THE AMERICAN JOURNAL OF SCIENCE, AND ARTS.

CONDUCTED BY

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PREFACE.

Two years and a half have elapsed, since the publication of the first volume of this Journal, and one year and ten months since the Editor assumed the pecuniary responsibility. Within this latter period, three volumes have been published, giving an average of a volume once in about six months, and of a number, once in half that time. It is intended, as far as practicable, to publish this Journal in quarterly numbers, but on account principally of the great geographical range from which the communications come, and of the large number of engravings, undeviating exactness on this point, is not always attainable.

The work has not, even yet, reimbursed its expenses, (we speak not of *editorial* or of *business* compensation,) we intend, that it *has not paid for the paper, printing and engraving*; the proprietors of the first volume being in advance, on those accounts, and the Editor on the same score, with respect to the aggregate expence of the three last volumes. This deficit is however no longer increasing, as the receipts, at present, just about cover the expense of the *physical* materials, and of the *manual* labour. A reiterated disclosure of this kind is not *grateful*, and would scarcely be *manly*, were it not that the public, who alone have the power to remove the difficulty, have a right to a *frank* exposition of the state of the case. As the patronage is, however, growing gradually more extensive, it is believed that the work will be eventually sustained, although it may be long before it will command any thing but gratuitous intellectual labour.

It is regularly transmitted to Sicily, Italy, Switzerland, Germany, France, Sweden, Ireland, Scotland, and England, and occasionally to other foreign countries. In London, in consequence of an application to the Editor from that city, a regular arrangement has been made for circulating the Journal in Great Britain. Many of the periodical scientific works of Europe, and most of those of London and Paris are forwarded in exchange.

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PREFACE.

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Washington, Baltimore, Charleston, and the Southern States generally, but especially South Carolina, demand a very considerable number of copies, and all the smaller cities receive a proportionate supply.

These facts, with the *obvious* one,—that its pages are supplied with contributions from all parts of the Union, and occasionally from Europe, evince that the work is received as *a national* and not as *a local* undertaking, and that the community consider it as having no *sectional* character. Encouraged by this view of the subject, and by the favour of many distinguished men, both at home and abroad, and supported by able contributors, to whom the Editor again tenders his grateful acknowledgments, he will still persevere, in the hope of contributing something to the advancement of our science and arts, and towards the elevation of our national character.

Yale College, Feb. 15, 1822.

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1. *Foreign—from Prof. Griscom.*

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II. *Domestic.*

ERRATA for the 9th No.

Pa. 144, line 27—for three times heavier, read *twenty-six times heavier.*

145, 26—after *fall* read *if.*

33—for analagous, read *analogous.*

157, 9—for relation, read *radiation.*

In the description of Michaelite, pa. 391, the analysis of *two* distinct varieties was given by mistake. The last analysis only, for which I am indebted to my friend Dr. Dana, belonged to that notice. J. W. W.

Some errata in Dr. B. W. Dwight's account of the Catskill storm have been accidentally lost.

For the 10th No.

In Mr. Brace's Catalogue there are some errors, chiefly of single letters, but we have not room to insert them here.

Pa. 320, line 10—for apurcpicca, read *a pure piece.*

309, 25—for acrons, read *acorns.*

332, 20—for H. A. Y. read H. A. S.

353 bottom line—for Dinostratus, read *Dinostrates.*

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

GEOLOGY, MINERALOGY, &c.

Art. 1.—*Account of the Mines of Anthracite, in the region about Wilkesbarre, Pennsylvania; by Mr.* Zachariah Cist.

Extract of a letter to the Editor, dated Wilkesbarre, July 24, 1821.

Dear Sir,

I have forwarded to your care, the enclosed letter to Mr. Brongniart, which, should you deem it of sufficient interest, you are at liberty to make use of, either in part or in whole, for your Journal.

The accompanying pamphlet, which was published a few years since, with the view of assisting the introduction of our coal into general use, will give you the desired information respecting its economical relations.

About two thousand tons are now annually consumed along this river, from this to tide water. The quantity sent to market from the Lehigh and Schuylkill mines, may be estimated from one thousand to fifteen hundred tons. The coal is here valued at 50 cents per ton, in the mine; costs about 50 more to raise it; and $12\frac{1}{2}$ to 60 cents, according to the distance from the bed, to deliver it at the river. It is transported in arks,* carrying from forty to sixty tons, to

* The foreign reader may need to be informed that this word is adopted in American *river navigation*, to denote a large rudely covered boat, in which those charged with the care of it *live*, as in a house, during their descent to the point of their destination, when the ark is broken up and sold for what it will bring.—Ed.

Harrisburgh, Columbia, and other towns on the river, where it sells at from $4 to $4 50 per ton. At Philadelphia, it brings from 30 to 40 cents per bushel.

Very respectfully, your obedient servant,

ZACHARIAH CIST.

P. S. The accompanying view of one of our Coal Mines, presents a section sufficiently complete of the strata of most of them.

Section of the strata at SMITH's bed, on the West side of the river. Dip to the South, about 20°.

1. Sand stone of the mountain, composed of coarse stone and quartz, from the size of shot to that of a pea, grain rather regular, used for building, very compact, and difficult to dress—color dark. This runs of great thickness, often in detached masses heaped on one another.
2. Slate, with considerable quantity of minute fragments of mica interspersed, containing vegetable impressions, fifteen feet thick.
3. Micaceous sand stone, four feet thick, easily worked, and used for grind stones, for which it is well adapted—color light blue.
4. Slaty coal, two feet thick, left to form the roof of the mine.
5. Coal worked, eighteen feet.
6. Tough fine blue clay, two inches.
7. Sand stone, containing but little mica. The first part of this is easily bored through, but it becomes gradually harder. About thirty feet of this stratum is exposed—its depth is unascertained.

Section of BOWMAN's mine, on the east side of the river—dip to the north at about 15°.

1. Coarse sandy schist, as you proceed in depth passing into argillite sixteen feet. This stratum contains vegetable impressions.
2. Coal, twenty-five feet thick.
3. Argillite, with pyrites imbedded, and investing the surface one foot thick. These pyrites seldom exceed one-fourth of an inch square, and are much flattened; the

plates lie over one another in a very confused manner; they readily decompose in a short time on exposure to the atmosphere.

4. Sand stone, rather soft at first, becoming harder in depth. About fifteen feet of this stratum is exposed, it is similar to the No. 7, at Smith's bed.

It is evident from the inclined position of the strata, that one bed of coal lies over another, the upper being evidently of much later formation.

At Blackman's bed, on the east side of the river—dip to the north, about 35°—the strata are :—

1. Argillaceous grit, with particles of mica, ten feet. The impressions in this are few, *chiefly branches of trees*, a plant about six feet high, in bloom, occurred in this.
2. Coal, twelve feet thick.
3. Argillite, thickness unascertained.
4. Sand stone, thickness not known.
5. Schist, with intervening layers of micaceous sand stone and argillite, the latter with impressions generally of *aquatic plants*.
6. Coal, fourteen feet thick.
7. Argillite, without impressions, thickness not known.

Letter to Mr. Alexander Brongniart, *Engineer of Mines, Member of the Royal Academy of Sciences, &c.*

Sir,

Through the medium of the American Journal of Science, your circular request, addressed to Naturalists and the friends of Science, has reached me, and desirous of affording you all the information in my power on the subject of organized remains which have come under my notice in this quarter, I have forwarded to you a collection of the vegetable impressions of the Anthracite formation, in the range of which I reside.

Engaged myself in forming a collection, and in figuring the fossil reliquiæ of this formation, I have transmitted only those of which I have duplicates. If it would be pleasing to you to obtain more of them, you have only to signify your wish in this respect and you shall be gratified.

Being here, without the facilities of referring to works on organised remains, should these specimens be recognised by yourself as similar to those of Europe, I should be pleased to obtain their scientific designation. I have therefore marked this set alphabetically, and have added corresponding letters to the drawings in my collection.

The valley of Wyoming, in the centre of which Wilkesbarre is situated, is about eighteen miles long and from three to four wide. Through this, the Susquehanna river, which is here seven hundred feet wide, winds, occasionally approaching the mountain, now on one side and then on the other. The land rises very abruptly on each side of the river to the height of one thousand feet above its level, and keeping nearly that height, extends to the east about thirty miles before it again descends. On the other side of the river, the high table land extends to a great distance. The top of these mountains, or highlands, is composed of argillaceous grit, coarse sand stone, (No. 1,) and quartz breccia, (2,) formed of rounded quartz pebbles, from the size of a pea to that of a hen's egg, imbedded in a siliceous cement, forming immense rocks. About eighteen miles to the east, occurs the variety of manganese (*a*) imbedded in a black vein of about ten inches thick, of black earthy manganese. The variety (3,) is scattered in detached lumps, from the size of a walnut to that of a man's head, all over this mountain, though not in great quantity in any one place.

On reference to the map annexed, you will perceive that the broad black streak denotes the length, breadth, and course of our coal formation. This extends in a S. S. westerly direction, from its commencement at the upper part of the Lackawana river, near the Wayne county line, down the course of that river to its junction with the Susquehanna, thence along the Susquehanna, keeping chiefly the east side, leaving this last river about eighteen miles below this place, it passes in a southward course on to the head waters of Schuylkill river, and from thence, after its crossing three main branches, becomes lost, a small seam of it only appearing at Peter's mountain, a few miles above Harrisburg. The only minerals in this extensive range of above one hundred miles in length, are micaceous iron ore, (3,) fer oligiste, found on the Schuylkill—specular iron ore, (4,) on the Lackawana, and in numerous places, owing to the decomposition of pyrites, bog iron ore.

On the height of land, the veins of coal are more level than in our valley, where the strata dip from the height of five hundred feet, at an angle of from 10 to 35°, *towards the river on both sides*, inducing a belief that the valley has been formed by the sinking of the surface.

The coal alternates with schist, argillite or thonschiefer, micaceous slate, *(5,)* and micaceous sand stone, (6 ;) which last is in strata from five to one hundred feet thick, the coal itself forming veins of from thirty to forty feet deep, though the general thickness is from twelve to fifteen feet. The deposition of vegetable matter to have formed such masses of coal, making allowance for its compression, must have been enormous. You will not fail to remark that the mica of the slate is very abundant, and the presumption is, that it is of very old formation.

The bed of the river is composed of coarse gravel, three fourths of which are pieces of granite, sienite, porphyry, primitive limestone, chert, hornstone, petrosilex, &c. ; although for one hundred and twenty miles above this, not one primitive rock is to be seen on either side of the river, whilst the entire bed of the river, as far up as I have been, is composed principally of the above primitive stones brought down the river, and rounded by attrition. This bed of gravel, which extends to a considerable distance on each side of the river, is, in many places twenty-five feet above its present level. The alluvion of the river is a clayey loam. All the finer clays which are found in it, vitrify at a strong heat, and have evidently been formed from the decomposition of the feldspar, of the granite gravel of its bed. This gravel, at Wilkesbarre, reposes on a thick bed of clay. Intermixed with these primitive stones, are found the habitations of molluscous animals, generally imbedded in chert.

About forty miles above, to the N. W. a stratum of sea shells, twenty feet thick, rises to the summit of the highest hill adjoining the river—they are chiefly bivalves. These, when burnt, form a coarse lime mixed with considerable sand. When long exposed to water, this stratum loses its calcareous matter, leaving the impressions of the shell in the sand. A specimen of this brought down by the river is marked.*

* With a figure resembling the Greek Delta

The vegetable impressions always accompany the superincumbent schist and argillite; none have been found among the coal, nor any, or rather very few, in the carbon-impregnated argillite of the floor. I have, in this last, however, met with the *phytolithus verrucosus*, figured by Martin in his Petrificata Derbiensia.

The mass of the impressions are in the argillite immediately in contact with the coal, although they are common in the coarse sandy schist* above it, and occasionally are found in the sand stone strata which alternate with the coal. There are above a dozen species of fern. A frequent impression, is that of a very broad-leaved, apparently, aquatic plant, probably a sedge, with a transverse thread across the leaf at every three or four inches. This leaf is sometimes found of the breadth of six and even seven inches. Another very much resembles the leaf of the Indian corn, (zea mays,) or rather that which comes to us in boxes of tea. Occasionally, very perfect specimens of flowers of a stellated form occur, and rushes and a variety of singularly formed plants and leaves, the originals of many of which are probably now lost. There are also numerous impressions resembling the bark of trees, or lichen attached to the bark, some of them forming tableaux four or five feet long, and a foot or more wide, so regularly and beautifully figured, that the colliers term them "*jacket patterns.*" These are very interesting, but the schist in which they are generally found, is so very friable, as to render it difficult to obtain any thing like large or perfect specimens; possibly they are aquatic algæ. In general, the cryptogamic class prevails, to which the algæ and filices belong—these last, in particular, are very numerous. Culmiferous plants also abound, but they are generally leafless, the impression of the stem alone being left.

One or two of the beds here are worked by leaving massive pillars eight or ten feet square at the base; but with the exception of these, the beds, which are very numerous, are worked *au jour*, that is, the superincumbent strata are first removed, when the coal is either blown off with gunpowder or taken off with wedges by drilling in a straight line, at suitable distances, or from twelve to twenty-four inches apart, several deep holes about two inches in diame-

* In this schist, the *phy. cancellatus* and *tessellatus*, figured by Martin and Steinhauer occur.

ter, dropping in each two long semicircular wedges, the thick end of each down, and driving in a long very gradually tapering wedge between them, so that the greatest pressure shall act at bottom. These wedges are alternately driven, until a large mass of the coal breaks off, when it is broken up with sledges, of a convenient size for handling. Gunpowder is occasionally used, but the effect is much less certain than that of the drill and wedges.

The specific gravity of our best coal, is from 1-5 to 1-6. The purer the coal the less is its specific gravity. In its purest state, the fracture is what the German mineralogists would term *muschliger*, that is of a conchoidal splintery fracture breaking like rosin. This is its true fracture: but when contaminated with slate, or pervaded by delicate layers of it, even imperceptibly so, its fracture becomes more angular, lamellar and cubical—in the former state, it affords but a small quantity of ashes, in the latter the quantity is considerable.

In the samples, the pure is marked No. 7, the impure 8.

Brilliant specimens of pavonine, or irridescent coal, are abundant; but this kind is found only *in the water*, or in moist situations.

Our anthracite, when pure, affords the most intense heat of any of the carbonaceous minerals. In a properly constructed wind furnace, of the cubic dimensions of ten or twelve inches, cast iron readily melts, and the most refractory clays, either become glazed, melt, or loose their form. The best Spring-Cove and New-Castle Delaware clay, used for glass pots in this country, which will stand the heat of a window glass furnace, for six or eight weeks, will melt in thirty minutes; and feldspar, in a few minutes, is changed to a porcelain. Water thrown on it is instantly decomposed.

I am, sir, very respectfully,

ZACHARIAH CIST.

Wilkesbarre, Pennsylvania, July 2, 1821.

Practical facts relating to the Lehigh or Wilkesbarre coal, cited principally from the pamphlet mentioned in the letter of Mr. CIST *to the Editor.*

[This pamphlet appears to have been published about six years ago, and although written evidently not with scientific, but with mercantile views, we have every reason to confide in the truth of the statement of facts, having often heard them from other, and those disinterested persons, of probity and intelligence. As the subject is one of national importance, and appears not to be extensively understood, we subjoin some certificates of practical men as to the value of this coal in different arts, depending on fire.—Editor.]

LEHIGH COAL.

The importance and value of this coal for manufacturing as well as for domestic purposes, is not generally known; but its use is rapidly extending, it having been found equal, if not preferable, to other fuel for most of the purposes to which it has been applied. For nailing, for the rolling and slitting of iron, malting, distilling, evaporation of salts, for steam engines, where the furnace is properly constructed; for all these purposes it is entitled to a decided preference. It produces a regular, steady heat, without smoke or unpleasant smell, and makes a most durable fire. Producing no soot, the pipe or chimney can never become foul, or be in danger of taking fire. Neither will the misery of a smoky chimney ever be endured where this fuel is used.

For blacksmiths use, it is superior to the bituminous coal for all general purposes, except, perhaps where a large hollow fire is required, for very heavy work. Some alteration, however, is necessary in the tue (twyer?) iron. The gudgeons of the bellows ought to be placed four or five inches above the level of the nose of the pipe; the back of the fireplace should be brought up slanting back, so that part of the fire may rest on it; the hearth should be filled up to nearly level with the bottom of the tue iron, and some little skill is requisite to keep the fire open, which is soon acquired.

