorine, for three days, the bottom of the vessel was covered with crystals resembling this salt. But when these crystals were dried between folds of thin paper and rubbed down in water to near saturation, they had not the least effect upon indigo or turmeric.

A pint of rain water was charged with chlorine until it bleached powerfully. Equal quantities of this watery solution were put into two porcelain vessels of equal size; the one exposed to a temperature of about 25° F. the other to a temperature of between 40° and 45°. At the end of fourteen hours a crust of ice, half an inch in thickness, was formed on the surface of the former; this was carefully detached and dried as much as possible, by filtering paper at a low temperature. It had a faint smell of chlorine, but when dissolved in water at 45° it exhibited no bleaching powers, while the unfrozen water of this same vessel appeared to have lost none of its efficiency upon indigo or turmeric, nor had the solution from the other vessels, exposed at 45°, at all deteriorated. Portions of these different solutions were now added to equal portions of solution of indigo, with papers of turmeric, and set aside for two days, taking care to preserve an uniformity of temperature throughout the whole progress of the experiment. At the expiration of this time, the dissolved ice had not in the least degree changed the color of the indigo, but the turmeric paper was slightly reddened;—the other solutions were perfectly colorless.

These experiments, as I conceive, warrant the conclusion, that the process of free and perfect crystalization destroys the bleaching powers of these substances, by the expulsion of chlorine. Is it probable that any definite compound of chlorine would be destroyed by this cause?

Passing now to the supposed chemical compound of chlorine and lime, it will be found that the explanations above given, and the arguments employed, will also apply.

It has been stated that dry lime in fine powder, though exposed to a copious stream of chlorine for several days, does not sensibly increase in weight. It may now be added, that when chlorine gas is transmitted through the proto-hydrate of lime, there is an increase of weight in the proportion of fifty to sixty per cent. It is, however, important to remark, that this increase is by no means definite, but varies according to circumstances, depending chiefly upon the skill of the manufacturer.

The proto-hydrate of lime is supposed to be composed of one proportional of pure lime, and one proportional of water. This, when exposed to an atmosphere of chlorine, is converted, according to Welter, into a sub chloride, which, according to him, is composed of

2 proportionals of lime,
2 " of water,
1 " of chlorine.

The same chemist asserts, that when the above is mixed with water, it is immediately decomposed; one half of the lime is precipitated, and the other half remains in solution, combined with the whole of the chlorine, and consequently forming a neutral chloride. The sub chloride is obtained by saturating hydrate of lime with chlorine, and the neutral chloride by dissolving the sub chloride in water, or by saturating lime dispersed through water, with chlorine.

The experiments of Dr. Ure are at variance with these ideas. He found that the solid residuum of a portion of the powder, (sub chloride of lime) left on the filter after two successive solutions, contained a notable quantity of chlorine, from which he infers, that the chloride is but sparingly soluble in water. And he remarks that he could never observe that partition occasioned by water in the elements of the powder of which Mr. Dalton, and M. Welter speak.*

It appears, therefore, that no certain evidence exists, that there is, in the above case, a definite compound of chlorine and lime. All the phenomena presented by this powder can

* Chemical Dictionary, 2d edition. The existence of the sub chloride of lime is also disputed by M. Houton Labillardiere. *See Thenard, 5th ed. vol. 2, p.* 474.

be explained, and all the differences among chemists reconciled, by the adoption of the principles heretofore advanced.

The water contained in the hydrate of lime is essential to the absorption of chlorine, and we have just seen that the amount of chlorine absorbed depends upon the amount of water. Thus, when the pure proto-hydrate is employed, no more chlorine is absorbed, than would have been taken up by the same amount of water, without the lime. Hence we can account for that apparent partition of the elements of the powder when more water is added ; and hence also the reason why the powder, thus prepared, should have been considered as a sub chloride. But when to the proto-hydrate we supply an additional quantity of water, more chlorine is absorbed, for the very reason that more water is present; and the residuum obtained in this case, when apparently dry, contains a larger quantity of chlorine than in the former case, when in fact it contains also a larger quantity of water.

The fact stated by Dr. Ure, that the combination of chlorine with the hydrate of lime follows no atomic proportion, and the well known fact that different commercial samples of the bleaching powder contain variable proportions of chlorine, accord with the remarks just made. For with equal care, the quantity of chlorine and consequently the efficiency of the compound depends upon the quantity of water, either combined or in contact with the lime.

Thus it is evident, that there is a strict analogy in the phenomena presented by the three supposed distinct compounds which I have examined. In each, water is essential to the absorption of chlorine ; in each, the amount of chlorine depends upon the quantity of water ; and in each, by exposure to air or to heat, the chlorine is evolved or gives rise to two new acid compounds, which are definite and combine with the bases forming muriates and chlorates. They are alike possessed of the properties of bleaching and disinfecting,—properties which are peculiar, and which belong also to a simple solution of chlorine in water. Now it is conceived more rational to refer these properties, in every case, to the same cause, provided this cause is constantly present, than to suppose that they belong to several distinct chemical compounds, as of chlorine and soda, chlorine and the carbonate of soda, chlorine and lime, &c. ; and particularly so when with a single exception, (the oxide of chlorine,) the known and acknowledged definite compounds of chlorine do not possess these peculiarities.

We are therefore forced to the conclusion,

1*st*, That there are no definite compounds of chlorine and soda, or of chlorine and lime. Analogy would lead us to extend this to all the metallic oxides; and we might hazard the general assertion that chlorine is not susceptible of combination, in definite proportions, with the metallic oxides, at any temperature, or under any circumstances. For it should be recollected that in consequence of the superior attraction of chlorine for the metals, whenever the oxides are highly heated in contact with it, oxygen is evolved, and a chloride of the metal is formed.

2*d*, That the bleaching and disinfecting powers of the supposed chlorides of soda, lime, &c., depend upon the chlorine held in solution by the water which exists in the hydrated oxides, or in which these oxides are dissolved or suspended; and that the same explanation will apply to the various saline solutions which exhibit these powers.

Mode of operation.—The first correct views upon this subject were suggested by Gay Lussac in his memoir on chlorimetry, who states that a solution of the bleaching powder, abandoned to the air is gradually decomposed; a portion of the lime combines with the carbonic acid contained in the atmosphere, and the chlorine is at the same time disengaged. He also shows, that this decomposition is retarded by keeping constantly an excess of lime in the solution. These views have been fully confirmed by the experiments of Gaultier de Claubry, which may indeed be considered conclusive on this point.

A solution of well saturated chloride of lime was submitted to the action of carbonic acid gas. After a few moments, there was a disengagement of chlorine, and by continuing the operation for a sufficient time, the whole of this gas was expelled. The liquid no longer exerted any action on colors, not even on infusion of litmus. Carbonate of lime was precipitated, which was afterwards redissolved in the excess of carbonic acid.

Air passed through a solution of potassa, rendered caustic by lime, produced no action on the solution of chloride of lime. But when the latter solution was abandoned to the air for some time, it lost its power of acting on vegetable colors, and a precipitate of lime was produced.

The following experiments were performed by M. de Claubry, to ascertain still more directly what takes place during the action of a compound of chlorine on air impregnated with putrid miasmata.

"Air blown through blood which had been left for eight days to putrefaction, and which disengaged an insupportable odor, was afterwards made to pass through a solution of chloride of lime; carbonate of lime was formed, and the air came out without smell, and completely purified by the chlorine.

"The same operation was again commenced, by making the air pass through a solution of caustic potassa, before sending it through the chloride; the air came out with a very fetid odor.

"Air was left for twenty-four hours in contact with some of the blood used in the preceding experiment. A portion having been put in contact with some chloride, the disinfection was complete in a few moments, and carbonate of lime was formed. The other part of the air was treated by caustic potash, and afterwards by chlorine; but it retained an insupportable odor."*

From these decisive experiments, it appears, that the carbonic acid given out by the putrid substance effects the evolution of chlorine; which last combines with the constituents of the miasmata, and neutralizes them in some hitherto unknown manner.†

An attentive examination of the manner in which carbonic acid causes the evolution of chlorine will perhaps throw additional light upon the chemical history of these disinfecting compounds.

It has just been stated that a solution of the supposed chloride of lime, when abandoned to the air, loses its chlorine, and there is produced a precipitate of carbonate of lime. This process, however, requires nearly two months exposure. But the same thing also takes place when we expose two separate vessels to the air, in one of which is lime water, and in the other a simple solution of chlorine. At the end of several days, the chlorine of the latter will be completely disengaged, and the lime of the former is converted into a

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* *Ann. de Chimie, Vol.* 33.

† It is difficult to reconcile with this view of the subject, the fact stated by Mr. Faraday, in the volume of Brande's Journal to which I have referred, viz: That when carbonic acid was passed through Labarraque's liquor of soda, equal to nearly 1300 times the volume of the fluid, very little chlorine was removed, and the bleaching powers of the fluid were but little diminished, though it no longer appeared alkaline to turmeric paper;—unless we adopt the opinion suggested at the close of this essay.

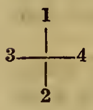
carbonate. Again a stream of carbonic acid passed through a solution of the chloride, effects a decomposition in a few hours, or at least, to so great an extent, that it no longer acts on vegetable colors or putrid substances—and at the same time carbonate of lime is formed. Now the conversion of lime into carbonate, by the contact of carbonic acid is not remarkable, and the evolution of chlorine is not to be regarded as an evidence of the decomposition of a compound of chlorine and lime or soda.

For the purpose of settling the latter assertion by experiment, I charged some rain water with chlorine until it bleached powerfully. On passing through it a stream of carbonic acid, or simply blowing into it through a glass tube for half an hour, the chlorine was so far discharged as to leave the solution without action upon indigo or turmeric. This result, I ascribe to the mechanical effect which the passage of a gaseous substance has, in bringing successive portions of the solution into contact with the air, and thus facilitating the evolution of chlorine.

Now when carbonic acid is passed through a solution of the supposed chloride of lime, it combines with the lime and is precipitated in the form of carbonate. There remains then, a simple solution of chlorine in water from which chlorine is disengaged by the carbonic acid as before stated. But when this gas is transmitted through a solution of soda, carbonate of soda is formed which is soluble, and the chlorine is then more difficultly disengaged for the reasons which have been suggested, when noticing the difference in the effect of ebullition upon simple solutions of chlorine in water, and upon various saline solutions charged with chlorine. In this way we can also account for the inefficiency of carbonic acid in removing the chlorine from Labarraque's liquid, as stated by Mr. Faraday. Further experiments seem still necessary to decide whether the disengagement of chlorine from lime, soda and carbonate of soda in solution, during the process of disinfection, is produced in each, in the same manner.

Art. V.—*Notice of a peculiarity in Vision; by* Chauncey E. Goodrich.

From my early years I have been sensible of a want of precision of eye sight. My eyes too, for the first eighteen years of my life, were occasionally weak and sore; but habitual study has strengthened them so that now they seldom fail. In my course of study in natural philosophy at college, I was particularly attentive to *optics*, yet I discovered no clue to the difficulties under which my vision labored. Having clearly ascertained that I was in *some* sense *short sighted*, I hoped to find a remedy in the use of common concave spectacles, but after repeated examinations of various assortments of glasses, I became much discouraged. Two years since, however, while in the city of New York, I purchased a pair of concave glasses, of No. 5, not because they suited me, but because I wished to try their influence on my sight. My first attempt at using them was in viewing some shipping in the harbor, when I was greatly surprised to find that all the *horizontal* portions of their rigging were seen with much greater, and the *vertical* portions with much less precision than when viewed with the naked eye. This new and curious fact suggested the propriety of pretty extended experiments on my sight, both with and without glasses. And first, with the naked eye—I then found that any *vertical* line as 1—2, (see the diagram below,) was seen with much much greater precision than any *horizontal* one 3—4, and that to see 3—4 with the same



precision with which I had seen 1—2, it was necessary to turn my head aside a full right angle,* and that too, at the expense of losing the clear view of 1—2, and I also found that in viewing the circumference of any circle, as

the portions that approach nearest to a *vertical* line, as 1—3 and 2—4, were seen with more precision and at a greater distance than the portions 1—2 and 3—4 which approach nearest to a *horizontal* line.

In strict accordance with the principles thus far developed, I found, that squares were seen in the form of parallelograms, circles in the form of ellipses, and spheres in the form of spheroids. I found too, that in viewing the human countenance, the eyes, mouth and chin, were seen less distinctly than the nose.

In the next place I tried the same experiments in the use of my glasses, and found an exact and reciprocal change of each of the above mentioned laws of my vision, that is, *horizontal*

* With the head turned aside at an angle of 45°, the lines 1—2 and 3—4 were seen with equal plainness, and in a degree intermediate between the upright view of the two lines.

lines and objects were now seen with about the same degree of definiteness with which *vertical* ones had been before, whilst *vertical* objects were seen with the same indistinctness with which *horizontal* ones had been before; circles were still, of course, seen as ellipses, but the transverse axis, instead of being perpendicular to the horizon as before, now became horizontal. The eyes and mouth of the distant speaker now became much more interesting objects of sight than before.

Let it be distinctly understood, that my sight has never been so short, or I might say rather so indistinct, as that of many persons. It is also worthy of remark, that whilst in common cases of short sightedness, the individual can see very well, provided the object be placed at *his* proper seeing distance, *I* had *no* seeing distance, but was perpetually mistaking objects at all distances within the compass of my vision; that both eyes are affected with the same difficulty, yet that the right one is both stronger and more discriminating than the left; and that neither the vertical object, seen with the naked eye, nor the horizontal one, seen through the glasses, are seen at more than about half the distance that they are by many good eyes.

Now on the supposition that, in the economy of vision, the refraction of light is achieved *principally* by the crystalline lens of the eye, I think the following conclusions plainly deducible.

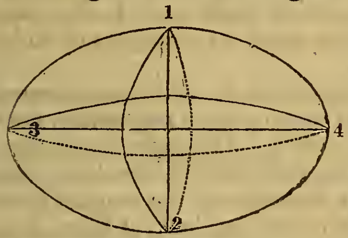
1. That the crystalline lens of my eye, instead of being formed of sections of a sphere, is really formed of sections of a spheroid.

2. That the transverse axis of this spheroid runs in a horizontal direction.

3. That the horizontal curvature of this lens is just of that degree adapted to produce tolerably correct vision, whilst the vertical curvature is too small, that is, a portion of too small a circle to produce the same effect.

Things being so, I am readily able to account for the two opposite effects of my concave spectacles. 1st, the interposition of a diffusing glass, (such as they are,) by diminishing the refraction, indisposes the rays of light coming in a horizontal plane, for correct vision. 2d, the interposition of the same glass exactly disposes the rays coming in a vertical plane to produce correct vision, because the vertical curvity is so small as to refract these rays in too great a degree.

In reasoning from facts, thus far, I find no difficulty. The next object is to interpose a glass of such a construction as shall refract the rays in the vertical plain alone, that is, counteract the too great vertical convexity of the lens of my eye. To accomplish this, accurately, is no small difficulty. Let 3, 1, 4, 2, be the crystalline lens, of which the straight line 1—2 is a vertical section, and the curve 1—2 the vertical curve, and let the straight line 3—4 be a horizontal section, and the curve line 3—4 be the horizontal curve. Now the points where the greatest refraction is needed are 1 and 2, whence the refractive energy ought to decrease gradually until it should actually disappear at the points 3 and 4, where nature refracts correctly. (I, of course, speak here rather of a diminution than an increase of refraction at the points 1 and 2.) To accomplish this, I conceive that I need a diffusing glass composed of sections of a spheroid, whose transverse axis is many times greater than its conjugate, but I know not that such a glass could be ground very readily. I have therefore been contented to procure plano cylindrically concave glasses, whose single curve is about equal to No. 5 of common spectacles. These spectacles I caused to be *made* in Philadelphia a few months since.



The assistance which they render my eyes is considerable, enabling me to read (Greek more especially than English on account of its more numerous horizontal strokes,) at a distance of three or four inches beyond the power of the naked eye.

Their power on my eye, in viewing objects near at hand, is a little too great, as they shorten the vertical dimensions of objects a little beyond their true proportion. Rectangular objects near at hand, unless one of their linear dimensions correspond with the greatest linear dimensions of my own body, that is, ordinarily with a vertical plane, are liable to be slightly disturbed. These difficulties would doubtless be, in a great degree, remedied, could I procure the spheroidal glasses mentioned above.

Note.—If such glasses as are mentioned above, can possibly be ground, I should be happy to be informed where, and by whom. C. E. G.

Princeton Theol. Seminary, Feb. 29, 1828.

Art. VI.—*Observations on Surveying Instruments, and the means of remedying their imperfections; by* Lucius Lyon, Surveyor and Civil Engineer—(*with a print.*)

Detroit, Michigan Territory, Jan. 26th, 1828.

Magnetism is the well known name of a mysterious power, manifested only by its effects, and of whose ultimate cause we are ignorant.

Among its effects, none is more important, than that which results from the application of one of its familiar properties, to the art of surveying.

By no other means at present known, can lines be run, new lands be laid off, estates subdivided, their boundaries defined, and the local position of places ascertained, with so much facility as by the magnetic needle. To perform the same services, in any other way, with any tolerable degree of accuracy, would be an interminable labor.

But, although the magnetic needle affords great facilities for the practice of surveying, and in most cases is the only means which it is practicable to employ; it ought not to be relied on as entirely correct.

It is subject to many irregularities, to which our present limited knowledge of the laws which govern magnetism does not enable us to apply corrections. Although more than three hundred years have elapsed, since Columbus, with astonishment, discovered the variation of the magnet from the poles of the earth; little or nothing has yet been done toward finding out its cause, or satisfactorily explaining the reasons for the different variation at different places, or the change of variation, at the same place.

Great improvement has, however, been made, in the application of the magnet to practical purposes, in the manufacture of magnetic needles, and in fitting them to the instruments with which they are used; as well as in perfecting the form, and increasing the accuracy and convenience, of those instruments. In this respect we seem to have improved more than other nations, in proportion to the unsettled state of the boundaries of extensive tracts of our lands, the newness of much of our country, and the consequent necessity for using surveying instruments. Of the truth of this remark, any person who is a competent judge, and who will take the trouble to compare American with English compasses, will be convinced. For although the latter generally show a high finish, and nice graduations; I have never seen one that had a convenient disposition of its parts. And they often present the inconsistency, of a nonius, by which the divisions may be read off to every minute, while the needle is so clumsy that the course cannot be determined, nearer than to half a degree.

The inaccuracy of surveys has, (as Mr. Gummere very justly observes,) been a more fruitful source of litigation in the United States, than all other causes put together. Hence arises the necessity that every person who practices surveying should be provided with good instruments, that error may be avoided as much as possible, and without such instruments it is in vain to expect any tolerable degree of accuracy. Hence also, our government, which has already surveyed about one hundred and forty millions of acres, and has more than one hundred and thirty millions yet to survey, with a view of the importance of the subject, and with a design to promote accuracy, directs, that no compasses be used in its surveys, but such as have Rittenhouse's improvements.

In the course of surveying more than three thousand miles, for the United States, and in using compasses manufactured by several of our best artists, although excellent of their kind, I have frequently experienced considerable inconvenience in passing over hilly ground, from not being able to elevate or depress, as the case might require, the forward end of the instrument. The theodolite is represented by writers on the subject, to be the perfection of instruments for this kind of business, but however well it may be adapted to surveying in an open country; it is altogether too unwieldy for use in the woods. Considering that an instrument combining the advantages of the theodolite in a portable form, would be a desideratum, I had what I conceived to be such a one made, to order, by Mr. Benj. Platt, a very ingenious artist of Columbus, Ohio—far a representation of which, see Fig. 1.*

Explanation of the Figure, and description of the instrument.

Fig. 1 represents a view of the "improved elevating compass," from a point somewhat lower than the compass box,

* Mr. Platt has for some time made compasses on a similar construction, and their superiority is bringing them into general use in the western country. He calls it the patent elevating compass.

as standing upright on its staff, with its forward end, or end farthest from the observer, elevated at an angle of about forty-five degrees.

A, a hollow plate, covering the whole bottom of the compass box, and about four tenths of an inch in thickness on the outer edge, a part of which plate projects and forms axles at D and *d*.

B and C, two bars about four tenths of an inch thick, encircling the compass box and attached by screws to the joints D, *d*, and turning on the aforesaid axles.

E, a plate, the upper part of which forms the card, or face of the compass, to which is attached the graduated ring. This plate, provided with a nonius represented at O, and with two spirit levels in the face of the compass, is turned at pleasure by the trundle P, and made fast by the screw T. The nonius should always be made to turn off, at least fifteen degrees. Compasses are usually faulty in this respect.

G, a semicircle, graduated to degrees, and attached to a projection of the circular bars.

H, an index with a nonius, by which the divisions on the semicircle may be read off for every five minutes, attached by a screw, to the end of the axle at D, and made fast to the semicircular arch, when necessary, by the thumb screw at *e*.

K, a *trigonometer* attached by screws to the circular bar, but which may be conveniently carried in the pocket. It has an index or hand with a fiducial edge, so divided as to correspond with the size of the divisions on the plate. One end of this index turns around a centre at *g*, and the other comes over the edge of the plate, (which forms an arc of a circle, and is graduated up to 45°, thence backward to 90°,) the index being the hypothenuse, and the divisions on the plate, the legs, of a right angled triangle.

L, ball and stem. Around the stem of the ball is a small circular plate in contact with the screws *a*, *b*, *c*, which pass through the top of the socket, and by which the compass may be nicely adjusted to a level, when great accuracy is required.

M, a screw to regulate the ball, and N, another to fasten the socket to the staff.

P, screw, which by means of a spiral spring, raises the needle off the centre-pin.

S, a screw acting against the spring, *i*, by which the compass may be made fast to the stem of the ball. This part of the compass which fits on to the stem, runs up through the plates, and has attached to it in the face of the compass, an index with a nonius, (see fig. 2.) If the screw at R, which fastens the compass to the part just described, be loosed, and the screw S made tight; the compass may be turned around at pleasure, while the index remains stationary—and thus any contained angle may be measured, without reference to the needle, with great facility.

T and V, are sight-vanes, with eye-holes and cross-hairs for levelling. They need be but short, as they can be elevated or depressed to the direction of the object at pleasure.

Fig. 2 shows an oblique view of the face of the compass, with the needle, index, and levels, and also shows the manner in which the parts of the joints are put together.

This instrument, after a fair trial in surveying upwards of five hundred miles, has fully answered my expectations. By the addition of a telescope, which may easily be made to the sight-vanes, it will unite all the excellencies of the theodolite, and have the advantage, that it may be divested of its appendages for measuring vertical angles, and rendered as portable as a common circumferentor. The *trigonometer* which is attached to it, may be carried in the pocket, and if well made, will entirely supersede the necessity of carrying a traverse-table; as on it, the latitude and departure for any course, and any ordinary distance may be seen at a glance. The surveyor will find it a very convenient and expeditious method of measuring the distance across streams, &c.—particularly if the weather be wet and he cannot use tables.

The experience that I have had with needles of different forms, seems to confirm the truth of Professor Eaton's remark, (Am. Jour. of Science, vol. XII, page 16,) namely, that "the flat kinds are the best, which are wide in the middle, and of a true taper to the points." I have been so well convinced of this, that for several years I have used no other. They should be nicely pointed, the south part blued by a gentle heat, and the north part well polished. No letters, as is usually seen in the face of compasses, to denote the cardinal points, ought ever to be placed on the card. They answer a good purpose on the mariner's compass, where the position of the card is always the same with respect to the cardinal points; but on the surveyors compass, they will be very likely to mislead those who pay any attention to them. A simple *fleur de lis* on the north part of the needle, is all that is necessary.

With a view to the improvement of instruments, and to obviate, if possible, some of the difficulties and embarrassments which the practising surveyor has to encounter, I will venture to add to the observations already made, a few

Remarks on the errors of the Compass.

Those in the use of ordinary instruments, will be many, such as may arise from imperfect graduations, &c.; but I shall mention only a few of those which are common to all, or at least the greater part.

Most of the compasses that I have seen, have steel centre-pins passing through the card, and extending from an inch, to an inch and a half below, and frequently of the size of a common crow's quill.

Should this pin by any means get magnetized, and acquire polarity, as it will be very likely to do, by standing in a vertical position; it is obvious, that in many cases, it might exert a sensible influence upon the needle. The larger part of the centre-pin which passes through the plate, should be of brass or copper, and into this the small steel pivot, on which the needle librates, should be firmly screwed.

Much uncertainty and difficulty in the practice of surveying, particularly in tracing old lines, arises from the constant changing of the declination of the needle.

This difficulty might be obviated in relation to future surveys, by carefully observing, once or twice every year, the exact variation of the magnetic, from the true meridian; and by establishing a true meridian line for the adjustment of different instruments.*

Such observations being made and registers of them kept, at as many places as might be necessary, we should thence, knowing the dates of the different surveys thereafter made, have the means of determining the precise bearing of a given line at any time when it might be convenient, whether the survey had been made by the magnetic, or by the true meridian. Such observations besides a practical, would have a

* Mr. Gummere, author of an excellent treatise on the theory of surveying, I think proposes something similar. See his discourse on land surveying.

scientific value, and may be made at any place in a variety of ways, with far less trouble than their importance might demand.*

In October, 1822, in company with I. Mullett, Esq., surveyor general of Michigan, I made several observations, to determine the precise variation of the needle at Detroit, and the mean of the different observations was 3° 13' 22" declination eastwardly. I have, during the present month, repeated the observations in company with the same gentleman, and find 2° 50' variation eastwardly; thus showing a traverse of the magnetic meridian to the westward of 23′ 22″ in little more than five years, or about $4'\frac{4}{10}$ per year. On the Island of Michilimackinac in July last, I found the variation eastwardly to be 2° 59′. In the winter of 1825–6, on the Grand River of Lake Michigan, in the western part of the peninsula, I observed the variation every clear night, for several months, and every night in a different place, extending over a tract of country about seventy miles long by twenty-four broad. The results were various, from 3° 45′ E., to 6° E., varying sometimes 50′ in a distance of six miles; and that without any apparent cause, as the country is entirely alluvial, and scarely a trace of iron can be found. The declination, however, generally appeared to increase in going westwardly.

Practising surveyors, in all parts of the United States, whether amongst the primitive mountains, or on the alluvial plains, often complain of the errors and perplexities arising from the aberrations of the needle, and suppose the cause, which they call local attraction, to exist in the earth.

In hilly countries, where ores abound, it is reasonable to suppose that they may exert an influence upon the needle, and sometimes cause it to vary from its general direction, but on extensive alluvial plains, where there is no trace of ores of any kind, its aberrations are, on this supposition, inexplicable; and I am well convinced that in most cases they depend entirely on another cause, which I do not recollect to have seen mentioned by any writer on the subject, namely, the developement of electricity or magnetism, or both, in some part of the glass of the compass, by its friction against the clothes of the person carrying the instrument.

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* Mr. Mullett keeps a register of the daily variation at Detroit.

The common method of carrying the compass for convenience and for the protection of the glass, particularly in the woods, is to throw it over the left arm, with its face towards the body, holding one sight-vane in the hand, while the other lies across the arm above the elbow.

In this position, one part of the glass will frequently come in contact with the covering of the body; and I have found by abundant experience, that it is the part thus excited, which, in a dry atmosphere, very often produces the aberrations of the needle so much complained of, the cause of which has generally been considered so inexplicable.

I believe, that in nine cases out of ten, where local attraction is suspected, the surveyor need not look beyond his instrument for the cause.

Sometimes from this cause, when the compass is set, and the needle let down on to the centre-pin, it will swing hastily around to a certain position, where it will suddenly stop, and remain for several minutes, until the excitement appears to have in some measure abated, when it will leisurely move off and apparently assume its proper position. At other times, when the surrounding atmosphere is drier, and circumstances seem more favorable to the developement of the disturbing cause, the needle when lowered on to the pivot, will fly immediately to some point in the glass, and attach itself so closely by one of its ends, that it is with difficulty, that it can be immediately removed.

Note.—With a view to ascertain whether the attracting cause is developed by friction in all compass glasses alike, I lately made several experiments in company with Mr. Mullett; the result of which was, that out of the four different compasses which we examined, three, by rubbing a few seconds on any part of the glass with silk or woollen cloth, would attract the needle from twenty to eighty degrees, and hold it in contact with the glass from five to fifteen minutes. The other glass, by rubbing, showed no signs of attraction, either for the needle or electrometer—neither would an excited stick of sealing wax, nor a disk of polished glass, when excited, affect the needle through it; although they would, through the other glasses at a greater distance. The glass was then placed over the other needles with the same result. Hence we inferred that this glass had no *affinity* for the electric or electro-magnetic fluid, and that it was impervious to it.

Neither of us having ever before used a compass glass that could not be excited, this singular exception of the fourth glass induced us to try another experiment, to see if a *steel magnet* of the same attractive power as the sealing wax, in relation to the other needles, when held at a certain distance, would attract the needle through this glass. The result proved that it would vary sensibly. Hence then, if the cause of the attraction of the needle, developed in the glass and sealing wax, be magnetism, there must be two kinds; one that can communicate its influence through this glass, and another that cannot.

On one occasion, the needle of my compass was so strongly attracted to the glass, that it was with the greatest difficulty that I could shake it off, and when I had succeeded in detaching it, it would immediately return and adhere as firmly as before.

In this dilemma, I washed the glass on both sides, in a neighboring brook, which seemed to lessen the attraction considerably, but so strong was the excitement about the instrument, that near half an hour elapsed before I felt any confidence in its accuracy.

To obviate the errors arising from this source, by preventing the friction of the glass, Mr. Mullett proposes to cover the face of the compass with two semicircular brass plates, to turn on hinges, and so contrived that by means of a spring, they can be made to fly open when required.*

I will only add, that the surveyor's compass, or any other instrument, depending on the needle, requires to be used with great circumspection.

In order to ascertain, whether the attraction of the needle in the aforementioned cases, was caused by the electricity excited, or by magnetism, which from the strong attraction of the needle, I suspected might be a concomitant, I subsequently made a variety of experiments with different substances, by a very delicate electrometer, and a small needle nicely balanced. A stick of sealing wax or a disk of polished glass, when excited, attracted and covered themselves with iron filings, and also attracted the needle and electrometer ; but on being dipped in water, they suddenly lost all their attractive power, and did not affect the needle. The disk of glass, however, when excited, did not seem to have its attractive power materially lessened by holding it between two brass plates for several minutes, and would attract either the electrometer or the needle; but the needle seemed the most sensitive, and would be attracted by a small excitement of the glass, when the electrometer, which was a small down feather, would not be moved. The stick of sealing wax, or the glass when excited and placed on a tea cup in a pan of water, could be drawn by a magnet from one side of the pan to the other, to and fro, at pleasure. The same could also be done by a piece of iron, a brass scale, or boxwood rule, or any thing else with equal facility. Hence it appears the attraction of the needle by the glass was not owing to any particular affinity of the electricity of the glass for the magnetism of the needle, but that the electricity attracted it by the same virtue, and with the same force that it does all other bodies.

* This would answer, provided the glass is the only part of the instrument in which the magnetic or electric influence can, in this way be developed, but I have observed at times, that the whole of one part of the compass appeared to be temporarily magnetized, and this is the only way that I could account for the hasty swing and sudden stop of the needle before mentioned, when it was apparently, not at all influenced by the glass. I have also observed in some instances, when the needle appeared to have been disturbed in settling, that putting the hand toward it, would attract it several degrees. I have never observed this curious phenomenon, except when I had been walking, and suppose it may be attributed to the electricity thus excited. Mr. Mullett and others, have observed the same thing in similar circumstances.

Art. VII.—*Observations on, and descriptions of the Shells, found in the waters of the Muskingum River, Little Muskingum and Duck Creek, in the vicinity of Marietta, Ohio; by* S. P. Hildreth,* M. D.

Although the river Ohio abounds in shells of the same genera as those about to be described, yet they have so generally been noticed by writers on natural history, while those living in the above streams and more immediately within the bounds of the State, have not received attention; that my observations have been confined to those streams almost exclusively.

From the variety of form, color, and outward appearance of bivales, the most careless observer could not but be struck with their beauty, and led to admire their rich pearly luster, and variegated surface. But the more carefully they are inspected, the more beauties he will find to attract his attention and to call forth his wonder. The beds of many of our streams are strewed with the open valves of the numerous family of the Unios; and where the waters are transparent, like those of the Muskingum, they, with the interspersed pebbles, afford all the rich variety and tessellated appearance of a Roman pavement.—Their beauties were not unknown, or neglected by that ancient race of men who once inhabited the pleasant vales of Ohio; as the valves of some of the most interesting kinds are often found buried in mounds, intermixed with other articles considered as valuable by the builders of those venerable monuments of the dead. They must also have been deemed very valuable as an article of food; as we find vast beds of the calcined shells, in the banks of the river, usually several feet below the present surface, and near them a hearth of stones with ashes and fragments of deer and fish bones promiscuously interspersed. —In those seasons of the year, when the waters were low, and game scarce, they no doubt constituted a large portion of their food. Some of the species are very fine eating,

* Dr. Hildreth, having with great propriety, made Mr. Barnes his authority for his descriptions, it was thought proper to communicate this memoir to that gentleman, in MS.—along with the drawings, and such of the latter have been engraved as were not among those contained in volumes 6 and 7 of this Journal, to which the reader is referred, for the figures now omitted. We have taken the liberty to add, in the form of notes, a few of the remarks of Mr. Barnes, communicated by our request.—*Editor.*

and much admired by the lovers of shell fish at the present day, particularly the Unio ellipticus, and Alasmodonta complanata, which are very large, and in the month of September abound in fat, to the extent of one or two ounces of clear oil in a single individual. In the early settlement of this vicinity, shells were much used for the manufacture of lime, being burnt in piles of alternate strata of logs and shells; and affording an article of the greatest purity and whiteness. They were in such abundance that a single individual could collect twenty five or thirty bushels in a day—But at present, I think they are less numerous, being destroyed in the low stages of water by hogs, which become very fond of them and will spend whole days in the water searching for their favorite food; many times preferring them to corn, which they have been known to leave, and go in search of the more luscious clam. They have also other harrasing enemies in the Muskrats; which collect vast heaps of shells at the mouths of their favorite retreats, in the vicinity of some sunken log, on which they sit and feast upon the choicest of the molluscous race. It is also said that the white perch make use of the more thin shelled varieties, for food; being provided with strong bony plates, thickly studded with smooth round teeth, and placed in the back part of the fauces, well calculated to perform the office of "nut crackers." The favorite haunts of most of the genera are about the heads and sides of sand bars and islands, where they can nestle in the sand and coarse gravel; other kinds prefer the rocky ripples, where they can lie under the projecting edges of the loose stones; in the latter situations, are found most of the crested or winged varieties, which probably accounts for the fact, that very few of the older subjects are found with crest perfect, but generally mutilated and broken. As to their manner of propagating the species, I have been able to learn but little from my own observations, or by enquiries amongst fishermen, or others much about our rivers; and except in one or two varieties, have derived but little aid from writers on Conchology. From the fact, that the young from the size of a pin head, to that of a pea, are found in great numbers in the sand and soft ooze at the bottom of our streams, where the water is still and calm, I am led to believe, that they are male and female, and propagated by a seminal fluid, in the manner of the finny tribe. But this is only a conjecture, which further observations may confirm or refute.

I have as yet noticed but one variety of Univalve, in our streams; neither have I been able to collect all the species of the bivalve, as I have heard of several, which are not in my collection.—The description of most of my shells is taken from the observations of Mr. Barnes, published in the 6th vol. of the Journal of Science; a gentleman who deserves much credit for his devotedness to American natural history.

Remarks.—My collection is generally made up of living subjects; and the color, &c. for the drawings, selected from several individuals of the same species.—The drawings were executed by Mr. Sala Bosworth, a young self taught artist of Marietta.

Genus Unio.

Generic character, from M. Lamarck.