When we take into view the trouble attending the making of charcoal, that not every kind of wood will answer, (hickory, maple, gum and chesnut being the wood generally used for this purpose,) the nightly watching while in the pit. where even in spite of every care it is often entirely consumed; the waste and destruction it causes of timber, which might be applied to more valuable purposes; and that with *one bushel* of this *mineral charcoal*, as much work may be done as with eight or ten of wood coal, and with a saving of time, we are warranted in the assertion, that the Lehigh Coal will soon supercede the use of charcoal altogether.

A similar species of coal was introduced about five years ago, into Lancaster, Dauphin and York counties, where it is much approved of by the smiths, and is burnt by the farmers in stoves* of a peculiar construction, and the use of it is rapidly extending. Not less than sixty thousand bushels have been used in those counties during the last year. A powerful consideration with the farmer is, that by using this coal, there is no need of his retaining so large a proportion of his farm in woodland; all that is necessary is to keep a sufficiency for building and fencing: the quantity of his arable land may be increased without any additional purchase, and the superfluous wood can be sold to advantage.

It is to be observed that the grates should be so constructed as to free themselves from the ashes, which is done by having no place, if possible, for the ashes to lodge, and making the bars smaller below than on the surface where the coal rests, placing them about 7-8 of an inch apart, and giving the stove or grate a strong draught of air; the sides and back of the grate should be formed of good fire brick; they should be perpendicular and not inclined.

The introduction of this coal is a subject of general importance. Whoever casts a retrospective glance of a dozen years will remember the low price of wood, and the little estimation in which woodland was then held. If he compares it with its present advanced price, and observes how those tracts are subdivided and cut up now, he will be able to form some idea what the price of firewood will probably be a dozen or twenty years hence, if no other fuel is adopted, or dependence placed on our forests alone for supplies.

The following statements form only a part of those which have been received; it is deemed superfluous to present any more. J. C.

* These stoves may be had at the furnace of Reuben Traxler, Berks county, Pa.

Certificate from Messrs. White & Hazard, proprietors of the extensive Wire Manufactory and Rolling and Slitting Mill, at the falls of Schuylkill, five miles above Philadelphia.

We have used the Lehigh Coal, and in the heating of bar iron for rolling, we find it to contrast with Virginia Coal as follows:

With Lehigh Coal, three men will roll *ten cwt. of iron* for wire, and burn *five bushels* coal per day of twelve hours.

The wages are	$ 4 00
Five bushels of coal, at ninety cents, is	4 50
With Virginia Coal, it takes *ten bushels* to heat *five cwt.* of bars, which is all the three men can do with this coal in one day	8 50
The wages as above, is four dollars per day, but rolling but *five cwt.* a day, it will take *two days* to roll ten cwt. making the wages for that quantity	8 00
Suppose the coal to cost only $2\frac{1}{2}$ cents per bushel, twenty bushels would be	00 50
	$8 50

It follows, that to us, Lehigh Coal at *ninety cents*, is equally cheap as Virginia Coal at *two and a half cents* per bushel.

WHITE & HAZARD.

Whitestown, November 1814.

Having made a trial of the Lehigh Coal, at the Pennsylvania Bank, in the large stove, I found them to answer for that purpose exceeding well—they give an excellent heat and burn lively. It is my opinion they *are nearly equal to double the quantity of any other coal* brought to this market for durability, of course less labour is required in attending to the fire—they require a strong draught.

My opinion is, they will be found *cheaper than wood*; they burn clean; *no smoke or smell of sulphur is observed*, or any dirt flying when stirred, which is a great objection to all other coal for family use.

If the fire places are properly constructed for burning this coal, I am well convinced that most of the citizens of Philadelphia will give it a preference to wood.

FREDERICK GRAFF.

We, the undersigned, do certify, that we are now using the stone coal for heating hoops for cut nails, and find it to *exceed any other coal or wood fire* for this purpose.

Our practice is, in the morning when we leave the shop for breakfast, to throw a quantity of coal on the fires, which will be fit for working on our return, and will last until we leave it at nine in the evening, when we again put on a quantity which lasts until the next morning at breakfast time. We find a very great advantage in thus having the fire ready to work at an early hour in the morning. Such a fire requires about a half bushel of coal in twelve hours.

We find also, that the hoops *heat in half the time* that they do with any other fire.

Upon the whole, we think that the Lehigh Coal is much the best for nailing, and not attended with one fourth the trouble of any other fire, and that the nails are, in our opinion, superior to others on account of the quickness of the heat, which does not cause the iron to scale so much.

We also cut one fourth more nails with this fire than with a wood fire.

GEORGE SMITH.
JOHN MORGAN.
DANIEL COLKGLASER.

December 7th, 1814.

I have used in my business for years past, occasionally, charcoal, sometimes Virginia coal, and at others Lehigh, and from use and careful examination of their relative value, I am perfectly satisfied that one bushel of Lehigh coal is equal in durability and value to nearly three of Virginia, and from ten to twelve of charcoal; and further, I find that they are the only coal I can depend on for welding of gun-barrels, as with them I am always sure of a true and uniform result. I have now used them twenty years, and would not be willing to be without them even if they cost me two dollars per bushel. I own three tilt hammers, and have worked for the United States and the state of Pennsylvania the last eight years.

It requires about a peck of coal a day, with a small proportion of charcoal, for one fire; with this I manufacture eight gun barrels or twenty pistol barrels, or one quart of this coal to a musket barrel.

DAVID HESS,
Smith and Gunbarrel maker, Northampton. Pa.
December 3, 1814.

I have used this kind of coal for the last two years, both for the malt-kiln as well as under the brewing copper, and also for distilling, for which purpose I find it to be *superior to wood, cheaper, safer, and attended with much less labor.*

In distilling, with thirty bushels of this coal and half a cord of wood (to raise occasionally the heat,) I distil one one hundred bushels of grain in a still containing one hundred and twenty-five gallons, upon the common old construction, in ten days, when I formerly used five cords of wood for the same quantity, taking longer time and requiring much more labor.

In order to dampen the fire, whilst occasionally mashing or drawing off the still, I have only to throw on some of the finest of the coal, and when again I want to raise the heat, I put on a stick or two of wood. The length of the bars of my grate is twenty-two inches, of inch square iron; they are set in loose, the ends widened, so that the bars may be about 7-8 of an inch apart, and placed thus side by side, they make a grate of fifteen inches wide—the stills are set bare to the fire, about sixteen inches above the grate, with single flues passing round each still, with doors to the furnace.

For malting, the advantages are, that producing no smoke and containing no sulphur, there is no danger of their smoking or otherwise injuring the malt, whilst the *regularity of the heat* is such, that the fires require little or no attention at night, and there is also no danger, with common attention, of burning the malt.

For brewing, or under the boiler, I prefer it for the reasons which induce me to use it in distilling.

WILLIAM BOWN,
December 20, 1814. Brewer and Distiller.

This may certify, that I have been concerned in distilling for two years past. The capacity of our large still is one hundred and twenty gallons, of the small one seventy. We make use of stone coal for fuel. We can, with ease, discharge our stills *six times in twenty-four hours*, and in that time use only about three bushels of coal, without any danger of burning the liquor or stills. It is not attended with half the labor of a wood fire, nor do we experience that difficulty of regulating the fire as is the case where wood is used.

JOHN P. ARNDT.

Experiments of Mr. Smith, of Bucks county, Plough manufacturer, shewing the excellence of Lehigh Coal for Blacksmiths work.

1st. In forging twenty plow clevices, used a *full heaped half bushel* weighed 45lb.

In making the same number of twenty, with *charcoal*, used *six bushels*, and took *two hours more time.*

2d. In welding up coulters that used to require *three heats with charcoal*, now require but *two* and frequently done with one.

3d. Laying sharemoulds and welding on the land-sides, that used to require *four heats* each, now done in *three* and frequently with only *two*, and taken in less time.

4th. In order to make a more accurate experiment, I yesterday morning weighed a bushel for each fire (72lbs. or the thirtieth part of a ton) having previously cut up two hundred of 3-4 square iron, which they forged into fifty-three plow clevices; one fire in working twenty-eight, used all their coal and one bushel of charcoal; the other, in working twenty-five had 8lbs. left, and completed their work in one hour less time than the same hands had done the twenty-eight with charcoal.

They are also found to work *steel better* than any other kind of coal; not burning either that or iron as other coal does. From the whole of my observations (and I have been particularly attentive to the use of them the month past,) I am fixed in the opinion that *one bushel* of this coal is *worth two of the Richmond*, and *ten* or *twelve* of the best charcoal. I also think Weiss's the best that I have seen, as they were so very pure that the smith had no occasion of clearing out his fire more than once a day.

The following statement taken from my book, will exhibit in a clearer light, the value of Lehigh coal:

Smith book account and wrought iron on hand, for the month of January, eighty-six days work done	$211
Charcoal used in forging the same, three hundred and seventy-five bushels, at $12 per hundred bushels	45
Smith book account and wrought iron on hand, from 1st February to the 25th March, one hundred and seventy-seven days work done	733
Charcoal used, two hundred and seventy-five bushels, deduct for same in proportion for January, as the work was similar	129
Seventy-five bushels of Lehigh coal used in forging the above, $604 worth of work, at $1 per bushel	604
Charcoal necessary to have done the $604 worth of work, agreeable to the experiment of January, one thousand and seventy-two bushels, at $12.	127
From which deduct $75, the price of the Lehigh coal	75
Leaving the balance in favour of the Lehigh coal of	52

It is my firm belief, that the time gained is worth more than the whole price of the coal.

JOSEPH SMITH.

Tinicum, Bucks County, Pa.
4th month, 2d day, 1814.

N. B. One of my journeymen, who was the most adverse, is now using the Lehigh coal at Boyertown, Berks county, at $75 per hundred bushels, in a neighbourhood where charcoal can be purchased for one tenth of the sum.

March 13, 1815. J. S.

I have, for two months past, made use of stone coal in my distillery, and am much pleased with it. I have ascertained that three bushels of coal (with a little dry wood to kindle) is sufficient to run my singling still six times, my doubling still once, and boil all the water for mashing, &c.

I find, in using this coal, a great saving of labor, and the copper is not so liable to be injured as by wood, because there is not so much danger of burning the still, or running foul at the worm.

My mode of setting stills for this kind of coal, is as follows:—I draw a circle sufficiently large to give room for a circular flue, round the body of the still, of about four inches, leaving an opening of twelve inches wide and two feet deep, for an ash hole; I then raise the ash hole twelve inches high, and put on my grate, which is made of inch square bars, placed about three-fourths of an inch apart, and a sufficient number to cover the ash hole. I prefer to have the square bars riveted (instead of putting them in loose as some do) into a cross bar at each end, to keep the bars stationary; I then put up a cast iron door frame in front, of fifteen inches wide and twelve high, with a cast iron door to it; then raise the side wall and back of the furnace a little flaring to the height of the cast iron door frame, levelling the top; then put down four brick for bearers, on which set my still; then drawing a flue of about four inches round the sides of the still, enclose it at the top rise of the breast. This mode I find to answer a very good purpose for stone coal. It is not necessary to have a slider or damper in the chimney, because by closing the front of the ash hole, and opening the door of the furnace, it will sufficiently check the operation of the fire when required.

GEORGE HAINES.

March 10, 1815.

I have used the Lehigh coals. They produce a greater degree of heat than any other fuel I am acquainted with—they give no smoke—contain no sulphur. I have tried them for my steam engine, and find them to exceed all others for keeping a steady fire, driving my engine well.—I find that iron heated by these coals, *does not scale*, as when heated with Virginia coals; therefore, I think a boiler will last as long again; and as they make no smoke, no soot (which is a non-conductor of heat) can accumulate on the outside of the boiler. While the boilers are clear of soot, less fuel will produce steam to drive the engine. The furnace must, however, for this purpose, be properly constructed for them.

These coals will no doubt prove the cheapest, most durable, cleanly, and pleasant fuel for warming apartments, as well as for many other useful purposes.—They are without doubt the best for making edge tools.

I believe that Lehigh Coal at 5*s.* per bushel is as cheap as Virginia at 2*s.* 9*d.*—In a grate or stove, a fire of this coal will last from twelve to fourteen hours.

OLIVER EVANS.

Art. II.—*Observations on the Serpentine rocks of Hoboken, in New-Jersey, and on the minerals which they contain; by* Thomas Nuttall.

[Read in the Academy of Natural Sciences of Philadelphia, May 8th, 1821. Forwarded in MS. for insertion in this Journal.]

This formation which appertains rather to the transition than the primitive range, and to the species of serpentine called the common kind, occurs at this place in a considerable mountain mass, which is washed by the tides of the Hudson. By its position it appears to be incumbent on the granite on which the city of New-York is founded, and in contiguity with a rock, sometimes coarsely granular, formed principally of quartz and felspar. Seams of breccia formed of angular fragments cemented together by a calcareous spar resembling arragonite, and which has been erroneously announced as a carbonate of magnesia, indicate at least the partial transition of this serpentine into the surrounding formations, or the transfusion of some foreign ingredient into the rocky mass while yet yielding and capable of easy penetration.

This serpentine, which differs so much in external character from the finer diaphanous or nephritic kind of Massachusetts, is of an uniform consistence, of an earthy fracture, perfect opacity, soft enough to be easily scraped by a knife, and of a dull yellowish-green colour, somewhat inclining to olive. Its specific gravity by Nicholson's balance was 2,820. It acquires but a feeble polish, and is commonly penetrated by octahedral crystals, said without sufficient authority to be chromated iron. Before the blowpipe it remains infusible, and by strong calcination looses 16 per cent. of volatile matter, and then acquires a pale brownish tinge. Decomposed by acids, without calcination, which obstructs the solution, it afforded 30 per cent. of silex, about 52 per cent. magnesia, with only two parts in the hundred of oxid of iron, and not a vestige of chrome, alumine or lime. So that as we shall perceive in the sequel of this essay, the magnesian earth pervades this formation and all its concomitant minerals in a manner hitherto unparalleled.

It is unnecessary for me to add any thing concerning the rare and singular mineral of this locality known as an almost pure hydrate of magnesia, but which, though perfectly colorless and transparent, still conceals an *essential* though minute portion of iron, and about 30 per cent. of water. That part of the mineral which presents a greenish colour, with the lamina less flexible and diaphanous, is a contamination, by degrees approximating it to a contiguous substance, which as a peculiar mineral I shall distinguish by the name of *marmalite.** Although this hydrate presents a high degree of purity and homogenity, it has never yet been detected in a proper crystalline form. Its lamina indeed appear almost always fasciculated in different directions, and in some specimens I have traced it into a magnesian marble, presently to be described, in which it presents triangular lamina diverging from a common centre so as to exhibit a radiating circle.

The substance above mentioned, which I shall term *magnesian marble*, appears as it were, to form a continuation of the same veins which afford the magnesian hydrate. Its colour is commonly, and constantly when pure, of a perfect white, sometimes of a very close grain, and with a fracture inclining to the conchoidal, but commonly splintery. The most compact kind even gives some sparks with steel, in the same fragments there are also almost always portions of a lamellar or sparry texture, the lamina as in marble, but more hyaline, crossing each other or implicated in different directions. In the cavities also occur small clusters of limpid crystals, too minute for very accurate investigation, but as far as visible through the microscope, presenting elongated six-sided prisms, with faces of unequal breadth,

* From *μαρμαιρω*, to shine, in allusion to its pearly and somewhat metallic lustre.

and either truncated at the apex, or with an acumination so indistinct as to be scarcely visible. If these crystals are to be considered as homogeneous with the sparry mass to which they adhere, they are essentially crystals of carbonate of magnesia, but at the same time there is nothing thus far discoverable in them by which they could be distinguished from carbonate of lime. This white substance presents sometimes a singular state of disintegration, filling the cavities of the veins with a perfectly friable and pulverulent substance of the colour and appearance of the magnesia of the shops. The specific gravity of this marmoraceous mineral taken by Nicholson's balance was 2,880.

Chemical characters. 50 grains of the white and sparry kind, possessing a splintery fracture, and giving fire with steel, after pulverization, and strong ignition for an hour and a half, came out a little tinged with brown, and had lost 25 grains. This powder dissolved almost instantaneously in nitric acid, and formed a saline brown mass, which was evaporated to dryness, when, being diluted and filtered, it left one grain of silex in a hyaline gelatinous form.

On the addition of the prussiate of potash a deep blue precipitate appeared, and amounted by the usual reduction to a quarter of a grain of protoxid of iron.

The whole of the earthy contents were now precipitated at a boiling heat with carbonate of potash, which when edulcorated and calcined gave 22 grains of what appeared to be magnesia, and which lost no appreciable portion on being boiled in caustic potash. Its solution, however, in sulphuric acid afforded 10 per cent. of gypsum, or nearly the proportion of three and a half grains of pure lime. From this experiment the magnesian marble of Hoboken appears to consist in the 100 parts of

Magnesia - - -	44,00
Carbonic acid and water	50,00
Lime - - - - -	3,50
Silex - - - -	2,00
Protoxid of iron - -	0,50
	100,00

The proportion of lime varies, so that in a highly coloured green and sparry specimen, scarcely distinguishable from serpentine, I obtained 48 per cent. of lime.

Nemalite, or Amianthoid Magnesite.

This substance, which forms veins in the serpentine of Hoboken, is in all probability one of the most deceptive minerals ever discovered, since it appears in every respect as a well characterized variety of amianthus for which it had always been mistaken. It possesses the usual silky lustre and flexible fibrous texture, and is commonly of a pale blue colour. It cannot indeed like the genuine amianthus be reduced to a flocculent mass, so as to be twisted and spun, and the fibres when presented to the flame of a lamp, instead of running up into a globule, like that of Massachusetts, remain infusible, become friable, opaque and rigid, and at the same time assume a light brown tinge from the oxidation of the iron contained in them. But the most singular character which this deceiving mineral presents, is its total solubility in acids, without effervesence, except in such fragments as have been exposed to the weather, or which are slightly contaminated by carbonate of lime. Its specific gravity I found to be 2,44.

By exposure to a considerable heat, in the experiment which I made it lost 30 per cent. and in sulphuric acid was all converted into a well characterised epsom salt, excepting about a grain of lime and a precipitate of iron, equivalent to about 5 per cent. of the protoxide.

This mineral when rubbed with a piece of iron as well as the lamellated magnesite phosphoresces with a yellowish light.

Marmolite.

This mineral, which has hitherto been considered in this country as a variety of talc, forms also narrow veins in the serpentine of Hoboken, and in that of the Bare Hills near Baltimore ; in the former locality it sometimes occurs in contact with the lamellar hydrate of magnesia and in the magnesian marble.

Its texture is foliated with the lamina thin, and often parallel as in diallage. Sometimes also cleaving in two directions parallel to the sides of an oblique and compressed four sided prism. These lamina, sometimes a quarter of an inch broad, are commonly collected into radiating or diverging clusters, of a pale green or greenish-grey colour and a pearly submetallic lustre, soft enough to be easily cut by a knife, and almost perfectly opaque, inflexible, and brittle. Its powder is unctuous and shining. By the influence of the weather it becomes whitish and more brittle. Its specific gravity by Nicholson's balance was 2,470.

Chemical characters. Before the blowpipe it decrepitates, hardens, and slightly exfoliates without showing any sign of fusion.

100 grains after an hour's ignition lost 15 per cent. and the fragments were then sufficiently hard to scratch glass.

The remaining 85 grains were dissolved in nitric acid and formed a thick and partly gelatinous mass. After the solution appeared complete, there remained on filtration and desiccation by ignition 35 grains of silex, which with potash readily fused with effervesence into a pellucid glass.

The metallic matter was then precipitated by prussiate of potash and by the grass green colour of the solution appeared mixed with a minute portion of chrome. This precipitate of a deep blue amounted when dried, after making the necessary reduction, to one half a grain of the protoxid of iron.

Concentrating the solution to dryness and lixiviating, there remained one grain more of silex.

The earth previously ascertained to be principally magnesian, was now precipitated by caustic potash, and the precipitate boiled to separate the alumine it might contain.

The alkaline liquor was again supersaturated with muriatic acid, to which ammonia was added, but without producing any precipitation.

The precipitate by caustic potash, after edulcoration and ignition, sufficient to expel the carbonic acid, weighed 46 grains, and was then redissolved in sulphuric acid, which after repeated digestion and solution, deposited five and a half grains of gypsum, equivalent to two grains of lime.

The remaining fluid crystalized into Epsom salt. Hence 100 parts of the mineral consist of

Magnesia - - - -	46,0
Silex - - - - -	36,0
Lime - - -	2,0
Water - - -	15,0
Protoxid of iron and chrome	0,5
	99,5
Loss	5
	*100,0

If chemical composition alone were to guide us in the classification of minerals, in this instance more particularly, we might conclude this substance to be essentially similar to the serpentine in which it occurs; but as this mineral has not as yet presented us with any thing like crystalization, I consider myself as rather justified in considering it a distinct mineral, and more particularly, as it might on equal grounds be referred to talc or steatite, from all which its external characters sufficiently remove it. From steatite, which does not essentially differ from talc, it is sufficiently distinguished by the peculiar association and form of its lamina, their opacity, brittleness, and infusibility. Its specific gravity, inferior hardness, and chemical composition equally remove it from Diallage, with which, however, it is more nearly associated by external characters, not knowing therefore where to refer it by comparison with other known minerals, I conceive myself justified in proposing it under a new denomination. By Cleaveland it appears to have been considered as similar to the indurated talc, to which, however, it bears no genuine affinity, the latter being rather a variety of asbestus.

From the remarkable predominance of magnesia in all the minerals which compose the hills of Hoboken, and their easy decomposition by sulphuric acid into an Epsom salt, uncontaminated by any alum, and only a very minute and almost accidental portion of lime, it is evident that a profitable and extensive manufactory of this salt, now so much used

* The Baltimore mineral contains only 30 per cent. silex, and notrace of lime.

in medicine, and imported largely into this country, could here be established.

In England it has been found profitable to manufacture this salt from the calcareous magnesian minerals. In this process, however, it becomes necessary to saturate the useless and predominating portion of calcareous earth besides the magnesia, which in the serpentine of Hoboken, and probably that of Baltimore, is entirely obviated by the absence of every soluble earth but the magnesian.

In Salinelle, in the department of Gard in France, this salt is fabricated to advantage from an earth which consists in the 100 parts of Silex 45, *magnesia* 22, water 32, and a trace of iron.

From such minerals and particularly from a substance so pure, unusually productive, and uncontaminated as that of the serpentine in question, the sulphate might be obtained in a degree of purity altogeter superior to that of commerce, usually manufactured from the bittern of sea-water which abounds in foreign ingredients.

A pulverization similar to that which is employed in preparing gypsum for agricultural purposes is all that would be requisite in these serpentine rocks ; and as far as my experiments have extended in the small way, the solution of this mineral is more complete before than after ignition, at least when a moderate heat is employed.

In the vicinity of Germantown, about eight miles from Philadelphia, a serpentine formation occurs so very similar to the Fahlunite of Sweden, that I could not satisfy myself of their distinction in any other way than by the educts of analysis. Like that mineral it occurs in disseminated, but partly confluent blackish-green masses, blended with a greyish-green, confusedly laminated tremolite, closely allied to Hornblende, and as well as the serpentine, soft enough to be easily scraped with a knife, and scarcely scratching glass. The fracture of this serpentine is somewhat conchoidal as in Fahlunite, though dull and merely translucent in their splinters, which emit a greenish light.

Its composition I found to be in the 100 parts

Silex - - -	33, 0
Magnesia - - -	42, 0
Lime - - -	3,50
Iron - - - -	7, 0
Water and volatile matter	13, 0
	98,50
Loss	1,50
	100

The composition of this variety, deducting the iron and small portion of lime, as well as that of Loudan grove near Chester, a few miles from Philadelphia, is also very well suited for the manufactory of Epsom salt.

ART. III.—*Notice of Iron mines and manufactures in Vermont, and of some localities of earthy minerals; by* PROFESSOR F. HALL, *in a letter to the Editor, dated*

Middlebury College, April 12, 1821.

IN my last communication, I promised you a description of some of the other iron ore beds of Vermont. I have since examined the one situated in Brandon, a town sixteen miles south from this place. The ore bed, lying about two miles north from the centre of the town, is owned by a number of gentlemen; two of whom are John Conant and Roger Fuller, Esqrs. of Brandon. The ore is found by digging a few feet below the surface, in a horizontal plain, extending several miles in length, and from fifty to a hundred rods in width. Where this plain now is, I could not help imagining, was once a deep valley, which, at a remote period, was filled with mineral matter, brought down from the Green mountain, by which it is bounded, on the east.

The ground being covered with snow, when I visited the ore bed, I had no opportunity to examine the surface of the earth. An ore digger, who has long resided on the spot, gave me all the information in his power, relative to the ore. He conducted me to a number of piles of it, which he had recently assisted in digging. An acre or two of land is made into a complete riddle by pits, from which the ore has been thrown. They are from six to twenty-five feet deep, and from eight to twelve in diameter. Their walls are perpendicular.

Several kinds of ore occur in this immense deposit; such as the *brown oxide*, both amorphous and hematitic, the *compact red oxide* and *yellow ochre*. The last is vastly the most abundant. In one pit, the brown oxide made its appearance within about six feet; in another, within twenty feet, of the surface. It runs in veins in the yellow ochre, which are sometimes a number of feet in thickness. It is very porous, but the pores are principally filled with ochre. The oxide is easily frangible; it soils the fingers, but does not feel greasy. Its colour is often of a bluish cast. When taken from the bed, it has no effect on the magnet. I exposed a small specimen to the action of the blowpipe, and its attraction for the magnet was speedily revived.

The compact red oxide is not however of a deep red. Its fracture is dull. All the varieties of the ore have more of an *earthy*, than of a metallic appearance. This bed of ore appears to be exhaustless.

In its vicinity is a forge, owned by Mr. Roger Fuller, in which are annually manufactured thirty-six tons of bar iron. The ore, on an average, yields thirty per cent. of pure iron. The iron, in this part of the country, is held in high estimation. It sells for one dollar in the hundred more than the best Swedish iron. Its superiority arises from its being tougher, and more malleable than most other iron. It plates with facility, into shovels, which are pronounced to be equal to the best English shovels. Mr. Fuller has recently erected an establishment for the manufacture of shovels, a few rods from his forge.

In Brandon village, a large and commodious furnace has lately been built, by Mr. John Conant, where this ore is manufactured into cast iron. The works have been in operation a short time only, but should they perform as much labour, monthly, through the year, as they have done since their erection, the whole quantity of cast iron annually made will amount to upwards of one hundred tons. I have seldom seen castings, which were so perfect. Conant's and

Broughton's patent stoves, the making of which constitutes the chief business of the establishment, are in so much demand, that they are disposed of as fast as they can be manufactured. At the forge, the ore is fused, without the addition of any foreign article for a flux. At the furnace, silicious limestone is employed for this purpose.

In the single county of Rutland, there are no less than four *blast* furnaces, and two or three pocket furnaces, as they are called, all in successful operation during a considerable part of each year.

I have just received a mineral from a gentleman at Montreal, which, if I mistake not, is *augite* imbedded in *ichthyophthalmite.* The latter substance is less brilliant, than a specimen I have from Sweden, but possesses *most* of its characters. The augite is green, and occurs in large imperfect crystals. The mineral was found at Long Sault on the Ottawa river, about seventy miles above Montreal.

Amianthus occurs, at Barton, Vt. Its fibres are white and remarkably delicate. Common and ligniform asbestus is foundin vast quantity, in Mount Holly, Vt.

I remain, Dear Sir,
With sentiments of high respect,
Your very obedient,
F. HALL.

Art. IV.—*Foreign notices in Mineralogy, &c.; communicated by* J. W. Webster, M. D. *of Boston.*

1.—*Notice of some minerals from the New South Shetland Islands.*

The arrival of a vessel, from the New South Shetland Islands, at this port, afforded me an opportunity of examining many interesting specimens of the minerals of those islands. From the general character of these substances, and from the close resemblance they bear to some of the mineral productions of Iceland and the Ferroe Islands, I am induced to think that the geological structure of the New South Shetland Islands, is similar to that of the two former, and that they are in part, if not wholly, of volcanic origin.* One of the specimens, which is now in my cabinet, is very much in favour of this opinion. It is a fragment of a Trap rock, composed of augite and felspar, and cannot readily be distinguished from portions of the Trap rocks of Iceland. This specimen is about six inches in length, and has an irregular prismatic form. Nearly the whole of one side of it is covered with calcedony, and small rock crystals. This is evidently part of a large drusy cavity. The calcedony has a slightly bluish colour, and is rather more than half an inch in thickness; and the transparent crystals rest upon it.

A second specimen is composed of jasper and calcedony. The jasper is red, (about the colour of arterial blood,) with bands of light yellow, and brown; the surface is irregular, and is covered on one side with calcedony of a most delicate flesh colour, in small mamillary concretions, studded with innumerable minute brilliant crystalline points.

The most singular specimen is a portion of a stalactite, which has been broken transversely. Its length is three inches and a half, its diameter rather more than two. The exterior layer, which is about a quarter of an inch thick, is composed of crystallized transparent quartz, within which is a layer of milk white calcedony of about the same thickness, and the centre of the specimen is filled by calcareous spar of a yellowish brown colour, and opaque. The calcareous spar is so hard near its junction with the calcedony, that it yields with difficulty to the knife. It however effervesces with an acid. The central portion is considerably softer.

Among these specimens are many globular, and ovoidal masses of calcedony, of various shades of white, grey, blue, and red. Their size varies from that of a hen's egg to the diameter of eight or ten inches. They are hollow, and are lined with crystals of transparent quartz and calcareous spar; of the latter I observed four forms, viz: *primitive*, *inverse*, *cuboide*, and *metastatique* of Häuy. The exterior of these *geodes* is irregular, having that indented surface so

* Mr. J. Miens, in the Edin. Philo. Jour No. 6, has given a very interesting account of the discovery of New South Shetland, and from the information obtained by him from the mate of one of the vessels which had been there, is disposed to consider the coast as composed of chlorite slate, or "schistose hornblend."

common in the calcedonies of other localities; and it is covered with a thin layer of green earth.

I have one very beautiful specimen of jasper, composed of alternate layers of red, brown, white, and *grass green.*

Among some specimens, which the captain of the vessel told me he picked up " on the summit of a lofty mountain," I observed three or four small pieces of selenite.

Coal and arsenical iron pyrites were also found in these islands.

The specimens of crystallized quartz brought here, were numerous, and many of them of great beauty.

Most of these minerals, as I was informed, were picked up " loose on the shores of the islands," but many were obtained by " digging into the rocks."

2. *Notices from the Edinburgh Philosophical Journal.*

" *Rock crystals containing nine globules of water formed and forming, in decaying granite in Elba*—The granite of Elba is sometimes traversed by fissures, and these fissures are frequently filled with a disintegrated granite, in which, we are told, are daily forming rock-crystals, nearly all of which contain bubbles of water; and sometimes there appears a vegetable-like matter floating on the water."

" *Strontites and precious opal, &c. in the Ferroe islands.*—Vargas Bedemar, who has lately spent a year in examining the geognostic structure of the Faroe islands, discovered strontites, in secondary trap; also opal, most frequently the precious kind, and but rarely the common or semi-opal; and he mentions having found adularia, heliotrope, and black flint also in the trap-rocks."

" *Mohs's characteristic.*—An English translation by Professor Mohs himself, of his characteristic, or characters of the classes, Orders, Genera, and species of minerals, has been lately published at Edinburgh. This classical work is but the forerunner of the system of crystallography of this profound naturalist."

" *Hausmann's New Mineralogical Work.*—Professor Hausmann, we understand, is at present printing a large work, "on the Forms of the Inorganic Kingdom," of which the first part will appear next Easter, and the second the following summer. Having finished this interesting work, he will next prepare and put to press, an account of his geognostical investigations in the Alps and in Italy."

"*Extraordinary mass of Platina discovered in Peru.*—A negro slave in the gold mines of Condoto, in the government of Choco, in South America, found a mass of platina of extraordinary magnitude, and which is now deposited in the Royal museum, in Madrid. It weighs rather more than one pound and a third, and is the largest piece of this metal hitherto met with. The largest specimen brought from America by Humboldt, and deposited in the King's cabinet in Berlin, and which weighs 1085 grains, was also found in Choco. These facts allow us to hope, that platina may be found in its original repository somewhere in that country.'

Dr. Brewster has given the name Comptonite to a mineral brought from Italy, by Earl Compton, (Resident of the Geological Society of London.) "It is found in small transparent or semi-transparent crystals, lining the cavities of an amygdaloidal rock from Vesuvius. The crystals are right prisms, nearly rectangular, with plane summits; or the same figure truncated on the lateral edges, so as to compose an eight sided prism. This last form is the most common. Comptonite, by exposing it in the state of powder to the action of nitric acid, is convertible into a jelly, like all the mesotypes.—It scratches stilbite, fluor spar, and apatite, but not mesotype. It is distinguished from stilbite, by its being convertible into a jelly by nitric acid, a property not possessed by stilbite. It is distinguished from auvergne mesotype, and from the mesotype or needlestone of Iceland by the angles of the primitive prism, &c.

From No. 5 of Edinburgh Philosophical Journal.

"*Account of three new species of lead ore found at Lead hills; by* H. J. Brooke, Esq. F. R. S. Lond. M. G. S. *&c. &c.*

Among some specimens of lead ore from Lead hills, I have found three new species, of which two have been noticed by Count Bournon, and one by Mr. Sowerby. I shall designate them by the names of

Sulphato-carbonate of lead.
Sulphato-tri-carbonate of lead.
Cupreous sulphato-carbonate of lead.