" Shell transverse, equivalve, inequilateral, free, beaks decorticated, somewhat carious; posterior muscular impression compound; hinge with two teeth in each valve; the cardinal one short, irregular simple, or divided into two, substriated; the other elongated, compressed, lateral, extending beneath the corslet. Ligament exterior."

Remarks.—Not expecting by these observations to throw much light on the study of Conchology, but only to describe the shells in this vicinity, I shall not divide the genus into classes, or parts, but go on as they are numbered in the drawings—the measure is by inches and decimals.

No. 1. Unio Crassus.—Fig. 1. } A. outside of the shell, C. inside.

Shell very thick, tumid; cardinal teeth lobed, angulated; posterior cicatrix deep and rough.—Hab. Muskingum.

Length, 3 inches; breadth, 4 inches; diameter 2 do.

Shell very thick, and oval—rounded behind, slightly angulated before; epidermis light brown; surface waved; beaks projecting; cardinal teeth deeply sulcated; anterior cicatrix striated; cavity of the beaks capacious, but not deep; naker, (or inside of the shell) pearly white and iridescent.

Remark.—It is a very common shell, and abounds in varieties.

No. 2. Unio Ellipticus.—Fig. 2.

Shell regularly oval; thick, convex, glabrous, beaks depressed; teeth elevated, triangular, striated.—Hab. Muskingum.

Length, 3.5 ; breadth, 5.00 ; diameter, 2.125.

Shell long before, short behind, equally rounded at both extremities ; beaks slightly projecting ; ligament elevated above the beaks ; epidermis dark brown, lighter in young specimens, and obscurely rayed—waved on the center of the disks, and wrinkled transversely ; teeth deeply divided, elevated and striated ; anterior cicatrix wrinkled, posterior cicatrix rough behind and smooth before ; cavity of the beaks moderate and angulated ; naker pearly and beautifully iridescent on the forepart.

Remarks.—I have a great many specimens of this shell, from very young to old ; they are remarkably uniform in their proportions. Its good qualities for eating, are said to be equal to those of any other shell in these streams.

No. 3. Unio Cuneatus.—Fig. 3.

Shell ovate, wedge shaped, thick, gibbous ; disks swelled ; a side view of the shell bearing a strong likeness to the head of the bald eagle ; lateral teeth thick ; inside a rich rose color.—Hab. Muskingum.

Length, 3.00 ; breadth, 4.4 ; diameter, 2.00.

Shell elongated and subtriangular, thick and ponderous ; anterior side narrowed, thin, angulated, wedge shaped, compressed ; umboes large and elevated, beaks low and distant, much decorticated ; anterior lunule, long heart shaped, with an elevated ridge running from the beaks to the anterior basal margin, and projecting on that part—basal margin slightly rounded and arcuated before ; anterior margin narrow and angulated ; posterior margin rounded and broad ; epidermis blackish brown ; surface wrinkled transversely. Cardinal teeth deeply divided and sulcated ; lateral teeth long, thick and striated ; cicatrices deep ; cavity of the beaks small and rounded ; naker a rich rose color and iridescent.

No. 4. Unio Undulatus.—Fig. 4.

Shell rhombic ovate, with numerous waving folds radiating from the beaks.

Length, 4.00 ; breadth, 5.25 ; diameter, 2.00.—Hab. Duck Creek.

Shell thick, obtusely rounded, behind, emarginate before ; beaks slightly elevated ; hinge margin sub-alated, compressed, carinated with a furrow on each side ; anterior dorsal margin sub-truncate ; epidermis blackish brown and finely wrinkled transversely; *oblique folds,* deeply indenting the anterior margin, furrows largest and deepest on the center of the disks and extending to the anterior basal margin, decussating the oblique waves; large oblong tubers below the beaks; cardinal teeth sulcated and crenated; posterior cicatrix very rough and shallow; naker pearly, irregularly spotted with olive, and most beautifully iridescent from the termination of the ligament to the anterior basal margin, affording the richest display of colors, in which violet and purple predominate, of any shell in my collection.

No. 5. Unio Plicatus.—Fig. 5.

Shell sub-quadrangular, tumid with distant oblique folds; hinge margin elevated, compressed, carinated.—Hab. Muskingum.

Length, 2.8; breadth, 2.9; diameter, 17.

Shell thick, posterior side short, obtusely rounded; anterior side compressed wedge shaped; beaks very prominent and projecting backwards as far as the posterior side; ligament elevated and passing between the beaks; hinge margin higher than the beaks; epidermis greenish; surface glabrous, deeply folded, indenting the anterior basal edge; cardinal teeth, sulcate, crenate; lateral in the left valve, curved, and extending up back of the cardinal tooth; posterior cicatrix rough and deep; cavity of the beaks deep and extended backwards; naker white, iridescent on the fore part, and tinged with gold color on the corslet and anterior edge.

Remarks.—This shell does not correspond, in all particulars, with Mr. Barnes's Plicatus, but still I think it the same. It will stand erect very firmly when placed on the posterior side.*

No. 6 & 7. Unio Undatus.—Figs. 6 and 7, two varieties.

Shell sub-orbicular, very tumid; waved; lateral teeth, *two* in each valve. White variety, length, 2.25; breadth, 2.5; diameter, 1.5.—Hab. Muskingum.

Shell thick, disks swelled behind, depressed before; beaks projecting backwards nearly as far as the posterior side, elevated and recurved, with the ligament passing between them; anterior lunule long heart shaped; disks waved trans-

* Mr. Barnes, we are informed, considers it as a variety of the following.—*Ed.*

versely from the beaks to the base; basal margin rounded behind, compressed in the middle, angulated slightly before; epidermis horn color or light chesnut; surface finely wrinkled and glabrous; cardinal teeth deeply sulcated and crenated; lateral teeth, *two in each valve;* muscular impressions deep and posterior one rough; naker pearly white and iridescent. Variety B. is smaller than the other, and of a rich pink, or deep flesh color on the inside; both varieties will stand erect, on the posterior side, and are neat, handsome shells.

No. 8. Unio Verrucoscus Purpureus.—Fig. 8.

Shell nearly circular, sub-truncate before, irregularly tuberculated; tubercles transversely compressed; inside purple.

Length, 3.5; breadth, 3.6; diameter, 1.9; (larger than the figure.)—Hab. Muskingum.

Shell very thick; rounded behind, sub-truncate before; beaks elevated, ligament deeply inserted; hinge margin nearly strait, compressed, alated; basal margin rounded; epidermis light brown, surface of the anterior part studded with transversely compressed tubercles; cardinal teeth very deeply sulcated, broad, and crenated cavity of the beaks very deep, compressed and directed backwards; posterior muscular impression very rough, anterior one compound; naker bluish purple, and iridescent.

No. 9. Unio Verrucosus Albus.—Fig. 9.

The exterior of this shell is much like that of No. 8; its form is sub-triangular, and angulated before; surface waved transversely, tubercles *round* and standing on the tops of the waves; cardinal teeth much smaller, and posterior cicatrix deeper; naker pearly white, and iridescent on the fore part; it is a most beautiful shell.—Hab. Muskingum.

No. 10. Unio Nodosus.—Fig. 10.

Shell sub-quadrangular, emarginate before, knotted, ridged, corrugated, lateral tooth terminating abruptly.

Length, 2.725; breadth, 3.25; diameter, 1.7.—Hab. Duck Creek.

Shell thick, short and obtusely rounded behind; beaks elevated, and approximate; with the ligament passing between them; anterior lunule compressed, alated; hinge margin strait; anterior dorsal, rounded; anterior margin, projecting; anterior basal, arcuated; basal and posterior margins, rounded; epidermis, greenish brown; corrugated and tuberculated over the center and anterior parts of the shell; tubercles large near the center of the disks, and very fine and beautiful on the beaks; wrinkled across the transverse striæ on the anterior lunule, giving it a feather shaped appearance; a broad, elevated, and nodulous ridge extending from the beaks to the anterior margin, and projecting in front; cardinal teeth sulcated and deeply crenated; lateral teeth, short, thick, rough and terminating abruptly, muscular impressions nearly smooth, and the sulcus in the cardinal tooth as deep as the bed of the posterior cicatrix; cavity, deep and angular; naker, a rich pearl color, tinged with blue, and iridescent on the fore part; a very beautiful shell in its exterior, and not less admirable on the inside.

No. 11. Unio Tuberculatus.—Fig. 11.

Shell, long ovate; surface, corrugated, waved tuberculated, ribbed, disks compressed; base arcuated.

Length, 3.00; breadth, 5.00; diameter, 1.5.—Hab. Duck Creek.

Shell, thick and rugged; anterior side compressed, narrowed, thin; posterior side, rounded, short, obtuse and broader than the anterior; beaks flat, and far back; ligament higher than the beaks; hinge margin, nearly strait, elevated, compressed; anterior dorsal, emarginate; anterior basal, emarginate; anterior margin, rounded; epidermis, dark brown; surface, thinly and irregularly tuberculated; tubercles, elongated longitudinally; an elevated ridge extending from the beaks and projecting on the anterior basal edge; irregular nodulous undulations, radiating from the elevated ridge to the hinge and anterior margins; cardinal teeth, crenated; lateral teeth, long and beautifully formed; posterior cicatrix, deep, and anterior half rough; cavity, angular, compressed and directed backwards; naker, pearly white, with spots of greenish, and most splendidly iridescent with purple, violet and gold, on the fore part.

No. 12. Unio Rugosus.—Fig. 12.

Shell, broad ovate; surface, tuberculated, ribbed, waved, disks swelled, base falcated.

Length, 1.6; breadth, 1.8; diameter, 1.2.; specimen small.—Hab. Muskingum.

Shell, narrowed and thin before; rounded and wider behind, beaks slightly elevated; hinge margin, compressed, carinate; basal margin, falcated, emarginate and compressed; anterior margin, rounded; epidermis, dark brown; surface, rough and scaly; waved transversely, having distant, irregular, transversely compressed tubercles; a broad nodulous ridge, extending from the beaks to the anterior basal edge, and projecting on that part; small oblique waves radiating from the ridge to the hinge and anterior dorsal margins; cardinal teeth, sulcated; lateral teeth, striated; posterior cicatrix, deep and not very rough; cavity of the beaks, angular, compressed and directed backwards; naker, white and moderately iridescent.

No. 13.—Unio Cylindricus. Fig. 13.

Shell, much elongated transversely, sub-cylindrical; disks, flattened, beaks not much elevated; teeth, sulcated obliquely.

Length, 1.5; breadth, 3.5; diameter, 1.2.—Hab. Muskingum.

Shell, thick, and elongated before; ligament, much depressed between the valves; hinge margin, strait and elevated; anterior dorsal margin, truncate and emarginate; posterior dorsal, rapidly narrowed; posterior margin, rounded and shortened; anterior margin, rounded; anterior basal, projecting; basal margin, shortened and arcuated; epidermis, olivaceous, wrinkled transversely, and maculated with deep green pyramidal spots, with the base inverted between the wrinkles; a broad nodulous ridge, extending from the beaks to the anterior basal margin, and projecting in front; with small elevations radiating from the ridge to the hinge and anterior dorsal margins; cardinal teeth, deeply crenated; lateral teeth, long and well defined; cavity of the beaks, deep, and directed backwards; posterior cicatrix, deep and rough; naker, pearly white, with colored spots; beautifully iridescent on the fore part.

Remark.—I have every size of this shell, from one inch to full grown.

No. 14. Unio Phaseolus.—Fig. 14.*

Shell, long ovate, thick; disks, rather flattened, ligament higher than the beaks; beaks, depressed and decorticated.

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* White variety of Cuneatus, No. 3. (D. H. B.)—Ed.

Length, 2.00 ; breadth, 3.5 ; diameter, 1.4.—Hab. Muskingum.

Shell, thick and ponderous ; anterior side, narrowed, thin, angulated ; beaks, low ; anterior lunule, carinated ; basal margin, arcuated ; anterior margin, narrow and rounded ; dorsal margin, higher than the beaks ; posterior margin, rounded and slightly gaping ; epidermis, light olive and finely wrinkled transversely ; cardinal teeth, rather small, lightly sulcated, and finely crenated ; lateral teeth, very broad and thick ; posterior muscular impression rough and deep ; anterior one, deep and striated ; naker, pearly ; cavity of the beaks, shallow, and inner surface marked with several deep folds, running obliquely from the cardinal teeth to the anterior margin.

Remark.—Quite a common shell in the Muskingum.

No. 15. Unio Orbiculatus.—Fig. 15.

Shell, nearly round ; inflated, beaks somewhat prominent, broad and directed backwards ; anterior lunule, broad heart shaped ; cardinal teeth, elevated, angulated.

Length, 2.5 ; breadth, 2.5 ; diameter, 1.75.—Hab. Muskingum.

Shell, nearly orbicular ; anterior margin, broad, and slightly rounded ; posterior, short and narrow ; disks, much inflated ; dorsal margin, lightly rounded, and basal margin the same ; ligament, thick and elevated, passing between the beaks ; beaks, a little projecting, distant and decorticated ; epidermis, a dark chesnut on the center of the disks, passing into a light brown as it approaches the margin ; surface lightly waved on the upper part of the disks, and finely wrinkled below, transversely ; cardinal teeth, direct, elevated and deeply sulcated ; lateral teeth, thick and prominent ; posterior cicatrix, deep, and rough before ; anterior cicatrix, broad, finely waved ; striated and beautifully iridescent ; cavity, broad and deep ; naker, flesh color, and very iridescent with purple and violet.

Remarks.—This shell is a variety of the crassus ; but differs so much from any I have seen that it deserves notice.

No. 16. Unio Foliatus, Fig. 16.

Shell, shaped like a grape leaf, surface waved ; disks, swelled ; base, arcuated, and anterior margin deeply emarginate.

Length, 2.00; breadth, 2.00; diameter, 1.12.—Hab. Ohio.

Shell, compressed and deeply emarginate before; rounded and projecting behind; beaks flat and eroded; ligament, more elevated than the beaks, and passing between them; hinge margin, broad and strait; anterior dorsal margin, projecting; anterior margin, emarginate; anterior basal, projecting; basal margin, arcuated; two elevated ridges, extending from the beaks, and projecting on the anterior dorsal and basal margins, with a broad furrow between; epidermis, dark olive; waved transversely, and obscurely rayed with green, across the waves; cardinal teeth small, and that in the right valve deeply sulcated; lateral teeth, short and thick; posterior cicatrix, deep and smooth; anterior one, strongly impressed and rough behind; cavity, broad and shallow; naker, white, tinged with a beautiful pea green; iridescent on the fore part.

Remarks.—Having but one specimen of this shell, I am unable to determine whether it is a new variety, or only a "lusus naturæ."*

No. 17. Unio Alatus.—Fig. 17.

Shell ovately triangular; hinge margin elevated into a large wing; valves growing together on the back of the ligament, inside purple.

Length, 4.5; breadth, 6.5; diameter, 1.7.—Hab. Duck Creek.

Shell moderately thick, disks flat and compressed, long before and short behind; beaks depressed; ligament concealed between the valves; hinge margin, very much elevated and compressed; basal margin nearly strait; anterior dorsal, emarginate; anterior margin, rounded and broad; posterior margin, rounded and narrow; surface deeply wrinkled; teeth elevated and crenate; anterior cicatrix, very broad; posterior composed of three distinct impressions, and also a row of very small impressions across the cavity of the beaks; naker, red-purple, very briliant, and most splendidly iridescent on the forepart.

Remarks.—It is difficult to procure a perfect specimen, of a full grown subject, the wing being more or less mutilated. The figure of this specimen has been drawn with great care,

* In Mr. Barnes's opinion it is new and distinct.—Ed.

and I believe is a faithful representation of the individual designed. The inner surface of some shells, is sprinkled over with small grains, like mustard seed in size, while others are nearly or quite free from them, as is the case with the present shell.*

No. 18. Unio Prælongus.—Fig. 18.

Shell much elongated transversely, narrow, thick, tumid, beaks flat, lateral tooth long, thin; inside white, tinged with green or purple.

Length, 2.25; breadth, 5.6; diameter, 1.9.—Hab. Duck Creek.

Shell, very long oval; anterior side somewhat pointed; posterior side short rounded, obtuse; beaks depressed; ligament elevated above the beaks; basal margin slightly compressed; when young, rounded; epidermis, blackish brown, wrinkled transversely, and rayed obscurely; naker, white, and tinged with spots of green, or purple under the beaks, with a row of small muscular impressions in the cavity; posterior cicatrix deep and not very rough; iridescent on the forepart.

No. 19. Unio Gibbosus.—Fig. 19.

Shell, elongated transversely, thick and gibbous; later tooth thick, incurved, inside purple.

Length, 2.00; breadth, 4; diameter, 1,1.00.—Hab. Muskingum.

Shell, much elongated transversely, thick and heavy; rapidly narrowed and rostrate before, narrow and rounded behind; disks somewhat compressed; anterior side much produced; beaks flat; ligament elevated; anterior dorsal margin, depressed and flattened; basal margin, nearly strait; epidermis, dark brown, deeply wrinkled transverely; naker, purple; teeth, crenate; lateral tooth, thick and rough, and folded over towards the inside of the shell; posterior cicatrix, deep, and rather rough; so deep that in old specimens, it is often worn through on this part.

No. 20. Unio Radiatus.—Fig. 20.

Shell, ovate, thin, finely striated, glossy, rayed, within bluish white.†

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* We are informed by Mr. Barnes, that they may be procured in abundance at Ticonderoga.—Ed.

† In Mr. Barnes's opinion, a young *Ventricosus*, and not the true *Radiatus*. —Ed.

Length, 2.00 ; breadth, 3.5 ; diameter, 1.4.—Hab. Duck Creek.

Shell, thin and fragile ; anterior side, broad ; disks, convex ; beaks, slightly elevated, and approximate ; ligament, elevated ; hinge margin, elevated, compressed, carinate ; basal margin, a little shortened ; in young shells, rounded ; anterior margin, narrow ; posterior, broad and rounded ; anterior dorsal, subtruncate ; epidermis, greenish yellow, rayed with dark green, and finely striated transversely ; surface, smooth and glossy ; cardinal teeth, crenated and long ; cavity of the beaks, small ; posterior muscular impression, broad ; naker, bluish white, or pearl color.

Remarks.—This is a very neat, and handsome shell—outer surface remarkably clean, and free from parasitic plants*—It is said to be very superior for eating.

No. 21. Unio Ovatus.—Fig. 21.

Shell, roundish ovate, convex, umboes elevated, beaks recurved, and approximate ; anterior lunule, flattened ; teeth, crest-like, elevated.

Length, 3.75 ; breadth, 5.00 ; diameter, 2.25—Hab. Muskingum.

Shell, broader before, and narrower behind the beaks ; thin and translucent when young ; and not thick when old ; disks, swelled ; umboes, prominent ; ligament, partly concealed ; anterior lunule flattened, and fuscous, becoming lamelar with striæ and wrinkles ; epidermis, yellowish, or horn color ; surface, glabrous and shining, deeply wrinkled, and *rayed in* young subjects ; cardinal teeth, crest like, elevated, compressed, oblike, nearly on a line with the anterior dorsal margin ; lateral teeth, short and elevated ; cicatrices, smooth and polished ; cavity, large and somewhat angular ; naker, pearly white.

Remarks.—This is one of the most common shells in the Muskingum, and remarkably uniform it its appearance. I think it a near relation of the *gracilis.*

No. 22. Unio Triangularis.—Fig. 22.

Shell, triangular, gibbous inflated, rayed, gaping ; anterior slope, flattened, ribbed, cancelate ; inside, white.

* Because it is young. *Mr. Barnes.—Ed.*

Length, 1.25 ; breadth, 2.00 ; diameter, 1.1.—Hab. Duck Creek.

Shell, moderately thick, acutely angulated before, obtuse, and somewhat angulated behind ; disks, inflated ; anterior slope, flattened, very broad, ribbed longitudinally, and wrinkled transversely ; beaks, one third from posterior extremity, decorticated, approximate, and somewhat elevated ; anterior lunule, oval heart shaped, in the smaller, and perfectly heart shaped in the larger specimens ; basal margin, a little depressed near the anterior extremity ; anterior margin, angulated ; posterior margin, rounded and broad ; epidermis, yellowish green, rayed with dark green, finely striated transversely, and with from three to six, more conspicuous transverse wrinkles ; anterior slope, marked with longitudinal ribs, which are beautifully cancelated ; ribs, projecting and forming a dentated edge ; cardinal teeth, two in each valve, compressed and crenulate ; lateral teeth, short, projecting, and terminating abruptly ; naker, bluish white, slightly iridescent.

No. 23. Unio Gracilis.—Fig. 23.

Shell, ovately triangular, very thin and fragile ; hinge margin, elevated ; ligament, concealed.

Length, 2.5 ; breadth, 3.5 ; diameter, 1.25.—Hab. Little Muskingum.

Beaks, depressed and placed far back ; ligament, between the valves, and covered ; anterior lunule, distinct ; hinge margin, elevated into a large wing, in the perfect specimens ; epidermis, sea green, wrinkled and striated transversely, glabrous ; cardinal teeth, very small, scarcely projecting ; lateral teeth, very thin and delicate ; naker, bluish white, tinged with violet, and beautifully iridescent.

Remark.—This shell is but a small specimen of the gracilis, in these waters. I have heard of one three times the size —the wing is much mutilated. The contour of the shell, independent of the wing, is much like that of the alatus. It is a more delicate shell, and inside more beautifully irised, if possible—not a common shell in this vicinity, as I have but one specimen.*

The above, are all the specimens of the Unio, that have as yet fallen under my notice ; but as my researches have

* It is abundant in Lake Champlain.(D. H. B.)—Ed.

been but partial, I have no doubt, of being able to add a number more to my collection.

Alasmodonta.

Generic Character.

Shell, transverse, equivalve, inequilateral, free ; beaks, decorticated ; posterior muscular impression, compound hinge, with prominent cardinal teeth in each valve, but *without lateral teeth.*

No. 24. Alasmodonta Rugosa.—Fig. 24.

Length, 2.25 ; breadth, 4.10 ; diameter, 1.20.—Hab. Little Muskingum.

Shell, oblong oval, about equally broad, before and behind ; beaks, very slightly elevated, wrinkled and decorticated, wax color beneath ; ligament, external, and rather higher than the beaks ; anterior lunule, distinct, with a slightly elevated ridge, extending from the beaks to the anterior basal margin ; basal margin, a little shortened, or nearly strait, the other margins rounded ; epidermis, chesnut brown, with a silky luster ; surface of the anterior part folded in a *pinnate* form ; folds deeper and larger as they approach the anterior basal margin ; curved upwards, and extending to the hinge, indenting the edge, and appearing on the inside ; teeth large and elevated, having in some specimens, a curved appearance ; cicatrices, smooth ; cavity, small ; naker, pale flesh colored in the center, pearly on the margin, with a narrow border of dark chocolate ; surface, glossy, with a rich blue tinge, over the fimbriated portion of the shell.

Remarks.—I have several specimens of this shell, young and old—in some, the teeth are much deformed, but the valves are equal and uniform.

No. 25. Alasmodonta Complanata.—Fig. 25.

Shell, ovately quadrangular ; hinge margin, elevated into a large wing ; valves, connate ; ligament, concealed ; wing, pinnate.

Length, 4.75 ; breadth, 5.9 ; diameter, 1.75.—Hab. Duck Creek.

Shell, short behind ; disks, much flattened ; beaks, slightly projecting ; ligament, between the valves ; anterior lunule, much compressed, and folded across the traverse wrinkles ;

hinge margin, elevated into a large wing, which is pinnated, or folded ; forming an obtuse angle with the post dorsal margin ; basal margin, rounded ; anterior dorsal, arcuated ; anterior margin, truncate ; posterior, rounded ; epidermis, dark brown, with a tinge of red below the beaks ; surface, wrinkled ; slightly elevated ridges and furrows extending from the beaks, to the anterior margin ; teeth, elevated, sulcated, and radiating from the beaks ; cicatrices, smooth ; cavity, small and angular ; naker, bluish white, and iridescent on the forepart, with a border of rich reddish brown, on the margin.

Remarks.—I have several specimens of this shell, in all of which the wing is folded, in some, very beautifully—generally found in ripples, or rapid water, and rocky bottom.

Genus Anodonta.

Generic Character.

Shell transverse, with three obsolete muscular impressions, hinge simple ; destitute of teeth.

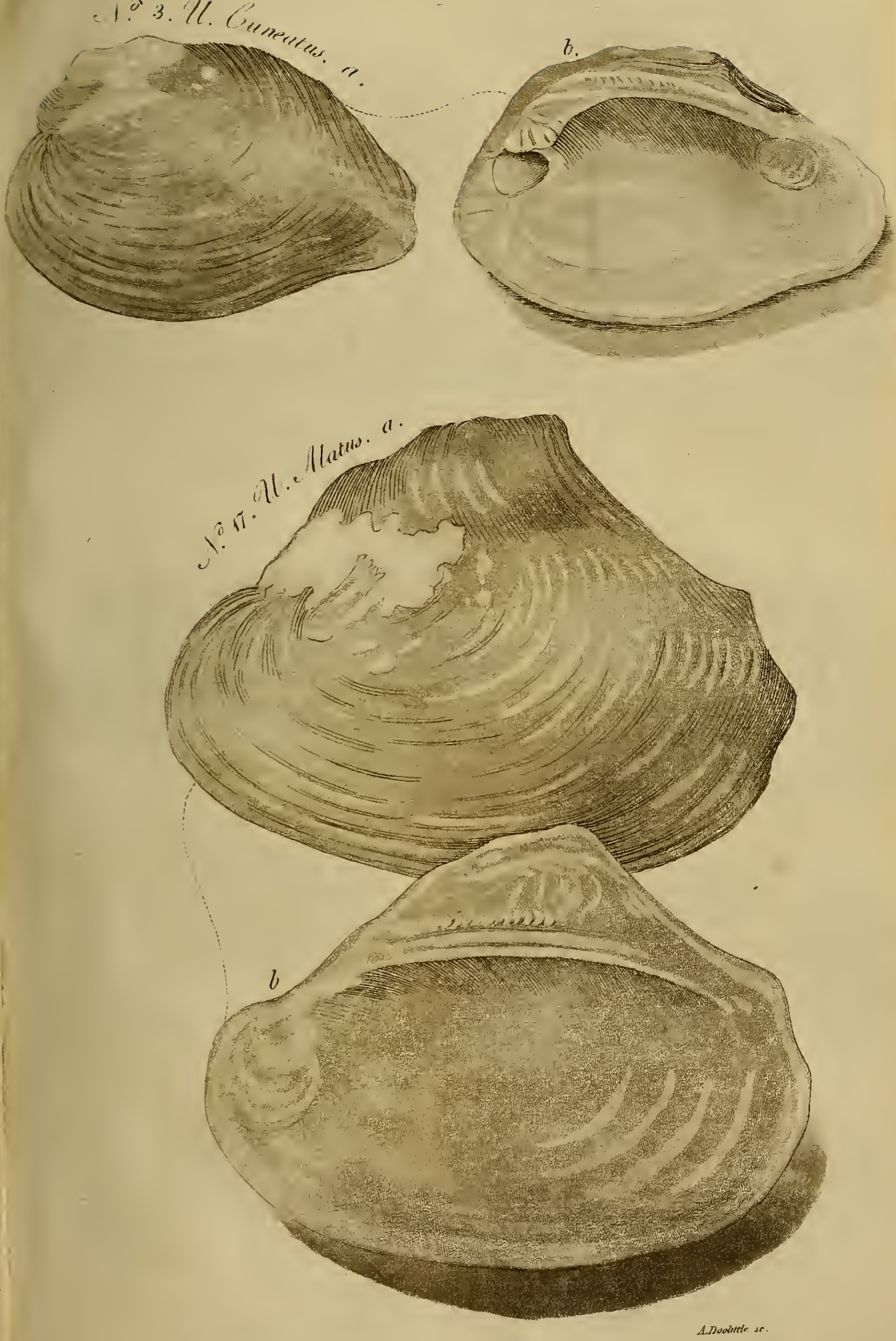
No. 26 Anodonta Undulata.—Fig. 26.

Shell very thin, not thicker than brown paper ; convex, nearly oval ; epidermis greenish, or olivaceous, darker on the umbo ; obscurely rayed and striated longitudinally ; rays lighter than the general surface ; distantly waved transversely, waves appearing on the inside ; beaks prominent, acute, approximate ; slightly decorticated, wax color beneath ; ligament partly concealed ; hinge margin rectilinear ; anterior dorsal margin compressed and angulated ; anterior margin sub-truncated ; posterior margin rounded and projecting ; basal margin ovally rounded ; surface glossy and polished ; destitute of cardinal or lateral teeth ; naker light cerulean, tinged with violet ; cavity capacious ; basal and anterior margins bordered with a broad line of rich brown.

Length, 1.75 ; breadth, 3.00 ; diameter, 1.25.—Hab. Little Muskingum. A very delicate and beautiful shell.

The only specimen of univalve, is figured No. 27, and was found in the Little Muskingum ; it is the largest I have seen of that species, smaller ones being very common.—It appears to belong to the genus Paludina, species Decisa ; as described in American Conchology, plate 2. fig. 6.—It is 1.5 in length, and 1.00 in diameter.

Closing Remarks.—In the above list of shells there are four varieties, which I have not seen described, and have ventured to



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give them specific names, viz. Orbiculatus, Phaseolus, and Foliatus, of the Unios; and Undulata, of the genus Anodonta—my other descriptions are generally copied from Mr. Barnes, except in particulars where my specimens differed from his. The subject is in a manner new to me, and lacks the finish of an experienced workman.

Art. VIII.—*On the Boulders of Primitive Rocks found in Ohio, and other western states and territories; by* Benjamin Tappan.

TO THE EDITOR.

It seems to have been taken for granted, that the masses of primitive and transition rocks, found in the territory north west of the Ohio river, scattered over the surface of the ground, and occasionally beneath the surface, as deep as excavations have been made, are of foreign origin. Found in a region wholly secondary, these boulders, (as they are called, perhaps from the French boule, a ball,) apparently out of *place*, have hitherto excited the attention of geologists, not so much to examine and describe them, as to invent some plausible theory concerning their removal from their supposed native seats, to their present situation. The terra incognita of the north seems to have been generally supposed to be the region from which they were removed, and the force which removed them water. One conjectures, that the whole of the basins of the Mississippi and of the present great lakes, may, in remote times, have been one immense lake, bounded on all sides, by an unbroken range of mountains, and that large pieces of floating ice, from the north side, might carry those blocks attached to them, and drop them, as the ice melted in going south.*

Another thinks, that "the impression is irresistible, that it is the result of an immense current, or body of water, pouring down from the north, sweeping the south side of Lake Erie and all the Sciota country and Miami valley."†

In general coincidence with these writers many others might be cited, some of whom have described these boulders, as rounded by attrition or water worn.

I doubt much, whether such theories have ever been advantageous to the cause of science. So great in most men,

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* Journal of Science, vol. 6, p. 98. † Journal of Science, vol. 13, p. 39.

is the inclination to indolence, that a plausible theory is likely to be preferred to a laborious investigation of facts, and to render the person adopting as well as the one inventing it, satisfied and contented, with so cheap and easy substitute for knowledge. I doubt also the soundness of these "speculative conjectures," and the force of these "irresistible impressions," and incline to think them altogether visionary.

The question how the boulders of primitive and transition rocks, found scattered over the north western territory, came there, can be answered, only when many facts, of which, as yet, we are entirely ignorant, are discovered and proved. The composition of these boulders may be similar to, or identical with the composition of some primitive and transition formation known to exist, *in situ*, in such relative position, as would admit of removal to the places where the boulders are now found, by the application of an adequate force. That such force could have existed and have been applied, consistently with the known laws of nature, must also be established.

McKenzie and Bigsby are not the only writers from whom we learn, that a ridge or mountain range, of primitive and transition formation, extends from the coast of Labrador to the north west of Lake Superior, dividing the waters which fall into Hudson's Bay, from those which fall into the lakes of the St. Lawrence; but, whether this is a continuous and unbroken ridge, seems doubtful. It may however be admitted as probable, and it may also be probable, that it contains all the varieties exhibited in the composition of the boulders in question, and yet these probabilities would be but a weak substratum whereon to erect a scientific edifice.

I do not pretend to have seen more than a small part of these boulders, and the portion which I have examined is much smaller. The northern ridge I have never seen, nor have I access to any geological description of it. The boulders which I have examined, are granite, gneiss, sienite, and greenstone; of granite and granitic aggregates every variety mentioned by Cleaveland, except graphic granite. Fine specimens of a porphyritic granite, apparently identical with that described by Doct. Bigsby in the Journal of Science, vol. 8, p. 65, are found near Columbus, Ohio. The gneiss also embraces many varieties, some of which alternate with hornblende slate, and some contain the common garnet; there is also a considerable variety in the sienite. Almost all the greenstones which I have seen, were situated in the valleys of rivers, and they are the only species which are rounded and smoothed by attrition. The largest mass that I have seen, is not more than two feet in diameter; the composition is uniformly fine grained, principally of hornblende, and to the naked eye the texture is apparently homogenous; and with a glass, the grains of feldspar and prisms of hornblende are plainly distinguished.

Is there any evidence, that similar minerals are in place north of the great lakes? If such evidence exists, as to all of them, it would lay a foundation to conjecture, that they all had the same local origin, but, if it exists as to a part only, such conjecture would not be admitted, any more than it would be reasonable to suppose, that all these boulders came from Massachusetts, because a mass of granite is found in the town of Randolph, Portage county, Ohio, identical in its appearance with the granite, excavated at Rail hill, Northampton, Mass.; or, because a mass of old red sandstone, apparently like the old red sandstone that underlies Mount Tom, is found in the neighborhood of the granite.

If it were ascertained, that there existed a northern ridge, composed of similar materials with the boulders, and the intermediate country were an inclined plain, descending to the north western territory, the "impression" might be strong, that the boulders came from that ridge, but it would not be "irresistible," for we should still want a force adequate to the removal of such ponderous masses. Could that force be water? To say, that an immense body of water was, at some remote period, collected at or near the north pole, and that it flowed over the north western territory, carrying with it large masses of granite and depositing them, at an altitude of one thousand one hundred and sixty-five feet above the present surface of the Atlantic ocean, where some of them now repose, would seem to be indulging something like the visionary daring of Capt. Symmes.

"It may be doubted whether the uniformity, order and regularity of the general laws of nature, which have at any time come within the limits of our observation, can warrant a supposition, founded on such complete changes in the mode of action."* It is incumbent on the supporters of

* "Essay on the formation of Rocks," &c. by William Maclure; Journal of the Academy of Natural Sciences, vol. 1, p. 261. This essay ought not to be mentioned without an acknowledgment—it is strikingly characteristic of its author; its extensive and accurate research, its clearness, precision and truth, are not more remarkable than its philosophic caution and invariable modesty.

such a theory, to demonstrate, at least the possibility of such a great mass of water being collected at the north, to sweep over this continent, or the conjecture that such was the fact must remain one of very doubtful authority.

The surface of Lake Erie is five hundred and sixty-five feet above the Atlantic ocean, and three hundred feet above Lake Ontario. If the water flowing into Lake Erie, were to raise it fifty feet, it would find its way into Lake Ontario by a channel probably eighty or ninety miles wide.* Lake Erie must be raised upwards of three hundred and thirty-four feet to pour any of its waters into the Sciota country or Miami valley, and upwards of six hundred feet to reach the highest grounds on which the boulders are deposited. The dividing ridge, (as it is sometimes called,) between the waters, flowing northward into the lakes, and southward into the Ohio and Mississippi, is about one thousand two hundred feet† above Lake Erie; where the head waters of the Allegany river run out of it, it continues to keep up the appearance of a ridge of land to the westward, until it reaches near to the west line of Pennsylvania, and is, on the turnpike road from Erie to Waterford about seven hundred feet above the lake; west of that line the ridge entirely disappears, and the waters flow north and south from a level and swampy country; not unfrequently, the same swamp is drained, upon one side, into the St. Lawrence and upon the other, into the Gulf of Mexico. This dividing ground in the state of Ohio, has been ascertained, by actual measurement, in the lowest place, to be three hundred and thirty-four feet above Lake Erie. It is, however, of unequal elevation; in some places certainly five hundred and fifty, and probably in others, six hundred feet above the lake, and if we take Lake Michigan to be, as represented, not more than twenty-five feet higher than Lake Erie, the lowest ground dividing the

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* I infer this from a view of the country on each side of Niagara river, and from the fact mentioned by Doct. Bigsby, (Journal of Science, vol. 8, p. 69,) that the "York Highlands" and "Burlington heights," some of the highest grounds in that region, are but three hundred feet above Lake Ontario, that is, they rise to the level of Lake Erie.