Count Bournon has described the first merely as a variety of carbonate of lead. The second he calls rhomboidal carbonate, and describes it as dissolving more readily in nitric acid, and with greater effervescence than common carbonate. Its primary form he supposes to be a rhomboid of 60° and 120°. The third species has been called by Mr. Sowerby, in his British Mineralogy, Green Carbonate of Copper.

The difference between the external characters of this third species and green carbonate of copper, and between that of the two first species and any carbonate of lead I had seen, induced me to dissolve some of the rhomboidal crystals in nitric acid. The effervescence was considerable, as described by Count Bournou; but I was surprised to observe, after the effervescence had ceased, a white insoluble residuum, which, on examination, proved to be sulphate of lead.

In consequence of the observation of this fact, and of the association generally on the same specimen of the three varieties, or some two of them, I have examined them all, and I believe the following results will be found correct:

The sulphato-carbonate consists of 1 atom sulphate } of lead.
1 " carbonate }

Effervescence, while dissolving in nitric acid, scarcely perceptible.

Specific gravity, 6.8 to 7.

Hardness nearly as sulphate-tri-carbonate.

Colour whitish, bluish, and greenish-grey, sometimes approaching to apple green. The crystals I have seen are seldom distinct, always minute, and aggregated together lengthwise, presenting a character approaching to fibrous.

From the measurements taken by the reflective goniometer on two cleavages; from the character of some of its secondary planes; and from the observation of its cleaving more readily in one particular direction than in any other, I conceive its primary form to be a right prism, whose base is an oblique-angled parallelogram of 59° and 120° 45″. But the crystals I have, are too imperfect to determine this point with precision, or to give the height of the prism.

The sulphato-tri-carbonate consists of

1 atom sulphate, } of lead.
3 " carbonate, }

Specific gravity, 6.3 to 6.5.

Hardness between sulphate of lead and cupreous sulphate-carbonate.

Colour of the rhomboidal crystals pale greenish, or yellowish, or brownish, or colourless and transparent, when very minute.

The prismatic varieties are colourless, or of various shades of pale yellow. The rhomboids are acute, measuring 72° 30″ and 107° 30″; and from not having found any other cleavage than one perpendicular to the axis of the crystal, I am induced to adopt this as the primary form.

The principal modifications I have observed, are those which pass into the six-sided prism by the truncation of all the solid angles of the rhomboid, and those which produce more obtuse rhomboids, of which there are three or four. The natural planes of all except the most minute crystals are more or less rounded, and consequently afford imperfect reflections.

The cupreous sulphato-carbonate appears, from the separate analysis of

3.59 grs.	to consist of		if the carb. of copper be chemically combined, and not accidental.
5. "	6 atoms sulphate,	of lead,	
5. "	4 " carbonate,		
1.41 "	3 " carbonate of copper,		

Specific gravity about 6.4.

Hardness between carbonate of lead and sulphato-tri-carbonate.

Colour blue to dark greenish-blue.

The primary form is a right prism, with either a rectangular or rhombic base. From the indication of joints parallel to all the planes of the latter; and from not having observed any joints parallel to more than four of the planes of the rectangular prism, I consider the right rhombic prism as the primary form. The angles of this prism are 95° and 85°; the planes which give the angle of 95° appear on many of the crystals as a dihedral termination to secondary forms, analogous to some prismatic varieties of sulphate of barytes. The crystals are generally very minute, and appear sometimes in small bunches, radiating from their common point of attachment to the matrix.

Besides the cleavages parallel to its planes, the rhombic prism divides also in the direction of its shortest diagonal, and its height is to the edge of the base as 2 to 1.

The fact that presents itself to our notice here, of so distinct a difference of crystalline form, produced by a change in the proportions only of the elements of the crystallized body, will tend to confirm the intimate relation that subsists between the chemical and crystallographical characters of minerals; and it appears to disprove M. Beudant's conjecture, that only the secondary form of crystals are affected by a change in the proportions of their constituent chemical elements.

It is remarkable, too, that lead should alone present so many instances of a single base combining at the same time with two acids.

London, 13th May, 1820.

From No. 6 of Edinburgh Philosophical Journal.

"*New works on Petrifactions.*—1. The well known geologist, Baron Von Schlotheim, is just about to publish an extensive work on petrifactions, and, judging from the accuracy, and extensive knowledge of the author, it cannot fail to prove a valuable addition to this interesting branch of natural history. 2. Emmerling, the Mineralogist, has also announced a work on the fossil organic remains met with in brown coal, and other new formations of the same description. 3. There has just been published at Leipzig, a work in folio, with numerous plates, entitled Geognostical Flora of a former world, by Graf Kasper Von Sternberg. From the plates of this work, sent to the Wernerian Society by Count Breunner, the drawings appear to be faithfully executed, and many of the objects represented are of the same description with those so abundantly distributed in our coal fields."

3. *Geological notices in Northern Africa, from the Quarterly Review, No.* 49.

"A narrative of travels in Northern Africa in the years 1818–19 and 20, &c. &c. by Captain G. F. Lyon, R. N. companion of the late Mr. Ritchie. 4to. pp. 382. London, 1821."

"From specimens of rock collected by Captain Lyon in various parts of his journey, Professor Buckland has been able to determine the geological structure of Tripoli and Fezzan; all of which may be referred to the three formations, 1. Basalt; 2. Tertiary limestone of about the same age with the *calcaire grossier* of Paris; 3. New red sand stone. The Soudah or Black mountains, as we have already stated, are of basaltic formation; their direction is east and west, and they extend probably across the continent, Horneman having crossed them nearly two hundred miles to the south-eastward of Lyon, where they take the name of the Black Harutsch. Some basalt also appears in the Gharian mountains; but this ridge, which runs probably to the borders of Egypt, is composed apparently of trap and calcareous rocks—the tertiary limestone above mentioned. The rocks contain marine shells, particularly two species of cardium, in a state of delicate preservation. Indeed most of the limestone formation, in every part of Northern Africa, appears to be loaded with fragments of organic remains, the most distinct of which, brought away by Captain Lyon, may be referred to the genera ortrea and pecten. We are informed by Horneman, that the ruins of the temple of Siwah are limestone, containing petrifactions of shells and small marine animals; and from this place, westerly, the face of the rocky chain rising abruptly from the sandy desert was so crowded and filled with marine animals and shells and white detached mounds, as it were wholly composed of shells, that when taken in connexion with the 'sea sand,' which covers the desert, this vast tract of country, he concludes, must have been flooded at a period later than the great deluge. Farther south and close to the Black Harutsch, the calcareous hills, rising steep from the level desert, are so friable, that 'petrified conchs, snail-shells, fish, and other marine substances,' may be taken out by the hand. 'I found heads of fish,' says Horneman, 'that would be a full burthen for one man to carry.' "

The third and last formation appears under its usual form of loose red sand, accompanied by rock salt and gypsum, associated with beds of a calcareous breccia, cemented by magnesian limestone, and of compact dolomite. The drift sand is composed of extremely minute grains of red semi-transparent quartz. Mr. Buckland observes, that the frequent occurrence of salt springs and of rock salt and gypsum, goes far to identify this sand of the deserts with the new red sandstone in the south of England. In this also are ferruginous concretions, forming œtites or geodes; the broken fragments of which are compact, sonorous, and of a dark liver colour, having a shining polished surface ; they are abundantly found among the sand. A narrow bed, entirely composed of tubular concretions of iron of similar origin, near the pass of Kenair, threw out irregular ramifications through the sand like the roots of trees, and presented at first sight the resemblance of lava. Most of the plains are strewed with magnesian limestone, or dolomite split into small laminated fragments, which break and rattle under the feet like pottery. Many other varieties of magnesian limestone and carbonates of lime are associated with the sand and sandstone of the hills and plains of this barren and miserable country."

Art. V.—*Miscellaneous notices of American Mineralogy, Geology, &c.*

1. *Notice of some facts at Hudson, in a letter to the Editor.*

Hudson, N. Y. Dec. 3, 1820.

Sir,

Having lately perused your Tour to Quebec, I was struck with the close resemblance which the strata of limestone at

Glenn's Falls, as described by you, bear to some detached rolled masses lately found in this neighbourhood, about forty feet below the surface. These pieces were thrown out in digging a well on the side of Prospect hill, about one mile from the river.—This city is built on a foundation of argillaceous marl lying in horizontal strata, and containing a considerable portion of sulphate of magnesia. In front of the principal street there is a steep bank composed of silicious slate, which rises about seventy feet above the surface of the river: as you recede from this, the ground declines ten or fifteen feet to Market square, from whence there is a gradual ascent for about one mile to the base of Prospect-Hill, on the north-west side of which this well was commenced at an elevation of about one hundred and seventy feet. The well was sunk about eighty feet, passing almost entirely through a solid mass of hard clay, (or pan,) not stratified, and containing rounded pebbles of quartz, &c. and rolled and water-worn pieces of limestone abovementioned, a specimen of which accompanies this letter, and is quite different from any thing of the kind in this district of country.—From the mouth of the well the hill rises about one hundred and eighty feet, with an uniform smooth surface, and falls off gently on the south-east, to a low meadow, which divides it from the north end of Becraft's mountain, so called. This is a solid mass of grey rock supporting a blue compact limestone; the upper strata of both rocks contain a great variety of petrifactions which have been described by Mr. Eaton and others. Prospect-Hill, on the contrary, presents no appearance of rock strata whatever, although on the surface and in the vicinity are found pebbles and rounded masses of quartz, granite, gneiss, &c. Among the pebbles we find slate of several colours, chlorite, jasper, basanite, *&c.*; these are also found in connection with a grey sand, which is taken from the adjoining vallies for building purposes, and which is evidently composed of the particles of disintegrated primitive rocks, and presents so strong appearance of alluvial deposition as to be apparent to the most careless observer. It appears therefore evident that this alluvial matter has been borne down by the rushing waters from its original situation in the primitive regions of the north, and deposited in its present location. The investigation of this subject appears to me of some importance in a geological view. If you should think otherwise I trust you will excuse me for troubling you on the subject. I have forwarded some of the crystals* of selenite, found in this vicinity during the last season, a description of which was published in several of the newspapers of the day, which possibly you might have seen.

I have the honour to be, with respect, yours, &c.

JOHN P. JENKINS.

PROF. SILLIMAN.

2. *Notices in Geology and Mineralogy, communicated in a letter from* DR. LYMAN FOOT, *of the United States army.*

Plattsburgh, 15th of June, 1819.

Dear Sir,

Our route from Niagara to this place was very interesting to me. We came down Lake Ontario to Sackett's harbour, and thence down the St. Lawrence to Salmon river, and then up Salmon river to French mills, from which we marched across the country to this place, a distance of sixty-five miles, the greater part of it an uninhabited wilderness. I was careful to preserve specimens of the different rocks, and believe I could point on a map to the different rock formations of the country through which we marched. I took some pains to examine the country from Fort Niagara to Buffalo as it appeared on the Niagara river. The river Niagara, thirty-five miles in length, forms the well known water communication between Lakes Ontario and Erie. Its width is from half a mile to six miles. From Fort Niagara† to Lewistown, a distance of seven miles, the borders of the river are nearly perpendicular, and from fifty to seventy feet in height. They are composed principally of hard clay, resting on a bed of red sand stone. In some places large

*They are of the usual form, tolerably distinct, and imbedded in clay.—*Ed.*

† Fort Niagara is situated on that point of land where the river empties into the Lake; was built by the French about the year 1725, surrendered to the British troops under command of Sir William Johnson in 1759, and by the treaty of 1783, fell within the U. States.

masses of pudding stone are found resting upon the sand stone, and rising nearly to the surface. The appearance of this rock is somewhat singular. It is composed almost entirely of rounded pebbles, from the size of ounce balls to that of grape and canister shot, adhering together like so many small rounded magnets, with little or no intervening fine sand to act as a cement. Yet it is pretty firm. I have seen lying on the beach masses of it as large as a half barrel, which were difficult to break. The pebbles composing this rock are principally carbonate of lime, some, however, are quartz, felspar, and gneiss. Petrifactions of various kinds, particularly of shells and roots are occasionally found in this rock. At Lewistown the banks of the river suddenly rise to one hundred and fifty feet perpendicular. They are composed entirely of compact limestone, the strata are nearly horizontal. They have more the appearance of art than of nature, and extend quite up to the falls, (a distance of eight miles,) so that the water when viewed from the edge of this bank, has more the appearance of falling into a great pit or chasm in the rocks than any thing else. Was any proof wanting to convince us that the water once rolled over the abutment at Lewistown, and that the banks above that were then no higher than they are now above the falls, the situation in which the gypsum is found, affords, I think, a decisive proof. It is found filling little cavities in the rocks, on the edge of this bank all the way from Lewistown to the falls, from one hundred to one hundred and fifty feet above the present highwater mark. It has an earthy appearance, is very soft when first broken out, but hardens on exposure to the air. As no gypsum is found in this neighbourhood except on this bank, it must have been deposited there by the water. I have seen one specimen distinctly crystalized. These little cavities in the rocks are numerous, most of them are filled with rhomboidal crystals of carbonate of lime, and on these rhomboidal crystals are occasionally found and deposited those almost cubic crystals of carbonat of lime, the cuboide of the Abby Häuy. From the falls to Buffalo there is nothing remarkable in the appearance of the country. The banks of the river are low, and its bed is rock, probably limestone. It is to be seen in most places on the bank of the river, rising a little above the surface of the water. At Black rock, just below Lake Erie, the banks are somewhat higher. Here the water glides down pretty rapidly over a bed of solid limestone. From the appearance at this place, and from various other reasons which I have not now time to state, I have no doubt but at some ancient period of time this northern extremity of Lake Erie was entire, and the waters of this and the upper lakes emptied themselves through a southern channel.

3. *New Locality of Chrysoberyl.*

Saratoga Springs, July 29, 1821.

TO PROFESSOR SILLIMAN.

Dear Sir,

I hasten to inform you of the discovery of a new locality of *Chrysoberyl* and *Prismatic Mica,* presuming that, as these minerals have not occurred very frequently in the U. States, it may afford you some gratification. They are found in a vein of granite which passes through gneiss; the vein was discovered some years ago, and fine specimens of laminated mica and common schorl, (black tourmaline) which occur in great abundance, and sometimes in beautiful, (though not perfect,) crystals, were taken from it. The rock in which this vein is situated, is about one mile north from the high-rock springs at Saratoga, and forms a part of the primitive region which approaches us from the north, and terminates, or passes beneath the secondary, near this spot. The surface of this rock is somewhat elevated, and remains uncovered for the distance of from two to three hundred yards; the vein is observed to traverse its whole extent.

The minerals which are found in this vein, are

1st. Felspar,—this assumes more or less the crystaline form, and affords well defined crystals of adularia.

2d. Common schorl—this is in great abundance; it is mostly in amorphous masses, from the size of an egg down to that of the smallest pin's head, it however, sometimes possesses a more regular form, presenting from two to five, or more sides of a beautiful crystal, with a one or two sided termination, while the remainder is irregularly diffused in the mass of its gangue. The colour is a shining velvet black. It is perfectly opaque.

3d. Laminated mica—this presents itself usually in large irregular tables, with some inches of surface, but it likewise occurs in rhombs, having sides of two or three inches in extent, and is in some instances an inch in thickness; it is as transparent as glass.

4thly. Garnets—both common and precious garnets are found diffused among the other materials of the vein, but none as yet have come to light in a very perfect state.

5thly. Chrysoberyl—this occurs in various forms; it usually presents two, three, or more sides, very perfect while the remainder, like the schorl, in the same vein, is diffused in the same mass that surrounds it. Two or more of the perfect sides of a crystal are usually striated, sometimes parallel to its edge, but frequently the striæ diverge from a line, drawn through the plane of one of the sides, at an angle of about forty five degrees. It is of a greenish yellow colour and is translucent.

6thly. Prismatic mica—this has been very recently discovered; it is beautifully transparent, and its delicate filaments strongly resemble those of the amianthus.

I shall do myself the pleasure of forwarding to you, by the first convenient opportunity, specimens of the above minerals.

Yours, &c.
JOHN H. STEEL.

Remarks.

We have seen some specimens of the chrysoberyl, forwarded by Dr. Steel. They appear extremely like those of Haddam. Col. Gibbs, who has seen a full suite of the Saratoga specimens, concurs with Dr. Steel in the opinion that they are genuine.—*Editor.*

4. *New Locality of Manganese.*

TO PROFESSOR SILLIMAN.

Sir,

I do not find noticed among the localities of manganese in the United States, that of this neighbourhood. During the late war, this article was at an extravagant advance; it is therefore desirable that the local existence of a mineral so essential to the chemist, the bleacher, and the potter, should be generally known. The specimens accompanying this are—

No. 1. Compact indurated manganese. Its colour is blue or purple black—very heavy, fracture splintry—fine grained and dull. It was analyzed by Woodhouse, (Coxes Med. and Phil. Register of April 1805, p. 451,) but he was misinformed as to its locality. It is found in detached masses, from the size of a walnut to that of a man's head, on the head waters of Bear creek, Lehigh and Tobyhannah, on the Broad Mountain.

No. 2. Brown frothy manganese. This is comparatively of little specific gravity, of a spongy mammillary, and porous texture; it is generally found in the bed of water courses. From friction with the finger it receives a high polish; also from the Broad Mountain.

No. 3. Grey oxid of manganese, with cellular cavities, the surfaces of which are covered with minute globules of a brilliant lustre, found imbedded in black earthy manganese of a greasy feeling. From the Tobyhanna, near the turnpike, on the broad mountain, it is sometimes found investing pebbles and cementing them in large masses.

Very respectfully,
Your obedient Serv't,
ZACH. CIST.

Wilkesbarre, Pa. May 10th, 1821.

5. *New locality of Beryl.*

Unionville, Chester county, Pa. May 7th.

TO PROFESSOR SILLIMAN.

Dear Sir,

I will briefly inform you of a locality of beryl which I discovered eighteen months since, and probably the most extensive that has been made public in this country. It is found seven miles west of Westchester, New Linn township, in what is called the Barrens, a serpentine ridge, extending nearly east and west, with some interruptions, through a great part of the state. The mineral is scattered over the surface, and for the most in irregular pieces, yet some tolerable crystals are found, from a few grains to 20 lbs. weight.

I am not yet able to give you all the information I could wish, but in a short time you may expect a more particular account respecting it.

Respectfully yours,
THOMAS SEAL.

6. *Notices of minerals and rocks chiefly in Berkshire, Mass. and contiguous to the waters of the upper Hudson, and the lakes George and Champlain, with occasional remarks on other subjects.*—Editor.

In a short tour for health in the latter part of last May and the beginning of June, in company with Mr. S. F. B. Morse, through a part of Berkshire and Vermont, and around the waters of Lakes Champlain and George, and the upper Hudson, a few observations were made, which may possibly be of some use to future travellers. They are presented, not as bearing, by any means, the character of thorough research; they were merely such casual notices as an invalid could make without much effort or sacrifice.

Marble beds of West Stockbridge and Lanesborough, Mass.

This is a part of the great northern region of white primitive granular limestone or marble, now so well known throughout the United States. These beds are evidently a continuation of those in Fairfield and Litchfield counties,* in Connecticut, and possibly of those at Kingsbridge and on the Schuylkill, near Philadelphia. It was remarked by Mr. M. that if primitive limestone thus extends, probably without interruption, for hundreds of miles, there seems to be no good reason for regarding it as merely a subordinate rock; it would seem to be as truly a regular member of the series of primitive rocks, as the mica slate and gneiss in which these strata are generally imbedded.

At West Stockbridge, as far as we had opportunities to observe, the primitive marble lies between strata of gneiss, and therefore partakes of its direction, which is nearly N. E.

* See this Journal, Vol. 2, pa. 201

and S. W. and of its dip, which is to the east, at an angle generally over 45 degrees and often much larger. This marble is not all white; much of it is grey, of various shades, and near its junctions with the other primitive rocks, it is much mixed with the mica quartz, &c. which are found in them. The Lanesborough marble is generally spoken of as the whitest in America; probably its finest specimens are not surpassed in this country, but we were disappointed in finding that but a small part of it, comparatively, is of a pure white; the greater part is mixed with dark colours, and many extensive ledges are of a gray colour. We found the workmen quarrying it under circumstances of considerable danger. The strata over their heads being in a sloping position like the roof of a building, and being also completely divided in the direction of their length and breadth, by the natural seams between the strata, they were kept from falling only by the feeble adhesion of the parts of the stone itself, at the bottom and ends of the uncovered layers; these being of the extent of some yards in breadth, and of many yards in length, presented, of course, an enormous unsupported mass, which gravity was constantly urging to its fall. We remonstrated with them as to the danger, and suggested to them the obvious and effectual expedient of props of timber; they assented to the danger, but seemed very little disposed to take any trouble to prevent the accidents, which are the more probable to occur from the constant exertion of force, by implements and gun powder, at the bottom of these vast pendent ledges of marble.

A small cavern. It is but a short time since a small cavern was discovered between the strata of marble in one of the quarries at Lanesborough; they accidentally opened into it, but the orifice is so small, that we could only with great difficulty, pass in, feet first, by lying nearly flat on one side, and thus pushing ourselves down, by the hands and elbows. This narrow passage is however only a few feet in length, and when once entered, we could walk erect, with sufficient room in every direction. This cavern is only one hundred and fifty feet in length, and would scarcely be worth mentioning, were not the occurrence of caverns in regions of primitive limestone a comparatively rare circumstance; they being much more frequent in transition and secondary regions.

This cavern is dirty and disagreeable, but is still worth visiting, especially if the observer has not seen any thing of the kind on a larger scale. The floor is descending and slippery, from the mud and water, and it is rugged from the masses of rocks and stones lying upon it; the water is constantly dropping from the roof, and every drop resounds with a distinct echo. The voice, especially when exerted in singing and hallooing, is prodigiously augmented, as is common in other caverns. The quantity of stalactite and sinter, in the common forms of pendent and protuberant and projecting masses, is very considerable; its fracture presents the usual concentric agate-shaped structure, but it is foul and dingy from the mixture of dirt, so that none of it, that we saw, is beautiful. A little trouble in blasting and breaking the rock at the mouth of this cavern would render it easily accessible.

It is well known that the materials for the walls of the city-hall of New-York were drawn from the quarries in the neighbourhood of West Stockbridge, and considerable use is made of the marble in the vicinity, especially in the monuments of the burying grounds. Our eyes were naturally attracted to these repositories of the dead, which, in all this region, are marked by white marble monuments. In one village we were struck with a peculiarity, which, however out of place, we will venture to mention. There is in the burying ground in this village a very decent vault, or tomb constructed in the usual form, with a door above ground—*but* on the door *there is a knocker.* Among a moral and religious people, we will not suppose this a mere freak of levity—a misplaced joke of the living upon the mute voice of the dead. What is it then? Did the builder feel that a door even of a tomb is *unfinished* without a knocker? A stranger incident rarely occurs to the traveller; not even the flagstaff on the tomb at New-Lebanon.

Chlorite abounds in the region about Lanesborough. It is frequent in the loose pieces of quartz along the road, and is very well characterized.

Mountain groups and ridges of singular grandeur and beauty occur in all the region from Litchfield to and around Williamstown and Bennington. In Pownal, the S. W. corner township of Vermont, there is a mountain group of most imposing sublimity, with a richness (as we saw it,) of light and shadow rarely surpassed.*

Tortuous Slate, singularly curved and involved, occurs on the right of the road a little south of Bennington : it is worth noticing as a curious specimen of the kind ; this slate appears very black, as if it were mixed with carbon.

Lime stone of a dove colour occurs in continued ledges for many miles before coming to Bennington : it follows the general stratification of the country, and appears to be a part of the great transition formation of limestone which continues on to Middlebury, &c.

Fluor spar, (as we are informed by Bishop Brownell, who discovered it,) occurs in an iron mine near and east of Bennington ; we had not time to visit this place, nor the locality of excellent manganese which exists in this vicinity. (Prof. Hall. Vol. III. pa, 57.)

Siliceous slate, and even the *Basanite* or *Lydian stone,* lie scattered on the hills near the Hudson : we crossed these hills in passing to this river from Bennington ; we did not observe the mineral in place, but from its frequency and the geological structure of this region, (transition slate,) we presume that it may be found in its proper bed ; quartz crystals were also of frequent occurrence in the stones of the roads and fences.

Yellow ochre of a delicate and bright colour, and formed in concentric bands like agate, also occurred on these hills.

Veins of crystalized calcareous spar exist at Baker's falls, inlaid in a black slate, and forming a striking feature, both by their contrast of colour and by their zigzag windings ; they are visible at a considerable depth through the water, and their ruins are abundant on the shores ; the slate in which they lie also effervesces with acids, as does that of Saratoga through which they are now digging the Northern Canal.

* Mr. Morse made sketches of several mountain scenes both here and on Lake George, and at Ticonderoga, and other places.

Satin spar was observed by Mr. Morse at Glenn's falls: it is in thin, delicate, but extensive veins, principally in the fallen rocks below the bridge; generally it is of a brilliant white, but sometimes it is black, although still retaining its fibrous structure. *Crystals of Bitterspath*, well defined and glistening in the black lime stone, occur at Glenn's falls.

Compact dove-coloured limestone, apparently of the transition class, forms ledges at the head of Lake George, and the walls of old Fort George are composed of it. In this limestone there is a singular feature. Its angles are rounded and smoothed, as if by the wearing effects of water, and (a circumstance which it appears much more difficult to account for,) there are numerous holes worn into the solid rock, sometimes shallow and irregular, but frequently deep and cylindrical, and bearing a very exact resemblance to those which are common in the ledges upon which cataracts fall; they appear as if they were produced by the same cause, namely, the wearing agency of water aided by small stones which it impels, in incessant vortiginous revolutions. If one were to judge from appearances, he would infer that a torrent of water once swept, with great impetuosity, through this defile, and wore these rocks as we now see them; this supposition has perhaps nothing to support it except these appearances, and if we relinquish it, we have no agent to which we can attribute them, but the ordinary wearing effects of atmospheric influences, which appear altogether incompetent to the production of these results.

Quartz crystals in the islands of the south end of Lake George.—These are commonly obtained by visitors; they are now become much more rare than formerly, and those which are procured are small, although still very limpid and beautiful. On visiting the island called Diamond Island, three or four miles from the village of Caldwell, and which has afforded most of these crystals, we found them occurring in the same compact limestone which forms the ledges at the head of the lake. This small island, scarcely covering the area of a common kitchen garden, is inhabited by a family, who occupy a small but comfortable house, and constantly explore the rocks for the crystals. These are found lining drusy cavities, and forming geodes in the limestone; these cavities are often brilliantly studded with them, and doubtless it arose from their falling out by the disintegration of the rock that the crystals were formerly found, on the shores of the island and in the water. At present they are scarcely obtained at all except by breaking the rocks. The immediate matrix of the crystals seems to be a mixture of fine granular quartz with the limestone; it is impressible by steel, but sometimes does not effervesce with acids.* The crystals of this locality are of the common form, very limpid, and often contain a dark coloured foreign substance imbedded in them.

Crystals of calcareous spar, well defined and of considerable size occur in the same rocks, sometimes with the quartz crystals, and sometimes by themselves; they appear to be modifications of the rhomboidal varieties.

Very brilliant rhombic masses of calcareous spar also present themselves in these rocks; these masses are not crystals, but have the crystaline structure, giving perfectly rhomboidal fragments with a high pearly lustre; they are very white and appear exactly like the Iceland crystals, only they are not transparent. They seem to be the bitterspath. The poor people on the island had no idea that the calcareous crystals were of any value, and had been in the habit of throwing them away; we took care to give them a different impression, and trust it may be useful to future visitors.

Crystals of Diamond Point. We passed down the whole length of the lake, (thirty-six miles,) in a very small open boat—a fisherman's skiff, rowed by two men. We stopped at a place on the north shore of the lake, called Diamond Point, from the fact that crystals are found also at this place. It has been recently opened by the man who lives on the island, and who was our guide on the present occasion. The rock and its associated minerals are the same as on the island, only we observed a greater variety of siliceous minerals;—portions of calcedony and hornstone and agate—elegant cavities occupied by quartz crystals, and some singular banded portions, concentric and curved like agate, but

* It commonly effervesces, and feebly scratches glass.

without beauty. It is probable that more research will discover interesting varieties of siliceous and other minerals in the lime stone of the south end of Lake George. It would probably repay a good observer who should investigate it with industry and attention.

Sands of Lake George.—At various places, we examined the sands of the shores of this most beautiful lake. Around its head, there is a good deal of magnetic iron sand, of a fine glossy black, and both here and in many other places, we found the detritus to consist almost entirely, of the ruins of primitive rocks, and of their imbedded and especially of their crystaline minerals.

Limpid quartz, garnet, and epidote, are of most frequent occurrence, and when mixed with the black iron sand they have a pleasing appearance, especially when spread out on paper and viewed with a magnifier. It is indeed somewhat difficult to believe that the garnet and epidote, and probably cocolite, often rich in their colours and highly translucent, are not *ruby* and *chrysoberyl.* It would be worth while to examine these sands more particularly, to ascertain whether there may not be *gems* among them, as the gems of Ceylon and of Brazil, and the hyacinths of Expailly in France, are found among alluvial ruins. Some sands shewn us by Professor Dewey, at Williamstown, and which came from the great falls of the Hudson, thirty miles above Glenn's Falls, are even more remarkable for richness and beauty than those of Lake George: they and all similar sands should be examined with an attentive eye.

Transparency and purity of the Waters of Lake George.—The fact is notorious, and the degree in which it exists is most remarkable: the bottom and the fish are seen at a great depth: the fishermen who rowed us asserted that they could, at particular times, see the fish at the depth of fifty feet: if even half of this statement be admitted, it is sufficiently remarkable. The water is also very pure, salubrious and agreeable to the taste. It is well known that the French formerly obtained and exported this water for religious uses,* and that they called the lake St. Sacrament.

* To be used as holy water.

The cause of the transparency and purity of these waters is obvious. With the exception of small quantities of transition lime stone, its shores, as far as we saw them, are composed of primitive rocks, made up principally of siliceous and other very firm and insoluble materials. The streams by which the lake is fed, flow over similar substances, and the waves find nothing to dissolve or to hold mechanically suspended. Clay, which abounds around the head waters of the contiguous lake (Champlain) and renders them turbid, scarcely exists here. It is remarkable however, that as we approach Lake Champlain, in the vicinity of Ticonderoga, the waters of Lake George become, for a few miles, somewhat turbid, and near the efflux they are very much so

Hœmatite.—This mineral appears to abound in the primitive mountains around Lake George. They informed us at the village of Caldwell, that Emery had been discovered down the lake, and was used considerably for polishing, grinding, &c. We obtained some of this mineral from a promontory called Anthony's Nose,* a few miles south of Ticonderoga, and nearly opposite to Rogers' Rock. It is a handsome and very well characterized hœmatite; it is compact, lamellar, fibrous, mamillary, botryoidal, &c. presenting the usual appearances of this most valuable iron ore, which seems to be far less common in the United States than the brown and black varieties. The colour and powder of this hœmatite are bright red. The people were unwilling to admit that it was not emery, since it polishes and grinds, but this is well known to be a property of hœmatite as well as of other forms of the oxid of iron. The hœmatite of Lake George may very possibly answer for *blood stones*, so much used in polishing gilded buttons, &c.

Flesh red Feldspar and compact Epidote.—These minerals we observed on the western shore of Lake George, eight miles from Ticonderoga. The felspar was in very large plates in granite, and the epidote in loose stones : the epidote was of a very intense yellow, like that of chrome, but with

* The boatmen called this mountain 'Tony's Nose, and the mineralogical traveller must enquire for the Emery in 'Tony's Nose, this being the style of the boatmen, who will of course be his guides.

a shade of green. Other minerals of more common occurrence, as garnet and black tourmaline, were observed here.

Plumbago.—This mineral, of singular beauty, occurs near Ticonderoga, both massive and disseminated, in brilliant plates, in a large grained crystalized lime stone. It has been mistaken for molybdena, a circumstance which, a few years ago, was common in this country. This locality we did not visit, nor the celebrated one of Roger's Rock,* where the cocolite is found.

Magnetic Iron of Crown Point.—We were not able to visit this place, but we saw them working the magnetic iron, from its vicinity, in the forges at Ticonderoga. This iron ore is both rich and beautiful in its kind; its structure is granular and almost crystaline; it has a brilliant black colour, and contains a yellowish imbedded mineral scarcely visible without a glass; it resembles cocolite, but is too soft, and at present we are not willing to give it a name.