† Darby's Tour, p. 175. The opinion, here given by Mr. Darby, is probably correct, for the Allegany river, after its long and rapid course from the state of New York to its junction with the Monongahela, is still considerably higher than Lake Erie. Thirty miles below the junction, at the mouth of the Big Beaver, the Ohio river is one hundred and twenty-seven feet above the level of Lake Erie.

waters flowing north and south, is found south of Lake Michigan, or between the heads of the St. Peter and Red rivers.

On the supposition, that an immense lake covered the north western territory, one thousand one hundred and sixty five feet above the ocean, its northern bank must have disappeared from the country west of Lake Superior, as the St. Lawrence, Mississippi, Red river and Saskashawine rise, in a vast plain from ponds and swamps, which are probably at no greater elevation than the great plain of the North Western territory.* If this difficulty were removed, and we could take for granted, that a sufficient barrier to the supposed lake, upon the north side, did exist in remote times, the south would remain to be provided for. On the inclined plane, over which the waters of the Mississppi flow to the gulf of Mexico, no appearance of any ridge or mountain range has been observed, lying in a direction across the course of that river below the mouth of the Ohio; the Ozark mountains and all the other elevated ridges seem to run parallel with the Mississippi valley, and if any of them are as high as the great plain of the North western territory their position precludes the supposition, that they ever formed the southern shore of the conjectured "immense lake."

It may be doubted, whether any of the hills bordering the Ohio river, are higher than the plain north west of them; the rivers Wabash, Miami, Sciota, Muskingum and Big Beaver, all rise in this plain; flowing, at first, with gentle current, and within low banks, they, (particularly the four latter) soon change the "even tenor of their way," to one more impetuous, and descend to the Ohio river, through vallies increasing in depth, as they rush onward. They, with their numerous tributaries, whose channels are similarly formed, seem to have cut up the whole country bordering on the Ohio, into ridges always running parallel with their courses; these ridges are lower below the falls of Ohio than above, and lower in proportion, as the great plain of the north west descends toward the south, with a greater declivity than the bed of the Ohio. The falls of the Ohio, at Louisville are not caused by the breaking through, or wearing away of a mountain range, their being no appearance of such range, upon either side.

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* Major Long's Expedition to the Rocky Mountains, vol. 2, p. 379.

What is called the falls is a natural dyke of limestone twenty two feet high, crossing the bed of the river, and the water is backed up by it, as it would be, in any place, by a mill dam of the same height—If the dyke were removed, the fall would disappear.

The justly celebrated traveller Volney (who examined the north western territory) was of opinion, that "it is an elevated plain, about as high as the Allegany range." Actual measurements prove that he was mistaken, as to the height of this plain, although they prove also, that it is in truth an "elevated plain" and render it highly probable, that the streams, flowing down its north side, would find descending ground to Hudson's bay, were it not for the intervention of the great valley of the St. Lawrence, as the waters from the north side of the continuation of this plain, west of the Mississippi, find their way into the northern ocean. To suppose therefore, this elevated table land to have been the bottom of an immense lake, or to suppose, that a current of water has swept some northern mountain up, on to this plain and scattered its fragments over it, are suppositions which appear altogether inadmissible.

How then came these boulders in their present situation? In the present state of knowledge, this question cannot be answered. In the mean time, ignorance is preferable to error, and what is unknown may be examined. It may therefore be asked, why may not these rocks have been created where they are now found? If we have not seen the operations of nature in forming primitive rocks, it may be because the process is so slow as to elude observation. It is evident that some classes of rocks are constantly undergoing the processes of aggregation and disintegration; the primitive as well as the secondary, are seen to decay and fall to pieces; the quartz, the hardest mineral which enters into the composition of granite, is of constant growth, in all its crystalline and some of its amorphous forms, and from the uniform analogies of nature, its aggregation into granite may be supposed as probable as its aggregation into sandstones is known to be certain. Again, why may they not have been thrown out by earthquakes or volcanos? The horizontal stratification of the great vallies of the Mississippi is not entirely uniform. In some places, the strata of limestone, in others of sandstone and in more, of the slates have evidently been disrupted and thrown out of an horizontal position, by some upward force, and are now seen in every inclination, from vertical to horizontal. Many of the masses of rock, now on the surface, seem to have been subjected to the action of great heat, and although no rocks of decidedly volcanic origin have been observed, our knowledge is too superficial and limited to warrant us in saying that such do not exist.

Steubenville, Ohio, March 27th, 1827.

Art. IX.—*On the Principles of Motion, and their use in the higher branches of Mathematics.*

The astonishing discoveries made in natural philosophy, and more particularly of those grand principles, which regulate the movements of the great bodies of the universe, are to be ascribed, principally, to the skilful use made of the mathematics in the development of these discoveries. As this science has thus afforded the most certain and powerful assistance to philosophy, the principles of the latter, common to both, have contributed to the extension and illustration of the former, in its more difficult and complicated researches. The idea of *motion*, either local, or of aggregation, or diminution is essential to that of the generation and investigation of all curvilinear figures, and is that which was employed by the ancients for that purpose. Similar views of quantity in general, generated by motion and regulated by certain laws, originated that most extensive and important of all the mathematical sciences, denominated by Newton *fluxions*, and by Leibnitz the *differential calculus*. The first of these great men illustrated the doctrine by motion, and demonstrated it by the ancient method of limits, showing the comparative effects of a motion which is uniform, and of one which is varied in any ratio of this, or according to any law dependent on the uniform motion. The latter estimated the same effects by that, which has been denominated by Aristotle the motion of aggregation, or the rate by which the infinitely small elements, or parts of any quantity are aggregated. There appear to be no just grounds of objection to either of these modes of conception, in the generation of quantity, as both are susceptible of demonstrations of equal validity and clearness with those of other branches of the mathematics, whose direct relations cannot be inferred. Our ideas of quantity, (the whole subject of the mathematics,) depend on some species of motion, which is conceived to measure the space, or interval occupied by the quantity, or numerically on the relation of the quantity to some standard measure, or unit; this mode of considering quantity is virtually a motion of aggregation, and when so estimated, has been denominated discrete quantity and the other, continued. There are only names given to what is immutable and identical, according to the two modes of existence in our ideas. But that which has been the subject of many cavils and much ingenious discussion on the principles of this science, is not any supposed want of clearness in either mode of conceiving of quantity. It is the logic or the legitimate deductions of the calculus in its first principles, where the ratio of variables dependent on one another, is to be estimated in their ultimate or vanishing state, which is oppugned. That, say the objectors, must be either something or nothing; if it be something, it must partake of all the successive variations, which arise from the variation of the magnitude, and will not be that which has been assigned by mathematicians as the true ratio: but if it be nothing, there can be no ratio assigned. Here the mathematician may come in and say that it is neither something nor nothing, if by those terms are meant substance or matter, but a species of quantity well known in mathematics to have a *ratio*, though without any material existence or occupancy of space, viz. the *limits* of quantities. Geometry, the clearest and most evident of all the sciences, assumes them as the fundamentals on which its towering fabric is built. Points, lines, and surfaces, are the first principles of reasoning in this accurate science. It is not our object to enter on any metaphysical discussion, relative to the connexion of these limits with the actual quantities with which they are inherently united. It will be sufficient to observe, that they have never been made a ground of objection to the elegant demonstrations of Euclid, Archimedes, Apollonius, and others; but because in the higher branches of mathematics, they are more remote and recondite, and less the subjects of common observation or comprehension; here there has been more room for disputants and cavillers, such as Berkeley, to raise objections, which undoubtedly must ever exist in the minds of those who have never penetrated the subject in any form.

Newton and Leibnitz had laid the foundation of this science on a sufficiently tenable ground; but illustration and more practical arguments were necesssary for the less penetrating and profound, the disciples of Berkeley and others. These, when the science was attacked, were abundantly afforded by the most superior minds. I need only mention the names of Robins, Jurin, and Maclaurin. Their writings have so completely established the foundations of the higher calculus, that scarcely a doubt on the subject of its true logic, had arisen for more than half a century. Since their time, however, Lagrange, an eminent mathematician, has proclaimed certain dogmas relative to this subject, and in them has afforded what by some is considered as a demonstration, which, if not satisfactory, is less exceptionable, than those of his predecessors; the substance of which appears to be,

1. That Newton's illustrations and demonstration of the science by motion or flowing, and the limits of ratios, are improper and unmathematical, as every science ought to be based on its own principles, and that that of motion is not mathematical but physical.

2. The method of Leibnitz too, which consists in the comparison of dependent variables when infinitely small, he pronounces as very objectionable, and not founded on any clear principles.

3. He considers the subject as peculiarly and exclusively belonging to algebra or analysis, and the theory of the development of functions.

Now from these positions, it would seem that those great geniuses who originated the science in question, and by whose reflected light only, Lagrange has shone as a mathematician, are considered by him as not having established it on a legitimate foundation, or as not having given to it the true metaphysique. Before he had found out a new one of his own, when there was no other than that of Newton or Leibnitz, did he mistrust the foundation of the calculus? On the contrary, did he not use it with great success and much to the improvement of science?

We have already shown that the idea of motion originated this science, and that it is truly a mathematical idea, as being inherently essential to that of quantity. As a cause producing effects, it is a physical attribute, but no otherwise than existing in matter. Motion itself, independent of its existence in body, and productive of physical action, is susceptible of more or less, and the ratio of one motion to another is assignable by an arithmetical or algebraical calculus.* It is not easy to conceive, why a principle, which has been the most productive source of discovery in the mathematics, particularly in descriptive geometry, and the reasonings and demonstrations of the properties of curve lines, should be exploded from the mathematics and exclusively confined to physics.

What is objected to Leibnitz's use of infinitesimals will equally apply to the ancient method of exhaustions, and even to the doctrine of limits, which never will be intelligible to those, who confound metaphysical, and mathematical infinity. In a full discussion of this subject I must refer to Maclaurin's Fluxions, or the works of Benjamin Robins. The other position of Lagrange, that the subject belongs peculiarly and exclusively to *analysis*, or *algebra*, is in our view wholly gratuitous, unless it be in reference to the calculus only, or the numerical operations, as indicated by the algebraic expressions, according to which the values of the variable quantities must finally be determined. But this is not peculiar to the science under consideration. Every branch of the mathematics, when brought to practice, must be reduced to the idea of quantity as constituted by aggregation, or as composed numerically of some quantity as the standard of measure, or the unit of that species of it, to which it belongs. In geometry, quantities are represented by lines, or some figure of the magnitude itself. In Algebra, the same are expressed by symbols, or letters, which designate the numerical parts of which they are composed. According to either mode of designation, the demonstration of the science depends on the same principles, viz. the determination of the ratio of increase, or diminution at a point. For this purpose, the ratio of the increments, or decrements of the variables is first considered, and then what that ratio will be at the point of vanishing. We know of no other method by which that ratio can be established; and to us, as it respects the demonstration, it appears wholly immaterial whether that be expressed geometrically, or algebraically. But according to either mode, it must rest on the doctrine of limits and limiting ratios, as a legitimate subject of mathematical demonstration. To have recourse to far fetched principles, which themselves are built entirely on fundamental truths, is *argumentum in circulo*, wholly inconsistent with

* See Robins' Mathematical Tracts, vol. 2.

logic, and derogatory to the purity, and evidence of the mathematics. For an illustration of our remarks, suppose e to be an increment of a uniformly varying quantity x; then $x+e$ will be the quantity varied by the increment, this variation will be uniform in all values of x, but the variation of the variables dependent on $x+e$, or what is denominated the functions of this new value of x, as $\overline{x+e}^n$; will not be uniform, but may be easily investigated by the development of $\overline{x+e}^n$; for greater simplicity suppose the function to be $\overline{x+e}^2=x^2+2xe+ee$, the increment, or variation of this from its first value, when it had no increment is $2xe+ee$, which is to the uniform increment of x, or e, as $2xe+ee$ to to e, or as $2x+e$ to 1.

Here the ratio of the increment of the function to its base, or root, is ascertained very readily by its algebraic development; and if this were truly its differential or fluxion, there would be no ground of questioning the legitimacy of the logic of this science, but the objection to it rests entirely on the casting away of the increment e, from the expression $2x+e$ of the ratio of the whole increment of the function, since e, must ever constitute a part of it while it has any finite value. It may be said that the ratio of $2x$ to 1, or what is called the differential co-efficient, is independent of e, and has a real value when e vanishes; which is true, but it is then at its limit and the ratio is that of the limit, and not of the increment, consequently no new discovery is made by this mode of conception. If the second term of the development be assumed as the true differential, this will be a *petitio principii*, or taking for granted what is to be proved. In short, we perceive no logical principles in LaGrange's Analytical demonstrations, which are not common to the geometrical. It must, however, be allowed, that the former afford facilities of operation, which are peculiar to analysis, but the latter are more remarkable for their clearness, and irresistable evidence. Both should go hand in hand, as each contributes to the other great advantages. A predilection for *analysis*, which term is improperly applied to algebra only, has led some modern mathematicians into extremes by imagining this instrument of discovery immeasurably potent. That it is very much so, will not be denied; but the abstract reasonings from symbols, do not always discover truth. There must be a reference to its kindred science, or great errors may be committed; for example, if it were required to inscribe any chord given in magnitude within a given circle, x denoting the versed sine of the arch, which will be subtended by the given chord, a the diameter of the circle, b the chord, x will be $= \frac{bb}{a}$; therefore whatever be the given magnitudes of b and a, there may always be found a value of x, which will satisfy the algrebraic equation, yet it is manifest, that if b be greater than a, the value of x, derived from the equation will be of no use for solving the equation. In pure Algebra where the numerical values only of the terms are considered, negative quantities independently considered, are absurd, and impossible; and because the rules of the science are derived from their connected, or relative effect on positive, or affirmative quantities, it is, that the operations of negative quantities never produce negative even powers as $-a^2$, the roots of such quantities are said to be impossible, but this is not otherwise the case, than that $-a$ itself is impossible in pure Algebra. The first is accounted so because there is no reversion of rules, which will produce its root, in the same manner as the impossibility in the irreducible case in Cardan's theorem, arises from the imperfection of the assumptions in the composition of the rules, being grounded on a very restricted condition. Pure Algebra, or Analysis, therefore is imperfect. It is only in geometry, that the use of negatives affords to it the greatest evidence, and universality.

In drawing conclusions from pure analytical expressions, without reference, to the nature, condition, or restrictions of the problem, we may commit the greatest mistakes, and fall into the greatest absurdities; some of the most egregious in the writings of Euler have been detected by Mr. Robins, which may be seen in the tracts of the latter vol. 2, p. 209, &c.

Our remarks were intended to show the connexion, harmony, and dependence of the two great branches of the mathematics, and that the fundamental principles of both are identical, although differently represented.

PROCLUS.

Art. X.—*On moving Stones, in Lakes, Ponds, &c.; by* Nathaniel Chipman.

TO THE EDITOR.

Sir—Having been lately favored by a friend, with the perusal of the American Journal of Science and Arts, I observed, in the 5th volume an anonymous communication, giving an account of a stone or stones in a pond in Salisbury, Connecticut, which appeared to be moving from time to time, from some unknown cause, in a direction to the shore.

In the 9th volume, Mr. Charles Lee, who acknowledges himself to be the author of the first communication, has assigned the true cause, which he discovered to be the floating ice of the pond, on its being broken up; and he has verified his opinion not by witnessing the actual operation, but by observation of the effects, which must necessarily have accompanied it.

As I have been so fortunate as to see the operation performed, I will give a brief statement of the facts and circumstances, which may serve to convince those, if any there be, who still doubt.

There is in Tinmouth, adjoining the farm on which I now live, and partly encompassed by it on the north, a pond, a little less than a mile in length from north to south, and about half a mile broad in the widest part. I became acquainted with it in the year 1775, when my father owned the farm and resided on it. I then observed several stones of different sizes; some might be called rocks, lying in the edge of the water, particularly on the west shore towards the north end of the pond, which evidently appeared to have been forced forward in a line inclining to the shore, by some powerful cause, leaving behind them channels of considerable length, and the largest having the longest channels. Many conjectures were at that time made respecting the cause, none of which appeared to me satisfactory. I repeatedly observed these stones afterwards, and found that they had, from year to year, from the appearances, been forced forward in the same direction. In the year 1782, I came into possession of the farm. I had observed, that as the warm weather advanced in the spring, the ice at the north part of the pond, where it was exposed to the influence of the sun and southerly winds, disappeared to a considerable distance, before it was disengaged from the south shore, where, by a tall and thick forest of hemlock and spruce, it was protected from the influence of both; and that when released from the shore, the ice was sometimes driven to the north by a southerly wind, in a field containing from sixty to eighty acres, and from two to three feet in thickness, and on a change of the wind to the north or north west, it was again returned to the south—this led me to believe that the ice was the agent in the removal of those stones. In order to be assured of this, I afterwards, in the spring of 1783, (if I rightly recollect the time,) took an opportunity, when the ice was moving to the north in a large field, before a south wind, to place myself by a large stone on the western shore, before marked for observation, which from the track left behind, appeared to have been moved in former years, to a considerable distance. The ice approached with a very slow motion, hardly perceptible. When it met the stone, the thinner edge of the ice gave way a little and was broken off, but it soon became sufficiently thick and strong to perform its task. As soon as it had taken a firm hold of the stone, I heard a grating noise of the gravel beneath, and plainly saw the motion of the stone, as well as of the gravel and earth that was accumulated and accumulating before it. I observed it attentively, while it was moved a foot or more, when the progress was arrested by the ice swinging round against the eastern shore of the pond, which was there too narrow to permit it to pass farther up. The course was not in a line directly to the shore, but making with it an acute angle to the north, in a line with the force impressed. I had observed by the track, that the movement had not been always in a right line, but deflected a little, sometimes on one side, sometimes on the other, occasioned no doubt by a variation in the line of the impelling force, from a like variation of the wind at different times. Having now fully satisfied myself of the cause of these movements, I sought no farther opportunity of witnessing the operation; others however have since told me they have made the same observations. I have always conversed freely on the subject, and have related the circumstances to many, and among the others to men of science, and so familiar was it to my mind, and the cause appeared to be so obviously pointed out by the situation, that when I lately found the phenomena considered as wonderful and almost exceeding credibility, the wonder appeared to me, that at a time when the ardor of philosophical research has left almost no corner or recess of the physical world unexplored, this should have been still considered as a wonderful secret of nature. But I believe it often happens, that while we are looking out for something more recondite and profound, we overlook the most obvious cause, which seems to solicit our notice—and perhaps as often reject it as an alien or a vulgar intruder, because we find no niche to accommodate it, in our favorite system.

Tinmouth, *Vermont*, *Jan.* 8*th*, 1828.

Art. XI.—*A Description of the Mineralogy and Geology of a part of Nova Scotia; by* Charles T. Jackson *and* Francis Alger.

In laying before the public an account of the mineralogy and geology of this Province, it will be perhaps necessary to premise a few geographical remarks on the situation and extent of the country, and to describe the ranges of hills and mountains, which are to be particularly noticed in this paper.

The peninsula of Nova Scotia is situated on the north eastern coast of North America, and is included within the forty third and forty sixth degrees of north latitude, and between the sixty first and sixty seventh degrees of longitude west of the meridian of Greenwich. It is connected with the continent by a narrow isthmus which joins it to New Brunswick, and is bounded on the north by part of the gulf of St. Lawrence, which separates it from Prince Edward's Island, on the north east by the Gut of Canso, which divides it from Cape Breton; on the west by the Bay of Fundy and New Brunswick, and on the south and south east by the Atlantic Ocean. The whole Province is nearly three hundred miles in length, by one hundred and fifty in breadth, and contains about fifteen thousand square miles of surface.

The face of the country presents us, with some irregularity, three distinct ranges of high land, two of which have some claim, to the title they bear of mountains; the other consists of rounded hills of inconsiderable elevation, extending through the county of Cumberland, and the districts of Colchester and Pictou. The other two ranges alluded to, are called the south and the north Mountains; the former extends through the Province in the direction east north east, passing through the counties of Annapolis, Kings, Hants, Colchester and Pictou. This range is bounded, on the north and west, by the valley through which the Annapolis River winds its course for more than eighty miles, and carries with it the rich loam brought by the rivulets and torrents which contribute their waters to swell this beautiful river, depositing it along its course, thereby forming a part of the fertile alluvium of this valley. The north Mountains however, contribute much more generously to the fertility of the land, from the peculiar rocks of which they consist, producing by their decay the most luxuriant soil. The north Mountains form the south western coast of the Province, skirting the Bay of Fundy, and having the Annapolis River at their southern base. They extend, with but a single interruption in their continuity, nearly one hundred and thirty miles, and present to the sea and insuperable barrier against its encroachments. The direction of this range is north east and south west, with a gentle curve towardst he Bay of Fundy, to which it presents a series of lofty mural precipices, well adapted to resist the encroachments of its overwhelming tides and tumultuous waves.—This range formed by far the most fruitful field of our researches, and rewarded our labros by presenting the most interesting appearances, and many rare and beautiful specimens.

We shall first give an account of Digby Neck, which affords peculiar facilities to the researches both of the mineralogist and geologist.

This narrow strip of land is a continuation of the north Mountains from the Annapolis Gut, and extending thirty miles south westerly, is bounded on the north west, by the Bay of Fundy, on the south east by Petit Passage, which separates it from Long Island by a narrow strait, of but from half to three quarters of a mile wide; on the south by St. Mary's Bay, a beautiful sheet of water which separates it from the main body of land, by about ten miles in its extreme breadth. At the extremity of Digby Neck is situated Long Island, before referred to. This island is, in fact, of the same range as Digby Neck, and may be considered, geologically, as a part of it, the continuity being interrupted by Petit Passage only. This Island is twelve miles in length, and in the same line of direction as Digby Neck. Continuing westerly, we next come to Brier's Island, which is separated from Long Island by Grand Passage.

Having thus given a geographical outline of this peninsula and its adjacent Islands, we will proceed to describe, in order, the rock formations and the minerals occurring in them. We did not examine Briers' Island, but from a description of it by its inhabitants, we have no doubt of its being similar to Long Island, which is composed of columnar greenstone, almost to the exclusion of every other rock. The greenstone is somewhat irregular in its columnar structure, not exhibiting that regular prismatic form which we shall hereafter notice, as occurring at some other places. It is of a darker color, and difficultly acted upon by the causes of decay, so that the Island exhibits but a comparatively thin soil, but sufficient to reward the labors of the husbandman. Few minerals of interest occur at this place; they are mostly such as we shall have occasion to notice as occurring, more abundantly, in other districts of the north Mountain range. They are veins of jasper, chalcedony and a little amethyst. At low water the amygdaloid, on which the columnar greenstone rests, is accessible; in which occurs chlorite, filling the cavities in this rock. Indeed this mineral prevails here, to the exclusion of the zeolite, which, as we shall hereafter show, more generally occurs. It prevails in nodules, filling the spheroidal cavities in the amygdaloid; when broken, it presents laminæ, of a beautiful leek green color, radiating from a centre, and rarely crystallized in low tabular crystals, often intersecting each other. It is soft, easily scratched with the finger nail—is somewhat unctuous to the touch and has an argillaceous odour when moistened—before the blow-pipe it melts into a black scoria. The chlorite has often been removed by external causes, thus imparting to the rock a vesicular appearance; but in some few cases, the cavities were naturally left void, constituting the real vesicular amygdaloidal trap.

The veins of jasper, as they traverse the amygdaloid, become singularly altered in their character, being converted into a substance resembling, in appearance, imperfectly burned bricks of potters clay. The specimens from the interior of the vein, where it had not been acted upon by exposure, presented the same appearance; some parts were in fact perfect clay stone.—As the veins entered the superincumbent columnar trap, they became altered in appearance, and in the course of a few yards, became converted into a very perfect red jasper. Three or four veins of this character were observed, which all presented similar appearances.

How did the columnar trap convert these veins of clay stone, if they may be so called, into jasper? We leave thos to decide, who are more conversant with such phenomena, as we only propose to describe, and not to account for the appearances we observed.

The next place we shall notice, is that part of Digby Neck about six miles from Petit Passage, as we proceeded in our examination towards Digby up the Neck, called Little River Settlement. There are at this place a few inhabitants ; and as the mouth of the river affords a convenient harbor for small vessels, some fishing trade is carried on from this place. The most remarkable geological feature observable here is the wonderful symmetry of form in the prisms of trap. They here present a lofty precipice to the sea, where the river empties into St. Mary's Bay, composed of regular prismatic columns of three, five and nine sides, frequently broken horizontally, and in some cases imperfectly articulated by their motion on each other; thus resembling, in a striking manner, the basaltic rocks of the Giant's Causeway on the coast of Ireland. These prismatic blocks are usually two or three feet in diameter, and sometimes of many yards in length unbroken; not unfrequently they have been dashed from their pedestals, and tumbled in confusion against each other, forming irregular Gothic arches, and by their rude forms give an additional wildness to the scene.—The only specimens that can be procured amongst these ruins are fine examples of the basalti-form structure of the trap, if indeed, it may not claim the rank of basalt; for it differs only in respect to its not being so often in articulated prisms, and in exhibiting more evidently its component minerals, than the specimens we have seen, which were brought from the north of Ireland, from Scotland and from Germany.—The exposed surfaces of these rocks, from the additional oxidizement of the iron, exhibit a brownish red coating, but on recent fracture, show the internal structure to be fine grained, and of a homogeneous aspect, the crystals of hornblende, alone being visible to the naked eye. This trap is very heavy, tenacious and sometimes sonorous. Its color varies but is generally greyish black. We did not notice in these columns any sensible magnetism, having at the time no good compass for the purpose; but that this property does exist, we have sufficient evidence, from the influence it exerts on a surveyor's compass, in determining the divisionary lines of estates. This is peculiarly the case on Digby Neck, and in the neighborhood of Little River ;

but it has perhaps hitherto been erroneously attributed to the existence of large deposits of magnetic iron ore, and has hence served to excite extravagant ideas in the inhabitants, and confer an imaginary value on many of their farms.

So far as the local peculiarities of this trap may be considered as forming a foundation of an opinion, it would at the places last mentioned, be entitled with unquestionable propriety to the restricted term, basalt; but, as some of its internal characters may differ from the universally acknowledged basalt from the Giant's Causeway, and as the existence of true basalt has been denied in North America, we have concluded to make use of the generic name trap, leaving the truth of the question to be decided by more experienced geologists.

The next place which will interest the mineralogist is Mink Cove, which is about four miles east from Little River. It is a harbour of inconsiderable depth, and presents nothing very peculiar in its geological features. A few interesting minerals, however, occur in the columnar trap, and amygdaloid; they are red, yellow and ribbon jasper, which traverse the precipices in veins, from eight inches to a foot wide, and running for a considerable extent through the rocks, the yellow jasper occupying the amygdaloid on which the columnar trap rests, passes as it enters the more dense superincumbent rock, into red jasper of fine texture, often rendered more beautiful by zones of various colors winding in concentric circles through the mass. They are fit subjects for the lapidary's wheel, and when polished, constitute ornamental specimens. A curious mineral also occurs, imbedded in the amygdaloid of this place; it consists of broad lamellæ of quartz, disposed in parallel and intersecting plates, having the insterstices filled with calcareous spar, giving the specimens the appearance of alternations of siliceous and calcareous sinter. Geodes of quartz also occur, enclosing crystals of transparent white chabasie, measuring nearly an inch in diameter. A vein of magnetic iron ore, about a foot wide, was also observed, but being very irregular in its course, and terminating abruptly, gave no promise of being worthy of exploration.

The next considerable indentation upon this coast is Sandy Cove. This cove is the largest on the coast of St. Mary's Bay, and from its favorable situation, affords a safe harbour to mariners. Here, however, there is not much that is interesting to a geologist. The surrounding wall consists of tabular greenstone, rising from the base of the precipice in huge sheets vertically inclined, and sometimes divided into separate blocks, which lie one above another with their reposing surfaces perfectly flat, and without exhibiting that peculiar relation of contact, which is so often observed in distinct columnar trap. Indeed, there are other apparent discrepancies in regard to the internal appearance of this trap, when compared with that from Little River. Its texture is coarser, and by careful inspection, the laminæ of feldspar may be distinguished from the other ingredients. Its specific gravity is also less; and from the abundance of hornblende and green earth, it assumes a distinct greenish hue. Nearer the head of the cove, the height of the precipice gradually declines, and finally for its continuation, a bank of brecciated and amygdaloidal greenstone is substituted, containing imbedded nodules of the different zeolite minerals. Mention was made of this interesting spot in a former number of the American Journal; but as the second and more attentive visit to it, brought to light many new veins, affording specimens of surpassing beauty, we are authorized, at the expense of repetition to notice all the minerals of this locality, as well as many others, which have come within the scope of our united researches. This we deem necessary to mention, as it is the object of this communication to embrace all the known facts and observations, which may conduce to the fulfilment of its title.

At this place occur geodes of chalcedony, invested with greenstone breccia, lined on the inner surface with beautiful crystals of stilbite, and sometimes with a delicate white filamentous substance resembling fibres of cotton. It is apparently fibrous mesotype, similar to that found by Dr. McCulloch, in the Island of Skye. Also interesting specimens of quartz are found at this place, in the form of the primary obtuse rhomboid, in a few instances perfect, and more than three eights of an inch in diameter; but usually the crystals are modified by the absence of solid angles and replacement of single planes, which by their extension, tend to produce the common six sided pyramids. Only one pyramid of each crystal however, is visible, as the base from which the other would proceed passes into massive quartz without the intervention of lateral planes.

The amygdaloid is traversed by narrow and indistinct veins of specular iron ore, sometimes hollow and enclosing white transparent crystals of chabasie. Not unfrequently, insulated crystals of the specular ore are imbedded in limpid chalcedony, thus forming a singular variety of agate. Also a curious variety of quartz, consisting of minute alternating layers, so intimately blended or interfoliated with lamellar calcareous spar, as to appear, at first sight, homogeneous; but by the aid of acids the calcareous portion is readily removed, forming between the siliceous laminæ, small cells.

But the substance more likely to interest the mineralogist at this place is laumonite. This curious mineral presents itself, traversing the amygdaloid in veins sometimes a foot wide, running in vertical, inclined and zigzag directions. The substance of the veins, especially of the crystals, is more or less decayed, in situations most excluded from moisture, either from that of the sea, or that which percolates through the rocks from above. For invariably, in those places which are, at every tide submerged, unaltered specimens can be obtained. Into the cavities of these veins, the laumonite projects in beautiful groups of crystals, which exhibit the forms of the primary oblique rhombic prism, firmly implanted at one extremity, and at the other terminated by a single rhombic plane, inclining from one acute angle to the other. The crystals are colorless and transparent, and frequently an inch in length. Often the calcareous spar which forms the walls of a vein, is scattered over these groups in insulated rhomboids, considerably more obtuse than the primary crystals, and it often exhibits examples of hermitropic combination. Interspersed also with these, are brilliant spangles of specular iron ore, which give much additional beauty to the specimens, and serve at the same time to support the crystals of this fragile mineral. It is very singular that we have been unable to discover in the form of these crystals, the least modification by the absence of either edges or solid angles; while in specimens from another locality, to be mentioned hereafter, it is as difficult to discover a single crystal which has not the addition of secondary planes.

The accompanying calcareous spar, like that similarly associated from Brittany, is exceedingly phosphorescent, emitting a beautiful golden yellow colored light. But this property is by no means peculiar to this substance thus associated, for we have examined specimens from other parts of Nova Scotia, as well as from various localities in Europe and the

United States, and find that all, without a single exception, possess this property, when placed on heated bodies. The count de Bournon observed that from Brittany to be more phosphorescent than any he had ever seen, but we are unable to say whether that from Nova Scotia is equal to it, not having a specimen of the former in our possession.

We would mention in this place, for the benefit of those who may hereafter visit this locality of laumonite, as well as another which we shall describe, that in order to preserve the transparency of these crystals, they should be prepared with a strong protecting solution of gum Arabic, in which to immerse them, otherwise from the rapid efflorescence which this mineral undergoes, every crystal will be sacrificed, and the mineralogist will have the mortification of seeing the products of his labor crumble into dust.

About one mile east of Sandy Cove, the specular iron ore appears to the mineralogist in more important veins, affording specimens not inferior in beauty, to those from Elba. When not massive, it occurs in flat tabular crystals, often with curvilinear and striated faces, exactly resembling specimens from volcanic countries. This ore traverses both greenstone and amygdaloid. Magnetic iron ore also occurs near it, forming veins in the same rocks, which are not, however, of sufficient extent to justify the expense of mining. The best specimens are found in the soil occupying the interior of the disintegrated veins, which appear to have been left naked by the previous decomposition of the amygdaloid, which formerly surrounded them. Indeed, the soil is abundantly mixed with large and very perfect crystals in the form of the primary octahedron, and also exhibits the passage of it in various degrees of advancement into the rhombic dodecahedron, which it sometimes completes, and thus becomes isomorphous with the Franklinite, which generally presents this decrement. The crystals are sometimes imbedded in a friable dark bluish black colored substance, which proved to be black wad, or the earthy oxide of manganese.

The widést veins of this ore which have yet been discovered in situ, are only about eight inches in diameter, and they appear almost uniformly to diminish in breadth, as they are seen at greater depths from the surface. About thirty years ago, it was the result of accident to discover in the soil over the amygdaloid, a quantity of this ore, just sufficient to produce in the minds of speculators a desire for the establishment of iron works. Accordingly, on the supposition that there was ore enough, a site was selected for a smelting furnace at Sissaboo River on the opposite shore of St. Mary's Bay. But before much was accomplished, from the unexpected decline of exertions on the part of one or two individuals, the project languished and was finally abandoned. We mention this as being the first attempt, however premature, to introduce the manufacture of iron ore into this province.

Crossing from Sandy Cove to the Bay of Fundy, about the distance of one mile, we came to an indentation called Outer Sandy Cove, between which and the inner cove, is a small but extremely beautiful lake of fresh water, with a sandy bottom, and having a very diminutive outlet into the Bay of Fundy. These two coves are nearly connected by this little lake. The rocks at this cove present no remarkable peculiarities of structure. The shore is composed of immense sheets of greenstone of the amorphous variety, which shelve or dip towards the Bay of Fundy, at an angle of 10° or 15° and finally disappear beneath its waters. The most interesting features of this place are the large veins of red jasper which appear in parallel ridges, resembling more than any other thing, the brick battlements upon the inclined roofs of houses, and extending from the highest part of the shore to low water mark. These ridges stand as monuments to show the continual effect of a turbulent sea, which has worn away the rock they traverse with comparative facility, and left them entire, or slightly polished, as obstacles to its further encroachments. They contain in some places, geodes of quartz, amethyst, and rich specimens of agate, formed by narrow threads of red jasper traversing white transparent chalcedony, in a zigzag manner, and when polished, constitute pleasing specimens.

Following the shore of St. Mary's Bay, eastwardly as we leave Sandy Cove, and examining at low water the fragments which have been detached from the precipices above, and profusely scattered along their base at the water's edge, agates of various kinds, possessing great beauty, were found in abundance. Some were of that variety called fortification agate, from a resemblance to military works, on the polished surface of the specimens. This variety is often found well characterized on the shore; sometimes in small nodules which have been polished by attrition, and resemble the Scotch pebble in every respect: at others it is found in large tabular masses, which are evidently the ruins of veins from the overhanging trap rocks. The specimens of this vicinity frequently contain the outlines of many fortifications in the compass of a few inches. The base of this agate is an opaque white chalcedony, alternating with rows of transparent quartz and yellow jusper, the last generally constituting the external layer.

Brecciated agate, composed of angular and spheroïdal masses of red and yellow jasper, of fine texture, cemented by transparent and amethystine quartz, often enclosing in geodes, beautiful crystals of purple amethyst, which, covering the whole interior of the cavity with protruding crystals, vie in beauty with any specimens brought from the banks of the Rhine. A large geode was found near the estate of Mr. Titus, on the shore of St. Mary's Bay, which, weighing more than forty pounds, was composed almost entirely of the richest purple amethyst, the mass having but a thin coat of fortification agate externally. On examination of the crystals of this geode, we found a substance of a reddish brown color, traversing the amethyst, in fibres, or acicular crystals, which, beginning at the implanted extremity of the crystal, shoot out into diverging scopiform and fasciculated groups, to the opposite extremity. On exposure to a full red heat, this amethyst loses its color, becomes transparent, and has a vitreous lustre; the included fibres, at the same time, are changed in color to a dark brownish black. On fracture of one of the crystals of amethyst, we obtained a portion of the fibres, which on examination before the microscope, showed a reddish brown substance, with specks of a brass yellow, which we recognized as sulphuret of iron, the color being very speedily changed to brownish black by exposure before the blowpipe, when it became magnetic, as did the surrounding brown substance. We are then led to conclude that the yellow was iron pyrites, and the brown fibres red oxide of iron, which doubtless, had its origin from the decomposition of the former. The amethyst, traversed by this substance, was of a much deeper color than that in which it was not present, and the color appeared in the immediate vicinity of the fibres; hence we should be led to think that a portion of its color was derived from this mineral. The fibres are so minute, that we are unable to ascertain if manganese be present in them.

Large masses of red jasper, weighing more than a ton each, lie scattered along the base of Titus' Hill, which rises abruptly from the shore of St. Mary's Bay. This jasper is frequently of a fine texture, and is banded by stripes of various colors. Sometimes it appears to have been made up of rounded fragments of red jasper, cemented by chalcedony, thus being converted into brecciated agate; but this is not uniformly the case, for the fragments are more frequently encrusted with druses of quartz, which unite them to each other. Cavities of considerable size are found in these masses of jasper, having their interior surfaces lined with a covering of crystallized quartz, which, projecting in stalactites from the superior part of the geode, to which they are attached by a slender neck, hang down into the centre, having the dependent extremity enlarged by a radiation of crystals. Small portions of jasper are frequently included in the crystals, and give a beautiful appearance to the specimens.

Amethyst is often contained in these cavities, and is of such beauty as to attract the attention of the people, for we found they had carefully preseved those specimens which were of prepossessing appearance. Calcareous spar, in a few instances, was found enclosed in the jasper—likewise chabasie of a dirty white color, but the crystals were of considerable dimensions, and regular form.

On the coast of the Bay of Fundy, about six miles east of Sandy Cove, is an inconsiderable indentation, known by the name of Trout Cove. It presents but few interesting minerals. The situation of the rocks, however, is picturesque. The columnar trap is recumbent on amygdaloid, which here exists in a very narrow and almost inaccessible bed at the base of the precipice; the rocks have been tumbled in great confusion against each other, forming rude irregular passages under their walls. The only minerals to reward the collector for visiting this place, are some varieties of agate, which do not occur elsewhere on Digby Neck. They have a ground of highly translucent chalcedony of a blue color, with angular fragments of red jasper included. It is of a very fine texture, and improves much on the lapidary's wheel, and constitutes beautiful specimens of this curious variety. The chalcedony has sometimes, imbedded in it, slender threads of blood red jasper, which accompanying several different shades of color, twisted in zigzag directions, and preserving its parallelism with the others, constitutes a singular combination of fortification agate, and bloodstone in the same specimen—the outworks of the fort being delineated by this blood red zone. The agates occur, constituting veins in the columnar trap, which are seldom more than three inches wide. Chalcedony, of a very fine texture and smooth surface, and on recent fracture, of a perfectly pure white, also occurs at this place. It occurs, like the agates above mentioned, in veins rarely more than an inch wide, in the columnar trap. This variety, on account of its fine texture and good color, appears well adapted to be worked into cameos and other articles of ornament.

The next place which we visited on the coast of the Bay of Fundy, is a cove, which has received the singular appellation of Gulliver's Hole. This cove is the largest indentation which the seas have been able to effect, on the iron bound coast of the Bay of Fundy. It penetrates about three fourths of a mile into the land, and being narrower at its entrance, which is protected by massy columns of trap rocks, it affords a secure retreat to the small fishing vessels which frequent these waters, when the wind is too violent for them to ride on the unsheltered coast. This locality will prove of interest to the mineralogist, on account of a curious variety of stilbite, which here occurs incrusting the walls of narrow, but deep and perpendicular fissures in the trap. On either side of these chasms, the stilbite occurs in compressed laminæ, projecting horizontally, or at right angles with the rock to which they are attached, for the distance of about an inch. They are crystallized, at their free extremities, in the form of the right rectangular prism, terminated by pyramids, and with numerous other modifications. The crystals are arranged in a very irregular manner, crossing and intersecting each other at right angles, so as to produce between them, cellular interstices of various forms. The color of this stilbite is white, with a slight tinge of grey—it is glistening and somewhat pearly on cleavage—before the blowpipe it melts easily into a porous glass, without color and transparent. Large sheets of this mineral are easily detached from the rock, by means of the hammer and chisel—they constitute remarkably fine specimens of this singular mineral.

Magnetic iron ore in veins about a foot wide, associated with jaspery red iron ore, occurs in the trap rock at this place; but as the veins are exceedingly irregular in their course, and often terminate abruptly, little dependence can be placed upon them for mining.—This remark will apply to all the veins of iron ore which we discovered on Digby

Neck; for, although the ore is very rich, yielding as much as sixty per cent of iron, it is so scattered in narrow unprofitable veins, that it can never do more than supply the mineralogist, with specimens of the objects of his science.

Proceeding in our researches eastwardly along the opposite shore, nothing of peculiar interest presents itself, until we reach nearly the extremity of St. Mary's Bay. This Bay is separated from Annapolis Basin, by a narrow isthmus on which the town of Digby is situated, and which connects Digby Neck with a moderately elevated range of hills to be mentioned more particularly when we treat of that formation. This isthmus, which no where attains an elevation of more than one hundred feet, is composed almost entirely of sandstone without presenting, so far as our examination has gone, any traces of marine or other organic relics. It is perhaps the old red sandstone; though we were unable to discover its junctions with the neigboring trap rocks, it being no where disclosed along the shore; and the surface, beyond the reach of the tide, consists of a deep soil, which throws a veil over the whole formation. It is probable however, that a junction does exist here, though at present excluded from observation; but as we shall hereafter mention the second appearance of this sandstone, in a distant section of the North Mountains, under circumstances of much local importance, it is perhaps unnecessary to dwell upon it. On the shore of St. Mary's Bay, a vertical section of this sandstone is presented, of about one hundred and fifty feet in height; spreading its broad face to the sea, and being the natural barrier to buffet its violence, it has received the appropriate appellation of the sea-wall. It consists of the red and grey varieties, alternating with each other in long parallel strata, running nearly north and south, and gradually inclining away at an angle of about ten degrees, till it disappears beneath the surface. The strata vary much in thickness, but from four inches to four feet, will include the limits of their variation. The first ten or twelve feet of the precipice, include uniform alternations of the grey variety alone—above this succeeds a beautifully variegated kind, made up with white, grey, and variously shaded red colored stripes, which, rising in continually widening strata, become gradually of a deeper red, and finally pass, distinctly, into the red sandstone, retaining this character, through the remaining superposition of the strata, forming the verge of the whole series.

This red sandstone consists of minute grains of siliceous and calcareous matter, interspersed with spangles of mica. Attached to it are small beds of reddle, or red chalk, usually occupying the spaces between approximate strata, and preventing their actual contact. This variety is comparatively soft and more readily acted upon by external causes than the grey, which has a much coarser, and by no means so uniform a texture. Both effervesce briskly in nitric acid, but the grey contains the greatest portion of the calcareous ingredient. This sandstone does not contain veins of gypsum or limestone. In fact, the reddle was the only simple mineral which we observed in it. The entire precipice, from the feeble cohesion of its parts, is rapidly acted upon by the ordinary causes of decay; large masses are almost continually losing their hold from above, and adding new matter to the slope of débris which inclines from its base into the sea, but before being crumbled into the sand, many of these fallen blocks which assume a cubical or prismatic form, as they usually do, are advantageously employed by the inhabitants, who obtain them during the absence of the tide, which here rises to the height of thirty five feet. Since the erection of the Annapolis Iron Works, the practical worth of this sandstone, as a material for supporting high temperatures, has been fully ascertained by the slight alteration it experienced, when exposed to the most intense heat of the smelting furnace, of which it formed the boshes and part of the lining.

About three miles N. E. of the sea-wall at Nichols' Mountain, magnetic iron ore occurs in compact masses, imbedded in a deep soil, resulting from the decay of the contiguous trap rock. These masses generally exceeded two feet in diameter, having two of their opposite faces smooth, implying that they once constituted a vein. The whole weighed about fifteen tons. It was conveyed to the furnace, smelted and found to produce with a due proportion of flux and charcoal, cast iron of superior quality. But on subsequent examination of its local situation, nothing promising a further supply could be discovered. The greenstone near, and immediately beneath it, was the brecciated variety, consisting of round masses formed of concentric layers, which by a moderate blow separate into a multitude of fragments. But it no where exhibited the slightest traces of the existence of veins. It seems probable therefore, that these weighty masses originally formed a vein in this rock, but like that mentioned at Mink Cove, terminated abruptly at a depth, less than that to which the decomposition of the greenstone has extended. The structure of this ore is coarse granular, sometimes crystalline and columnar. It is highly magnetic, and some fragments possess polarity. Its specific gravity is very great, averaging 5. and consequently it contains about sixty five per cent, of pure and malleable iron, though of cast iron it yields ten or fifteen per cent. more, from its addition of carbon during the operation of smelting it. The masses sometimes presented beautiful druses of amethyst in violet crystals, projecting from an incrustation of chalcedony, which contains small globular masses of mesotype and calcareous spar. They also contain brilliant druses of quartz, presenting a botryoidal stalactitic appearance. In a few instances, the amethyst, quartz and chalcedony are united in one specimen, enclosing imperfect crystals of the magnetic iron ore, constituting, when polished, a very singular and interesting variety of brecciated agate, and showing the metallic concretions, deeply imbedded in the transparent chalcedony.

Near this place, a small stream takes its rise from the mountains called William's Brook, which, running some distance south eastwardly, empties its waters into St. Mary's Bay. On the banks of this stream, near its source, we discovered veins of a radiated milk quartz in the amygdaloidal trap, coated externally with a thin incrustation of green earth, and having vacancies internally crystallized, and enclosing in some of the geodes, a beautiful pearly white foliated heulandite and stilbite often radiated, and sometimes intersected by the laminæ of heulandite. The two minerals being thus exhibited together in the same specimen, their distinguishing peculiarities are rendered much more obvious. Indeed, the most unpractised eye readily distinguishes the bright pearly lustre of the heulandite, from the dull greyish white reflection of the stilbite. In the same geode with the heulandite, occurs a greenish mineral, crystallized in the form of the obtuse rhomboid, and possessing all the characters of chabasie, excepting color. It is probably that mineral, colored by green earth. These masses often occupy the whole interior of the geodes, and are deeply indented by the pyramids of the surrounding quartz crystals; whence we suppose it to have been of more recent formation, or at least of induration, than the quartz enveloping it. Botryoidal cacholong also occurs, encrusting the interior of vacant cavities in veins of quartz. This locality will repay the mineralogical traveller for the trouble of a visit; and the course of the stream is a correct guide to the spot where specimens may be procured.

The only place which we have not already described, worthy of a visit from the geologist, is that part of Digby Neck where the North Mountain range is interrupted by the Gut of Annapolis. This is two miles from the town of Digby. At this place, is situated the Light-house, which serves to guide navigators to the entrance of Annapolis Basin, the most capacious and secure harbor for large vessels in Nova Scotia, and in which, as is observed by one of her historians, a thousand ships may ride in safety, secure from every wind.

The site of the Light-house is on a projecting rock of columnar trap of the most compact variety, and the numerous irregular crevices have been filled with chalcedony, jasper and agate, which, adhering firmly to the contiguous rock, give it additional firmness, enabling it to resist successfully the fury of the waves, which, in boisterous weather, dash completely over the precipice, and wash from its surface, every trace of soil or vegetation. The centres of the columns of trap appear to be more readily acted upon by the sea, than the parts contiguous to the chalcedonic veins, and thus concavities are produced, in which the spray from the sea slowly evaporated, leaves crystals of its saline contents, thus constituting natural salt pans.

The rocks at this place are columnar trap, incumbent on amygdaloid, and present a surface exactly corresponding to that on the opposite side of the Gut, which is but half a mile wide, and appears as if it had been separated by violence, and not worn away by the action of the water.

Passing Annapolis Gut and pursuing our investigations along the coast of the Bay of Fundy, our attention will first be directed to *Chute's Cove*, which is twenty miles from Annapolis Gut. The intermediate coast we did not examine, but from the information we obtained in regard to it, we are led to believe that it presents a line of uninterrupted precipices of trap rocks, affording the mariner but few places of landing, and the coves that occur are not of sufficient magnitude to ensure protection from the sudden gales which spring up on this coast.

Chute's Cove forms a wide interval in the prevailing abruptness of the coast. Its bottom presents a great extent of surface, and on examination at low water, it appears to consist of distinct columnar greenstone, whose individual faces are probably the summits of long columns rising vertically from deep foundations. These faces, which are of course subject to the periodical overflow of the tide, present, from the action of the sea, assisted by the motion of sand and pebbles, shallow, basin like cavities, regularly curving from the centre up to the polished brim, formed by a substance of a different nature from the bottom. This substance, which never exceeds half an inch in thickness, is a quartzose cement. It entirely surrounds the columns; preventing their immediate contact; and from its less obvious marks of dimunition, it forms small projections rising above their surfaces, serving to protect most effectually, that portion nearest approaching the sides. Thus the comparatively greater diminution of matter towards that point is readily accounted for, and the formation of these basin like cavities would seem the natural effect of long continued exposure, did they not themselves prove satisfactorily what causes have operated in forming them. We also observed several columns beyond the reach of the sea, which exhibited these appearances in a less striking manner, though to an extent sufficient to prove that the effects of ordinary causes have a direct tendency to produce eventually these depressions. This greenstone, as regards internal characters, corresponds, almost precisely, with that from Little River before mentioned.

About a mile west of this cove, among water worn masses which form a loose pavement descending into the sea, we observed several egg shaped masses of amygdaloid, exhibiting on their surfaces, small globular concretions of heliotrope, invested with green earth, and presenting all the intermediate shades of color, from transparent chalcedony to an almost opaque green. We also picked up several imperfectly polished masses of greenstone porphyry of a fine texture, exhibiting distinct faces of crystals of white feldspar in the form of a parallelogram: but we did not succeed in finding this rock in place.

Leaving Chute's Cove, and proceeding about six miles eastwardly, we arrive at St. Croix Cove. At this place, the rocks resume their abruptness, and present lofty precipices of columnar trap, resting on amygdaloid, which abounds with its usual zeolites. The shape of the cavities which the amygdaloid presents, is quite singular. Instead of the spheroidal shape, in which they usually occur, we are here presented with cylindrical cavities, from half an inch to two inches in diameter, and often more than a foot in length. They are mostly vertical or but slightly inclined, and sometimes branch in a curious manner. The interior of these cylinders is usually coated with a thin layer of green earth, over which an incrustation of beautiful crystals of heulandite is deposited. A considerable space is usually left void in the centre, and the projecting crystals are remarkably perfect, exhibiting many curious modifications on the primary form. The most common is the replacement of the solid obtuse angles, and the lateral acute edges by single planes, thus producing a hexahedral prism with dihedral summits. The heulandite is not always crystallized, but often entirely fills the tube with laminæ, intersecting each other in an irregular manner, as if it had attempted crystallization in a space too limited to allow room for the crystals to become perfect. They are evidently the product of one crystallization, for there are never concentric layers of this mineral in the tubes. These cylinders, studded with brilliant crystals of heulandite, constitute specimens highly interesting to the mineralogist; but the form and position of the cavities may be considered valuable evidence in accounting for the origin of the trap rocks. Our limits will not permit us to dwell on this subject sufficiently, to weigh the evidence against any theory, but we may venture to hint at the evidence which may be derived from their form and position. If the cavities were produced by the expansion of an elastic fluid,—the pressure being equal in all directions, a spherical cavity would necessarily be produced; and this might be converted into a cylinder, either by the hardening of that portion of the rock to which the upper hemisphere was attached, while by a subsidence of the tenacious mass below, containing the other hemisphere, a cylindrical cavity or tube would be produced. The tubes are often bent at right angles, as if the rock had been subjected to an alternate irregular elevation and depression. The occurrence of native copper in a similar cavity, a few miles to the east of this place, might probably be adduced as evidence that the production of this rock was attended with heat. In the instance referred to, there was a crystal of green analcime attached to a filament of native copper, which, projecting from the rock, probably served it as a nucleus on which to crystallize. The crystals of heuandite, &c. were doubtless deposited subsequently to the formation of the cavities, as the incrustation always received its impressions from the irregularities of the tube, and never left any, although it received an indentation from the slightest prominence in the rock. The only way in which we can account for these cavities, on the supposition that the rocks were of aqueous origin, would be, to suppose the upright tubes to have been produced by the ascent of some elastic gas; but as the cavities are soon arrested by a dense superincumbent rock, and have no outlet, and at the same time diminish in size as they ascend, there is reason to suppose the cavities to have been produced by some condensible elastic fluid, as steam. Their position shews the force which produced them to have acted in a direction up and down, and their irregularities perhaps indicate the rising and falling of the fluid mass.

We shall take occasion hereafter to shew the relations of shale, red sandstone and trap, in the production of trap-tuff and amygdaloid, which will lead us to infer, that the vicinity of the trap is necessary to the formation of amygdaloid, and that the production of that rock was attended by heat.

Before leaving this cove, we would mention that foliated heulandite occurs in veins two or three inches wide in the amygdaloid, and that mesotype is found abundantly in the soil formed by the disintegration of this rock.

From St. Croix Cove, pursuing the coast easterly, the amygdaloid, crowned with columnar greenstone, continues and forms an abrupt precipice for five miles, where it is again interrupted by Martial's Cove.—The rocks at this place, and the ruins which the neighboring shore presents cannot fail to reward the labor of those who may visit this locality, as scarcely a week passes, without the downfall of some impending steep, which scatters its treasures along the shore, before shaded by its brink. Here the heulandite is not confined to spheroidal masses, as a mere constituent of amygdaloid, but exists in veins sometimes six inches wide, extending vertically from the base of the precipice to its extreme verge. Some of them which have fallen in connexion with the immense massess of greenstone, exhibit broad laminæ of a pearly white appearance. It is usually colorless and transparent, but in one or two instances, specimens were found of a red color resembling those brought from Scotland and Germany. But in speaking of the interesting productions of this place, we should not pass over a very curious, and in fact, hitherto unknown association of analcime with native copper. The analcime occurs in the form of the primary crystal, and by the replacement of these planes on all its solid angles, presents the passage of that form into the trapezohedron. It is of a verdigris green color, but towards the centre of many crystals, this color diminishes in intensity, and in some, it entirely disappears, leaving them transparent. They also approach the emerald green. The copper is partially imbedded in these crystals, sometimes in globular concretions about the size of a common pin's head, and at other times in minute filaments, having one extremity attached to the amygdaloid, in the cavities of which they both occur. These globules are soft and malleable, and when scraped, possess the brilliant lustre of pure copper. The crystals presenting themselves under an aspect so new and beautiful, induced us to examine them more particularly in order to ascertain the nature of their coloring matter. As the amygdaloid contained a portion of green earth, at first we ascribed the color to this substance, as it is well known to penetrate other minerals and impart to them a green tinge. But as a few of these crystals were covered by a thin film of a green carbonate of copper, it seemed probable that this substance might be the occasion of the green stain which more uniformly pervaded them. In order to ascertain it, we digested the powder of a crystal which contained no copper mechanically united with it, in nitric acid and detected this metal in the solution by appropriate tests. It is probable that this metal may yet be discovered at this locality in crystals occupying alone the cavities of the amygdaloid, as has been observed in a similar rock in one of the Faroe Isles.

The next places of mineralogical interest, which we shall mention, are Hadley and Gates' Mountains.—They are situated near each other, and each of them attains the height of about three hundred feet, rising gradually from the Bay of Fundy. The summit of the former is composed of amygdaloid, in which nodules of chlorophæite seems to take the place of the zeolites. The nodules are frequently half an inch in diameter. They are sometimes hollow, enclosing crystals of dog-tooth spar. Specimens of the chlorophæite when recently broken, are of a greenish tinge, sometimes approaching leek green; it is translucent on the edges and soft, yielding to the nail with about the same readiness as horn silver. The fracture is distinctly conchoidal. On exposure to the air, the color changes, and the substance becomes black and opaque. This peculiar change is also observed in specimens, before being removed from the rock, even to the depth of six inches from the surface. We would observe that this substance from its deceptive appearance has occasioned much speculation among the inhabitants, and that a company was formed not long since, for the purpose of working it as an ore of copper. This mistake seems to have originated from the use of the mineral rod, which in Nova Scotia, as well as in New England, has led many an honest farmer into ruinous speculations.

In the possession of a person, residing near this locality, we observed a beautiful cylinder of heulandite. It was twelve inches long, and one in diameter at the largest extremity. Had we not seen before examples of this form, we should have pronounced this specimen to be a stalactite, formed in the larger cavities of the amygdaloid. It consisted of brilliant, transparent laminæ, placed at right angles to its axis. Its surface was invested with a coating of green earth and seemed as it were, to have been painted artificially. It was found at St. Croix Cove, and obviously filled the entire space of a cavity corresponding with its dimensions. This being a large and very perfect representation of the forms under which this substance there occurs, we were induced to mention it.

Gates' Mountain is also formed mostly of amygdaloid and the included minerals are peculiarly large and abundant. In obtaining specimens, the labor of digging or even of using a hammer is here entirely avoided ; for masses of thomsonite and mesotype are found abundantly scattered over the fields. Indeed, in some spots, the rock which has resulted from the decomposition of the amygdaloid, is literally filled with masses of these minerals, from the size of a bullet to that of a twenty four pound ball. We shall mention these two minerals from their remarkably well characterized appearance. The large masses of thomsonite are composed of long and slender crystals, radiating from opposite points of the surface, and meeting in the centre, where they unite in a very irregular manner, forming narrow cells in which may be observed distinct, colorless and transparent crystals in the primary form, measuring more than an inch in length. These crystals are occasionally replaced on their solid angles and terminal edges, but the replacements are not deep. This thomsonite agrees with that from Dumbarton in Scotland in its chemical and physical characters.

The mesotype is in masses of a finely radiated or plumose structure, and when broken, presents in the less compact parts, small intersecting fibres of a beautiful silky white appearance. Its texture, near the surface, is unusually compact, breaking with a splintery fracture; and some specimens in this respect, as well as in point of color, resemble the bones of fishes, for which they are sometimes mistaken by the inhabitants, who plough them up from the soil of their fields. We did not observe, in any of these specimens, well marked appearances of crystallization. Attached to the mesotype and thomsonite, are small masses of foliated stilbite and crystals of analcime. Several veins of magnetic iron ore occur on this mountain, but they are worthless, in a practical view, from their narrowness and inconsiderable extent.

The next place which will prove interesting to the mineralogist is Peter's Point. This name is given to a promontory which projecting into the Bay of Fundy, forms a shelter on the west to a small creek, into which a stream sufficiently large to carry a saw-mill, called Stronoch's Brook, discharges its waters. The geological features of this place are similar to those at St. Croix Cove, excepting that the cylindrical cavities are here wanting, and the amygdaloid has been washed away from under the superincumbent columnar rock, which presents an overhanging precipice, threatning to crush the traveller who may venture beneath its frowning brink, from whose summit, large masses of rock detached by the frosts are almost continually falling.

Near this Point, under the protection of an arch of columnar trap, a deep cavity was discovered in the amygdaloid, which, having a narrow aperture, expanded internally to the diameter of six feet, in every direction. The mouth of this little cavern being enlarged, so as to admit of examination, its walls were found to be thickly encrusted with laumonite in a remarkably fine state of preservation. Specimens were easily detached by the hand, and were found to consist of successive layers of radiating crystals, which, in the centre of the mass, were of a fine flesh red color. The external surface of this crust, and the interior of cavities which frequently occur, were richly studded with transparent and colorless crystals, of great perfection and beauty.

They are in the form of the oblique rhombic prism, terminated by a rhombic plane passing from one of the acute solid angles to the other, and almost constantly replaced on the acute solid angles by a single triangular plane resting on the acute lateral edges ; these secondary planes are always small, and never obscure the primary form of the crystal. The cavities, in the laumonite, are often filled with water which serves to prevent the efflorescence of the crystals, which are thus preserved in an unaltered state. The surface of this mineral is frequently enriched with crystals of calcareous spar, exhibiting the forms of the rhomboid more obtuse than the primary, and the scalene triangular planed dodecahedron. Large and perfect crystals of apophyllite in the form of the square prism, generally replaced on the solid angles by single triangular planes, which are in various degrees of advancement, sometimes almost concealing the primary form are found at this place. This mineral agrees perfectly with specimens in our possession, which were from standard localities in Europe. The crystals are eminently axotomous, and this cleavage is so easily obtained, that it is with great difficulty the crystals can be preserved entire. The cleavages parallel to the sides of the right square prism are easily obtained, but the natural joints are not so open as in the direction of the terminal plane. It agrees likewise in chemical characters with the apophyllite from the Bannat ; hence there can be no doubt of its identity with that species.

This cavern is the first place in Nova Scotia, which furnished us with this rare mineral, and as we did not exhaust it, future explorers may obtain a rich reward, for the trouble of searching for this locality.

We shall next describe French Cross Cove, which is about twelve miles from Peter's Point. At this place, the amygdaloid and columnar greenstone form together a precipice rising perpendicularly, to the height of three hundred feet, and exceeding in elevation any other we have yet noticed. The entire front of this precipice can be examined only at low water, when it presents four large parallel beds distinctly separated from each other. The lowest is a reddish amygdaloid, largely impregnated with spheroidal zeolites ; the next is an amygdaloid of the common appearance, and contains but few minerals, although it presents many cavities unoccupied. The third layer is rarely vescicular, and seems in fact to pass into amorphous greenstone. The last is composed of tabular and columnar greenstone rising in irregular columns to the top of the precipice. The stratified disposition of these rocks, we believe, is an uncommon occurrence. How far it continues we are unable to say, as further progress along the coast was impracticable. Nor did the tide allow us time to examine this coast so attentively as we desired, or it is probable we should have discovered the line of junction between the greenstone and the sandstone, on which, doubtless, the whole precipice is incumbent. But as few masses of sandstone were observed lying on the beach, it is probable this junction is visible only at very low tides. Dr. M'Culloch has mentioned an appearance similar to this, in the Island of Staffa; but there the precipice consisted mostly of columnar basalt, and the three beds composing it did not exhibit that distinct relation of contact which distinguishes the one we have mentioned. (Trans. Geol. Soc. vol. II.) The amygdaloid near this precipice furnishes good specimens of laumonite and mesotype; but the most abundant mineral it contains is heulandite, which, from the beauty of its crystals, we shall here describe. It occupies the interior of veins of quartz, and is sometimes found lining the surfaces of botryoidal chalcedony and geodiferous quartz. The crystals are in the form of the right oblique angled prism, with the obtuse solid angles replaced by triangular planes, and the acute edges are also replaced by one plane, and the crystals thus pass into the hexahedral prism. They are colorless and transparent. On cleavage parallel to the terminal plane of the prism, the laminæ present the brilliant pearly white appearance characteristic of this species. The lateral planes often present a remarkable vitreous aspect. None of the heulandite however, from this locality possesses the red color peculiar to that brought from the Tyrol. Specimens of it are frequently interspersed with stilbite in projecting bundles of crystals, which well show the characteristic difference between the two minerals. Analcime of a reddish color is also associated with it, and is probably that variety called sarcolite.

No further examination was made of this coast until we arrived at Cape Split. This bold promontory, terminating the north eastward limit of the north mountain range, projects into the Bay of Fundy, and the extremity of the cape having been detached from the main land, probably from the undermining of the amygdaloid by the tumultuous waves, which caused the weighty mass to fall from the contiguous rocks into the sea beneath, leaving a wide chasm through which the tides form a rapid and dangerous "race-way." The name of this cape doubtless originated from an opinion of its having been thus separated from the adjacent precipice, an event which occurred before the memory of the oldest inhabitants of the country. This cape forms the southern boundary of a strait called by the inhabitants "the gut," which connects the waters of the Bay of Fundy with the Basin of Mines. It presents a lofty mural precipice extending southward, and gradually increasing in height, till it finally reaches the elevation of nearly five hundred feet above the level of the sea at Cape Blomidon, which is fifteen miles from Cape Split. The intervening coast is constituted of regular columns of trap, resting on, and alternating with amygdaloid which abounds with analcime, transparent and colorless, but sometimes it is of an apple green color internally, and invested with an opaque white crust on the surface. Heulandite here occurs in crystals of uncommon size, and is associated with calcareous spar in rhomboids, and with stilbite and apophyllite, the last in small tabular crystals scattered over the surface of the stilbite. Accompanying the analcime we found a mineral resembling that variety of mesotype, called needlestone. It occurs in tetrahedral prisms terminated by low pyramids, formed by four triangular planes resting on the terminal edges. One of the terminal planes is often extended at the expense of the others, which it sometimes nearly obliterates. This mineral occurs in groups of crystals, radiating from a centre which is sufficiently compact to yield a splintery fracture, and is white like ivory. The crystals when perfect are transparent and colorless, and have a remarkable vitreous lustre. They are sufficiently hard to scratch glass, and are brittle. The needlestone fills cavities in the amygdaloid and is always formed on the surface of the analcime, which it never penetrates, but receives an impression from the crystals of that mineral. The geodes in the quartz at this place are often filled with amethystine crystals, forming successive layers, and are externally incrusted with cacholong.

Hornstone, masses of agate, &c. occur scattered among the ruins of the trap rocks, which become entirely inaccessible as we approach Cape Blomidon. This cape forms an abrupt termination of the north mountains, or as they are called in this district, the Cornwallis Mountains, on the east. This cape presents us with the outcropping of the sandstone which here gives support to the trap rocks, and constitutes the chief part of the precipice, being more than three hundred feet high, and having the columnar trap resting upon and scarcely attaining the elevation of a hundred feet above it. The sandstone forms a projection beyond the trap which is called by the inhabitants of the county "the offset." This rock is stratified, and dipping at an angle of ten or fifteen degrees, passes under the trap. It runs in the direction of the north mountains, which it probably supports through their whole extent, as we discovered it in several places along their declivity, as represented on the map. It does not include any organic remains at this place, nor veins of gypsum. At Finney's mills in the township of Wilmot it contains a bed of calcareous breccia, including nodules of hornstone, and small masses of radiated gray oxide of manganese. The sandstone at this place is highly calciferous. This rock never distinctly appears on the coast of the Bay of Fundy, although from the appearance of trap-tuff containing fragments of it, we should be led to consider it as not far beneath the accessible base of the precipice at French Cross Cove. We have now finished our description of the north mountains, which comprise the whole district of the trap rocks in Nova Scotia, excepting the extremities of the capes on the opposite side of the Basin of Mines which remain to be noticed.

(To be continued.)

Art. XII.—*A Theory of Fluxions**; by Elizur Wright.

Sec. I. *The nature of Fluxions.*

The design of fluxions is to investigate the relations of quantities that increase or decrease by degrees that are less than any assignable one, that is, where the alteration of magnitude is effected by one continued increment or decrement.

To illustrate the nature of fluxions by geometrical quantities, let us suppose that a (Fig. 1. A ________ B . . . . . . C) point, moving from A, generates the line AB$=x$, this line is called a fluent. Now if the point is conceived to move still onward, for a given time, with the same degree of velocity, which it had at B, it generates the line BC$=\dot{x}$, called the fluxion.

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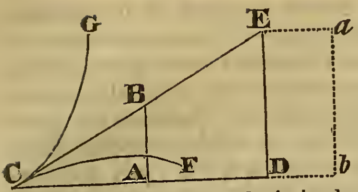
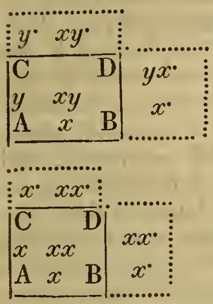
*Communicated by the author, to the Connecticut Academy of Arts and Sciences, and published from their papers.

Fig. 2.

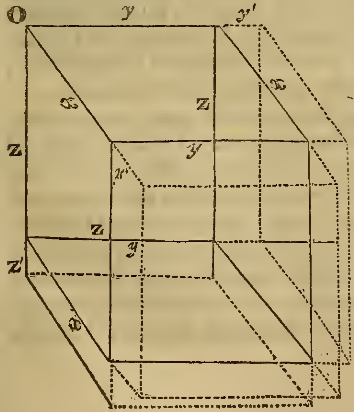


In the triangle CED, suppose the generating line AB, variable in length, to move from C to D, the area generated by this motion is termed the fluent. If the generating line should still flow on, with the magnitude it had at the moment in which the fluent CED is completed, the rectangle EabD, generated by this motion, is called the fluxion.

Fig. 3.



We may imagine a superficies to be generated thus: let the dimension of length be represented by x, Fig. 3, and that of breadth by y; let these two quantities be supposed to commence their existence and motion together, at the corner A, and let them so proceed in their motion, as to preserve the intended proportion between them. When they arrive at the situation CD, DB, the fluent CDBA equal to xy is generated. Conceive the lines x and y to move still onward with the same motion they had at the instant when the fluent was completed, for any assigned time, great or small; and they will generate the parallelograms $yx^{\cdot}$ and $xy^{\cdot}$, termed the fluxion. When the length and breadth are equal, the figure becomes a square, the fluent xx being represented by CDBA, and the fluxion by the two equal parallelograms $xx^{\cdot} + xx^{\cdot}$, or $2xx^{\cdot}$.



Again we may conceive a solid to be generated in the following manner. Let x be the variable quantity representing the dimension of length, y that of breadth, and z that of thickness. Let each of these be supposed to commence its existence and motion at O, and let each dimension increase in such a manner as to preserve the intended proportion between the lines x, y, z. The lines x and y, by their motion, generate the superficies xy. Let this superficies be conceived to move from the point, at which it commenced its existence, downward, until the solid intended to be generated is completed: at that instant xy becomes an invariable quantity, and bounds the solid at the bottom. Conceive the point generating the line z to move yet onward, carrying along with it the superficies xy, the result will be $xyz^{\cdot}$, the first term of the fluxion. Proceeding in like manner, xz represents the superficies that bounds the side opposite to the commencing point, and $xzy^{\cdot}$ will be the second term of the fluxion. Also yz represents the superficies, that bounds the end, opposite to the commencing point; this multiplied by $x^{\cdot}$, the fluxion of the length will be $yzx^{\cdot}$, the remaining term. Collecting the three terms together, $xyz^{\cdot}+xzy^{\cdot}+yzx^{\cdot}$ is the fluxion of a solid, whose dimensions are expressed by the product xyz. Corresponding to these three terms, the fluent consists of three pyramids. The first is a pyramid, whose apex lies at the corner at which the solid originated, and whose base is at the bottom of the solid: the second has its apex at the same place, and base at the opposite side: the third, its apex at the same place, and base at the opposite end. When the three variable quantities become equal to each other, the solid becomes a cube, and the fluxional expression is $x^2x^{\cdot}+x^2x^{\cdot}+x^2x^{\cdot}=3x^2x^{\cdot}$. But, inasmuch as the philosophical idea of motion is not essential to the method, and is introduced merely for the purpose of illustration, we may conceive quantities of the first, second, third, fourth powers, and of any power whatever, to be generated in a manner somewhat analogous to those which are geometrical, that is, by passing successively through every assignable magnitude. Here we proceed in a manner purely mathematical, for we may suppose a quantity to assume any magnitude, at pleasure, out of the endless variety of magnitudes, contained within the limits of the greatest and the least.