Mountains of Lake George.—There can be no doubt that, whenever they are thoroughly explored, they will abundantly reward the geologist and mineralogist. We, however, saw them only as picturesque objects; as such, they are certainly very fine. Particularly as we proceed north from the Tongue Mountain, which is twelve miles from Caldwell. For twenty miles beyond this, on the way to Ticonderoga, the scenery combines, in an uncommon degree, both richness and grandeur. The mountains are all primitive: they form a double barrier, between which the lake, scarcely a mile wide, but occasionally expanding into large bays, winds its way. They are steep and precipitous to the very water's edge: they are still clothed with grand trees, and possessed by wild animals—deer, rattle-snakes, and bears. They give, in some places, the most distinct and astonishing echoes, returning every flexion of the voice with the most faithful response. We saw them hung with the solemn drapery of thunder clouds, dashed by squalls of wind and rain, and soon after decorated with rainbows, whose

* This omission arose from want of time and want of health.

arches did not surpass the mountain ridges, while they terminated in the lake, and attended our little skiff for many miles. The setting sun also gilded the mountains and the clouds that hovered over them, and the little islands, which in great numbers rise out of the lake and present green patches of shrubbery and trees, apparently springing from the water, and often resembling, by their minuteness and delicacy, the clumps of a park, or even the artificial groups of a green-house. Fine as is the scenery at the southern end of the lake, and in all the wider part of it, within the compass of the first twelve miles from Fort George—its grandeur is very much augmented, after passing Tongue Mountain, and entering the narrow part, where the mountains close in upon you on both sides, and present an endless diversity of grand and beautiful scenery. It is a pleasing reflection, that even after this part of the United States shall have become as populous as England or Holland, this lake will still retain the fine peculiarities of its scenery, for they are too bold, too wild, and too untractable, ever to be materially softened and spoiled by the hand of man.

This digression, although not altogether in place in a scientific Journal, may perhaps be pardoned by the reader, and therefore we will presume so far as to add, that the deer are still hunted with success upon the borders of this lake. The hounds drive them from the recesses of the mountains, when they take refuge in the water, and the huntsmen easily overtaking them in an element not their own, seize them by the horns, knock them on the head, and dragging their necks over the side of the boat, cut their throats. There is a celebrated mountain about fourteen miles from Ticonderoga, called the Buck Mountain, from the fact that a buck, pursued by the dogs, leaped from its summit, overhanging the lake in the form of a precipice, and was literally impaled alive upon a sharp pointed tree, which projected below.*

Walls of Ticonderoga.—After all the dilapidations of time and of man, Ticonderoga, with its mutilated walls and bar-

* This circumstance was mentioned to us by the man whose dogs drove the buck to this desperate extremity. He stated, that he had sometimes taken forty deer in a season.

racks, and with its picturesque environs, presents one of the finest ruins in America. Happily the garrison ground, constituting a farm of about six hundred acres, and including the old French lines, as well as the forts and barracks, has fallen into the hands of a gentleman, whose good sense and just taste will not permit a stone to be removed. This scene, fine in its natural beauty and grandeur, and still finer in its historical associations, may therefore go down to posterity without farther mutilation. Our business with it is now, however, of a humbler kind. The rock of which the walls and barracks of Ticonderoga* are built, is a black fetid compact lime stone. It abounds in this region, and constitutes the ledges on the shores of the contiguous part of Vermont. Its stratification is nearly horizontal, and it abounds with organized remains, corallines, bivalves, &c. At New-Shoreham, which is immediately opposite to Ticonderoga, they informed us that the water of the wells dug in this lime stone is offensive, and unfit for use. Hence the inhabitants use the water of the lake, and they provide ice houses, that the water may, in warm weather, be rendered agreeably cool.

7. *Other Mineral Localities, &c.*

Fluor Spar near Providence, R. I.—This new locality was discovered about a year since, in Seekonk, Mass. three quarters of a mile from India bridge in Providence, on the north side of the road, and a few rods from the house of Professor Burgess. It occurs in a vein of quartz traversing a sienitic or granitic rock which has been blasted to form the road, and the fragments of rock abound with this mineral. It occurs also in the rocks in the fields on the south side of the road. This fluor, which was at first taken for amethyst, is of a deep purple: in the specimen forwarded to us by Mr. *Thomas H. Webb* there are no crystals. The phosphorescence by heat is of a lively green mixed with spots of red. It may perhaps be regarded as a chlorophane.

* Every where in the vicinity called, with quaint brevity, *Ti.*

Fluor Spar in Tennessee.—Extract of a letter from H. H. Hayden, Esq. to the Editor.

Baltimore, August 28*th*, 1821.

This fluate of lime which I have sent you, was collected and brought to me by a young gentleman from Tennessee, who was graduated at our Medical University about two years since. He informed me that it was found in Smith County, Tennessee, where it was abundant: that it was known to the inhabitants by no other name than the blossoms of lead, of which it was considered a manifest indication: that considerable excavations had been made in search of lead, in doing which, the fluate of lime was discovered in isolated masses of various sizes, which were broken up and thrown upon the surface. From these he gathered the specimens which I have.

As to its geological situation, I have no means of ascertaining at present; but believe it to be in the primitive range, and if I remember correctly, he informed me that it occurred on the side of the mountain, and near the road leading to the Atlantic States.

Of this substance he brought me perhaps a dozen pieces, all of which are either whole or parts of cubes. The most predominant colour is that of a beautiful violet or purple. Some of a yellow, and filled with brilliant pyrites. Among them is a specimen of two cubes united, (though mutilated,) having the angles accuminated, and such as is represented in the Abby Häuy's work, plate 32d, fig. 87, and which he terms, "Chaux fluatèe Bordeè." Of this locality I have not the smallest reason to doubt, being well acquainted with the gentleman;* and moreover, I think the mineral the most interesting of the kind that I have yet seen from any part of the United States.

Crystalized Gypsum.—We are indebted to William Leffingwell, Esq. for a very fine crystal from Ellsworth, Trumbull County, Ohio. It is a very perfect rhomboidal crystal, or rather it is composed of two crystals united. It is

* Dr. Magee.

about three and a half inches long by one and a half in diameter.

We have other specimens from Virginia: one was received from the late R. P. Barton, Esq. through Mr. John Grammer, Jr. It is six inches long by one inch in diameter: its form is that of a prism of six sides. It is from the Shannondale sulphur springs; found in the bottom of them, near the Shenandoah River. It is found near considerable masses of lime stone: the crystals occur in groups which appear to shoot "from a matrix of clay, marl, and calcareous earth."

We have also received similar specimens from the same place, from Mr. Sanford I. Ramey, of the Senior Class in Yale College.

Crystals of gypsum occur in clay near Hudson. (Mr. Curtiss.)

Native Yellow Oxid of Tungsten.—We have omitted, for some time, to mention a fact which we ascertained a year or two since; namely, the existence of the ore mentioned above, which we suppose to constitute a new species.

It occurs incrusting the ferruginous tungsten of Mr. Lane's mine, and occupying the cavities. It is not abundant. It is insoluble in acids, but readily dissolves in ammonia, from which it is precipitated by acids, white, becoming yellow.

Tantalite in Haddam rocks.—Dr. Torrey writes, that a specimen of the granite of Haddam, Connecticut, which he sent to Count Wachtmeisten of Stockholm, has recently been examined by Professor Berzelius, and found to contain *tantalite*, in a state resembling that of Finbo in Sweden. The Haddam mineral occurs crystalized in small prisms in the same rock with the chrysoberyl.

The Chrysoberyl of Haddam.—The genuineness of this mineral has been admitted by Häuy, Jameson, and other distinguished mineralogists to whom specimens have been sent; but Dr. Torrey writes—"The mineral found in the granite of Haddam, which is generally supposed to be chrysoberyl, and which I sent to Professor Germar of Halle, for examination, he thinks is a new variety of beryl. The specific gravity is only 2. 7. Before the blow-pipe it melts into a milk-white enamel, and besides it is entirely too soft for chrysoberyl."

In reply to Dr. Torrey, we remarked, that we imagined the mineral examined by Professor Germar could not be the *crystalized chrysoberyl of Haddam*, whose character we suppose to be unquestionable. We suggested, that it might be a compact granular mineral, occurring in the same rock, and which we suppose may be *beryl in mass.*

Dr. Torrey again writes that he believes the mineral which he sent to Professor Germar, was not crystalized: that the latter remarked, it should perhaps be called *granular beryl*, and that it is doubtless the massive mineral to which we alluded.

It has been already mentioned in this article, pa. 37, that the chrysoberyl has been recently found at Saratoga. We would mention also, that there is a locality of it in Haddam, *east of the river*, and different from the one usually visited. We had specimens from Dr. Dart, two or three years ago, but cannot name the precise spot.

Plumbago from North Carolina.—It is of a very fine quality, and appears well adapted both for crayons and pots. It occurs a few miles north of Raleigh, and exists in great quantities. It has long been used in the vicinity as a pigment. We are indebted for this information to the Hon. Judge Johnson, of the Supreme Court of the United States; and also for the most beautiful yellow ochre, from the waters of the Oconee in Georgia, and for a handsome fine grained greyish white marble well polished. This is from the waters of Broad River in South Carolina. Both the last are abundant.

Chromat of Iron.—A compact specimen, said to be chromat of iron, has been handed to us by John Wales, Esq. It is from Wilmington, Delaware, but not having examined it *chemically*, we cannot answer for its genuineness.

Micaceous Iron—Of extreme beauty, is found a few miles from Northampton. It has a high lustre, and is contorted with delicate flexions, as if it had lain between the layers of mica slate, which we presume must have been the fact. Dr. Hunt and Mr. W. C. Dwight of Northampton, have favoured us with specimens; and similar ones from Hawley in Mass. have been transmitted by Dr. Jacob Porter of Plainfield. This last is particularly beautiful, and is sprinkled with points of magnetic iron readily attractable, while the micaceous part, even in powder, is unaffected by the magnet.

Green Foliated Talc, from Windham, Vermont.—This mineral, communicated by Professor Hall and by Mr. Bradley of Yale College, is not inferior in beauty to the Venetian talc, and is well worthy of the attention of mineralogists. Good specimens have been transmitted by Dr. Jacob Porter from the soap stone quarry at Middlefield, Mass. and by Mr. Thomas H. Webb from Smithfield, R. I. The latter has a silvery appearance.

Actynolite.—This mineral well crystalized and of good colours, occurs with the talc at Windham, Vermont, also at Saybrook, (Professor Hare,) and at Middlefield, (Mr. Coleman, Tutor in Yale College,) at Cummington, (Dr. Jacob Porter.) The first mentioned, is as beautiful as that of the Tyrolese Alps, and much resembles it.

Rose Quartz of Southbury, Con.—This occurs abundantly, forming a large rock about eighteen miles from New Haven. It is of a lively agreeable colour, and is the same mentioned at pa. 298, vol. I. of this Journal.

Crystalized Chlorite—Discovered by Mr. T. Nuttall, and communicated by Dr. Mead; found near the falls of the Schuylkill. Its colour is a deep bottle green. It is foliated, mammillary, and botryoidal, and is found in a hornblende rock.

Black Oxid of Manganese.—This useful mineral, of a very excellent quality, has been recently discovered by Mr. Calvin Pease, of Hillsdale, Columbia County, N. Y. The specimens are apparently very pure, and of such size and weight as imply a valuable mine of this substance. Mr. Pease does not however, say in his letter where the mine is situated—we presume in his vicinity.

Red Oxid of Titanium—Is found by Mr. Lane in the vicinity of his mine at Huntington. The crystals are occasionally as large as the thumb, and larger. They are often geniculated, and possess in their fracture a high resinous lustre, and a dark reddish brown colour. They often come out in irregular masses, and might then at first be mistaken for garnet.

Sulphate of Lead.—On page 173, vol. III. we mentioned a remarkable argentiferous galena found at Huntington, in Mr. Lane's mine. Connected with this galena is an incrustation of sulphate of lead. It is tolerably abundant, but is no where in crystals or in masses: it occupies merely the surface and cavities of the other ores of lead. It gives metallic lead instantly by the blow-pipe, but does not effervesce nor dissolve in acids. According to Mr. Lane, it is equally rich in silver as the galena. This, if correct, is we believe a new fact; but we have not examined the ore in this respect.

Black Tourmaline—Well crystalized in quartz, from Dr. Porter, of Plainfield.

Garnet Mass.—From the same. This remarkable mass is as large as a head, and composed entirely of garnets, individually about a quarter of an inch in diameter. They are trapezoidal and rhomboidal: often translucent and rich in colour, and truncated deeply on the solid edges. They are either in mere juxta position, or cemented by *hyalin* quartz.

Green Mica, Hinsdale, Mass.—Dr. Jacob Porter.

Dr. Webster has discovered Hyperstene in abundance in the vicinity of Boston.

We have many other localities on hand, and some of them are sufficiently interesting, but they must be postponed to another number.

BOTANY.

ART. VI.—*Notice of the Plants collected by Professor* D. B. DOUGLASS, *of West Point, in the expedition under Governour* CASS, *during the summer of* 1820, *around the great Lakes and the upper waters of the Mississippi: the arrangement and description, with illustrative remarks, being furnished by Dr.* JOHN TORREY.

Letter from Dr. Torrey to Professor Douglass.

NEW-YORK, August 4, 1821.

Dear Sir,

INCLOSED I have the pleasure of sending you a catalogue of the plants from the North-West, which you forwarded me some time since for examination. Many of the species are very rare, others are from entirely new localities, and the whole are valuable in increasing our knowledge of botanical geography. To those species which are but little known or imperfectly described, I have added such remarks as I supposed would be useful.

The Indian and popular names and localities are taken from your notes annexed to the specimens.

With great respect,
I remain your humble Servt.
JOHN TORREY.

Professor DOUGLASS,
West-Point Military Academy.

CATALOGUE, DESCRIPTION, &c.

DIANDRIA.

Monarda allophylla *Mx.* }
Mollis L.–WILLD.–PH. } *(Wild Balm.)* Savannah Portage. July 10.

TRIANDRIA.

Monogynia.

Fedia radiata *Mx.* *Valeriana radiata Willd.* *V. locusta [radiata L. Sp. pl.*	Gross Isle, May 22d.

Iris lacustris *Nutt. Gen.* 1. p. 23. Scape five to six inches high, about the length of the leaves. Radical leaves eusiform, one fourth of an inch broad. Mr. Nuttall discovered this Iris in the same place where it was found by Capt. Douglass—on the gravelly shores of the Islands of Lake Huron.

Sisyrinchium mucronatum *Mx. Pluk. Phytorg.* t. 61. f. 1. Gross Isle, May 21.

Explanatory letter from Prof. Douglass to the Editor, dated New-York Aug. 22, 1821.

Dear Sir,

I must beg leave to observe, in the first place that the collection of plants was made by a person, who, besides not being a professed botanist, was almost constantly engaged with other objects of research. The formation of an Herbarium, requiring much leisure and frequent attention, could scarcely be expected, under such circumstances, and would not have been undertaken, except in the exigency of having no professed botanist attached to the Expedition. Secondly, the region of country traversed by the Expedition, particularly that bordering upon Lake Superior and the upper Mississippi, as well as a considerable portion of that on the Ouisconsin and Fox Rivers and around Lake Michigan, is but indifferently rich in plants at best, and this collection is besides chiefly confined to such as flower in the course of the summer months. The deficiency I have endeavoured to supply as far as possible by notes, particularly on the forest growth, which I have interspersed in my journal; these however being at West Point, it is at present out of my power to communicate them.

Finally, a part of the collection was injured by an accident on the Ouisconsin, in which my canoe was very nearly filled with water before it could be got ashore. The consequence of which was that nearly all the plants in one case were completely spoiled before I was able to dry them. Such as the collection is, however, the catalogue is entirely at your service, and I am glad that so much interest has been given to it by Dr. Torrey. The *uvularia perfoliata* of this catalogue is the plant which I mentioned to you some time since, as efficacious in the cure of the Rattle-snake bite—Of this I have been witness, but the efficacy of the *Pedicularis Canadensis* for the same purpose, I can only state from report.

I remain, dear Sir, your friend
and humble Servant,
D. B. DOUGLASS.

DIGYNIA.

Panicum *longisetum.** Stem terete, smooth, a foot and a half high; leaves lanceolate, very large, (about an inch broad) subglaucous; spike compound, resembling a panicle, dense, clandestine at base, somewhat nodding; spikelets alternate and opposite: calyx three-flowered, exterior valve very small, the others unequal, ovate acuminate, hispid, each terminated by a long awn.

Awns from one and a half to three inches in length.

On the banks of Fox River, &c. August.

Bromus ciliatus *L.* }
canadensis Mx. } On Fox River. August.

Arundo phragmites *L.* (*Reed.*) Near the head of the Mississippi.

Elymus hystrix *L?* Involucrum one to two-leaved, lateral, linear, nearly the length of the corolla.—With the preceding.