By attending to the manner in which fluxions are obtained, the following things will be evident. 1. That each of the variable quantities, in its turn, after the generation of the quantity, termed the fluent, is completed, flows still onward for a given interval of time, producing, by an uniform motion, a line of a finite length; which may be termed *the fluxional base*. 2. That all the other variable quantities, at the instant in which the fluent is completed, become invariable, and accompany the point producing the fluxional base, as it moves onward; and may be termed *the fluxional coefficient.* 3. That, in a complete fluxional expression, there are as many terms as there are variable quantities, that is, in yx there are two, $yx^{\cdot}+xy^{\cdot}$, in xyz three, $xyz^{\cdot}+xzy^{\cdot}+yzx^{\cdot}$. In the square two, $xx^{\cdot}+xx^{\cdot}$; in the cube three, $x^2x^{\cdot}+x^2x^{\cdot}+x^2x^{\cdot}=3x^2x^{\cdot}$; and in the biquadrate four, $x^3x^{\cdot}+x^3x^{\cdot}+x^3x^{\cdot}+x^3x^{\cdot}=4x^3x^{\cdot}$, and so on. Hence may be derived rules for assigning the fluxions to fluents, which is called the direct method of fluxions. But cases exist, in which some of the terms are wanting, among which is the fluxion of the area in the triangle and curvilineal figures, the formula of which is $yx^{\cdot}$; and the fluxion of the solid content in the cone and pyramid, which, although they have three dimensions, have but one term $ax^2x^{\cdot}$; the fluxional base being the fluxion of the height, and the fluxional coefficient ax^2, the generating superficies. To quantities of this kind, fluxions may be assigned, by considering the manner in which they increase, and setting down their fluxions, instead of their increments.

In assigning the magnitude of fluxions, mathematicians are not restricted to any particular limits. But although the fluxional base $x^{\cdot}$ is an indeterminate quantity, and may have any assignable magnitude, great, or small; yet when it is one fixed, all the fluxional bases, which belong to the same expression, are determined by it: for all the fluxions, that enter into the same equation, must be understood to be produced contemporaneously.

Sec. 2. *Some principles relating to Fluxions.*

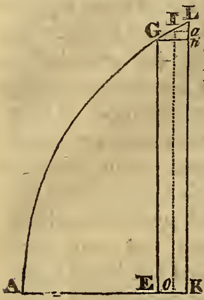
Prin. I. If a quantity, varying by insensible degrees according to the laws of continuity, pass from one state of magnitude to another; *it must successively have all the intermediate degrees of magnitude* from the least to the greatest.

Prin. II. No portion of a curve can be assigned so small, but there may be one still smaller. This follows from the infinite divisibility of quantities.

Prin. III. *No portion of a curve can be taken so small as to become a straight line.*

For from Prin. II, no portion of a curve can be taken so small, but one can be taken still smaller, and therefore the portion taken can be divided into two parts; and if divided into two parts, from the nature of a curve their directions are different, and therefore not a straight line. Hence a circle cannot be a polygon of an infinite number of sides.

Fig. 4.



Prin. IV. The fluxion GnKE *is not an elementary part of the fluent* AKL; that is, the fluent AKL is not compounded of any number of any such small spaces as GnKE whatever. For, however small the curvilineal space GLKE may have been made by repeated divisions, the fluxion GnKE still differs from it by the triangle GLn; and, notwithstanding we may continue to subdivide it, there will always remain the triangular space ILa, by which the fluxion differs from an elementary part.

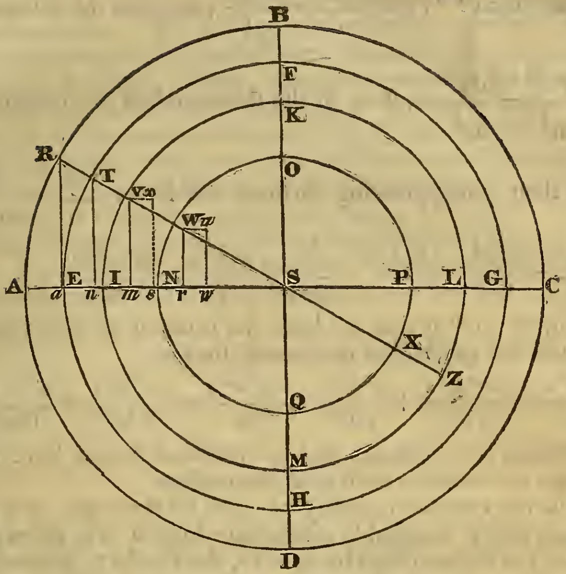
Prin. V. If the difference between two quantities, continually approaching towards each other, becomes *less than any assignable quantity, those two quantities are then equal.* For if it be said that they are unequal, let their difference be represented by D, then if the approximation be continued, their difference will, at last, become less than D, and so D is not their difference, which is absurd. Therefore the proposition advanced is true.

Prin. VI. When the difference between any two quantities is less than any assignable quantity, the one may be taken for the other.

Sec. 3. *The grounds of Fluxions.*

Every variable quantity, which occurs in the process of a mathematical calculation, may be considered as an isolated term in a *series of fluents*, that may be conceived to arise, when that variable quantity is expanded.

Fig. 5.



1. Draw the circles ABCD, EFGH, IKLM, NOPQ, and from the points, where the radius RS intersects the circles, draw the ordinates Ra, Tn, Vm, Wr, and ARa, ETn, IVm, NWr, will be a series of fluents. Suppose the fluents that are taken to be IVm, and NWr. Put the diameter $WX=a$, $VZ=n$, the abscissa $Nr=x$; then $Wr=(ax-x^2)^{\frac{1}{2}}$, $Im=\frac{nx}{a}$, $rw=x^{\cdot}$, $ms=\frac{nx^{\cdot}}{a}$, $Vm=\frac{n}{a}(ax-x^2)^{\frac{1}{2}}$. Hence the fluxion

$$Wuwr=Wr\times x^{\cdot}=(ax-x^2)^{\frac{1}{2}}x^{\cdot}=a^{\frac{1}{2}}x^{\frac{1}{2}}x^{\cdot}-\frac{x^{\frac{3}{2}}x^{\cdot}}{2a^{\frac{1}{2}}}-\text{, \&c., and}$$

the fluxion $Vxsm=Vm\times\frac{nx^{\cdot}}{a}=\frac{n^2}{a^2}(ax-x^2)^{\frac{1}{2}}x^{\cdot}=\frac{n^2x^{\frac{1}{2}}x^{\cdot}}{a^{\frac{3}{2}}}-\frac{n^2x^{\frac{3}{2}}x^{\cdot}}{2a^{\frac{5}{2}}}-$, &c.

The fluent $NWr=\frac{2a^{\frac{1}{2}}x^{\frac{3}{2}}}{3}-\frac{x^{\frac{5}{2}}}{5a^{\frac{1}{2}}}-$, &c., and the fluent IVm $=\frac{2n^2x^{\frac{3}{2}}}{3a^{\frac{3}{2}}}-\frac{n^2x^{\frac{5}{2}}}{5a^{\frac{5}{2}}}-$, &c. If the fluents taken are proportional to their corresponding fluxions, we have, $\frac{2a^{\frac{1}{2}}x^{\frac{3}{2}}}{3}-\frac{x^{\frac{5}{2}}}{5a^{\frac{1}{2}}}$: $\frac{2n^2x^{\frac{3}{2}}}{3a^{\frac{3}{2}}}-\frac{n^2x^{\frac{5}{2}}}{5a^{\frac{5}{2}}}::a^{\frac{1}{2}}x^{\frac{1}{2}}\dot{x}-\frac{x^{\frac{3}{2}}\dot{x}}{2a^{\frac{1}{2}}}:\frac{n^2x^{\frac{1}{2}}\dot{x}}{a^{\frac{3}{2}}}-\frac{n^2x^{\frac{3}{2}}\dot{x}}{2a^{\frac{5}{2}}}$.

Now by multiplying we have the product of the extremes equal to the product of the means, that is,

$$\frac{2n^2x^2\dot{x}}{3a}-\frac{8n^2x^3\dot{x}}{15a^2}+\frac{n^2x^4\dot{x}}{10a^3}=\frac{2n^2x^2\dot{x}}{3a}-\frac{8n^2x^3\dot{x}}{15a^2}+\frac{n^2x^4\dot{x}}{10a^3}.$$

Whence it is evident, that proportional fluents have their fluxions in the same ratio with themselves.

4. In the variable quantity $ax-x^2$, let the value of x pass through every assignable magnitude from 0 to a, given one; and let the fluents taken be $ax-x^2$, A $ax-$Ax^2, B $ax-$Bx^2, C $ax-$Cx^2; these will constitute a series of fluents, which are proportional to their fluxions. For, selecting any two fluents as A $ax-$Ax^2, and C $ax-$Cx^2, their corresponding fluxions are A$a\dot{x}-2$A$x\dot{x}$, and C$a\dot{x}-2$C$x\dot{x}$. Suppose that A$ax-$Ax^2 : C$ax-$Cx^2 :: A$a\dot{x}-2$A$x\dot{x}$: C$a\dot{x}-2$C$x\dot{x}$. By multiplying, we obtain the identical equation, AC$a^2x\dot{x}-$ 3AC$ax^2\dot{x}+2$AC$x^3\dot{x}=$AC$a^2x\dot{x}-3$AC$ax^2\dot{x}+2$AC$x^3\dot{x}$, that is, the product of the extremes is equal to the product of the means.

By a series or set of fluents or fluxions is to be understood those that are in geometrical proportion, for it may be remarked "that two fluents cannot be of the same set, unless they are of a nature to be compared with each other, that is, the one must be a multiple of the other by a whole number, or a fraction. And this multiple of the fluent, being constant, will always be a multiple of the corresponding fluxion: therefore the fluxion will vary as the fluent. Generally, x^n : $nx^{n-1}\dot{x}::2y^n:2ny^{n-1}\dot{y}$. If $y=ax$, then $x^n:nx^{n-1}\dot{x}::2(a^nx^n)$: $2n(a^nx^{n-1})\dot{x}$ Multiplying the extremes and means, $2n$ $(a^nx^{2n-1})\dot{x}=2n(a^nx^{2n-1})\dot{x}$." Hence we derive the two following theorems. Th. I. Any two terms in a series of fluents, will have their corresponding fluxions in the same ratio with themselves. Th. II. Any two terms in a series of fluxions, will have their corresponding fluents in the same ratio with those fluxions. These two theorems lay the foundation upon which the whole doctrine of fluxions is built.

Sec. 4. In the series of fluents, Fig. 5, take IVm the fluent sought, together with any one of the remaining terms, as NWr, then from what has been said concerning the grounds of fluxions, it appears, that these fluents and their corresponding fluxions, are in the same ratio, that is, Wuwr : NWr : : Vxsm : IVm. For the purpose of illustration, admit that the second term NWr, is by some means obtained, and that it is $\frac{2a^{\frac{1}{2}}x^{\frac{3}{2}}}{3} - \frac{x^{\frac{5}{2}}}{5a^{\frac{1}{2}}}$ —, &c. The first and third terms can readily be had; for, from the nature of fluxions, Wuwr= W$r \times \dot{x} = a^{\frac{1}{2}}x^{\frac{1}{2}}\dot{x} - \frac{x^{\frac{3}{2}}\dot{x}}{2a^{\frac{1}{2}}}$ —, &c., and Vxsm=V$m \times \frac{n\dot{x}}{a} = \frac{n^2x^{\frac{1}{2}}\dot{x}}{a^{\frac{3}{2}}} - \frac{n^2x^{\frac{3}{2}}\dot{x}}{2a^{\frac{5}{2}}}$ —, &c. Now the product of the second and third term is $\frac{2n^2x^2\dot{x}}{3a} - \frac{8n^2x^3\dot{x}}{15a^2} + \frac{n^2x^4\dot{x}}{10a^3}$, which being divided by the first term, the result is $\frac{2n^2x^{\frac{3}{2}}}{3a^{\frac{3}{2}}} - \frac{n^2x^{\frac{5}{2}}}{5a^{\frac{5}{2}}}$ —, &c., =IVm the fluent sought. Hence if any easy method of obtaining the second term can be had, the object will be attained: but here a difficulty is presented, which in the ordinary method of getting the last term of four proportional quantities, would be insurmountable. This property, then, consisting in the identity of ratios in fluxions and their fluents, would have been wholly useless, had it not been far *a remarkable peculiarity* in these proportional quantities. It is this, that fluxions and their fluents *mutually arise*, and as it were, *grow out of each other;* that is, a fluent can be made out from certain known parts of its fluxion, and conversely, by means of a few rules, embracing what is called the direct and inverse method of fluxions. To illustrate the manner in which this is done, let the four terms of the proportion be

A : B : : C : D, and inversely, B : A : : D : C, and let the ratio be r, and $\frac{1}{r}$. If, instead of multiplying the third term by the second, and dividing this product by the first term, we multiply the third term by the ratio, the result will be the same, that is, $Cr=D$, and $\frac{D}{r}=C$. From the nature of an algebraic expression, the ratio here is always given, and in the process, preserved distinct from the other part of the term. Hence, in order to obtain the fourth term, it is necessary only to multiply the third term by the ratio. The formula for the ratio in the direct method of fluxions is $\frac{n\dot{x}}{x}$, n representing either a whole number, a fraction, or a mixed number; and either a positive, or negative quantity. In the inverse method of fluxions, the ratio is $\frac{x}{n\dot{x}}$. For $ax^n \times \frac{n\dot{x}}{x} = nax^{n-1}\dot{x}$, and $nax^{n-1}\dot{x} \times \frac{x}{n\dot{x}} = ax^n$.

Scholium.—From the foregoing investigation it is manifest, that, whatever the source may be from which fluxions emanated, they are nothing more than certain artificial proportional quantities, of a finite magnitude, by the help of which their corresponding fluents may be found. Thus a luminous view of this abstruse branch of the Mathematics is presented, depending on the plain, familiar, and acknowledged principle of the identity of ratios. This principle, as I have been informed, has, in a very concise manner, been touched upon by *Dealtry*;* and it appears to me to develope the real nature of fluxions. It is important to notice distinctly, that it avoids the seeming error attending the Differential Calculus, arising from the rejection of the infinitely small quantity, which is the difference between the increment and the differential—the Gordian knot, which has long perplexed the most eminent Mathematicians.

Sec. 5. By describing polygons in the circle, and by continual bisections of the arcs, subtending the sides of the pol-

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* Although Dealtry has alluded to this proportion, between the fluents and fluxions, yet, (in justice to the author of this memoir, it ought to be stated,) he overlooked the object for which it is now introduced.

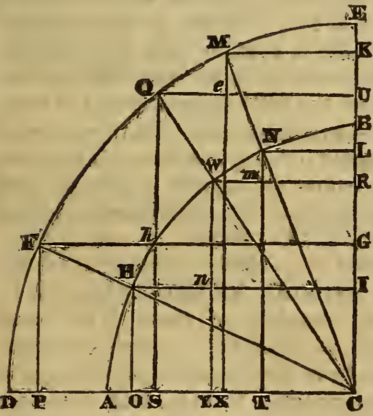
ygons, it is proved that circ. NOPQ : circ. IKLM :: WX^2 : VZ^2.

That this is the peculiar proportion, that fluents bear to their fluxions, can be made to appear in the following manner, in Fig. 5. The fluent NWr : IVm :: WX^2 : VZ^2, because these are similar portions of similar figures, and are as the squares of their homologous sides, and in circles as squares of their diameters. Hence NOPQ : IKLM : WX^2 : VZ^2 :: fluent NWr : fluent IVm :: fluxion $(ax-x^2)^{\frac{1}{2}}\dot{x}$: fluxion $\frac{n^2}{a^2}(ax-x^2)^{\frac{1}{2}}\dot{x}$. Although the principle of fluxions was thus touched upon, it was (as it were) unwittingly. None of the antients, as it seems, understood its nature, and extent; but they proceeded but little farther than to investigate some of the properties of the conic sections.

Demonstration of the identity of ratios in fluents and their fluxions.

Lemma.

Fig. 6.



Let AHNB be any curve whatever, and suppose DFME to be another, drawn parallel to it, and consequently similar. Draw the lines CM, CF from the determined point C to the curve DFME, and from the points, where these lines intersect the curves, draw the ordinates NT, MX, HO, FP. Now, if the line CQ be drawn from C to any proposed point Q in the arc FM, and ordinates be drawn from the points of intersection; the parts, into which the curvilineal spaces HNTO, FMXP are divided, are proportional; that is, WNTY : QMXS :: HWYO : FQSP.

Demonstration.

From the similarity of figures, CW : CQ : : WR : QU : : NL : MK : : WR − NL : QU − MK (5. E. 19.) : : Wm : Qe : : HI : FG : : HI − WR : FG − QU : : Hn : Fh. Also WY : QS : : Wm : Qe : : HO : FP : : Hn : Fh. Hence WY · Wm : QS · Qe : : HO · Hn : FP · Fh (6. E. C.) : : WmTY : QeXS : : HnYO : FhSP.

Secondly, bisect the arcs NW, WH, and MQ, QF, and suppose parallelograms to be drawn corresponding to the bisections. Let the parallelograms within the arc NW be represented by A, B; those within the arc WH by C, D; those within the arc MQ by N, O; and those within the QF by P, Q. Then proceeding as before we obtain A : N : : B : O : : C : P : : D : Q. Hence A : N : : A+B : N+O : : C+D : P+Q (5. E. 12.) : : the polygon within the arc NW : the polygon within the arc QM : : the polygon within the arc HW : the polygon within the QF.

For the same reason, if ever so many polygons be formed by bisecting the arcs, they will be in the same constant ratio, and at the same time will converge towards the curvilineal spaces WNTY, QMXS, HWYO, FQSP, as their limits. When the number of bisections is greater than any assignable number, the series is supposed to have run through an infinite number of terms; and the little spaces, lying between the polygons and the curves, are exhausted. On this account the process is called *the method of exhaustions.* The perimeters of the polygons have now undergone a change into curves, and the polygons become the curvilineal spaces. Hence WNTY : QMXS : : HWYO : FQSP. Q. E. D.

To investigate the fluxions of variable quantities, let the similar curvilineal spaces AHNBC, DFMEC, (Fig. 6,) be divided into any proposed number of parts NBCT=a, HNTO=b, &c., and MECX=n, FMXP=o, &c., by drawing the lines CM, CF, &c., from the point C to the curve DFME, and drawing the ordinates NT, MX, HO, FP, from the points where the lines CM, CF, &c., intersect the curves. Then, by the foregoing lemma these curvilineal spaces are proportional, that is, $a : n : : b : o : : c : p : :$, &c. Hence $a : n : : a+b+c+$, &c. : $n+o+p+$, &c. : : AHNBC : DFMEC. (5. E. 12.)

Fig. 7.

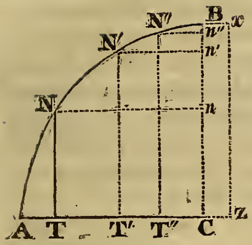
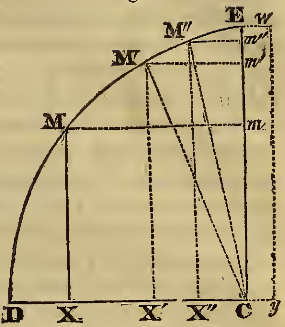


Fig. 8.



2. From the before mentioned parts, select the pair NBCT, MECX, the part NBCT being removed to prevent the figure from being too much crowded. Draw the line CM' from C, to the middle of the arc ME, and divide NBCT and MECX by drawing the ordinates N'T', M'X', from the points of intersection of CM' with the curves. Let the division N'BCT' be represented by a', and M'ECX' by n'. Proceeding in the same manner, subdivide N'BCT' by the line N"T", and M'ECX' by the line M"X", and let N"BCT"$=a''$, and M"ECX" $=n''$, and so on. By the foregoing lemma, these divisions form a series of proportional quantities, that is,

$$a : n : : a' : n' : : a'' : n'' : : a''' : n''' : :, \&c.$$

3. Let the parallelograms NnCT, N'n'CT', N"n''CT", &c., be represented by A, A', A", &c., and the parallelograms MmCX, M'm'CX, M"m''CX", &c., by N, N', N", &c., and they will form the following series of proportional quantities,

$$A : N : : A' : N' : : A'' : N'' : : A''' : N''' : :, \&c.$$

4. As we proceed in these two series, the differences NBn, N'Bn', N"Bn'', &c., and MEm, M'Em', M"Em'', &c., between the curvilineal spaces and the rectilineal ones continually lessen, and the curvilineal expressions of the antecedents approach towards the rectangular expressions of them, and both converge towards the ordinate BC, as their limit; and in like manner the consequents converge towards the ordinate EC, as their limit. Here, although we cannot arrive at the nascent and evanescent terms themselves, yet we can ascertain the relation between the prime and ultimate ratios; for suppose the divisions are continued, until these differen-

ces are less than any assignable quantities; then upon the principle of exhaustions the evanescent antecedent becomes in effect equal to the nascent one, likewise the evanescent and nascent consequents become equal, and according to Prin. V., the one may be taken for the other. The equality of these terms forms the connecting link, by which the two infinite series are united, so as to become *one series*, having the same ratio throughout. To exemplify this in symbols, $a : n :: a' : n' :: a'' : n'' ::$, &c. . . . . . in infinitum . . . . . evanescent of a : evanescent of n :: nascent of A : nascent of N.

Nascent of A : nascent of N ::, &c. . . . . in infinitum . . . . $A''' : N''' :: A'' : N'' :: A' : N' :: A : N$.

Hence $a : n :: a' : n' :: a'' : n'' ::$, &c. . . . . in inf. . . . . $A'' : N'' :: A' : N' :: A : N$.

It hence appears, that the series, expressed in terms of the curvilineal spaces, is identified with the series, expressed in terms of the rectilineal spaces. And, since any antecedent and its consequent may be taken at pleasure, to express the ratio, let A : N be taken, and it will be, the fluent AHNBC : the fluent DFMEC $:: a : n :: A : N ::$ the fluxion BxzC : the fluxion EwyC $:: y\dot{x} : my\dot{x}$.

Q. E. D.

Here, without any error whatever, a transition is made from the ratio $a : n$, expressed in terms of the curvilineal spaces, to the ratio A : N, expressed in terms of the rectilineal spaces.

It will readily be perceived, that the foregoing proportion illustrates the important analytical fact, that the ratio of two infinite series, or rather, of the incommensurable quantities, which they are designed to express, can be had in finite terms; although, taken separately, their exact sum or measurement, cannot be obtained.

To represent this in symbols, let the division $NBCT = a = B + B' + B'' + B''' +$, &c., in infinitum, (Fig. 6.) and the division $MECH = n = C + C' + C'' + C''' +$, &c., in infinitum, then,

$$\frac{B + B' + B'' + B''' +, \text{\&c.} \ldots\ldots \text{ in inf.}}{C + C' + C'' + C''' +, \text{\&c.} \ldots\ldots \text{ in inf.}} = \frac{A}{N}.$$

Here it will be well to notice, that although the two variable quantities, which are compared in the foregoing demonstration, are, *even at first*, so taken, that they are always accurately in the same ratio; yet it is unknown, until we arrive at what Sir Isaac Newton terms the *ultimate ratio*, which "is neither before those quantities cease to move, nor after; but at the very instant in which they arrive at their last place, and the motion ceases." (See Newton's Princip. Lem. XI.)

Corresponding with these ideas of the illustrious inventor of fluxions, variable or flowing quantities are considered, first, as in the act of arising into existence; quantities in this incipient state are called *nascent quantities:* secondly, as in the act of disappearing or ceasing to be; in this vanishing state they are called *evanescent quantities.* Mathematicians have taken different views of nascent and evanescent quantities. Whilst some have considered them as quantities at which we can arrive, and which have a real existence; others have held them to be non-entities, and have complained of Sir Isaac Newton, for having first supposed certain quantities to exist, having certain properties and relations, and these properties and relations still to remain, after the quantities themselves have vanished. Whilst some have held, that they were real quantities, but small beyond the reach of imagination; others, with Cavalerius, have supposed them to be entirely divested of magnitude, and have called them *indivisibles.* In this diversity of opinions, it will be well to attend to their nature, and to the station which they hold in the system of mathematical quantities. Here it must be considered, that we can never arrive at quantities, which are less than any assignable ones, as is evidently the case with nascent and evanescent quantities. They are therefore infinitely small. And of an infinite quantity, we can form only a negative idea. To obtain that quantity, which is less than any assignable one, is contradictory; to overtake that, which recedes as fast as it is pursued, is impossible. Therefore whenever quantities are said to be infinitely great, or infinitely small, they must be considered as *moveable, ever retreating, unassignable quantities;* for a positive infinitive quantity is beyond the grasp of any created being. But, notwithstanding we can form no positive idea of infinite quantities; yet, in some cases, we can have a clear conception of certain relations, which belong to them. For instance, let two cylinders, whose bases are to each other as 2 : 1, be extended to any assignable equal lengths, the proportion will always be as 2 : 1. Now suppose this length to be greater than any assignable one, that is, let no bounds be set to their length, then, since it cannot be affirmed that the length of the one is less than the length of the other, it is manifest, that the ratio between them of 2 : 1 still exists. For another instance, take the proposition, that the areas of similar polygons, inscribed in circles, are as the squares of the diameters of those circles. As before observed, when two series of polygons are produced by a continual bisection of the arcs of their circumscribing circles, all the terms will have the same ratio, should the series be continued ever so far. And it is affirmed, that, admitting the series to be infinite, the ratio extends through all the infinite number of terms : for if it does not, the ratio stops at some assignable place in the series ; but there can be no reason given why it should stop at this place ; therefore it follows, that the ultimate ratio, with which the two series vanish, is a thing which can be had, although we cannot arrive at the ultimate terms themselves. It hence appears that even the science of the Mathematics has its mysteries: which may well serve to repress that pride, which is apt to arise in those who are conversant about truths, that are clear and demonstrable; but abstruse, and withdrawn from minds of the ordinary cast.

As the areas of the polygons are obtained by adding together the small parallelograms, of which the polygons are composed; it seems to be implied, that, when we arrive at the curvilineal spaces, the ratio supposes the addition of an infinite number of infinitely small parallelograms. No such thing is pretended. Without considering the manner in which the areas of the curves are obtained, it is inferred, that the ratio, which reaches through all the infinite number of terms in the two series of polygons, that are compared, exists also in the curvilineal spaces, which are their limits; and that the ultimate ratio, which is the ratio formed by the evanescent terms, is the same with that of the limits themselves, because their difference is less than any assignable quantity. Limits are therefore used instead of evanescent quantities, at which we cannot arrive. Hence the object of exhaustions is not to obtain the last term of an infinite series. That this was Sir Isaac Newton's idea of nascent and evanescent quantities, and limits, is evident from his Scholium to the XI. Lemma of his Principia. Speaking of the nature of ultimate ratios, he says: "Those ultimate ratios with which quantities vanish, *are not truly the ratios of ultimate quantities, but limits*, towards which the ratios of quantities decreasing without limit do always converge; and to which they approach nearer than by any given difference, but never go beyond, nor in effect attain to, until the quantities are diminished *in infinitum*."

I have given the ideas of Sir Isaac Newton concerning some of the properties and relations of infinite quantities in his own words, because I conceived, that a just notion of prime and ultimate ratios, nascent and evanescent quantities, and especially the limits of infinite series, was of great importance in gaining a knowledge of a science, at once the most sublime, beautiful, and subtle, that has ever exercised the ingenuity of man; and because I conceived, that the doctrine could not be expressed in a manner more clear and perspicuous, than in the words of that illustrious philosopher.

The limit of x^n is nx^{n-1}, and the limit of a^x is Na^x, N being the Napieran logarithm of a. In curvilineal figures it is the same with the ordinate, and in the circle it is $(ax-x^2)^{\frac{1}{2}}$, in the ellipsis it is $\frac{c}{t}(tx-x^2)^{\frac{1}{2}}$, in the parabola it is $(px)^{\frac{1}{2}}$, and in the hyperbola $\frac{1}{Ax}$. These limits are also the same with the fluxional co-efficients, and bear the same relation to their corresponding fluents, that a line does to a superficies, or a superficies, to a solid. Hence limits are always one dimension less, than the fluents to which they stand related. The fluxional base $\dot{x}$ is a fundamental quantity, which supplies the defect in dimensions; and, by making fluxions to be things of the same kind with fluents, renders it possible, that a proportion between them may exist. This insertion of a fluxional base constitutes the difference between fluxions and indivisibles. Fluxions, then, may be defined to be the ratio of variable quantities.

Some Mathematicians have expressed themselves concerning infinitely great, and infinitely small quantities, as though they were quantities, at which we can arrive; hence they have treated of them much in the same way, as of finite ones. This is evidently inconsistent with that accuracy and clearness of reasoning, for which mathematical science is justly celebrated. Owing, probably, to this erroneous idea of infinity, they have spoken in a very loose way of a differential quantity, as though the curvilineal space MECX, (Fig. 6.) was intended by it; considering the part MEK to be so far diminished by repeated subdivisions, as to become of no consequence. In conformity with this idea, they have called it *an infinitesimal*, to express in a strong manner the smallness of the quantity from which they might be allowed to expunge the part MEK. But however small it may be, it has still *some* magnitude, and so far it must, at least in theory, be considered as involving an error.

Sec. 6. *Fluxions of the higher Orders.*

When, in the generation of a variable quantity, its fluxion is different at different stages of its production, it may be considered as a fluent, and its fluxion taken, which is called the second fluxion. Also when the second fluxion is a variable quantity, the fluxion of this fluxion may be taken, which is called the third fluxion. After the same manner, fourth, fifth, sixth, &c., fluxions will arise, when the preceding ones are variable quantities. The first fluxion of x^2 is $2x\dot{x}$, its second fluxion, considering the fluxional base $\dot{x}$ a constant quantity, is $2\dot{x}^2$. The first fluxion of x^3 is $3x^2\dot{x}$, its second fluxion is $6x\dot{x}^2$, and its third fluxion is $6\dot{x}^3$. In each of these instances, the last term becomes a constant quantity, and the next fluxion is equal to 0. It hence appears, that the index of the power of a variable quantity points out the highest order of fluxions, which that power admits of. The relation of the fluxions of the several orders to the corresponding increment of a variable quantity, may be discovered in the following manner. Suppose $\dot{x}$ to be the increment of x, then

$2x\dot{x}+\dot{x}^2$ is the increment of x^2,

and $2x\dot{x}+2\dot{x}^2+0$ are the orders of the fluxions,

again $3x^2\dot{x}+3x\dot{x}^2+\dot{x}^3$ is the increment of x^3,

and $3x^2\dot{x}+6x\dot{x}^2+6\dot{x}^3+0$ are the orders of the fluxions.

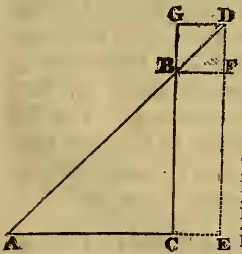
By comparing the terms, which compose the increment, with the corresponding terms, which constitute the first, second, third, &c., fluxions, it will be found, that the powers of x and $\dot{x}$ are the same in each; therefore if the several terms in the latter quantity be divided by certain divisors A, B, C, &c., it will become equal to the former, and the corresponding terms themselves will be equal; that is, $\frac{2x\dot{x}}{A}+\frac{2\dot{x}^2}{B}=2x\dot{x}+\dot{x}^2$. Taking the corresponding terms, $\frac{2x\dot{x}}{A}=$

$2x\dot{x}$, hence A=1; also $\frac{2\dot{x}^2}{B}=\dot{x}^2$, hence B=2. Again $\frac{3x^2\dot{x}}{A}$ $+\frac{6x\dot{x}^2}{B}+\frac{6\dot{x}^3}{C}=3x^2\dot{x}+3x\dot{x}^2+\dot{x}^3$. Let the corresponding terms be taken, and $\frac{3x^2\dot{x}}{A}=3x^2\dot{x}$, hence A=1; also $\frac{6x\dot{x}^2}{B}$ $=3x\dot{x}^2$, hence B=2; likewise $\frac{6\dot{x}^3}{C}=\dot{x}^3$, hence C=6. Putting x^3=E, it will be, $\dot{E}+\frac{\ddot{E}}{2}+\frac{\dddot{E}}{6}=$ the corresponding increment of x^3. By taking higher powers, we may extend the series to any proposed length. Taking for instance x^4, and proceeding as before, we obtain $\dot{E}+\frac{\ddot{E}}{2}+\frac{\dddot{E}}{6}+\frac{\ddddot{E}}{24}=$ the corresponding increment of x^4. and so on for other powers.

If the power of x is supposed to be infinite, then the foregoing series also becomes infinite; and if the digits which produce the several multiples are taken, we have,
$\dot{E}+\frac{\ddot{E}}{2}+\frac{\dddot{E}}{2.3}+\frac{\ddddot{E}}{2.3.4}+\frac{E^{\cdot\cdot\cdot\cdot\cdot}}{2.3.4.5}+$, &c. . . . in inf. = the corresponding increment.

Whence the law of continuation in the series is manifest. This series may be derived from the celebrated theorem, published by Taylor in his Methodus Incrementorum, by making $z=\dot{z}$, (See Maclaurin's Flux., Vol. 2, Sec. 751,) and it hence appears, what share the fluxion of each order contributes towards producing the increment of any proposed power.

Fig. 9.



Let ABC be a half square, AC=BC $=x$, CE=BF=$\dot{x}$. The first fluxion is the parallelogram BFEC=$x\dot{x}$, the second fluxion is the small square GDFB $=\dot{x}^2$. When $\dot{x}$ is invariable, $\dot{x}^2$ is a constant quantity; hence the third fluxion is equal to 0, and the series of fluxions here ends. By the figure it is manifest, that the increment BDEC is composed of the first fluxion BFEC, and half the second fluxion DBF.

Fig. 10.

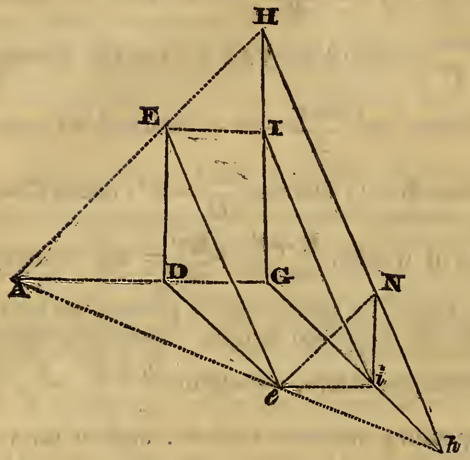
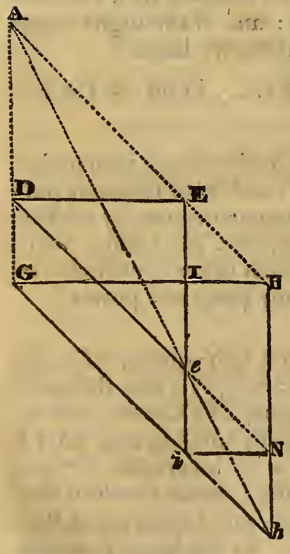


Fig. 11.



Figures 10th and 11th, are two different views of the same section of a cube, in which the same letters answer to the same parts; and the base lines, and those parallel to them, are distinguished by full lines, and other parts by occult lines. This section is a pyramid, whose apex A is at one of the corners of the cube, and whose base GH*h* is half the square that composes a side. By the section it appears, that this pyramid is one sixth part of the cube. Let the pyramid ADE*e* represent the fluent, and DE*e*GH*h* an increment corresponding to DG, the fluxion of the axis. Let EI, and *ei*, parallel to DG, meet GH, and G*h*, in I and *i*; and *e*N, parallel to EH, meet H*h* in N. The first fluxion $\frac{2x\dot{x}}{2}$ is represented by the prism DE*e*GI*i*; the second fluxion $x\dot{x}^2$, by a parallelopipedon, which is double the prism EIH*ei*N; the third fluxion $\dot{x}^3$, by a cube, which is made up of six prisms, similar and equal to *e*N*ih*. Because $\dot{x}^3$ is a constant quantity, the fourth fluxion is equal to 0. From the section it is evident, that the increment DE*e*GH*h* is composed of three parts; the prism ED*e*IG*i*, which is the first fluxion; the prism EIH*ei*N, which is one half the second fluxion; and the pyramid *e*N*ih*, which is one sixth part of the third fluxion.

For the benefit of the Mathematical students, I have presented to Yale College, a set of models designed to give a geometrical illustration of the higher orders of fluxions by the sections of the Pyramid and Cube. No. I. represents the several orders of fluxions arising from the Pyramid, and explains by solid figures the diagram in Maclaurin's fluxions illustrating his celebrated theorem, which is, that the first fluxion, half the second fluxion, and one sixth of the third fluxion, are equal to the corresponding increment in the third power. The fluent is represented by a Pyramid of a white color, whose base is half a square of two inches. The first fluxion by a short prism of a red color, one inch in length. The second fluxion by a parallelopipedon of a yellow color two inches in length, having its ends a square of one inch, formed by the union of two equal prisms. The third fluxion by a small cube of a blue color, having its sides one inch, formed by the union of the six little pyramids. No. II. is all of a white color, and represents merely the increment $3x^2\dot{x}+3x\dot{x}^2+\dot{x}^3$ of the cube.

An actual inspection of these sections, as all must be sensible, will give the clearest idea of the nature of these quantities, but for the sake of those who may not have the opportunity of viewing the models, I have attempted to explain No. III. by drawings. Fig. 1. is one of the three pyramids, of which the fluent, (fig. 2.) which is a cube, is composed. The apex of the first may be conceived to be situated at the nearest left hand corner at the top, having its base at the bottom. The second has its apex at the same corner, and base at the side opposite: and the third pyramid has its apex at the same corner, and its base at the opposite end. Fig. 3. 4. and 5., are *kathetic* views of the several orders of fluxions arising from the three pyramids just mentioned; in which the lines representing their thickness in the projection, fall behind and are hidden. When the first fluxion is produced, the three bases of the pyramids are supposed to be invariable, and by their motion to generate the three parallelopipedons of a red color, (fig. 3. 4. 5.) representing the three terms of the first fluxion $x^2x^{\cdot}+x^2x^{\cdot}+x^2x^{\cdot}$, or $3x^2x^{\cdot}$. Next, the two flowing sides in each of the red parallelopipedons by their motion, produce the six parallelopipedons of a yellow color, (fig. 3. 4. 5.) representing the second fluxion $6xx^{\cdot 2}$. And lastly, the ends of the yellow parallelopipedons, that are supposed to flow, produce the six cubes of a blue color, (fig. 3. 4. 5.) representing the third fluxion $6x^{\cdot 3}$. To construct the whole solid figure representing the higher orders of fluxions in the cube, we are to imagine the sections fig. 3. to be placed at the bottom of the cube (fig. 2.); those of fig. 4. at the side opposite; and those of fig. 5. at the end opposite to the corner A, at which the fluent originated. These figures are to be placed about the cube in such a manner as to make the same letters stand together. To the fluent, add the first fluxion, half the second fluxion, and one sixth of the third fluxion, and it constitutes the cube NLCKMO, (fig. 6.) composed of the original fluent EGCDBF, (fig. 2.) and the increment.

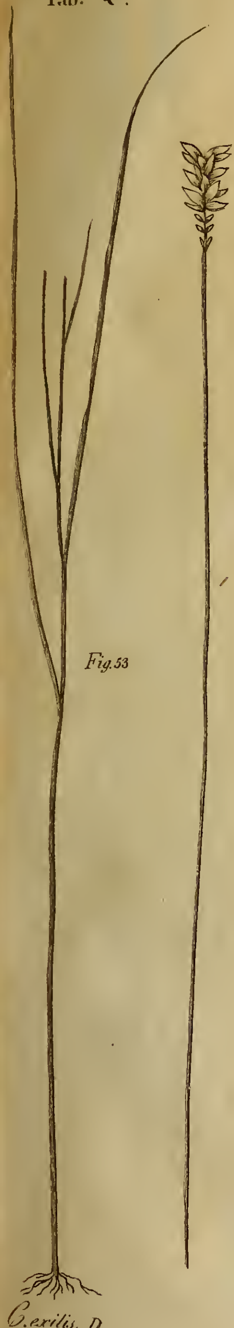
N. B. The reader will notice that the position of the cube in fig. 6. is different from that in fig. 2. as is denoted by the letters. The side ACBD, fronts the reader. BDFH is the base of the fluent, the edge FH being the more distant one of the base. ABFE, the left hand side. EGFH is the side opposite, and farther distant from the reader, of which the edge EF only should be seen, after the whole figure is formed, the plane NOMP is the base.

Tallmadge, *Ohio*, *April*, 1828.

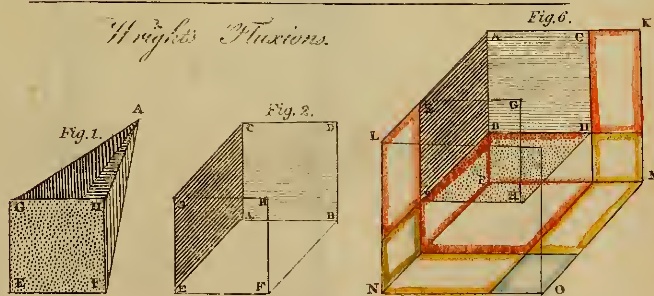
See the annexed plate, in which the figures are reduced to half their original size.—*Ed.*

Dewey's Carices.

Tab. Q.



Wright's Fluxions.



A. Doolittle sc.

Tab. R.

C. Wormskoldiana. Hornem.

C. Xanthophysa.
β. nana, D.
γ. minor, D.

A. Doolittle, sc.

Art. XIII.—*Caricography.*

Appendix, continued from Vol. XII. p. 297.

No. 125. Carex *exilis*, Dewey.
Tab. Q. fig. 53.

Unispicata androgyna et dioica gracili, setaceo-foliata; spica fructifera *distigmatica* infernē stamenifera subdensiflora simplici; fructibus ovato-lanceolatis utrinque convexis divergentibus serrulatē marginatis, squama ovata acuta paulo longioribus.

Culm 12-20 inches high, slightly triquetrous, very slender, scabrous above; leaves triquetrous, setaceous, sheathing towards the bases, not half the length of the culm; androgynous and dioecious; spike single, simple, oblong, half inch in length, rather dense-flowered; staminate spike closely imbricate, with lanceolate scales; stigmas two; fructiferous spikes staminate below; fruite ovate, lanceolate, convex on both sides, diverging, scabrous on the margin; pistillate scale ovate, acute, tawny, white on the edge, a little shorter than the fruit; colour of the plant pale green.

Flowers in May; found at Danvers, Mass. by Wm. Oakes, Esq., and, is a singular and beautiful plant. It grows in small tufts, and also separate, in wet, cold meadows.

β. *squamacea*. Tab. Q. fig. 54.

Spica androgyna longiore; floribus stameniferis plurimis decurrentibus.

Androgynous spike often more than an inch long, with abundance of staminate flowers, and a few fruit at the summit. It is a rather larger plant than the preceding, but closely resembles it.

Flowers in May—June; found at Ipswich, Mass. by Mr. Oakes, in dense and large tufts on the overflowed lands of Ipswich river.

No. 126. C. *Okesiana*, Dewey.
Tab. Q. fig. 55.

Spicis distinctis; spica stamenifera solitaria brevi-bracteata, oblonga, gracili; spicis fructiferis *tristigmaticis* subbinis ovatis distantibus bracteatis, inferiore subpedunculata; fructibus ovatis subtriquetris subinflatis nervosis brevi-rostratis glabris ore integris, squama ovato-lanceolata paulo longioribus.

Culm about a foot high, triquetrous, scabrous above; leaves linear, triquetrous, erect, rather stiff, a little shorter than the culm, sheathing at the base; bracts long, lance-linear, with short sheaths; staminate spike single, an inch and half long, slender, triquetrous, pedunculate, with a scaly and linear bract, and closely imbricated and oblong and obtuse scales; stigmas three; pistillate spikes about two, ovate, distant, lower one on a short peduncle; fruit ovate, triquetrous, nerved, crowded, somewhat inflated, smooth, short-rostrate, with mouth entire; pistillate scale ovate, acute, tawny, a little shorter than the fruit; colour of the plant, a light green.

Flowers in June; grows on the edge of ponds, with C. *aquatilis*, at the base of the White Mountains, N. H.—found by Wm. Oakes, Esq., in honor of whom it is named. It has a remote resemblance to C. *Elliotii*—but differs in various characters. It seems to be clearly a new species.

Of the following species already described, the researches of our botanists afford us additional knowledge.

C. *Wormskoldiana*, Hornem.
Vol. XI. p. 154. Tab. R. fig. 56.

Dioica unispicata simplici interdum bracteata planifoliata; spica fructifera dis-et-tris-stigmatica oblonga acuta densē imbricato-cylindracea; fructibus ovatis et subobovatis brevi-rostratis pubescentibus vel pilosis, squamam ovatam acutam subaquantibus.

Culm 4-8 inches high, nearly round, smooth, scabrous above, sheathed towards the base, sometimes with a setaceous bract a little below the spike; leaves flat, smooth, lanceolate, nearly as long as the culm; spike cylindric, an inch long, closely imbricate, acute, brown; stigmas often *three*, sometimes appear to be *only two* on the same spike; fruit ovate, and somewhat obovate, obtuse, rostrate, pubescent or pilose; pistillate scales ovate, acute, dark brown, green on the keel, rather longer than the fruit; staminate scale ovate-lanceolate, tawny, whitish on the edge; colour of the plant yellowish green.

Flowers in June; found by Wm. Oakes, Esq., on the Alpine parts of the White Mountains, N. H. for the first time (1827) in New England.

C. *Xanthophysa*, Wahl.

Vol. VII. p. 274, and Tab. D. fig. 15. Vol. X.

Spicis distinctis; spica stamenifera solitaria; spicis fructiferis tristigmaticis crassis subternis distantibus laxifloris ovatis exsertē vel inclusē pedunculatis folioso-bracteatis; fructibus oblongo-canicis inflatis magnis rostratis divergentibus ore bifurcatis, squama ovato-lanceolata subaristata longioribus.

Culm 2-5 feet high, triquetrous; leaves linear lanceolate, large, sheathing towards the base; bracts long, leafy, with sheaths of variable length, sometimes wholly inclosing the peduncles; staminate spike single, pedunculate, short, small, with lanceolate scales; pistillate spikes two to four, ovate, thick, distant, upper *ones sometimes* staminate at the apex; stigmas three; fruit oblong-conic, sometimes an inch long, large, diverging, often nearly horizontal, rostrate and bifurcate; pistillate scale ovate-lanceolate, or lanceolate-acuminate, variable in length, usually a little shorter than the fruit; colour of the plant is pale yellowish green.

Flowers in May; grows in marshy places on the more elevated tracts of land—common, but not abundant, in New England. In a marsh at Middlefield, Mass. it grows to the height of five feet.

β. *nana*. Tab. R. fig. 57.

Spicis fructiferis subbinis subapproximatis subexsertē-pedunculatis folioso-bracteatis; fructibus subinflatis rostratis, squama ovata acuta duplo longioribus.

Culm about a foot high, rather slender; pistillate spikes about two, an inch distant, often nearer, with peduncles slightly exserted; fruit more slender than the preceding, half inch long, about twice as long as the ovate and acute scale. In other respects, it is like the preceding.

Flowers in May—June; found by Wm. Oakes, Esq., at the base of the white Mountains, about ponds—also, near Hanover, N. H.

γ. *minor*. Tab. R. fig. 58.

Spicis fructiferis binis aggregatis.

Less than the preceding with which it grows—has two clustered pistillate spikes, with the staminate spike very small.

C. *siccata*, Dewey. Vol. X. p. 278.

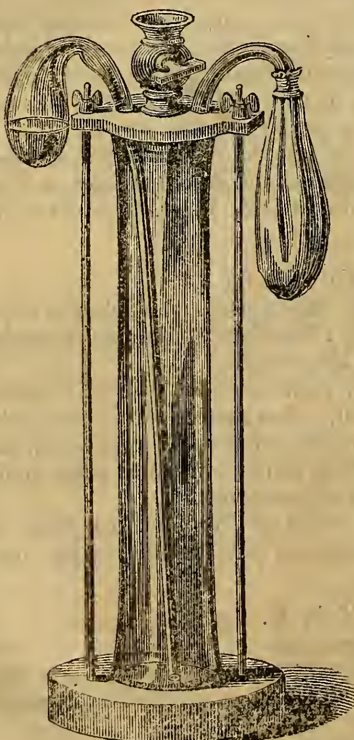
When described, this plant had been found only in the vicinity of Westfield, Mass. It has been found by Mr. Oakes, at Ipswich, Mass. 1827.

C. *aquatilis*, Wahl. Vol. X. p. 267.

Found by Mr. Oakes, in 1827, in a marsh near the base of the White Mountains, N. H.

Art. XIV.—*Some new modifications of apparatus, calculated to facilitate the experimental illustration of the science; by* Robert Hare, M. D. *Professor of Chemistry in the University of Pennsylvania.*

Combustion of pulverized metals in chlorine.

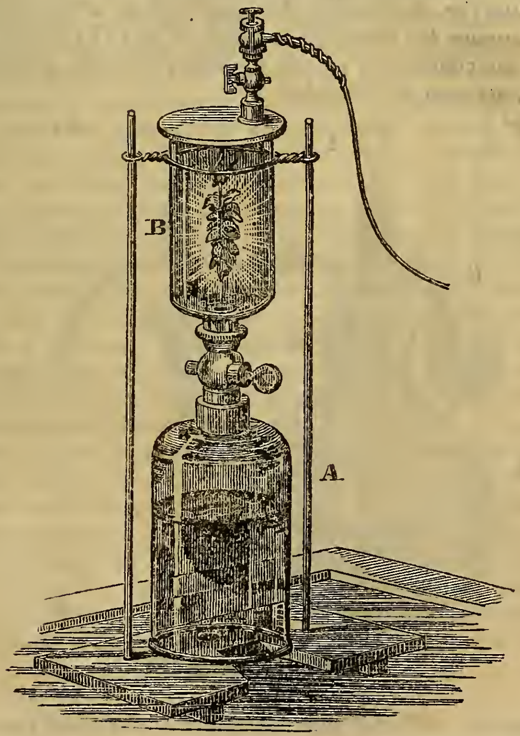


A jar, about thirty inches in height, is placed between two iron rods, which, towards their upper terminations, have been cut by a screw-plate, and duly furnished with screw nuts. By these means, a lid is pressed upon the mouth of the jar, so as to be air tight. Into the centre of the lid, a cock is fastened, the key of which, instead of being perforated as usual, is drilled only half through, so as to produce an excavation capable of holding a thimbleful of powder.

There is inserted into the lid, on one side, a recurved tube, to which a large uninflated bladder is tied, so that the cavity of the bladder, may freely communicate with that of the jar. On the other side, the beak of a retort is introduced, so as to reach the bottom of the jar.

The body of the retort, being properly supplied with muriatic acid and manganese, and heat being applied, chlorine is evolved; which being heavier than atmospheric air, soon occupies the greater part of the jar, the air being expelled through the aperture, by which the beak of the retort enters, without closing it air tight. The retort being removed, and the hole well corked, the cavity in the key of the cock is duly charged with pulverised antimony, which on turning the key half round, falls through the chlorine, and is converted, as it falls, into a shower of fire. Considerable expansion ensues; but the bladder receives so large a portion of air, as to prevent any explosion; while the cock, being, from its construction, always closed, and the junctures being tight, the spectators are protected from the noxious fumes.

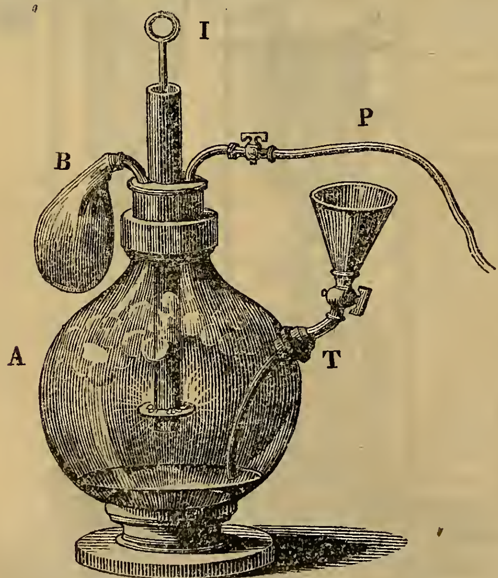
Apparatus for the combustion of metallic leaves, in chlorine.



The ends of a glass cock are severally cemented into the perforated necks of two bell glasses, A, B, one of them smaller than the other, and surmounting it in an inverted position. The brass plate which covers the orifice of the upper bell, is so fitted to it, as to form an air tight juncture, and is furnished with a cock terminating in a gallows and screw, for attaching a leaden pipe proceeding from an air pump. A hook is soldered to the lower surface of the plate, from which some leaves of Dutch gold* are suspended. Suppose the lower bell to be filled with chlorine over the hydropneumatic cistern, the upper one exhausted by the air pump. On turning the cock, the chlorine will rush into the upper bell, and cause the instantaneous combustion of the included leaf metal. Afterwards the upper bell will be replete with the fumes of the resulting chlorides, of the metallic matter of the alloy.

Apparatus for procuring nitrogen.

Apparatus for abstracting the oxygen from atmospheric air, and leaving the nitrogen so situated, as to be drawn easily from the containing vessel, in such quantities, and at such times, as may be desirable.



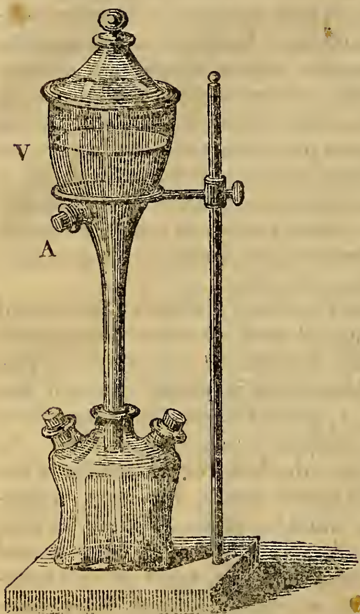
Concentric with the axis of the globular glass vessel, A, is a portion of a gun barrel, which is soldered to a large stop-

* An alloy of copper.

ple of brass, ground to fit, air tight, in a brass collar cemented upon the neck of the vessel. On one side of the gun barrel, a flexible lead pipe, P, with a cock, is soldered into a perforation in the stopple, which enables it to communicate with the interior of the globe. In like manner another tube is soldered into the stopple, which establishes a communication between the cavity of the uninflated bladder, B, and that of the globe. Into a tubulure, T, another larger pipe is luted, so that while one part proceeds, within, to the bottom of the vessel, the other is surmounted without, by a cock and funnel. The gun barrel is closed at the lower end —at the upper end is open. Near the lower end is soldered, a cup of sheet copper, perforated so as to allow the gun barrel to pass through it for about an inch.

On this cup, the phosphorus in small pieces is placed, and the bottom of the vessel being covered by water, the stopple is seated in the brass collar, as seen in the figure. The cocks being all shut, the phosphorus is heated through the gun barrel by a red hot iron, I, passed down the bore of the barrel, until the heated part is opposite the copper cup. As soon as the combustion begins, the hot iron should be withdrawn; but when the flame burns dimly, the iron, meanwhile, returned into the fire, must be again applied, to support the temperature, until all the oxygen may have united with the phosphorus. At the commencement of the combustion, the bladder is inflated in consequence of the expansion of the air arising from the heat; but, as the volume of the air is reduced, about one fifth, by the condensation of its oxygen, and as the heat causing the expansion escapes, the air which had inflated the bladder, returns into the globe. Its return should be accelerated and completed, by compressing the bladder, the neck of which, while compressed, should be tied. Water should then be introduced through the funnel, the cock being opened for the purpose, until the deficit caused by the loss of oxygen, be compensated. By the introduction of a farther quantity of water, any requisite portion of the gas may be made to flow out, through the pipe, P; which, in the original, is long enough to reach under the sliding shelf of the pneumatic cistern.

Apparatus for showing some of the distinguishing properties of carbonic acid gas.



Having introduced into the three necked bottle, represented in this figure, one or two ounces of carbonate of ammonia, add about half as much deep orange colored nitric acid, an active effervescence will ensue, arising from the expulsion of the carbonic acid from the ammonia, by the stronger affinity of the nitric acid. At the same time sufficient fume will be generated to make it evident, how far the vessels are occupied by the gas, to the exclusion of atmospheric air.

The movements of the carbonic acid gas will thus be recognized, as ascending to the upper vessel, it will fill, and finally overflow this vessel, through the crevice, between the brim and cover.

The cover being removed, a lighted candle will cease to burn, when lowered into the fume, indicating the space occupied by the gas. This space will comprise the whole cavity of the vessel, so long as the aperture, A, is closed ; but, on removing the cock from this aperture, the gas will flow out, and the stream marked by the accompanying fume, will be seen descending towards the table, and will extinguish the flame of a candle if made to encounter it ; or, it may be received into a mug, so as to arrest the combustion of a taper introduced into it, or upon which the contents of the mug may be poured.

Under these circumstances, a taper will burn any where within the vessel, V, if it be not below the aperture, A, above which the gas is not now seen to extend itself. But if one of the orifices of the bottle be opened, the carbonic acid will be found entirely to desert the upper vessel.

It will thus be made evident, that this gas, from its greater specific gravity, has, in the atmosphere, some of the habitudes of liquids ; while its incapacity to support combustion, will be demonstrated.

That wells are so often fatal to those who enter them, is owing to the tendency of carbonic acid towards the lowest accessible cavities. This gas may be displaced from such situations, by mechanical agitation, by means of any bulky body alternately raised and depressed quickly. Any very inflammable matter, lowered while in a state of inflammation, as a cloth dipped in spirit of wine, or turpentine, would dislodge the gas if not let down into it so precipitately as to be extinguished. The firing of guns into the well, might be useful. Moistened gunpowder, in the same state as in the squibs made by boys, might be worthy of trial. An ounce of gunpowder might be spread over the bottom of a bucket, lowered into the well, and ignited by letting a squib, burning coal, or red hot iron, fall into it.

Art. XV.—*General Geological Strata ;* by Prof. Amos Eaton.

(Continued from p. 159.)

No one is qualified for examining geological facts, nor for reading essays or unsystematic treatises on geology, until he has fixed in his mind a systematic arrangement of *general strata.* Almost any system, however defective, will serve for a kind of repository wherein he may collate facts for future examination.

A system of general strata should be as simple as possible, without doing violence to nature. The following remarks and definitions were prepared for those who wish to give a little attention to geology, as circumstances may afford convenient opportunities ; or who may intend to pursue the study extensively. Both classes of geologists should commence alike ; as neither can enter upon the threshold of the science, without some general views of classification.

Every geologist would willingly devote considerable time and attention to this part of the science, if he had no other motives than personal relief from the geological jargon which he is compelled to endure in every steam-boat and canal packet, and at every public watering place. The absurdities of Ditton, Whiston, and Buffon, are outdone by our travelling Werners and Huttons. Even grave looking clergymen and civilians, who cannot distinguish granite from pudding-stone, often hold us by the button to tell us how a ridge was thrown up, or a rock thrown down, or how a breach was made through a mountain.

Could the attention of such persons be drawn to the contemplation of facts as they present themselves at every step, and could they be induced to systematize those facts and to use them as subjects for solid instruction, the taste, and even the morals of the community, would be greatly improved.

After becoming familiar with a system of general strata, every geological fact that passes under observation, excites deep interest. The mind will then withdraw itself from the vagaries of fancy, and enter with avidity upon the investigation of substantial things.

I do not offer this nomenclature as a perfect system. But it is the best I am capable of preparing without more knowledge of the subject. Though I have devoted more time to American geology than any other person, and that too under the most favorable auspices,* I confess that my investigations have, at every step, convinced me, that the work is but begun. The wonderful discoveries of Cuvier and Buckland have opened a new source of inquiry, which almost promises to revive the long lost history of the antediluvians. We are already enabled to look beyond the flood, and to hold communion with beings which have left no descendants on the earth, and to learn much of their characters.

The growing importance of geology requires redoubled vigilance in teachers to guard the science from those absurdities, which are calculated to degrade its character. Long experience has convinced me, that the most essential safeguard is a correct nomenclature of general strata. The study is not laborious, if conducted judiciously. Like the famous adit at the Southampton mines: though the miners make their way slowly into the granitic rock; a traveller may overtake them in a few minutes. So the student may soon overtake the science of geology; though to advance it, a very little, requires much labor and reflection.

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* My expenses have been defrayed for the last seven years by the Honorable Stephen Van Rensselaer; who has expended more than eighteen thousand dollars, during that period, in causing researches and trials to be made, for the purpose of improving and extending the natural sciences.

In this nomenclature, I omit many of the numerous general strata, given by Europeans, specimens of which may be found in this country. But the same European geologists would, in my opinion, consider the omitted strata as beds or varieties, even in their own country, after examining them here. The numerous primitive ranges in Europe cut up the strata into such limited portions, that it is difficult to distinguish between what ought to be treated as a bed or a variety, and what as a general stratum. Here we have no general stratum which cannot be traced from one hundred to five hundred miles. It was said by De Luc, that the general strata must be settled in America, where nature seems to have executed her works upon an enlarged scale.

Probably future geologists will find it convenient to divide the Lias and Third Graywacke into several general strata. But it is the opinion of several American geologists who have visited Europe, and of two European geologists whom I have accompanied to some of our important localities, that both of these strata and the two interposed, are comprised in the Oolitic formation of the English. It is certain that the essential characters of the upper and lower layers of what I have called Third Graywacke and Lias, are very accurately given by Philips and Conybeare as layers of the Oolitic formation. Therefore, to follow these eminent geologists, we must put the whole vast range of the Allegany and Catskill Mountains in the same general stratum, and all other visible rocks, excepting the saliferous, between the River Hudson and the Rocky Mountains. But we must treat some minute beds of a few yards in extent, on the east side of the Hudson, as general strata.

According to the nomenclature here adopted, the Lias, Geodiferous limerock, the Cornitiferous limerock, and the Third Graywacke, occupy, as uppermost rocks, more than half of the great states of New York, Pennsylvania, and Virginia, and nearly all the states of Ohio, Indiana, Illinois, Kentucky, Tennessee, and the Michigan Territory. If we adopt the European nomenclature, we must treat of this vast territory under the Oolitic formation, though no Oolite has ever been found in it—the Saratoga Oolite being confined to the transition sandstone of Werner, (our Calciferous sandstone.) For these and other reasons, I prefer continuing the use of descriptive terms which cannot mislead; and leaving to others the business of giving precise technical names.

In the preceding Synopsis, a specimen of each general stratum is represented by a wood cut figure. The order of superposition and the direction of the strata may be perceived at a single view. Several other characters of each stratum are also exhibited by these figures.

The original classes of Werner, (primitive, transition, and secondary,) are retained ; because I cannot discover any advantages in the proposed alterations. I adopt Bakewell's name for volcanic or basaltic rocks. And I prefer the old general appellation, Detritus, to tertiary formation. For boulders of ancient rocks cannot be considered as of the tertiary formation, and the recently indurated Detritus, being only a modification of it, in the form of puddingstone, &c., does not require a particular name.

*Names under the Primitive Class.**

1. Granite, is an aggregate of angular masses of quartz, felspar, and mica. *Subdivisions.*—It is called *crystalline*, (granite proper,) when the felspar and quartz present a crystalline, not a slaty, form. It is called *slaty*, (gneiss) when the mica is so interposed in layers as to present a slaty form. *Varieties.*—It is *graphic*, when the felspar is in a large proportion, and the quartz is arranged in oblong masses, so as to present an appearance resembling Chinese letters. It is *porphyritic*, when spotted with cuboid blocks of felspar. This variety is peculiar to the slaty division.

2. Mica Slate, is an aggregate of grains of quartz and scales of mica. Subdivisions.—*Compact*, when the slaty laminæ are so closely united, that it will present an uniform smooth face when cut transversely. *Fissile*, when the laminæ separate readily by a blow upon its surface.

3. Hornblende Rock,† is an aggregate, not basaltic, consisting wholly, or in part, of hornblende and felspar. Sub-

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* Every rock consists, *essentially*, of one, two, or three, of the following nine homogeneous minerals. These are called the *geological alphabet;* and every student must procure, and familiarize himself with, a specimen of each, before he commences the study of geology—quartz, felspar, mica, talc, hornblende, argillite, limestone, gypsum, chlorite. He should procure also a specimen of iron pyrites, hornstone, calc-spar, reddle-ore, bog-ore, glance-coal, bituminous-coal.

† I believe Maclure first applied this general name, to all the varieties of primitive hornblende rock.

divisions.—*Granitic*, when it presents the appearance of crystalline granite, with hornblende substituted for mica. *Slaty*, when of a rifty or tabular structure. Varieties.—*Gneisseoid*, when it resembles slaty granite (gneiss) with scales of hornblende substituted for mica. *Greenstone*, when of a pretty uniform green color, and containing but a small proportion of felspar, generally of a slaty structure. *Porphyritic*, when spotted with cuboid blocks of felspar. *Sienitic*, when speckled with small irregular masses of felspar.

4. Talcose Slate, is an aggregate of grains of quartz and scales of mica and talc.* Subdivisions.—*Compact*, having the laminæ so closely united that a transverse section may be wrought into a smooth face. When the quartzose particles are very minute and in a large portion, it is manufactured into scythe-whetstones, called Quinnebog stones. *Fissile*, when the laminæ separate readily by a blow upon the surface. Varieties.—*Chloritic*, when colored green by chlorite. In some localities the chlorite seems to form beds; or rather the rock passes into an aggregate consisting of quartz, mica, talc, and a large proportion of chlorite. Vast beds of pure chlorite are embraced in this rock on Deerfield river, in Florida, Mass.

5. Granular Quartz, consists of grains of quartz united without cement. Subdivisions.—*Compact*, when it consists of fine grains, so as to appear almost homogeneous; generally in large rhomboidal blocks. *Sandy*, when the grains are so slightly attached as to be somewhat friable. Varieties.—*Translucent*, when it is so compact and homogeneous as to transmit light. *Yellow*, when slightly tinged with iron, (probably a carbonate.) *Ferruginous*, when an aggregate of minute crystals, strongly colored yellow or red with the carbonate or peroxyd of iron. There is a remarkable locality two miles north of Bennington village, in Vermont. Large masses may be found consisting of six-sided crystals, with six-sided pyramids on both ends.

6. Granular Limestone, consists of glimmering grains of carbonate of lime united without cement. Subdivisions.—

* That a small proportion of talc scales should serve to distinguish this rock from mica-slate, would scarcely satisfy a mere cabinet student. But the travelling geologist will acknowledge its importance. See Taghconnuc and Saddle mountains, and the same range along the west side of the Green mountains to Canada.

Compact, when it consists of grains of nearly pure carbonate of lime, so closely united that it will take a polish. *Sandy*, when grains of quartz are aggregated with the grains of carbonate of lime, but so loosely as to be somewhat friable. Varieties.—*Dolomite*, when it consists in part of magnesia, and is friable. *Verd-antique*, when it is variegated in color by the presence of serpentine, giving it more or less of a clouded green.

Names under the Transition Class.

7. Argillite, is a slate rock of an aluminous character, and nearly homogeneous, always consisting of tables or laminæ whose direction forms a large angle with the general direction of the rock. Subdivisions.—*Clay Slate*, when the argillite is nearly destitute of all grittiness, and contains no scales of mica or talc. *Wacke Slate*, when it is somewhat gritty and contains glimmering scales of mica or talc. Varieties.—*Roof Slate*, when the slate is susceptible of division into pieces suitable for roofing houses and for cyphering slate. *Glazed Slate*, when the natural cleavages are lined with a black glazing. This variety contains anthracite coal and marine organic relics.

8. First Graywacke, is an aggregate of angular grains of quartzose sand, united by an argillaceous cement, apparently disintegrated clay slate, and is never above the calciferous sandrock. Subdivisions.—*Compact*, when the grains are so fine and united so compactly, as to be suitable for quarrying. *Rubble*, when the grains, or a part of them, are too large for quarrying. This division is often very hard, and sometimes contains felspar, and has the appearance of coarse granite; though some of the largest pebbles are generally rounded. It is often colored green with chlorite. Every kind of first graywacke is almost horizontal—being a little elevated at the edge next to the primitive rocks only.

9. Sparry Limerock, consists of carbonate of lime, intermediate in texture between granular and compact; and is traversed by veins of calcareous spar. Subdivisions.—*Compact*, when the masses or blocks, between the veins of spar, are sufficiently homogeneous and uniform to receive a polish. *Slaty*, when the rock is in slaty tables or laminæ, with transverse veins of calcareous spar. This rock is often cut into very small irregular blocks by the spar, which gives it the name of checkered rock.

10. Calciferous Sandrock, consists of fine grains of quartzose sand and of carbonate of lime, united without cement, or with an exceeding small proportion. Subdivisions.—*Compact*, when the rock is uniform, or nearly so, without cells or cavities. *Geodiferous*, when it contains numerous geodes, or curvilinear cavities; which are empty or filled with calc spar, quartz crystals,* barytes, anthracite, or other mineral substances different from the rock. Varieties.—*Oolitic*, when it consists in part of oolite, of a dark color, and harder than the kind which is common in the lias oolitic formation of Europe.

11. Metalliferous Limerock, consists of carbonate of lime in a homogeneous state, or in the state of petrifactions. Subdivisions.—*Compact*, when it contains but few petrifactions, and is susceptible of a polish. *Shelly*, when it consists of petrifactions, mostly of bivalve molluscous animals. Variety.—*Birdseye marble*, when the natural layers are pierced transversely with cylindrical petrifactions, so as to give the birdseye appearance when polished.

12. Second Graywacke, scarcely distinguished from first graywacke, excepting by its relative position, being always above calciferous sandrock. Subdivisions.—*Compact*, when in blocks or slaty, consisting of fine grains. *Rubble*, when it consists of, or contains, large rounded pebbles. The rubble of second graywacke is in a much smaller proportion than in first graywacke. Varieties.—*Red sandy*, when it passes into red sandstone, which formation occurs in a few localities. *Hone slate*, when soft, and suitable for setting a fine edge. *Grindstone*, when the quartzose particles are sharp-angular.

Names under the Secondary Class.

13. Millstone Grit, is a coarse, hard, aggregate of sharp-angular quartzose sand or pebbles; mostly without any cement, always grey or rusty grey. Subdivisions.—*Sandy*, when it contains few or no pebbles. *Conglomerate*, when it consists chiefly of rounded pebbles.