Atheropogon Apludoides *Muhl.* in Wild. Sp. pl. 4. p. 937. *Muhl Gram.* p. 287. *Nutt. Gen.* 1. p. 78. *Chloris curtipendula* Mx. This grass has certainly a two-valved calyx as described by Nuttall and Muhlenberg. The inner valve however, is almost setiform. Neutral flower partly lodged in a grove of the inner valve of the hermaphrodite flower, two-valved, exterior valve with a very short awn below the apex, the other deeply cleft and two-awned. Hermaphrodite flower with lanceolate glumes, exterior one trifid, or with three short awns, interior one bifid. Authers blood red. Nuttall remarks that the neuter flower consists of *one folded valve*; this however, did not seem to be the case in the specimens I examined. HAB. On the Ouisconsin river and the Mississippi generally. August.

Oligostachyum. *Nutt.* l. c. Mr. Nuttall has described this plant very accurately and minutely in the work quoted. He discovered it on the plains of the Missouri. Capt. Douglass found it in abundance on the Mississippi above Sandy Lake.

TETRANDRIA.

Comus canadensis *L.* On the River St. Mary's.

PENTANDRIA.

MONOGYNIA.

Batschia canescens *Mx.* } (*True Puccoon.*)
Anchusa canescens MUHL. CAT. } Near Detroit.
A lutea minor &c. GRON. virg 19. }

Menyanthes trifoliata L. Portage of Pt. Keeweenah, Lake Superior, June 26th.

Pulmonaria virginica *L.* Black Rock, May 2d.

Primula farinosa *L. Muhl. Cat.* Leaves abovate-spatulate, crenately toothed, under surface covered with a yellowish green powder. Corolla lilac coloured, segments two parted. On a careful comparison of the American plant with specimens of *P. farinosa,* from Germany and Norway, I can find no difference except that the leaves are more *toothed* than *crenate* in the former. Shores of Lake Huron. Mr. Nuttall found it in the same place, but not in flower, and Muhlenburg states in his catalogue of North American plants that it grows in Canada. It is a rare plant in this country and is not described in Pursh's Flora.

Lysimachia ciliata *Mx.* Sandy Lake and Upper Mississippi generally.

Phlox divaricata *L.* Black Rock, May 2d.

Campanula rotundifolia *L.* St. Louis and Upper Mississippi. July.

Caprifolium parviflorum *Ph.* } On a primitive peninsula near Deadman's river, Lake Superior June.
bracteosum Mx.
Lonicera parviflora LAM. PERS.
diorca L. ACT.–WILLD.
media MURR.

Dierville Tournefortü *Mx.* } Savannah Portage. July.
humilis PERS.
canadensis MUHL.
lutea PH.
Lonicera Diervilla L.

Ribes lacustre *Ph.* } Shores of Lake Huron.
axycanthoides B. lacustre PERS.

Floridum *Willd.* } With the preceding.
rocurvatum Mx.
pennsylvanicum LAM.

Viola pubescens *Ait.*
pennsylvanica, Mx.
Claytonia Virginica *L.* Black Rock, May 2d.

Comandra umbellata *Nutt.* / *Thesium umbellatum* L. / *corymbulosum* Mx. — Point Keeweenah, Lake Superior. Used by the Indians and traders in fevers.

DIGYNIA.

Apocynum androsaemifolium *L.* On the river St. Louis. July.

Thaspium aureum *Nutt.* / *Smyrnium aureum* L. — Near Detroit.

TRIGYNIA.

Viburnum Lentago *L.* Near Detroit, May 20th.

TETRAGYNIA.

Parnassia caroliniana *Mx.* East shore of Lake Michigan, Sept. 6th.

PONTAGYNIA.

Aralia mudicaulis *L.* (*Sarsaparilla.*) Near Detroit.

HEXANDRIA.

MONOGYNIA.

Tradescantia virginica *L.* A variety with very narrow leaves. West shore of Lake Michigan, August 27th.

Hypoxis erecta *L.* (*Wabunocausk.*) Shores of Lake Huron.

Phalangium escullentum, *Nutt. Gen.* 1. p, 219. / *Quamash* PH. FL. AM. 1. p. 226. / *Scilla esculentum* BOT. MAG. 1596. — Root bulbous, truncated, nearly round, and an inch and a half or two inches in diameter. Scape two or three feet high, leaves more than a foot long, and about half an inch wide. Flower pale purple, in a spiked raceme. Stigma trifid, Capsule three-angled, three-celled. Found on Cross Isle, Detroit river, May 18th. Mr. Nuttall has observed it near the confluence of Huron river and Lake Erie, near St. Louis, and on the lowest banks of the Ohio. Gov. Lewis brought specimens of this plant from the upper part of the Missouri, near the Rocky Mountains, where the natives use the bulbous roots extensively as an article of diet. They are known among them by the name of *Quamash*, and are eaten, baked between hot stones. Capt. Douglass did not understand that the Indians of the region where he found the plant, made use of the roots for food.

Uvularia perfoliata *L.* On the Islands of Lake Erie, This plant is said to cure the bite of a rattle-snake, and is believed by the Indians to grow wherever that animal is found.

Streptopus roseus *Mx.* *Uvularia rosea.* BOT. MAG. 1489. *Muhl. Cat.* p. 34.	Shores of Lake Huron, May 30th.
Smilacina canadensis *Ph.* *Convallaria canadensis* REDOUTE. *Majanthemum canadense* DESF. *Convallaria bifolia* MX.	(*Matasbuck*) Nearly allied to *Conval bifolia* of Europe. May 28th. Shores of L. Huron.
Racemosa *Desf.–Ph.* *Convallaria racemosa* L.	Shores of Lake Huron.
Stellata *Desf.–Ph.* *Convallaria stellata* L.	Gross Isle, May 22d.

Dracena borealis *Ait.* (*Cus-cus-cun-domeneca.*) Leaves oblong, oval, sometimes obovate, muscronate, smooth, membranous six-seven inches long and from two to three inches broad, ciliated on the margin, Scape six to eight inches high, terminated by three or four nodding flowers of a yellowish-green colour. Corolla six-petalled, petals lanceolate, rather obtuse, slightly connected at the base. Stamina the length of the corolla, inserted at the base of the petals : others oblong, two-celled, large, style thick, one third the length of the stamina : stigma three-lobed.

Shores of Lake Huron, May 28th.

Trigynia.

Trillium erectum *Willd.* a *atropurpureum* Ph. *T. rhomboideum* a Mx.	(*Birth root*) Black Rock May 3d.
Grandiflorum. *Salisb. in Parad. Lond.* *T. rhomboideum and grandiflorum* Mx.	With the preceding.

HEPTANDRIA.

Trientalis europæa B. angustifolia* *Americana* Ph. *Europæa* B. *Americana* Nutt.	(*Schoshogonicish.*) Shores of Lake Huron, May 28th.

OCTANDRIA.

Œnothera biennis *L.* Upper Mississippi generally.

Epilobium spicatum *Lam. Pers. Muhl. Cat.* *Angustifolium* L. et plur. auct.	St. Louis River, &c.

Acer saccharinum *L.* Shores of Lake Huron.

DECANDRIA.

Monogynia.

Arbutus Uva ursi *L.* (*Kinni-kinnik.*) Smoked by the Indians as a substitute for tobacco. The Arbutus is seldom used by itself, though it forms the principal ingredient in the composition called *Kinni-Kinnik.* The bark of Cornus sericea, and of several other plants are generally mixed with it, though a little tobacco is preferred. Pursh says the Indians of the Missouri call it *Sacacommis.*

Andromeda polifolia B. *rosmarinifolia.** Leaves linear, revolute. This variety is perhaps the A. polifolia a. *angustifolia* of Aiton, and Pursh, and is probably a distinct species from A. polifolia of Europe. It is not uncommon in New-England and in the northern parts of the state of New-York, growing in sphagnous swamps, and on the borders of mountain lakes.

Ledum latifolium *Ait. Willd.* (*Labrador tea,*) Shores of Lake Superior &c. June 19.

Kalmia glauca *Ait. Willd.* With the preceding.
Pyrola rotundifolia *L.* Savannah portage, July 10th.

Digynia.

Mitella diphylla *L.* Shores of Lake Huron May 10th.

Tiarella cordifolia *L.* (*Paa-sewung.*) Root mucilaginous. Petals lanceolate acute, attenuated at the base, three-nerved. Shores of Lake Huron.

Pentagynia.

Cerastium *n. sp.* Cespitose, pubescent. Leaves lanceolate-oblong erect, acute shorter than the joints: flowers are long terminal peduncles; leaflets of the calyx oblong; corolla obovate two-cleft twice the length of the calyx. Sandusky, May 8th. About eight inches high.

This species is allied to *C. termifolium* of Pursh, but the leaves are much broader, and the calyx obtuse. The petals are only twice instead of thrice the length of the calyx. With the *C. glutinosum* of Nuttall, it has also much affinity, but that plant is much larger and *viscous*, and the capsule is *double the length* calyx, while in our plant it appears to be oblong and shorter than the calyx.

ICOSANDRIA.

Monogynia.

Prunus virginiana *L. Willd.* } Shores of Lake Huron.
Cerasus virginiana Mx. }
——— Depressa *Ph.* With the preceding.

Pentagynia.

Cratægus pyrifola *Ait. Willd.* (*Wild Apple.*) Detroit, May 30th.

——— punctata *Ait. Willd.* With the preceding.

Pyrus ovalis *Willd. arb.* } On the river St. Mary's
Mespilus Amebanchien. Walt. }

Polygynia.

Rosa parviflora *Ehrh. Willd.* On Lake Superior. July 4th.

Rubus saxatilis B. *canadensis* Mx. Head of the Mississippi. Swamps.

Geum rivale *L.* Shores of Lake Huron, May 30th.

Potentilla anserina *L.* Near Detroit.

——— pennsylvanica *Mx. Willd.* } Willdenow and
Geum agrimonoides Ph. } Pursh quote as a synonim of this plant the *G. Pennsylvanica* of Gmelius Flora Sibirica, 3. t. 34. f. 1, but the figure is altogether unlike our plant, and does not agree with Michaux's description of it. Willdenow however, remarks, "Planta sibirca majus est glabra sed foliorum florumque structura eadem ac in Americana"! Sp. pl. 2. p. 1099.

POLYANDRIA.

Monogynia.

Actaea Americana *Ph.* }
Rubra Willd. } Shores of Lake Huron.
Spicata Mx. }

Sarracenia purpurea *L.* (*Ko-ko-koh Mokasin.* Owls' Mockasin.) Point Keewenah, Lake Superior, June 26th.

Cyamus luteus *Nutt.* }
Flavicomas Salisb. Ph. }
Nelumbium luteum Willd. }
Nymphæa Nelumbo Walt. }
N. Nelumbo Bl. } The only difference Willdenow makes between his N. speciosum and luteum is that the former has hispid peduncles and petioles, and the latter smooth ones. He however describes a variety of the N. speciosum with smooth peduncles and petioles, and the American plant according to Nuttall and the present Prof. Barton had them sometimes partly muricate. Hence there seems to be but little difference between the two species. The colour of the flowers, unless there are other distinctive characters, is not of much consequence.

Found in great quantities near Sandusky Bay, west end of Lake Erie.

PENTAGYNIA.

Aquilegia canadensis *L.* Near Detroit. May.

Polygynia.

Ranunculus fascicularis *Muhl. Cat.—Big. Fl. Bost.* Near Detroit.

sceleratus *L.* With the preceding.

DIDYNAMIA.

Gymnospermia.

Stachys aspera *Mx. Ph.* excl. syn. The *S. tenuifolia* of *Willd.* is placed as a synonym to this species by Pursh, but Muhlenberg makes them distinct in his catalogue. Specimens of *S. tenuifolia* sent from N. Carolina by Mr. Schweinetz, appear quite different from the *aspera*. The short description of the former by Willd. will agree equally well with either. Ontonagon river, June 30th.

Hyssopus anisatus *Nutt. Gen.* 2. p. 27. } Stem obtuse-
Stachys fœniculum Ph. 2. p. 407. } ly four-angled leaves ovate-cordate, with large accuminate serratures, hoary beneath. Flowers in a dense somewhat interrupted spike. Stamina and style excert. Savannah Portage. July.

First discovered on the plains of the Missouri by Mr. Nuttall.

Verbena hastata *L.* Upper Mississippi, generally.

Angiospermia.

Bignonia radicans *L.* Near Sandusky Bay.

Bartsia coccinea *L.* } Near Detroit.
Euchronia coccinea Nutt. }

Pedicularis canadensis *L.* Near Detroit. Said by the Indians to cure the bite of a rattle-snake.

——— gladiata *Mx.* Shores of Lake Huron, May 30th.

Linnæa borealis *L.* Near White Fish Pt. Lake Superior, June 19th.

Gerardia Pedicularia *L. Willd.* Ouisconsin river, Aug.

TETRADYNAMIA.

Arabis rhomboidea *Pers.* } B. *purpurea** Smooth: *bulbosa* MUHL. } root bulbous granulated leaves rhomboid; the superior ones with large repand teeth, inferior ones in very long petioles, obsoletely toothed, cordate. Flowers corymbose, pale purple, as large as in *Raphanus sativus.* About ten inches high. *Cardamine rotundifolia* Mx?

—— lyrata *L.* Banks of Lake Huron, June 5th.

Dentaria laciniata *Muhl. Willd.* } Black Rock, May 3d. *concatenate* Mx. }

——— diphylla *Mx.* (*Indian pepper.*) In the same place.

MONADELPHIA.

Lobelia claytoniana *Mx.* Savannah Portage.

DIADELPHIA.

Petalostenum violaceum *Mx.* } Prairies of the Upper *Dalea violacea* WILLD. } Mississippi, below Sandy Lake.

——— villosum *Nutt. Gen.* 2. p. 65. Petals 5, nearly equal alternating with the stamens. Calyx five-toothed. Grows with the preceding species. First discovered by Nuttall on the banks of Knife River, near Fort Mandan, Missouri.

Polygala paucifolia *Muhl. Willd.* Shores of Lake Huron.

Vicia *Douglassii.** Spikes many flowered, somewhat retrorsely imbricated, shorter than the leaves; stipules ovate-lanceolate, entire, leaflets numerous, (5 to 6 pairs) ovate oblong, mucronate, slightly pubescent beneath.

Resembles *V. cracca.* Sandusky Bay. May 8th.

Pisum maritimum *L.* Sandy Point, Lake Superior, July 4th.

SYNGENESIA.

Liatris squarrosa *Willd.* Stem erect, smooth, about two feet high. *Serratula squarrosa* L. Leaves very long and narrow, smooth, slightly scabrous on the margin. Raceme about six-flowered, flowers approximated, on short peduncles, calyx containing twenty florets, subcylindric, squamose below ; scales ovate mucronate, a little ciliate, interior ones foliaceous. Segments of the corolla linear, villose within. West shore of Lake Michigan, August 27th. Allied to *L. graminifolia.*

——— scariosa *Willd.* } *Serratula scariosa* L. } Stem simple, three feet high, nearly smooth. Leaves lanceolate, very smooth, and the upper surface a little shining. Flowers in a long dense spike, very numerous, (40 to 70,) on short peduncles : calyx twenty–twenty-three flowered ; scales spatulate, obtuse, membranous and coloured : pappus a little longer than the villous seed ; corolla deeply cleft, smooth, with diaphanous punctures. West shore of Lake Michigan, August 27th.

Erigeron bellidifolium *Muhl.–Willd.* } *pulchellum* Mx. } Near Detroit.

GYNANDRIA.

Neottia cernua *Willd.* } *Ophrys cevnua* L. } East shore of Lake Michigan.

Calopogon pulchellus R. Brown. } *Cymbidium pulchellum* Swartz. } *Limodorum tuberosum* L. Mx. } Portage of Pt. Keeweenah, Lake Superior, June 26th.

Cypripedium spectabile *Swartz.* } *album* Ait. } *canadense* Mx. } Point Keeweenah, Lake Superior, June 26th.

——— pubescens *Willd.* (*Mockasin flower.*) Presque Isle, June 5th.

calceolus Mx.
calceolus B. L.

MONOECIA.

Hexagynia.

Zizania palustris *Lin. Mautiss.* 295. *Sp. pl.* 1408. *Willd. sp. pl.* 4. p. 395. *Muhl. Gram.* p. 271. *Schreb. Gram.* t. 29. *Z. aquatica* Lamb. in Lin trans 7. p. 264. Pursh. 1. p. 60. 2. p. 210. Gron. virg. 148. *Z. clavulosa* Mx. 1.

p. 75. Muhl Gram. p.270. Willd. sp. pl. 4. p. 394.—(*Wild rice—Water oats.*) Abundant in the shallow rivers which fall into the Great Lakes, but in the greatest luxuriance and plenty in Fox river.

Polyandria.

Quercus alba *L.* St. Louis and the upper Mississippi. This was the first oak seen after leaving Michilimakinak.

Fagus ferruginea *Ait.-Willd.* Shores of Lake Huron.

Betula nigra *L.* Savannah Portage.

Monadelphia.