14. Saliferous Rock, consists of red, or bluish-grey, sand or clay-marle, or both. The grains of sand are mostly

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* On the north side of the Mohawk River, opposite to Spraker's Basin on the Erie canal, hundreds of quartz crystals have been found in a ledge of this rock, containing anthracite coal. The crystals are mostly perfectly limpid, and have pyramids at both ends; but some are in limpid globules.

somewhat rounded, and all the varieties of this rock, in some localities, form the floor of salt mines and salt springs. Subdivisions.—*Marl slate*, when the rock is soft, slaty, and contains minute grains of carbonate of lime. *Sandy*, when it is in solid blocks or layers, consisting of red or bluish-grey quartzose sand. Varieties.—*Grey-band*, the uppermost layers of bluish-grey sandrock. *Conglomerate*, (breccia,) consisting chiefly of rounded pebbles, red, grey, or rust-color, as under the superincumbent rocks at Mount Holyoke, the Palisades, on the Hudson river, &c.

15. Ferriferous Rock, is a soft, slaty, argillaceous, or a hard, sandy, silicious rock, embracing red argillaceous iron ore. Subdivisions.—*Slaty*, consists of green, or bluish-green, smooth soft slate, generally immediately under the layer of red argillaceous iron ore. *Sandy*, consists of a grey, or rusty-grey aggregate of quartzose sandrock, in compact blocks or layers, overlying or embracing red argillaceous iron ore. Variety.—*Conglomerate*, consists of rounded pebbles, cemented together by carbonate or oxide of iron, or adhering without cement.

16. Lías, consists of rounded grains of quartzose sand, clay slate, and sometimes partly of other aluminous compounds, of a dark or light grey color, aggregated with fine grains of carbonate of lime. Subdivisions.—*Calciferous slate*, when it is of a slaty texture, and the argillaceous and calcareous constituents predominate. *Calciferous grit*, when it is in blocks or thick layers, and the quartzose sand or sharp grit, predominates. Varieties.—*Conchoidal*, when the slaty kind is separated into small divisions, somewhat of a lenticular form, by natural conchoidal cleavages. *Shell grit*, when the gritty variety consists, in part, of petrifactions of quartzose sand.

17. Geodiferous Limerock, consists of carbonate of lime, combined with a small proportion of argillite or quartz, in a compact state, mostly fœtid, and always containing numerous geodes. Subdivisions.—*Swinestone*, when it contains very little or no quartzose sand, is irregular in structure, fœtid, and abounds in geodes. *Sandy*, when it contains quartzose sand, is stratified, scarcely fœtid, and contains but few geodes.

18. Cornitiferous Limerock, consists of carbonate of lime, embracing hornstone. Subdivisions.—*Compact*, when the rock is close-grained; and it generally contains hornstone

in layers. *Shelly*, when it consists of shells and contains hornstone in nodules or irregular masses.

19. Third Graywacke, having the character of first and second graywacke in general; but differing in containing much iron pyrites, fine grains of carbonate of lime, in larger or smaller proportion, and in having the quartzose grains mostly rounded. Subdivisions.—*Pyritiferous slate*, when the rock has a slaty structure, and is in thin laminæ, or in blocks or thick layers. *Pyritiferous grit*, when the rock has a silicious or gritty structure, containing a large proportion of quartzose sand or pebbles. Varieties.—*Red sandstone* and *red wacke*, when the grey rock passes into a dirty orange, and thence into a red silicious sandrock. This has been called old red sandstone; but I do not believe that such a general stratum is admissible. *Conglomerate*, (breccia,) when the rock consists chiefly of rounded pebbles, of a light red, greyish red, or rust-color.

Names under the Superincumbent Class.

20. Basalt, is a hornblende rock, not primitive, probably of volcanic origin. Subdivisions.—*Amygdaloid*, when amorphous, of a compact texture, but containing cellules, empty or filled. *Greenstone trap*, when of a columnar structure, or in angular blocks, often coarse-grained. Variety.—*Toad-stone*, when the amygdaloid has a warty appearance, and resembles slag.

Names under the Alluvial Class.

21. Antediluvion, when the detritus is in layers, so situated that it must have been deposited from water, while standing over it at great depth, in nearly a quiescent state. Subdivisions.—*Plastic clay*, when it will not effervesce with acids; being destitute of carbonate of lime. *Marly clay*, when the clay contains fine grains of carbonate of lime, sufficient to effervesce strongly with acids. *Bagshot sand* and *crag*, when it consists of quartzose sand, nearly pure, or combined with a little loam, it is called bagshot sand; when it passes into a gravelly formation, often containing pudding-stone, beds of clay, &c., it is called crag. Variety.—*Hard-pan*, when the crag consists of gravel, strongly cemented by clay.

22. Diluvion, consists of a confused mixture of gravel, sand, clay, loam, plants, shell-animals, &c., so situated, that

it must have been deposited from water, in a state of forcible and violent action. To make its character perfectly evident, it must be so situated, that the elevation of the water, sufficient for making the deposit, could not have been effected by any existing cause.

23. Ultimate Diluvion, a thin deposit of yellowish-grey loam, reposing on crag or some other substance in ancient uncultivated forest grounds. It is so situated, that it could not have been produced by the disintegration of any stratum in the vicinity, nor by water when running with much velocity. It appears to have been deposited from waters greatly elevated, and which had been rendered turbid by violent action, but had become almost quiescent. It may be considered as the last settlings of a deluge.

24. Post-diluvion, when the detritus is so arranged that coarse pebbles appear towards the source of the waters which deposited them, and fine sediment more remote.

Names under the Analluvial Class.

25. Stratified Analluvion, is the detritus, formed by the disintegration of rock strata, which remains in the situation formerly occupied by the rocks, retaining the same order of superposition. Subdivisions.—These take the names, and retain the essential characters, of the original rocks ; as, *saliferous*, *ferriferous*, *lias*, *&c.*

26. Superficial Analluvion, is the detritus formed by the disintegration of the exposed surfaces of all rocks, and remains on or near the place of disintegration. Subdivisions. —*Clay-loam*, when the detritus is fine and adhesive. *Granulated*, when in coarse grains, or friable. The character of the soil depends on the character of the rock disintegrated.

Query—Could not the antediluvial detritus be divided into primitive and secondary, as proposed by Mr. Schoolcraft? See Index to the Geology of the Northern States. If this is practicable, it would carry us farther back into the history of the antediluvial world. The *primitive* would probably be found to contain either no organized remains, or those of marine origin only. The *secondary* alone would contain the antediluvial organic relics.

INTELLIGENCE AND MISCELLANIES.

I. Foreign.*

1. *Oil of the seed Croton Tiglium.*—The great energy and efficacy of this medicine have attracted the attention of the medical profession, and its effects in many cases in which it has been used, have been so powerful and beneficial, that it bids fair to become a prominent article of the materia medica. A late number of the London Journal of Science and the Arts contains some observations upon this oil by Mr. Frost, in which he remarks, that the best manner of giving it is in the form of a pill, as by that means the unpleasant feeling about the throat, produced in taking it otherwise, is avoided. The tiglium seed oil, which is on sale, is frequently admixed with olive, castor, or rapeseed oil, which, in a medical point of view, is rather an advantage than otherwise, as it tends to moderate the violence of its action. The genuine oil is so powerful as to produce death in the dose of a very few drops; but different samples vary in point of strength, which of course depends on the rate of active matter which they may contain. The plant is a native of the East Indies ; it is a shrub seldom exceeding ten feet in height. It belongs to the twenty first class monoecia, and the eighth order monadelphia of Linnæus, and to the natural order euphorbiæ of Jussieu.

The expressed oil of the seed of this plant is entirely soluble in ether and the oil of turpentine, and partially so in alcohol. One hundred grains of the seed consisted of 32 shell and 68 kernel = 100. One hundred grains of the seed digested in three drachms of sulphuric ether sp. grav. .71—afforded 25 grains of fixed oil.

2. *Strength of Leaden Pipes.*—Experiments on this subject have been made at Edinburgh, by Mr. Jardine, at the Water Company's yard. The method followed was to close one end of a piece of pipe, and then throw water into it by a forcing pump attached to the other end, the force or pres-

* We here insert a number of extracts and abstracts which were prepared, as will appear by the dates, some time since—but the articles are still interesting, and may not have been seen by most of our readers.

sure being measured by a gague belonging to the pump When the water from the injecting pump first begins to press out the pipe, little or no alteration is observed on it for some time. As the operation proceeds, however, the pipe gradually swells throughout its whole length, until at last a small protuberance is observed rising in some weak part, which increases until the substance of the pipe, becoming thinner and thinner, is at last rent asunder, when the pipe breaks with a crash, and the water issues with great violence.

In the first experiment, the pipe was of one and a half inch bore, and the metal, which was remarkably soft and ductile, one fifth of an inch in thickness. This sustained a power equivalent to that of a column of water one thousand feet high, equal to thirty atmospheres, or four hundred and twenty pounds per square inch of internal surface, without alteration; but with a pressure of water equal to twelve hundred feet of water it began to swell, and with fourteen hundred feet, or six hundred pounds on the square inch, it burst. When measured after the experiment, it was found to have swelled until it became of a diameter of one and three fourths of an inch. The edges of the fracture were not ragged, but smooth and sharp like a knife.

In a second experiment, the pipe was two inches in diameter, and one fifth of an inch in thickness. It sustained a pressure equal to that of a column of water eight hundred feet in height with hardly any swelling, but with one thousand feet it burst. The fracture here was not so fine as in the former pipe, the metal being much less ductile.—*Caledonian Mercury.*

3. *Inspiration of Inflammable Gas.*—By Signor Giacomo Cardone.—This experiment was made in consequence of the difference of opinion on the effects of this gas on the lungs, entertained by Scheele, Fontana, and others. The air being expelled from the lungs as much as possible, the mouth-piece of a bladder containing thirty cubic inches of the gas was applied to the mouth, and the gas inhaled at two inspirations. An oppressive difficulty of respiration, and a distressing constriction at the mouth of the stomach were the first sensations; these were followed by abundant perspiration, a general tremor over the whole body, seeming to commence at the knees; an extraordinary sense of heat, slight

nausea, and violent head-ach. My eyes says Sig. G. beheld things but indistinctly, and a deep murmuring sound was in my ears. After a short time, all these effects ceased, except that of heat, which increased in an alarming manner; but ultimately by the abundant use of cold drinks I was restored to my original state of health.—*Giornale di Fisica*, viii. 295.

4. *Artificial Gold a new alloy.**—The Hanoverian Magazine contains a description by M. Dittmer, of the following compound of different metals, prepared by the privy counsellor, Dr. Hermstadt, which may supply the place of gold, not only as to color, but also for its specific gravity and ductility. The materials consist of sixteen parts, by weight, of pure platina, seven parts of copper, and one part of zinc, equally pure; these metals are to be mixed together in a crucible, covered with powdered charcoal, and perfectly fused, so as to form a homogeneous mass.—*Rev. Enc.* xxvii. 900.

5. *Comparative analysis of the elastic Bitumen of England and France*, by M. Henry the younger.—The French bitumen was found in October, 1816, by M. Oliver, in the Montrelais, distant a few leagues from Angus, at the depth of thirty fathoms, of ophiolite, mixed with veins of quartz and carbonate of lime.

Physical characters of the two bitumens.—1. That found in Derbyshire is in brown or blackish masses, and lightly translucent on the edges, and appears greenish by transmitted light; it is more or less elastic; burns readily with a white flame, and exhales a bituminous smell. Its specific gravity varies from 0.9052, to 1.233.

2. The French bitumen presents nearly similar characters; its color is very deep blackish brown, it is opaque, inodorous, moderately compact, compressible, very tenacious, and very elastic; by transmitted light it is rather black than greenish. It floats on water, and burns with a clear bluish white flame, and a bituminous odor. The composition of the two, according to M. Henry's analysis, is per cent.

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*The Franklin Journal contains an article entitled "Mosaiac Gold," extracted from the London Journal, giving a long account of this new alloy.

	English elastic bitumen.	French elastic do.
Carbon,	52.250	58.260
Hydrogen,	7.496	4.890
Nitrogen,	0.154	0.104
Oxygen,	40.100	36.746
	100.000	100.000

Bulletin des Sciences.

6. *Proportion of Male and Female Children.*—M. Bailly, of the French Institute, has lately made a series of observations connected with the subject of the relative births of male and female children. From exact registers kept in one locality, it appears, he says, that there were more female conceptions than male conceptions in the months of March and July ; and these two months, he observes, are, the first on account of the occurrence of heat and the second on account of the heat of the weather, the part of the year least favorable to the activity of the generative powers, at least with a view to fecundations.

7. *On the species or varieties in the Human Race.*—Linnæus, in his "*Systema Naturæ*," divided men into four varieties, according to the color of the skin ; giving each variety the name of the part of the world where it was most common. Duméville considers that there were six distinct varieties, which he names: 1. Caucasian, or European Arabs ; 2. Hyperborean ; 3. Mongolian ; 4. American ; 5. Malay ; 6. Ethiopian. Cuvier reduced the number of varieties to three. Vizey, in his history of man, divided the genus into two species, according to the facial angle, noting three varieties and sub-varieties to each species. Desmoulins has lately, further divided the genus man into eleven species ; and Bory Saint Vincent, in a very elaborate paper on the varieties and species of this genus, has added four other species to this extended list ; and has given the peculiarities, habits, manners, and appearances of each of the species, and an account of their probable origin. He divided the genus into two sections ; the first he called *Leiotrichi*, or smooth haired men, which he again sub-divided into those which are peculiar to the old world, as 1. *Homo Japeticus*, the sons of Noah, which he divided into several races ; 2. Homo Arabicus—the Arabs ; 3. Homo Indicus—the Hin-

doos; 4. Homo Scythicus—the Scythians; 5. Homo Sinicus–the Chinese. Secondly, those smooth haired men which are common to the old and new world, as 6. Homo Hyperboreus—the Laplanders; 7. Homo Neptunianus—the Malays and New-Zealanders; 8. Homo Australasius—the New-Hollanders. Thirdly, the straight haired men which are peculiar to the new world, as 9. Homo Columbicus—the Carribees; 10. Homo Americanus—the Americans; and 11. Homo Patagonicus—the Patagonians. The second section he designates by the name of Ouloitrichi, or crisped haired men; usually called negroes. The white varieties of this tribe are not known; 12. Homo Oethiopicus—the Ethiopians; 13. Homo Cafer—the Cafre; 14. Homo Melaninus—the Cochin Chinese; and 15. Homo Hottentottus—the Hottentots.—*Ann. Phil.*

8. *A new mode of preparing paper for draughtsmen, &c.*—Reduce to a powder, and dissolve quickly in a glazed earthen vessel, containing cold water, some gum tragacanth, having been well worked with a wooden spatula, to free it from lumps. There must be a sufficient quantity of water, to give to this diluted gum the consistence of a jelly. Paper, and some sorts of stuffs upon which this composition is smoothly applied, with a pencil or a brush, and dried before a gentle fire, will receive either water or oil colors; in using water colors they must be mixed with a solution of the above gum. This cloth or paper so prepared, will take any color except ink. When it is intended to retouch any particular part of the drawing, it should be marked with a sponge or clean linen, or a pencil, (containing some of the above mentioned liquid;) if the part is only small, it will then rise quickly, and appear as if repainted.—*Frank. Jour.*

9. *Formation of metallic copper by water and fire.*—In making cement copper in Germany, plates of *solid* copper are obtained, and also reguline copper in the fibrous, capillary, dentiform, reniform, and botryoid external shapes; and in the smelting of some sulphurets of copper, fibrous, lamellar, and crystallized pure copper is formed.—*Edin. Phil. Jour.*

10. *On the poison of the common Toad.*—The following is an abstract of Dr. Davy's paper on this subject, lately read before the Royal Society.

The popular belief in the venomous nature of the toad, Dr. Davy states although of great antiquity, has been rejected as a vulgar prejudice by modern naturlists; decidedly so by Cuvier; but like many other long received and prevalent opinions, it is a true one, and the denial of it by philosophers, has resulted from superficial examination. Dr. D. found the venomous matter to be contained in follicles, chiefly in the cutis vera, and about the head and shoulders, but also distributed generally over the body and even on the extremities. On the application of pressure, this fluid exudes, or even spirts out, to a considerable distance, and may be collected in sufficient quantity for examination. It is extremely acrid when applied to the tongue, resembling the aconite in this respect, and it even acts upon the hands. It is soluble, with a small residuum, in water and in alcohol; and the solutions are not affected by those of acetate of lead, and of corosive sublimate. After solution in ammonia it continues acrid; it dissolves in nitric acid, to which it imparts a purple color. By combination with potash or soda, it is rendered less acrid, apparently by decomposition. As left by evaporation of its aqueous or alcoholic solutions, it is highly inflammable, and the residuary matter that appears to give it consistence seems to be albumen. Though more acrid than the poison of the most venomous serpents, it produces no effect, on being introduced into the circulation; a chicken inoculated with it was not affected. The author conjectures that this "sweltered venom," as it is correctly termed by our great dramatist, being distributed over the integuments, serves to defend the toad from the attacks of carnivorous animals; "to eat a toad" has long been held as an opprobrious difficulty; and the animal is still further protected in this respect by the horny nature of its cutis, which contains much phosphate of lime, &c. As the venom consists, in part, of an inflammable substance, it is properly excrementitious, and an auxiliary to the action of the lungs in decarbonising the blood. This view of its use is confirmed by the fact, that one of the two branches of the pulmonary artery supplies the skin, its ramifications being most numerous where the follicles of venom are thickest. Dr. Davy finds the skin of the toad to contain pores of two kinds; the larger, chiefly confined to particular situations, and which, when the skin is held up to the light, appear as iridescent circles, and the smaller more numerously and generally distributed, which appear as luminous points of a yellowish color. Externally, these pores are covered with cuticle, and some of the larger ones even with rete mucosum ; internally they are lined with delicate cellular tissue. By inflating the skin Dr. D. ascertained that it was not furnished with spiracula, the existence of which he had been led to suspect by some particular circumstances in the physiology of the animal.—*Ann. of Phil.*

11. *Opposite effects of a change of density of the air, as affecting the going of a clock.*—Davies Gilbert, Esq. M.P. a short time ago published some ingenious investigations on the vibrations of pendulums, and shewed, that on a change of an inch in the height of the barometer, an astronomical clock ought to change its rate, in consequence of the alteration in the buoyancy of the air, by two tenths of a second a day. Having applied to Mr. Pond and Dr. Brinkley, to examine this point, he was surprised to find they had discovered no such change. On reconsidering the subject, he finds a cause which before he had supposed too small to have any effect, almost exactly counteracting the effect of the change of buoyancy. This cause is the alteration of the arc, by the altered resistance of the air. He remarks: "It is an extremely curious circumstance, that, without any reference to the attainment of this balance between opposite disturbing causes, our clocks should have been fortuitously made to vibrate, very nearly in the arc which reduces them to equality." For the mathematical investigations and tables illustrative of this singular coincidence, we must refer to the Quarterly Journal of Science for October.—Dub. Phil. Jour.—*Ed. Phil. Jour.*

12. *Distribution of land and water.*—From the unequal distribution of the continents and seas, the southern hemisphere has long been represented as eminently aquatic; but the same inequality makes its appearance, when we consider the globe divided, not in the direction of the equator, but in that of the meridians. The great masses of land are collected between the meridians of 10° to the west, and 150° to the east of Paris; while the peculiarly aquatic hemisphere commences to the westward, with the meridian of the coasts of Greenland, and terminates to the east with the meridian of the eastern shores of New Holland and the Kurile Isles.

This unequal distribution of the land and water, exercises the greatest influence upon the distribution of heat at the surface of the globe, upon the inflections of the isothermal lines, and upon the phenomena of climate in general. With reference to the inhabitants of the centre of Europe, the aquatic hemisphere may be called western, and the terrestrial hemisphere eastern, because in proceeding westward, we come sooner to the former than to the latter. Until the end of the fifteenth century, the western hemisphere was as little known to the inhabitants of the eastern hemisphere, as a half of the lunar globe is at present, and probably, will always remain, with respect to us.—*Humboldt*, *Ed. Phil. Jour.*

13. *Notice regarding steatite or soapstone, and its principal uses.*—Steatite is, as is well known, a variety of the talc genus. Its color is white, green, or grey; it is also sometimes, though rarely, red and yellow. Its specific gravity varies from 2.60 to 2.66. It is a compound of silica, alumina, magnesia, and oxide of iron and water, which vary according to the locality. It is very common in Cornwall and Germany. As it is fusible only at an exceedingly high temperature, and is easily wrought, excellent crucibles may be made of it, which are further hardened by fire, and which are only with great difficulty penetrated by litharge. It is also employed in making moulds for melting metals. In England it is used in the manufacture of porcelain. M. Vilcot, an artist of Liege, made several trials of it, with the view of finding out whether it might not be susceptible of being employed by the lapidaries. He prepared cameos of this substance, the color of which he brightened in the fire, and which he rendered so hard by the elevation of the temperature, as to give sparks with steel. They were then colored, yellow, grey, or milk white, by different solutions. He polished them upon the stone, and ended with making them assume all the lustre of agate. Some pieces even resembled onyx in color, but a serious inconvenience was, that the markings were easily altered by the fire, and could no longer be restored. Steatite has a great affinity for glass; it is also employed, in the manner of paste, reduced to a fine powder, and mixed with coloring matters, for painting upon this substance. It also serves for a sympathetic crayon for writing upon glass; the traces seem effaced when a piece of woollen cloth is passed over them, but they reappear immediately when moistened by the breath, and again disappear when the

glass becomes dry. Steatite is not so easily effaced as chalk, and does not, like that substance, change its colors. Tailors and embroiderers also prefer it to chalk, for marking silk. It possesses the property of uniting with oils and fat bodies, and enters into the composition of the greater number of balls which are employed for cleaning silks and woollen cloths; it also forms the basis of some preparations of paint. It is employed also for giving lustre to marble, serpentine and gypseous stones. Mixed with oil, it is employed to polish mirrors of metal and crystal. When leather, recently prepared, is sprinkled with steatite, to give it color, and afterwards, when the whole is dry, it is rubbed several times with a piece of horn, the leather assumes a very beautiful polish. Steatite is also used in the preparation of glazed paper; it is reduced to a very fine powder, and spread out upon the paper, or it is better to mix it previously with the coloring matter. The glaze is then given to the paper with a hard brush. It facilitates the action of screws, and from its unctuosity, may be employed with much advantage, for diminishing the friction of the parts of machines which are made of metal.*

14. *Botany.—M. Ramond on the Vegetation of the summit of the Pyrenees.*—In a memoir on this subject read at the Academy of Sciences on the 16th of Jan. 1826, M. Ramond remarks, that, from the base of a high mountain to its summit, the vegetation presents a foreshortened view of the same modifications, which are observed from the same base to the Poles. In proof of this, M. Ramond describes the *Pic du Midi*, which rises fifteen hundred toises above the level of the sea. On its summit, the barometer stands between nineteen inches and twenty inches three lines. The greatest height of the thermometer, in summer, does nor exceed 62° or 63° of Farenheit. Hence M. Ramond concludes that the temperature of the *Pic du Midi varies* between the same limits as in *regions situated between* 65° *and* 70° *of latitude.* "I have ascended," says M. Ramond, "thirty five times into this island, lost in the middle of the vast ocean of air, and I have remarked that not a flower appears till the summer solstice. The spring, consequently, does not begin at that height till the summer has commenced at the foot of the mountain." This peak is accessible only during

* See a notice of this use, vol. 13, p. 192, of this Journal.

three months of the year. The month of September is the most convenient for ascending it. In July and August, it is not uncommon to see snow fall, which remains for a long time.

M. Ramond, even in that climate, has collected one hundred and thirty species of cryptogamic, or phanerogamous plants, which preserve themselves under the snow. On a small spot, accidentally laid bare, he observed seven species of plants which vegetate vigorously.

It is a curious circumstance, that the species observed in the *Pic du Midi*, are related to the same genera as the species collected by Captain Parry in Melville Island, near the Pole. This island, notwithstanding its extent, presents only one hundred and thirteen species, which is seventeen less than M. Ramond has collected on the *Pic*. In the Island, as on the Pic, there is only one shrub, which is the willow, reduced to the same dimensions. The climate is not so rigorous, on the *Pic* as on the Polar Islands. The winters are certainly less severe, but the summers are not more warm. Leaving the summit of the mountain, M. Ramond describes the modifications which vegetation experiences as we descend towards its base; and he speaks particularly of certain vegetables belonging to warmer latitudes, which are found in very limited spaces. If we do not admit that these plants prove the existence of ancient communications with the countries to which their species belong, we must recognize an alarming number of particular creations. M. Ramond endeavors to explain these facts by geological considerations, which, however, he offers only as a simple hypothesis.—*Le Globe, Jan.* 19, 1826, *Tome* iii. *No.* xiii. *p.* 62.

15. *Polar Fogs.*—The fogs that pervade the Arctic seas, in the summer months, have been generally supposed to be produced by *the moist air depositing its vapor in consequence of being chilled by contact with the seas, &c.* But Dr. Wells (on dew,) proves that dew and hoar-frosts, result only from air, perfectly or imperfectly saturated with moisture, coming in contact with a cooler body. Dr. James Hutton, (Trans. Roy. Soc. Edin. Vol. I.) has shewn that volumes of air, of unequal temperatures, and holding moisture in solution, must be mingled to produce *mist and fog*; and the circumstances of the arctic seas, appear to be in perfect accordance with these conditions.

Before the end of June, the shoals of ice are usually divided and scattered; and the temperature of these icebergs is evidently lower than that of the surrounding water, and will therefore impart a corresponding influence to the air; therefore, the atmosphere resting on the interrupted surface of the ocean, will be warmer than that in the immediate vicinity of the icebergs. This cooling influence too, in consequence of its elevation considerably above the sea's surface, will be diffused, not only by radiation *upwards*, but horizontally into the surrounding air. The portion of atmosphere between two or more neighboring pieces of ice, will necessarily be, in the middle, of higher temperature than in the immediate vicinity of the ice, which must present considerable inequalities of temperature, affecting the surrounding air; of which numerous examples are found in accounts of Polar voyages; and Captain Franklin, particularly, remarks, "the temperature of the surface of the water was 35° when among the ice, 38° when just clear of it, and 41° 5′ at two miles distant," consequently, such unequal distribution of temperature will produce the effect stated, and the density of such mist or fog, will depend on the quantity of vapor contained in the air, and the differences of the intermingling temperatures.

The elevations of the mist will also be regulated by the height of the masses of ice; and, accordingly, Capt. Ross remarks, "the fog was extremely thick upon the surface of the sea, but at the mast-head, and at the top of the iceberg it was *perfectly clear*." Capt. Scoresby too, in his paper read before the Wernerian Society on the fogs of the Polar Seas, alludes to this definite elevation, and to the clearness of the supervening sky. Two icebergs may, however, be so situated, that their reciprocal horizontal radiations may cool the air between them, and reduce it to nearly a uniform temperature, thus preventing the formation of mist.

16. *Mode of preserving wooden buildings from the effects of fire, invented by* Dr. Fuchs, *Professor of Mineralogy in Munich.*—The following is the process; ten parts of potash or soda; fifteen parts of quartz (sand,) and one part charcoal, are melted together. This mass, dissolved in water, and either alone or mixed with earthy matters, applied, to wood, completely preserves it from the action of fire.—*Ed. Phil. Jour.*

Foreign Literature and Science; extracted by Prof. J. Griscom.

17. *Premiums awarded by the French Academy.*—At a public session of the Academy, on the 25th of August, 1827, at which M. Picard presided, the prize of Eloquence was divided between M. M. *Girardin* and *Patin.* Two other discourses were honorably mentioned.

The prize of Poetry was decreed to *Pierre-Augusto* Lemaire, adjunct professor of the university. The subject was the heroism of unfortunate Greece.

On the termination of the literary session, M. Picard read the report on the prizes founded by M. de Montyon. Agreeably to the will of this benevolent individual, the Academy decreed eleven prizes to the same number of *females*, for acts of the most disinterested virtue during the preceding year. The prizes to each person varied from three thousand francs to five hundred francs, according to the merit of the acts for which they were assigned. The females who received these honorable testimonials of virtuous deeds, reside in different parts of France.

The prizes to be bestowed upon the authors of *works most useful to the public morals* were then decreed. 1st, a prize of six thousand francs for the work of Madame Guizot, entitled, *Education domestique*, ou *Lettres de famille sur l'education*, 2 vols. 8vo; 2d, a prize of four thousand francs to the work of M. *Alibert*, first physician in ordinary to the king, entitled, *Physiologie des passions*, ou *Nouvelle doctrine des sentimens moraux*, 2 vols. 8vo; 3d, a prize of three thousand francs to the work of M. *Merville*, entitled, *Les deux apprentis*, 4 vols. 12mo; intended by the author for the benefit of young artizans, in order to divert them from the shame and disgrace attendant upon disorderly conduct and the frequenting of bad company.

Premiums of a similar nature will be decided in the ensuing year; and in addition to these, from the funds left by M. Montyon, the following: 1st, for 1828, a prize of six thousand francs, on a question of morals, the particular subject to be left to the author. 2d, for 1829, a prize of eight thousand francs, on this subject—*Charity, considered in its principles, its applications, and its influence on morals and social economy.* 3d, for 1830, a prize of ten thousand francs, on the following; *On the influence of laws over morals*, or of *morals over laws*.—*Rev. Encyc. Aout*, 1827.

18. *University of* Halle.—*Jubilee Fête of Chancellor* Niemeyer.—On the 18th and 19th of April last, there was celebrated in this University one of those fêtes which in Germany is dedicated to distinguished men, and which are peculiar to the literary establishments of that country. It was on account of the fiftieth anniversary of the promotion of M. Niemeyer to the doctorate of philosophy. This aged and respectable man is well known by his valuable works on education, and he has held for a long time, the station of chancellor of the University of Halle. All Germany wished to avail itself of what is called the *jubilee of the doctorate*, to furnish this servant with a testimonial of public esteem and gratitude. The Prussian minister of state, two bishops, and many other functionaries attended the fête. On the eve of the 18th, the children of the Latin school, planted two young oaks behind the monument of Franck, a professor pronounced a discourse, and the scholars sung a hymn. The next morning the chancellor received the felicitations of an immense crowd of citizens and strangers, as well as various deputations of the learned bodies of Prussia, and other parts of Germany, Austria excepted. The deputation of the university sent him a Latin poem, and that of the faculty of theology, a *programme*, or public dissertation on the subject of the fête. The deputation of the city, conducted by the burgomaster, presented him with a civic crown of oak leaves in silver imitation. The *Franck* institution had struck a gold medal, with this inscription; *Alteri conditori suo ante hos L. ann. creato doct. phil. instit. Franckiana Hal. A. MDCCCXXVII d. XVIII. April.* The other institutions, caused to be presented or recited by the masters and by about one thousand four hundred children, of both sexes, portions of Latin and German poetry. All the public authorities of the province, sent in like manner, their felicitations by deputies. The president of the regency, in the name of twenty-three public Prussian functionaries, sent to the venerable man a silver vase, with the inscription; *A. H. Niemeyerum de juventute sua optimè meritum viri venerantur.* Another deputy offered him, in the name of sixty Mecklenburgians, pupils of the university, a beautiful porcelain vase of the Royal manufactory of Berlin, with these words; *Vi-*

rorum erga A. H. Niemeyer de se juvenibus optimè meritum pietatis pignus.

At 11 o'clock, M. Niemeyer was conducted into the great hall of the university, in the midst of a brilliant assembly, where he was addressed by Professor *Schutz* an octagenarian. The curator of the university then gave him a letter of congratulation on the part of the king, accompanied by a magnificent porcelain vase, on which was painted a portrait of his majesty and a view of Potsdam. The king, by a delicate attention, had chosen this day for granting a sum of forty thousand thalers for the construction of new buildings for the university. Several discourses were pronounced, and the congratulations of the various universities of Germany, were made known, as well as the public dissertations on account of the solemnity.

At 2 o'clock, the University gave a banquet of one hundred and sixty covers to the heroes of the feast. The celebrated philologist, HERMANN, of Leipzig, had composed for the occasion some Latin verses; others were recited in German. The next day, at the request of the burgesses, M. Niemeyer pronounced a sermon in the church of St. Mary, in which were executed several choruses of the composition of Handel. On the same day, M. Niemeyer gave a fête to the university, which was terminated by a soirée, attended by more than two hundred persons.

Not less than twelve remarkable works have been mentioned, which the savans in different parts of Germany have brought forward on the occasion of this jubilee. The orientalist, *Gesenius*, has dedicated to M. Niemeyer, the first portion of his great work; *Thesaurus linguæ Hebrææ et Chaldææ.—Idem.*

19. *Chlorine and Chlorides.*—About a year after the discovery of chlorine by SCHEELE, the distinguished Swedish chemist, GUYTON DE MORVEAU was very successful at Dijon, in endeavoring by means of muriatic acid fumigations, to purify a church, rendered very infectious by cadaverous exhalations, and also a prison in which typhus had made some progress. Some years after, the same means were employed to enable the laborers to remove, without danger, the putrid masses which had been for many generations, collecting in the burial place of the Innocents; in 1792, Fourcroy made use of it, to disinfect the dissecting rooms and

hospital wards of Paris. Guyton De Morveau, after some further experiments, contrived a small disinfecting apparatus, which had considerable success; and about 1809, M. Massuyer was the first who employed liquid chloride of lime, in purifying the military hospital of Strasburg.

Nothing further was done until the society of encouragement, at the request of the Prefect of the Seine, proposed in 1820, a premium for the invention of a method, either chemical or mechanical, of fabricating catgut from animal intestines, without injury from the putrid fermentations which render the workshops of this manufactory so unhealthy. *M. Labarraque*, an apothecary at Paris, first solved this problem, and obtained the prize. He proposed the use of chloride of lime, and has ever since been engaged in the perfection of his first process, in propagating the value of the chlorides and extending their applications. Instructed by his first trials, and guided by a just and acute spirit of observation, he has pointed out their uses in exhumations, and in all cases in which putrid exhalations may vitiate the atmosphere. He has rendered an invaluable service to humanity and the arts, not only in applying the fumigations of chlorine to operations which it frees from all danger, but in turning the attention of men to an agent, the employment of which, may have an immense influence upon life and health. Since the labors of Labarraque, M. Wallace has recommended gaseous chlorine, mixed with aqueous vapour, as an external application, against chronic affections of the abdominal viscera, and especially those of the liver. M. Roche has announced to the society of medicine, that in less than three months, he had cured by means of the chloride of soda, a scaldhead, which for eleven years had resisted all other kinds of treatment. M. M. Cullerier and Gorse have successfully employed chloride of soda, in the cure of syphilitic ulcers, which spread an infectious odour, and in general against wounds and ulcers of a putrid and gangrenous character. M. Labarraque and others have shewn its efficacy in cases of asphixia from privies and other foul places; the agricultural society of la Charente has recommended it as very salutary in stables, and cases of diseased cattle, and learned physicians have announced, that they were upon the track of a discovery of the highest interest to humanity, by the employment of chlorides in diseases of the lungs. May this hope not be disappointed.—*Rev. Ency. Nov.* 1827.

20. *Analysis of Tourmaline.*—Until 1818, chemists had made fruitless endeavors to explain the character which distinguishes the tourmaline from other minerals. Breithaupt sought to prove from theoretical considerations, that boracic acid was a principal constituent. In his opinion, *boracite*, tourmaline, anatase and axinite belong to one family, which he called the *schorl family*, although these minerals have not the same crystalline system. The first actual discovery of boracic acid in tourmaline, was by an apothecary of Brünn, whose name is *Petke.*

The following is the method of analysis adopted by *C. G. Gmelin.*

The mineral, reduced to fine powder, was mixed with carbonate of barytes and strongly heated. The mass was then dissolved in a sufficient quantity of muriatic acid, and the solution was evaporated to dryness on a sand bath. M. Gmelin assured himself, by direct experiment, that at this temperature, the quantity of boracic acid which is volatilized is so small, that it may be safely neglected. The silica was obtained in the usual way, in treating the residuum of the evaporation with water. Carbonate of ammonia was added to the fluid, which was then filtered, evaporated to dryness, and heated gradually to a feeble redness. In this way, the boracic acid was retained in combination with the ammonia, and no aqueous acid vapour could be disengaged during the calcination, as in the decomposition of sulphate of ammonia. The residue, after being weighed, was sprinkled with alcohol mixed with a little muriatic acid, and the alcohol, being separated, was set on fire. The same operation was repeated, until no trace whatever of green could be perceived in the flame.

All the boracic acid which had combined with the ammonia, and which had afterwards been separated from it by the heat, was thus obtained. The residue again heated and weighed, shewed by its loss, the quantity of boracic acid.

The quantity of boracic acid which M. Gmelin found in tourmaline of different kinds varied, from nearly two to more than five per cent. Some tourmalines contain lithia to the amount of 2.04 per cent. Soda and potash, or at least one of them are also constituents.—*An. de Ch. and de Ph. Nov.* 1827.

21. *Capillary Action.*—It has been found by M. Emmet, that in a glass tube, in which water rose to 4.575 inches, a

nearly saturated solution of sub. carbonate of potash rose 4.45 inches; concentrated muratic acid 3.35 inches; one part of sugar in 4 of water to 3.25; one part of alcohol in 10 of water to 3.2; concentrated alcohol to 1.95. In another tube in which water rose to .4 inches, nitric acid rose to .3; pure fish oil to .15; oil of lavender to .15.

In a tube in which cold water rose to 2.45, boiling water rose only to 2.05; cold concentrated alcohol .95; boiling .875; water, mixed with snow 2.25, heated to 70° F. 2.1; at the boiling point 1.8.—*Bul. Univ. Juillet*, 1827.

22. *Intense Light.*—It is stated by *M. Pleischl*, that hydrate of lime, pulverised and exposed upon charcoal to a stream of oxygen, through a blow-pipe with an orifice $\frac{1}{50}$ inch in diameter, fed by a common lamp, gives the most intense light. He attributes this to a sort of pulverulent atmosphere, which the lime disengages at that temperature. Substances which do not emit molecules in a gaseous state cannot produce so vivid an incandescence.—*Idem.*

23. *Solubility of Silex.*—When the liquor of flints is treated with an excess of acid, silex remains in the liquor combined with the acid. The carbonic acid even has the property of holding silex in solution, especially at a certain temperature. It is in this state, that silex is found in a great number of mineral waters, from which it is deposited only at the surface, as the water cools and the carbonic acid escapes. The solubility of silex, recently precipitated, in carbonic acid, is the cause of its presence remaining so long unsuspected in a great number of combinations.—*Ibid.*

24. *Theory of Nitrification.*—M. Longchamps has endeavored to prove (Annales de Chimie et de Phys. Sept. 1826,) that the oxygen and azote of the air, in contact with calcareous substances, sufficiently porous, under the influence of humidity and heat, are competent for the production of nitric acid, without the concurrence of animal matters. Gay Lussac has disputed this point with M. Longchamps, (Annales de Chimie de Janvier 1827,) which has occasioned an animated controversy between them, and a letter from the latter to the minister of *war*, the marquis de Clermont-*Tonnere*, requesting him to name a commission to

try this matter. The minister has refused to accede to this request, on the ground that the theory is purely speculative, and not supported by any direct or positive experiments.

It may be observed however, that a great number of facts and experiments, ancient and recent, such as the production of ammonia by the azote of the air, &c. appears to justify the theory of M. Longchamps. T. Graham, in an article in the Philosophical Mag. (March 1827,) adopts this theory with the following addition: he thinks that the carbonic acid of the air, being dissolved as well as this air, in the hygrometric water of the porous carbonate of lime, reacts upon the latter salt, and dissolves a part of it; that this solution of lime, being in the presence of oxygen and azote, is favorably situated for the production of nitrate of lime. He cites, in support of this, the experiments of Thouvenel, and he thinks that the putrefaction of organic matter, by the production of carbonic acid, favours, to a great extent, the progress of nitrification.—*Ibid.*

25. *New Compounds of Bromine.*—M. Serullas has discovered, that bromine becomes solid at a temperature between 18° and 20° (cent.) below zero. At 20° it is very hard and brittle. In putting two parts of bromine in contact with one of hydrioduret of carbon, there was a sudden formation of bromuret of iodine and hydro-carburet of bromine. These can be separated by means of water, which dissolves the first only. The second, washed with a weak solution of potash, is a colorless liquid, denser than water, with a penetrating and ethereal odour, an excessively sweet taste, and very volatile. It was this product that M. Balard obtained, by throwing a drop of bromine into a flask full of olefiant gas. The hydro-carburet of bromine is solid between 5° and 6° cent. above zero. It is then hard and brittle like camphor.

The author obtained hydro-bromic ether, by putting into a retort forty parts of strong alcohol, one of phosphorus, and then seven or eight of brome. The action is very rapid. The distilled liquor being diluted with water, leaves, at the bottom hydro-bromic ether, in a separate state. It is colorless, heavier than water, of a strong ethereal odour, and pungent taste, soluble in alcohol, and insoluble in water.

One part of bromine, added to two parts of cyanuret of mercury, gives bromuret of mercury and cyanuret of bromine. The latter crystallizes and may be distilled. It becomes gaseous at 15°, has a pungent odour, is soluble in water and alcohol, and is excessively deleterious.—*Ibid.*

26. *Formation of Ammonia.*—Note by M. Chevalier.—Two ounces of clean turnings of iron were heated in a covered crucible, and when cool, were introduced with an ounce of water into a flask, the beak of which dipped into mercury. After an exposure of ten hours, it gave signs of alcalinity ; and four days afterwards, the water saturated by muriatic acid, produced a very sensible quantity of muriate of ammonia. The natural oxides of iron all contain it ; and one hundred and fifty grammes of red hematite pulverised, furnished two grammes of hydro-chlorate of ammonia. The ferruginous waters of Passy also contain ammonia. These facts ought to be added to those already known with regard to the formation of ammonia by the azote of the air.—*Ibid.*

27. *Fluoric Acid and Fluates.*—Chemists are divided in opinion on the nature of fluoric acid. Some, with Berzelius, consider it as a compound of fluor and oxygen,—others, of fluor and hydrogen. If fluor spar is a compound of lime (calcium and oxygen,) and fluoric acid (fluor and oxygen,) in attacking it with concentrated sulphuric acid, there is a formation of sulphate of lime, a disengagement of fluoric acid (fluoric and oxygen,) and a disengagement of the water previously combined with the sulphuric acid. If fluor spar is simply a fluoride of calcium, on attacking it with concentrated sulphuric acid, one portion of the water of the acid will be decomposed ; its oxygen will unite with the calcium, and produce lime, which will form sulphate of lime, and the hydrogen, uniting with the fluor, will produce a hydracid, which escapes in the gaseous form. The question has remained hitherto undetermined, from the difficulty of getting clear of the action of the water. But, M. Kuhlmann having thought of treating fluor spar with anhydrous sulphuric acid, found that the acid was not decomposed ; a proof that fluor spar is a true fluoride of calcium, and fluoric acid a real hydracid.—*Ibid.*

28. *Emigration of Butterflies.*—A singular phenomenon was observed, in June last, by a respectable family of Neufchatel, (Switzerland,) while at their country seat in the dis-

trict of Grandson, (Canton de Vaud.) On the 8th or 10th of that month, Madame de Meuron Wolfe, saw with surprise, a crowd of objects flying by the window of their dining hall, which from their number excited her attention, but distrusting her own sight, she called her son to observe what was passing upon the terrace.

It proved to be an immense crowd of butterflies, which were crossing the garden with the greatest rapidity. The family left the table to see the curiosity, and although not naturalists, they could but admire the beautiful spectacle. The butterflies were all of one description and among the most beautiful of our country. They were caught very easily in a net, and were recognized as the thistle butterfly, called in French, the *belle-dame.* They all flew in the same direction, traversing the garden diagonally, and exactly from south to north. The presence of man did not affright them, and they flew very near each other.

The stream continued more than two hours, without any interruption, from the moment of their perceiving them, and it is probable they had been passing some time before they were noticed. The column was ten or twelve feet in breadth; they did not rest upon the flowers;—their flight was low, rapid, and equal. Such is the unanimous account given me by the family, who examined the novelty with that kind of interest which neglects no characteristic circumstance.

But the most singular thing in this fact, is, that it concerns a kind of butterfly, the caterpillars of which never live in company, (at least in our country,) and are isolated on leaving the egg. I should have been less surprised, had it been the *Petite-tortue*, *Paon de jour*, or *Morio*, the caterpillars of which live in common and in very numerous families upon the nettle and willow tree. What singular cause could have produced the union of the *Belle-dames*, separate from their birth, in so numerous a phalanx, and occasioned them to leave their country, for a northern climate, mountainous and severe? From what region did they come, and in what place will they rest?

So striking a fact should have excited attention in other places, for in reality these same butterflies have been seen in Piedmont, by Professor Bonelli, of the Academy of Turin, at a period anterior to that of their being seen in Switzerland. According to his relation, in a letter addressed to Mr. Moricand, of the 13th of June, 1827, the appearance of the *Pa-*

pilio Cardui, took place at the end of March, 1826, in the neighborhood of Turin. On leaving Turin, they took a direction *en masse*, from south to north. Where there were any flowers, the air was filled with them, and in the evening the plants were covered. They were the most numerous on the 29th of March, and were seen in great numbers on many successive days. After that their numbers sensibly diminished, but some remained even till June.

This beautiful butterfly, without being rare, is not common in our country, but possessing a knowledge of these facts, I have this year observed with astonishment, an incredible number of insects in the districts of Grandson and Yverdon, and what is more singular, is, that this is not the usual time of their appearing, which is the end of summer or autumn.

I have found a great number also at the foot of the mountains, and even upon the Jura, where their brilliancy contributed much to the embellishment of nature.—*Bib. Univ. Aoust*, 1827.

29. *Rewards of Science.*—The Academy of Sciences at Paris, have granted from the funds left for that purpose by the Baron Moutyon, the following prizes:—

To Pelletier and Caventou, to whom the healing art is indebted for the discovery of Sulphate of Quinine; 10,000 francs.

To M. Civiale, as having first practised on the living subject, *lithotrity*, and for having operated with success, by this method on many calculous patients; 10,000 francs.

For the second edition of the work of M. Laennec, entitled; De l'Auscultation mediate; 5,000 francs.

To M. Le Roi d' Etioles, for his exposition of the various methods employed for curing the stone without recourse to the operation of cutting; 2,000 francs.

To M. Henri (Ossian,) for having perfected the art of extracting Sulphate of Quinine, and much lessened the commercial value of that salt; 2,000 francs.

To M. Rostan, for the work entitled, *Cours de Medecine Clinique;* 1,500 francs.

To M. Gendrin, for his *Histoire anatomique des inflamations;* 1,500 francs.

To M. Bretonneau, for his *Traité des Inflammations speciales du tissu muqueux;* 1,500 francs.

To M. Ollivier d' Angers, for his *Traité de la Moelle epiniere et de ses maladies;* 1,500 francs.

To M. Bayle, for the *Traité des maladies du cerveau et de ses membranes;* 1,500.

To M. Rochoux, to aid him in printing his *Recherches sur les differentes maladies*, qu'on appelle *fievre jaune;* 1,000 francs.—*Idem.*

30. *Sulphate of Quinine.*—This valuable compound was first prepared by the authors of its discovery; but the consumption increasing, Pelletier, Robiquet, and Levaillant engaged in it in the large way in their chemical manufactories. It would be difficult to ascertain rigorously, the number, origin, and importance of the establishments in which the sulphate of quinine is at this moment prepared; but to give the academy at least a proximate idea, we will here state the numerical results of the work of two fabrics during the year 1826; the one is that of one of us, M. Pelletier; the other, that of M. Levaillant; this pharmacentical-chemist, has obligingly communicated the amount of his registers.

	cwt.
Bark, (Quinquina) treated by M. Pelletier on his own private account,	276
——— treated by M. Pelletier in company with August Delondre,	460
——— by Levaillant for M. Delondre,	420
——— by Levaillant for himself and various capitalists,	437
Total,	1593

The various barks made use of were not equally rich in Quinine; some barks gave 3 gros, 50 grs. of sulphate; others, very light, furnished but 2 gros; but the sulphato of quinine was identical; the mean of the results was 3 gros of sulphate of quinine to the pound of quinquina equal to a $\frac{23}{1000}$, which furnishes in 1826 a mass of 59,057 ounces of sulphate of quinine by the two factories alluded to. We are certain of being below the truth, in admitting that the amount manufactured by all the other chemists in France has been equal to the quantity made by one of us, viz. 31,000 ounces, corresponding to 80,000 lbs. of quinquina; we have then 90,000 ounces of sulphate of quinine; now, in admitting that the mean quantity administered to each of those who have taken it, is 36 grains, in various doses, (and for the most part much less than this is sufficient completely to check the fever,) we shall have in 1826, the number of 1,444,000 individuals who have partaken of this remedy.

Letter of Pelletier and Caventou to the members of the Royal Academy of Sciences.—*Idem. Mars*, 1827.

31. *Rural Economy.*—M. Lullin, of Geneva, in a pamphlet dictated by philanthropy and intelligence, proposes to agriculturists to substitute cows for oxen, or at least to unite the former in the labor of the farm. The substitution, he maintains, would increase the quantity of milk as well as of calves. Cows can work with advantage until six weeks or two months prior to calving, and resume their labor a fornight or three weeks after. The diminution of milk in working cows, he supposes, may be one fourth ; here eight working cows would perform the labor of six oxen, and afford at the same time as much milk as six cows without work. A cow will do as much work, it is alledged, as one ox of equal size.

The superiority, in point of cheapness and profit, of horned cattle over horses, in the work of a farm is considered as very great. Oats, harness, and shoeing are all considerable items. The price of a horse is equal to two oxen or three cows. Horned cattle are subject only to forty seven kinds of diseases, while horses are liable to 261 ; and finally a horse aged, blind, or past service, is entirely lost, while an ox or cow fattens in old age and sells to advantage. In case too, at any time, of a broken leg, the animal may serve for food. The amount of manure it is said would be doubled by the substitution of cattle for horses.—*Idem.*

32. *On a Gelatinous Quartz; by* M. Guillemin.—This substance, white, of a resinous lustre passing to dull, translucent on the edges, with a conchoidal fracture, scarcely scratching glass, and scratched by steel, is particularly remarkable for its property of absorbing a large quantity of water : it commonly contains 11 per cent, which is not combined, since it can be expelled entirely by prolonged desiccation : immersed in distilled water, it absorbs it again, (disengaging air bubbles,) to the amount even of 25 per cent. Infusible with the blowpipe, this mineral dissolves almost instantly in boiling caustic potash. Its chemical analysis gives 97.7 silex and 2.3 alumine. Differing from quartz and silex in many respects, and especially in density, which is less, in the propor-

tion of 18 to 26, it much resembles the *quartz concretionné thermogene* of Haüy; but the latter is found in concretions in certain hot springs, while the gelatinous quartz is found in sandstone, covered by the coal sandstone, with which it presents a concordant stratification, and superposed in the same manner as the pudding stone, which immediately covers the primitive stratum at Zortérais, department of the Allier; sometimes it serves as a cement to the sandstone, and sometimes forms masses in the midst of it, often considerable, the surface of which exposed to the air, passes into quartz nectique. The whole must have been deposited at the same time, for the quartz and the sandstone are intimately mixed: there is even a sort of passing from one to the other, and the gelatinous portion always contains round grains of quartz so that it is rare to find the sandstone deprived of this gelatinous matter, which serves as a cement when only in a small quantity. No spring in the neighborhood is thermal, saline, or incrusting.—*Bull. Univ. March*, 1827.

33. *Extract of a letter addressed to M. de Férussac, Berlin, Feb.* 27, 1827.—There is here at the present time, a mule from a stag and a mare. The authorities have attested the phenomena, and the structure of the beast is singular enough; the fore part is a horse and the hinder part a deer, but all the feet are those of the horse. The same stag has covered a second mare, and the result is in anticipation. The king has purchased the mule for the island of *Pfaneninsel*, where there is a menagerie.—*Ibid.*

34. *The Duke de la Rochefoucauld.*—Detached pieces issued from the pen of the Duke, with an abundant and fruitful facility; all tended to the same end, but by different ways. He rarely put his name to them: it was sufficient for him to have paid a tribute to public good. Among those writings there is one which I may be permitted to cite in concluding this notice, both because it is intimately connected with the objects of this society, and because, as it was published but a few months before he was taken from this world, it remains as his last work, and includes his last thoughts;—we may justly regard it as a legacy, which in his last moments, he was desirous of leaving to the national industry. It is the "Statistics of the Canton of Creil," modestly printed at Senlis. One hundred copies only were printed without the name of

the author. It was written on the borders of eighty with a neatness and precision, truly remakable. It furnishes a picture of the industry of a simple Canton, which, within a compass of twelve miles by six, includes one hundred and seventy nine factories, employing more than eight thousand workmen of all ages, distributing among them four millions in wages, and pouring into the commerce of the country about sixteen million of produce. Liancount is the nucleus of this fruitful activity, and has given an impulse to it by its own example. Each manufactory is rapidly described, with the history of its foundation, its vicissitudes, its progress and the causes which have contributed to them, with a detail of the sources whence the raw materials are drawn, the sale of its products, and the extent and the merit of its operations. It is impossible to include in a narrow compass a greater number of instructive facts. In inviting us also to verify the happy results obtained in the Canton of Creil by this development of labor, he adds, " we shall every where observe a reciprocity of benevolence established between masters and workmen; and we may, if we are inclined, consult the authorities, civil and religious, to learn from them that the introduction of (manufacturing) industry into their commune, has produced in the manners of the people an amelioration which becomes every day more obvious."

These are almost the last ideas traced by his hand, and we perceive in them in some sort an epitome of those which occupied and directed his whole life.

Extracted from the notice of the Duke de la Rochefoucauld, read before the society for the encouragement of national industry by Baron Degérando.—*Bull. d'Encour. Mai*, 1827.

II. Domestic.

1. *Singular organic relic.*—A workman recently broke a mass of very firm conglomerate rock, quarried for the new State House now building at New Haven, and found, lodged in a cavity, so completely enclosed as to exclude the possibility of external introduction—a piece of wood,* the small limb of a tree, apparently of the pine family—with the bark entire—the wood not mineralized—but fresh, and in

* We did not see the specimen of wood, but the facts were reported by credible witnesses.—Ed.

perfect preservation, and not even attached to the walls of the cavity, (except slightly at one end,) but lying in it as in a case. The piece of wood was not larger than a finger, and the cavity but two or three inches in diameter: it was lined with a soft and feebly coherent matter, resembling the substance of the rock in a state of rather minute division.

The conclusion from this interesting fact appears irresistible, that this piece of wood was floating in the waters, which were charged with the materials of this rock, and became enclosed, during their consolidation; thus proving, that this rock had never been ignited; and that a tree or shrub was in existence when it was formed. That it is a very ancient rock of this class is evident from its composition, presenting quartz—fresh and brilliant red feldspar and mica—along with entire fragments of granite, gneiss, mica slate, argillite, &c. being evidently an early offset, from the destruction of a primitive formation. It passes from a fine sandstone into a coarse pudding stone. The rock has been usually referred by our geologists, to the red sandstone formation; it is in many places covered by ridges of greenstone trap. In the same rock formation, but fifty miles from New Haven, were found the bones of a large animal. See Vol. II. p. 147, and Vol. III. p. 247, of this Journal, to which we refer for more particular geological details. We add the following fact relating to the same rock in Scotland.

Antediluvian Footsteps.—In the red sand stone quarry of Corncodale Muir, about two miles to the north of the town of Lochmaben, in the county of Dumfries, are numerous and distinct impressions of feet, which leave no doubt that this rock, while in a soft state, had been traversed by living quadrupeds. Casts taken from some of these prints are in possession of several geologists. The simple inspection of the tracks makes it impossible to doubt in what manner they have been produced. The great numbers of the impressions in uninterrupted continuity—the regular alternations of the right and left footsteps—their equi-distance from each other—the outward direction of the toes—the grazing of the foot along the surface before it was firmly planted—the deeper impression made by the toe than by the heel, the forcing forward of the sandy matter of the rock, by the downward and scarcely slanting direction in which it is remarkable that all the animals have traversed this singular acclivity—and, in the largest specimen found in a different part of the quarry, the sharp and well defined marks of the three claws of the animal's foot, are circumstances which immediately arrest the attention of the observer, and force him to acknowledge that they admit of only one explanation.

2. *Plane surfaces not separated by a blast in certain cases.*

Wallingford, Vt. May 16, 1828.

TOP ROF. SILLIMAN.

Dear Sir—I beg leave to call your attention to a fact, for the explanation of which a gold medal and one hundred guineas were offered by the Royal Society.

The experiment is this; cut from a card two pieces about two inches in diameter, let one of them be perforated in the centre, and let a common quill be introduced into the perforation, with one end even with the surface of the card —let the other piece of card be made a little convex, and lay its centre over the end of the quill, with the concave side of the card down—the centre of the upper card should be from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch above the end of the quill. On attempting to blow off the upper card, by blowing through the quill it will be found impossible.

I prepared the pieces of card very carefully, according to direction, and to my astonishment, the upper card *could not be blown off.*

When the edges of the two pieces of card were made to fit each other very accurately, the upper card would be moved, and sometimes it would be thrown off, but when the edges of the card, were on two sides, sufficiently far apart to permit the current of air to escape, the loose card retained its position, when the current of air sent against it was strong, when it was inclined at every angle through 180°; but when very little inclined, if the current of air ceased, the upper card would immediately fall. The experiment succeeds equally well, whether the current of air be made by the mouth, or from a bellows. When the tube fitted the perforation of the card rather loosely, a comparatively light puff of air would throw both cards three or four feet in height. When, from the humidity of the breath, the upper surface of the perforated card had a little expanded, and the two opposite sides were somewhat depressed, these depressed sides were distinctly seen to rise and approach the upper card directly in proportion to the force of the current of air.

I have this moment discovered another fact with this simple apparatus, equally inexplicable with the former. Let the loose card be laid upon the hand with the concave side up—blow forcibly through the tube, and at the same time bring the two cards towards each other—when within $\frac{3}{8}$ of an inch, if the current of air be strong, the loose card will suddenly rise, and adhere to the perforated card. If the card through which the tube passes, have several perforations made in it, the loose card is instantly thrown off by a slight puff of air. An explanation is requested by your ob't. serv't.,

NAT. IVES.

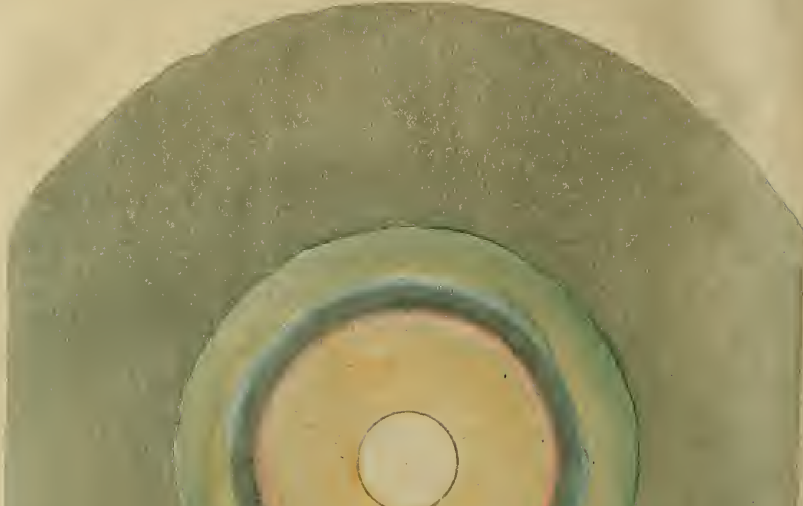
Explanation by Dr. Robert Hare.—The phenomenon above alluded to, is usually illustrated by means of two disks,* into the centre of one of which a tube is fastened, so that on blowing through the tube the current is arrested by the moveable disk. Under these circumstances the moveable disk is not removed, as would be naturally expected.

Supposing the diameter of the disks to be to that of the orifice as 8 to 1, the area of the former to the latter must be as 64 to 1. Hence if the disks were to be separated (their surfaces remaining parallel) with a velocity as great as that of the blast, a column of air must meanwhile be interposed, sixty-four times greater than that which would escape from the tube during the interim. Consequently if all the air necessary to preserve the equillibrum be supplied from the tube, the disks must be separated with a velocity as much less than that of the blast, as the column required between them is greater than that yielded by the tube; and yet the air cannot be supplied from any other source, unless a deficit of pressure be created between the disks unfavorable to their separation.

It follows then, that under the circumstances in question, the disks cannot be made to move asunder with a velocity greater than 1-64th of that of the blast. Of course all the momentum of the aerial particles which constitute the current through the tube will be expended on the moveable disk, and the thin ring of air which exists around the orifice between the disks; and since the moveable disk can only move with 1-64th of the velocity of the blast, the ring of air in the interstice must experience nearly all the momentum of the jet; and must be driven outwards, the blast following it in various currents, radiating from the common centre of the tube and disks. The effect of such currents in producing an afflux of the adjoining portions of any fluid in which they may be excited, is well known, having been successfully illustrated by Venturi. See Nicholson's Journal, quarto, Vol. II. p. 172.

* The word *disk* is used by experimental philosophers, to signify any plane surface bounded by a circle, whether it be merely a superficies, or have a sensible thickness, as in the case of a wafer, or a piece of coin.

LUNAR CIRCLES. Nov. 2. 1827.



A. Doolittle, sc.

Accordingly the afflux of the air towards the disks counteracts the small velocity which the blast would communicate, and thus prevents their separation, and may even cause them to approach each other, if previously situated a small distance apart.

This rationale commences with the assumption that the disks will remain nearly parallel. That there cannot be much deviation from parallelism must be evident, since any obliquity will make the opening greater on one side than on the other; and the jet proceeding with most force towards the widest opening, will increase the afflux of air upon the outer surface of the moveable disk in the part where the current is strongest, and thus correct the obliquity.

The phenomenon is advantageously exhibited, when the area of the tube is to that of the disk, as stated; but were any other ratio, which can be successfully employed, substituted, it would not alter the explanation.

(Communicated by Mr. Amos Doolittle.*)

3. *Singular appearance of circles around the Moon.*—On the evening of the 2d of November, 1827, between the hours of seven and eight, there appeared, around the moon,† (a little more than its width in diameter,) a very luminous saffron colored light. On the outer edge was a circle of bright red, which was graduated into a dark purple; around the purple was a circle of bright blue which faded into a yellowish green, increasing towards the outer edge, to a very vivid green. There appeared to be faint white rays passing from the moon across these columns, whose circles formed, around this lunar glory, a larger circle of a dark leaden color, which gave the whole a very beautiful appearance.

It was observed by a great number of spectators at New Haven, who all say they never saw any thing of the kind equal to it in the whole course of their lives, and some of the spectators were aged people. A little girl ran in to her friends exclaiming "come and see the prettiest moon that ever was."

NOTE.—The Geological Profile which forms the frontispiece of the present volume, and the pictured tablet, at pp. 144—5, to illustrate Prof. Eaton's Geological Nomenclature, were presented to this Journal, by the Hon. Stephen Van Rensselaer, whose liberality to the cause of useful knowledge, and whose enlarged views of the primary interests of his country, entitle him to its warmest thanks, and to the gratitude of posterity.

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* Mr. Doolittle, engraver to this Journal, has presented to the public the annexed plate, representing this beautiful appearance, and his daughter Miss Sarah Doolittle, has colored it, as she copied the hues at the moment, and before they had changed or materially faded.—It is a very correct representation, as it was seen by the Editor among many others.

† The moon was about two hours from its rising.

4. *Meteorological Table.*

Prof. Silliman—Dear Sir—I send you the following Meteorological Table, extracted from a Meteorological Journal of observations made from the thirtieth day of April, 1827, to the first day of May, 1828, at Fayetteville, New Fane, Vt. in lat. 42° 58′ North, and long. 4° 20′ East from Washington.

I am, Sir, very respectfully yours.

MARTIN FIELD.

1827 and 1828.	THERMOMETER.											WEATHER.				WINDS.								MISCELLANEOUS.					
					Maximum of temperature.			Minimum of temperature.				No. of days of diff. variations																	
Mont's	Mean temp. at sun rise.	Mean temp. at 2 o'clock P. M.	Mean temp. at 9 o'clock P. M.	Aggreg. of mean temp. each month.	Day.	Hour.	Highest degree.	Day.	Hour.	Lowest degree.	Range of Therm'r.	Clear.	Cloudy.	Rainy.	Snow & hail.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Inches of water in rain, hail & snow in day time.	Inches of water in rain, hail and snow at night.	Aggregate of water each month.	Inches of snow and hail.	Lightning & thunder.	Aurora Borealis.
May,	47.1	64.6	54.	55.2	27	3 P. M.	88°	3	5 A. M.	32°	56°	22	9	7	0	5	4	1	1	3	7	5	5	2.1	2.5	4.6	00	1	2
June,	56.6	74.2	63.9	64.9	13	2. 30	89	2	4	44	45	22	8	8	0	4	3	–	1	7	5	4	6	1.6	3.2	4.8	00	7	2
July	61.4	79.7	65.3	68.8	1	3	96	7	4.30	52	44	24	7	7	0	1	–	2	1	8	6	3	10	3.2	2.0	5.2	00	4	1
Aug.	58.	73.5	63.9	65.1	6	1	90	29	5	39	51	22	9	5	0	–	1	2	3	5	4	5	11	2.4	2.0	4.4	00	4	4
Sept.	49.	67.5	55.	57.2	3	3	80	30	6	34	46	21	9	5	0	3	6	2	1	3	6	2	7	3.1	5.5	8.6	00	3	4
Oct.	42.3	54.8	44.3	47.1	4	2	70	28	6	28	42	20	11	6	0	1	2	2	–	8	5	3	10	2.1	4.4	6.5	00	0	4
Nov.	25.6	34.8	28.	29.5	3	1	50	11	6.30	11	39	19	11	4	3	2	2	–	–	2	1	2	21	2.2	2.6	4.8	10	0	1
Dec.	23.	27.	24.	24.7	15	3	48	23	9 P. M.	—6	54	17	14	3	3	1	4	–	1	6	–	10	9	1.2	3.9	5.1	12	0	0
Jan.	22.	31.5	22.5	25.3	13	2	54	22	9 P. M.	—7	61	18	13	3	3	3	2	4	2	5	2	5	8	1.6	2.3	3.9	13	0	2
Feb.	25.	38.5	28.6	30.7	7	1	57	12	9 P. M.	8	49	18	11	5	3	–	1	2	1	7	6	6	6	–.9	4.0	4.9	17	0	0
March,	26.5	43.	30.6	33.4	28	3	70	1	6 A. M.	10	60	22	9	2	4	2	2	1	4	6	3	5	8	1.2	1.6	2.8	12	0	1
April,	32.6	49.6	38.	40.1	30	2	60	17	6	24	36	20	10	1	3	8	3	3	1	2	1	1	11	1.5	1.3	2.8	8	0	2
Ag.tem	39.1	53.2	43.3	45.4	Recapitulation,							245	121	56	19	30	30	19	16	62	46	51	112	23.1	35.3	58.4	72	19	23

Remarks.—It appears from the foregoing table, that the mean temperature of the year was 45°.4. ; that the mean temperature of the summer months was 66°.3
winter do. 25°.9—40°.4 Difference.

Maximum of temperature for the year, occurred July 1st, and was - - - - - 96°.

Minimum Jan. 22d, - - - -7°.

Whole range of temperature, - - 103°.

The whole quantity of water, in inches, which fell in rain, hail and snow was 58.4—35.3 of which fell in the night time. On the 19th, 20th and 21st of September, there fell eight inches of rain. The whole quantity of snow and hail was seventy-two inches, but as the weather was mild, and the snow storms were usually succeeded by warm rains, there were but a few days of good sleighing in Vermont, during the winter. The greatest depth of snow upon the earth, at any time, did not exceed twelve inches. The quanity of water, in rain, hail and snow, which fell during the last year, was two tenths of an inch more than that of the year preceeding; and the temperature of the summer months was two degress less; but the comparative progress and maturity of vegetation in those years was truly surprising—In consequence of a mild and open winter, followed by a very warm and dry spring, which was succeeded by swarms of devouring insects, which destroyed much of the growth of the summer of 1826, a greater scarcity of provisions, both for man, and beast, was experienced in some parts of Vermont, than has occurred since the first settlement of the State. But the last season was directly the reverse; the crops were never more abundant, nor in a finer state of maturity.

Fayetteville, May 1st, 1828.

5. *Postscript* to the Pluviometrical Observations of Dr. Darlington, published at p.* 29, *of this volume.*—Since the foregoing was written, I have seen in the "*Register of Pennsylvania*," a statement of the rain as it fell at, and near Philadelphia, for a number of years past,—by which it appears, that the quantity was much *less* than I have made it: so much less, indeed, that it would warrant a suspicion that there must be some inaccuracy in one, or both, of the accounts. The statement in the "*Register*" makes the *average* of the last five years only 36.30 inches; whereas my account gives an average of 47.46 inches. It is hardly probable there could be that much difference in the quantity, in two places so near each other (not exceeding twenty-five miles:) and yet I am unable to account for the discrepancy. My rain guage was a tin vessel, accurately made, six inches deep, and six inches square

* Accidentally omitted in the last No.

—being an exact cube, open at top: and as the guages commonly used, are inverted cones, I should suppose mine would have exhibited a rather *less* quantity than those, on account of its allowing more evaporation—especially during light rains, in warm weather. I cannot well perceive how such a guage as mine could catch *more* rain than actually fell: yet it has almost constantly shown more than the published accounts from *Washington City*, *Albany*, and *Philadelphia*. I find, nevertheless, that my statement agrees remarkably with one preserved by Mr. Jefferson, in his Notes on Virginia—which shows an average of 47.038 inches, in a series of five years, just half a century prior to my observations, viz. from 1772 to 1777.—As statements of this description are of no value, unless made with fidelity and accuracy, I thought it due to the occasion, to make these few additional remarks. W. D.

6. *New Haven Gymnasium.*—This Institution, whose plan was announced at p. 385 of Vol. XIII, of this Journal, was commenced on the 1st of May, and is now in successful operation, with a competent and increasing number of pupils.

It was very fortunate that the parent institution at Northampton, was organized and carried into effect by gentlemen whose eminent qualifications and devoted zeal, have enabled them to establish a high standard of excellence, in this kind of Seminary; so important to this great and growing country. Uniting academic and domestic discipline—providing equally for intellectual, physical and moral culture—and fitting the pupil either for business or the University, according to his destination in life; it is most happily adapted to meet the wants of a large class of pupils in the United States. The example set at Northampton, has been successfully followed at Amherst and elsewhere, and the public expect much from the Gymnasium of the Messrs. Dwights. The location and accommodations of their school, are peculiarly happy—they have introduced able instructors—their own talents, and zeal will be brought to bear incessantly upon the great object, and we cannot doubt, that as guardians and instructors of so interesting a portion of the youth of this country, they will honor the memory of their illustrious father, and continue the influence which he so extensively and happily created. June 16.

7. NOTICE.—Within the year 1829, I intend to publish a system of American Geology, carefully compared with the geology of the eastern continent. If I succeed in preparing it in a manner which shall be acceptable to my scientific colleagues, I shall add seven or eight copper-plates, illustrative of the science.
Rensselaer School, April 30th, 1828. AMOS EATON.

8. *Chesterfield Tourmalines.*—Mr. Clark, the proprietor of these minerals, designs to explore his locality to a greater extent, the present season, than he has heretofore done, and will be better prepared to furnish collectors of Cabinets who may visit him.

INDEX TO VOLUME XIV.

I

J

L

M

N

O

P