Pinus balsamea *L.* } Mississippi, above Sandy
Abies balsamifera. Mx. arb. } lake.

—— nigra *Lamb.* } On the Mississippi, and near St.
denticulata Mx. } Louis.

—— banksiana *Lamb.* } Near the head of the Missis-
rupestris Mx. arb. } sippi.

Thuya occidentalis *L.* River St. Mary's.

Euphorbia corollata *Ait.*

DIOECIA.

Diandria.

Salix lucida *Muhl.-Willd.* Shores of Lake Superior.

—— incana *Mx.* Shores of Lake Huron. This species is omitted in Pursh's Flora Amer.

Octandria.

Populus balsamifera *L.* Savannah portage.

—— trepida *Willd.* With the preceding.

grandidentata Mx. } In the same place.
—— tremuloides *Mx.* }

Shepherdia canadensis *Nutt.* Shores of Lake Huron.
Hippophaë canadensis L.

Monadelphia.

Juniperus communis *L.* Near Chicago.

—— prostrata *Pers.* Synop. 2. p. 632. *Muhl. Cat?* p. 98. *repens* Nutt. Stem prostrate; branches running eight or ten or more feet along the ground; leaves imbricate in four's, ovate submucronate, bearing a gladulous depression in the middle. Berries larger than in the I. virginiana, but nearly of the same smell and taste. On Lake Huron, where it was also observed by Mr. Nuttall.

Taxus canadensis *Willd.* } On the St. Louis river.
baccata minor Mx. }

Art. VII.—*List of Plants growing spontaneously in Litchfield and in its vicinity.*

[Communicated by Mr. John P. Brace.]

MONANDRIA.

Digynia.

Calltriche.
1. hiterophylla (Ph.)
verna Muhl.
aquatica Big.

In a ditch near Wolcottville manufactory. June.

Cinna.
1. arundinacea *L.*

Shady Swamps. August.

DIANDRIA.

Monogynia.

Utricularia.
1. vulgaris Ph. et Big.
macrorhyza N. Y. Cat.

Streams of the Little Pon v. v. Aug. Yellow.

2. cornuta Mx.

Spagnous Swamps, near the Cranberry pond. Aug. Yellow.

Gratiola.
1. aurea Muhl.

officinalis Mx. ?
Wet places. Aug. Yellowish white.
2. virginica *L.*
Wet places. Aug. Purple.
3. neglecta TORREY, N. Y. CAT.
pubescens EATON.
Borders of the Bantum Lake. Aug. Yellow.
Veronica.
1. serpyllifolia *L.*
Streets and pastures. Blue. May.
2. beccabunga
Brooks. June. Blue.
3. sentillata *L.*
Wet places, near streams June. Blue.
4. arvensis *L.*
Dry places in streets. May. Aug. Blue.
5. peregrina SM.
Cultivated fields. May. White.
Lycopus.
1. Europaeus *L.*
Wet places. Aug. White.
2. Virginicus *L.*
With the last. Aug. White.
Monarda.
1. *didyma L.*
Near old garden spots. July. Red. Introduced.
Collinsonia.
1. Canadensis *L.*
Woods. Aug. Yellow.
Fraxinus.
1. discolor Mx. f.
americana. Woods. May.
2. sambucifolia. Wild swamps. May.
Circaea.
1. Lutetiana *L.* Moist woods. May. White.
var. alpina. With the last.

DIGYNIA.

Anthoxanthum.
1. odoratum *L.* Meadows. May. June.

TRIANDRA.

MONOGYNIA.

Sisyrinchium.
1. anceps *Lmk.* Wet meadows. June. Blue.

Iris.
1. Virginica *L.* Near streams. June. Blue.
2. Versicolor *L.* With the last. Blue.

Xyris.
1. Jupicai MX.
Caroliniana PH.
flava EAT.
Border of the Bantum Lake. Aug. Yellow.

Schoenus.
1. albus *L.*
Rhynchospora alba
Spagnous swamps of the Cranberry pond. Aug.
2. glomeratus *L.*
R. glomerata.
Wet pastures. July.
3. mariscoides MUHL.
Borders of Ponds. Aug.

Cyperus.
1. parviflorus MUHL. Banks of ponds. Aug.
2. strigosus *L.* Wet pastures. Aug.
3. poeformis. PH. With the last. Aug.
4. mariscoides. Sprengel.
Scirpus cyperiformis MUHL.
Mariscus cyperiformis. N. Y. CAT. et SYN.
Dry sandy fields. Aug.
5. inflexus. MUHL.
uncinatus. PH. Banks of ponds. Aug.
6. bicolor. BARTON. With the last. Aug.
7. diandrus. TOR. N. Y. CAT. With the last. Sept.

Dulichium.
1. spathaceum RICH.
cyperus spathaceus WILD.
In swamps, near ponds. Aug.

Scirpus.
1. tenuis. WILLD. Overflowed places. June.
2. capitatus. *L.* Borders of ponds. July.

3. trichodes. MUHL. Overflowed places. July.
4. intermedius. MUHL ? Wet places. Aug.
5. capillaris. MUHL. Sandy fields. Aug.
6. lacustris. Borders of Dog pond. Goshen. June.
7. acutus. MUHL. Borders of ponds. June.
8. debilis PH. et MUHL. Sandy borders of the Great Pond. Sept.
9. autumnalis. MUHL. With the last. Sept.
10. Americanus. PERS.
triquetus MX. Marshes near ponds. July.
11. palustris *L.* Borders of ponds. July.

Eriophorum.

1. Virginicum *L.* Cranberry pond swamps.
2. angustifolium *L.* With the last. July.
3. vaginatum GUAD.
cespitosum PH. With the last. April.

Tricophorum.

1. cyperinum PERS.
Eriophorum cyperinum *L.*
Wet meadows. July.

DIGYNIA.

Oryzopsis.

asperifolia MX. Woods. May ?

Panicum.

1. glaucum *L.* Cultivated grounds. Aug.
2. Crus-galli. *L.* With the last. Aug.
3. Latifolium *L.* Woods. June.
4. pubescens. MUHL. Pastures. July.
5. discolor. With the last. July.
6. nitidum. LMK. Pastures. July.
7. agrostoides. MUHL. Wet meadows. Aug.
8. geniculatum. Muhl. Borders of ponds. Aug.
9. capillare. *L.* cultivated grounds. Aug.
10. lanuginosum ELL ? Mount Tom. June.
11. nervosum Muhl ? Pastures. July.
12. depauperatum. With the last. July.

Digitaria.

1. sanguinalis Muhl.
Panium sanguinale *L.*
Streets. Aug.

2. paspalodes. Mx. Sandy streets. Aug.

Paspalum.

ciliatifolium. Mx. Barren pastures. Sept.

Aristida.

dichotoma Mx. Sandy streets. Sept.

Alopecurus.

1. pratensis *L.* Meadows. June. Introduced.
2. geniculatus. MUHL. Wet places. June.

Phalaris.

1. arundinacea. Mx. Wet meadows. Aug.

Milium.

pungens. TORREY (MSS.) Mount Tom. May.

Agrostis.

1. alba. *L.* Meadows and streets. July.
   Var. purpurascens. Near Streams. July.
2. vulgaris. SM. Meadows. July.
3. Mexicana. MUHL. Wet meadows. Aug.
4. Virginica. MUHL. Streets. Sept.
5. diffusa. MUHL. Wet meadows. Sept.
6. setosa. MUHL.
   racemosa. Mx.
   Polypogon glomeratus. N. Y. CAT. Swamps of the Cranberry pond. Sept.
7. tenuiflora. MUHL. Shady places. Sept.

Muhlenbergia.

1. erecta. SCHREB. Wet woods. July.
2. diffusa. SCHREB. Streets. Sept.

Leersia.

1. Oryzoides. SWARTS. Swamps. Aug.
2. Virginica. WILD. Wet woods. Aug.

Trichodium.

laxiflorum. Mx. Meadows and streets. Aug.

Phleum.

pratense. *L.* Meadows. July. Introduced.

Aira.

1. obtusa. Mx.
   truncata. MUHL. Wet meadows and near streams. June.
2. pallins. MUHL. Var. Aristata. Pine Island Swamps. June.

Elymus.

1. hystrix *L.* Wet woods. July.

2. Canadensis. Wet pastures. Aug.

Eleusine.

Indica. Mx. Waterbury river turnpike. Sept.

Triticum.

repens *L.* Grass plots. July.

Var. Aristata Pers. Meadows and hills. July.

Briza.

canadensis. Swamps. July.

Dactylis.

glomerata *L.* Meadows. July.

Poa.

1. annua. *L.* Fields &c. April to Sept.
2. nervata. Muhl. Swamps. July.
3. hirsuta Mx. Sandy fields, near the Waterbury river. Sept.
4. trivialis *L.* Wet meadows. June.
5. pratensis. *L.* Meadows. May.
6. compressa. *L.* Woods. June.
7. palustris. Muhl. Wet meadows. July.
8. knerva. Torrey (Mss.) Banks of the Bantum. May.
9. elongata. Torrey. (Mss.) Swamp at the head of the Sherman brook. July.
10. aquatica. Wet meadows. July.

Windsoria.

pallida. Tor. N. Y. Cat. Swamps. July.

Festuca.

1. teuella. Willd. On rocks. June.
2. elatior. *L.* Meadows. July.
*3. fluitans, *L.* Overflowed grounds. July.
4. nutans. Willd. Woods. June.
5. palustris. Schreb. Pastures. June.

Bromus.

1. secalinus. L. In green fields. Aug. Introduced.
2. pubescent. Muhl. Woods. July.
3. canadensis. Mx.

ciliatus. L. Moist woods. July.

Danthonia.

spicata. Nutt.

avena spicata L. Dry hills and fields. July.

* A new species of Festuoa, as yet not well examined, is found differing from F. fluitans. in having acute glumes.

Arundo.
canadensis Mx.
cinnoides Muhl. Wet places by rivers. July.
Andropogon.
1. purpurascens. Muhl. Rocks. Sept.
2. fuscatus. L. Fields. Sept.

Trigynia.

Lechia.
1. major. L. Dry hills. Aug.
2. minor. L. Sandy fields. Aug.

Mollugoe.
verticillata L. Sandy fields. Aug. White.
Quervia.
canadensis L. Rocky hills. July.
Proserpinacea.
palustris. L. Ditches near ponds. July.

TETRANDIA.

Monogynia.

Plantago.
1. major. L. Fields &c. July.
2. lanceolata. L. With the last. June.

Houstonia.
cerulea. L. Pastures and meadows. May to Aug. blue.
Mitchella.
repens. L. Pine woods. June.
Cephalanthus.
occidentalis. L. Near streams. July. White
Galium.
1. tinctorium. L. Swamps. July. White.
2. asprellum. Mx. Wet Meadows. July. White.
3. trifidum. Willd. Swamps. July. White.
4. aparine L. Hedges. May. White.
5. triflorum. Mx. Woods. July. White.
6. circægans Mx. Woods. July. Purple and white.
var. lanceolatum N. Y. Cat. With the last. July.

Dipsacus.
sylvestris L. Road sides Bradleyville. Aug. blue.

Cornus.
1. canadensis. L. Pine swamps. June, White.
2. Florida. L. Woods, (not common.) May. White.
3. sericea. Willd. Swamps. June. White.
4. circinata l. Her.
tomentulosa Mx. Rocky woods. June. White.
5. alba. Willd. Swamps. White. June.
6. paniculata l'Her. Borders of fields. June. White.

Pothos.
foetida. Mx. Wet meadows. April.

Isnardia.
palustris. L.
Ludwigia palustris. Ell.
nitida, Mx. In ditches. Aug.

Digynia.

Hamamelis.
Virginica L. Woods. Oct. Yellow.

Tetragynia.

Ilex.
canadensis Mx. Pine Island swamps. May. Green.

Sagina.
procumbens. L. Brooks. June.

Potamogeton.
1. perfoliatum. L. In pond, (as are all the following species.) July.
2. fluitans L. July.
3. nutans. L. July.
4. lucens Mx. July.
5. gramineum Mx.
pauciflorum. Ph. July.

PENTANDRIA.

Monogynia.

Cynoglossum.
officinale. L. Road sides. May. Blue.

Myosotis
1. virginiana L. Damp woods. July.

2. arvensis. L. Mount Tom. May. White.

Lysimachia.

1. racemosa. Mx.
stricta. Ait.
bulbifera. Curtis. Swamps. July. Yellow.
2. thyrsiflora. Mx.
capitata. Ph.
Swamps near the Sherman brook. June. Yellow.
3. quadrifolia L. Meadows. July. Yellow.
4. ciliata. Mx. Hedges near streams. July. Yellow.

Menyanthes.

trifoliata. L.
Swamps of the Cranberry pond. June. White.

Villarsia.

lacunosa. Neut.
Menyanthus trachysperma. Mx.
Lakes and ponds. Aug. Yellow and white.

Convolvulus.

sepuim L. Borders of fields. July. White.

Datura.

stramonium L. Road sides. Aug. White.

Verbascum.

1. Thapsus L. Road sides and old fields. July. Yellow
2. Blattaria L. Road sides. July. Yellow.

Azalea.

1. nudiflora L. Rocky woods. May. Red.
2. viscosa L. Swamps. July. White.
var. pubescens. Swamps on hills. July. White.

Solanum.

1. dulcamara. L. Hedges. July. Blue.
2. nigrum. L. road sides. July. White.

Physalis.

Pennsylvanica. L. Street s. South Farms. Yellow.

Lonicera.

parviflora Pers.
dioica. L. Pastures. June. Red.

Xylosteum.

ciliatum. Pine Islands. May. Yellow.

Diervilla.

humilis. Pers. Hedges and woods. June. Yellow.

Campanula.

1. rotundifolia. L. Rocks of Canaan falls. July. Blue.
2. amplexicaulis Mx.
perfoliata. L. Sandy hills. July. blue.
3. erinoides. Muhl. Wet meadows. Aug. White.

Lobelia.

1. Claytoniana Mx.
Meadows, (common.) June—July. blue.
2. pallida. Muhl. Woods. July. Blue.
3. Kalmii. L. Borders of Dog pond, Goshen. Aug. Blue.
4. inflata. L. Pastures. Aug. Blue.
5. cardinalis. L. Borders of Brooks. Aug. Scarlet.
6. siphilitica. L. Ditches, Salisbury. Aug. Blue.
7. Dortmanna. L. North border of Bantum Lake. July. Blue.

Triosteum.

perfoliatum. L. Shady places. June. purple.

Rhamnus.

franguloides. Mx.
alnifolius Willd. Swamps. June. Green.

Ceanothus.

Americanus L. Woods. July. White.

Celastrus.

scandens L. Borders of fields. June. White.

Vitis.

1. Labrusca. *L.* woods. June.
2. vulpina. *L.* woods. June.

Ampelopsis.

quinquefolia. Mx. near streams. Aug. Green

Impatiens.

noli-tangere. *L.*
fulva Nutt? wet places. July. Orange.

Viola.

1. palmata *L.* woods. May. Blue.
2. pedata *L.* Mount Tom. May. Blue.
3. blanda. Wild. bog meadows. May. White.
4. primulifolia. *L.* meadows May. Blue.
5. cucullata *L.* meadows May Blue.
6. rotundifolia Mx. banks of streams. April. Yellow.
7. uliginosa, MUHL. wet meadows. June. Blue.

8. rostrata woods. Canaan. May. blue.
9. pubescens. Ait. woods. June. yellow.

Claytonia.

spatulata wet meadows. May. white and pink.

Ribes.

1. recurvatum. Ph.
   floridum *L.* woods. May. green.
2. triflorum. Wild. wet places. May. green.

DIGYNIA.

Asclepias.

1. Syriaca *L.* borders of woods. July. purple.
2. phytolaccoides. Ph. hedges. July. purple.
3. incharnata. *L.*
   var pulchra banks of rivers. July. purple.
4. quadrifolia. Ph. In rocky woods. June. white.
5. tuberosa. *L.* In pastures. Aug. orange.

Apocynum.

androsæmifolium *L.* hedges. July. red.

Gentiana.

1. saponaria *L.* meadows. Sept. blue.
2. crinita Willd. meadows. Sept. blue.
3. Quinqueflora Willd. pastures. Sept. blue.

Cuscuta.

americana Willd. Twining round other plants.

Panax.

trifolium *L.* woods. May. white.

Chenopodium.

1. album. *L.* cultivated grounds. Aug. green.
2. Botrys. *L.* sandy roads. Aug. green.
3. murale. Ph. cultivated grounds. Aug. green.

Ulmus.

1. fulva. Mx. near streams. April.
2. americana. Mx. hills. April.

Hydrocotyle.

americana *L.* wet places. July.

Sanicula.

Marylandica. *L.* woods. July. green.

Angelica.

1. atropurpurea *L?*
   triquinata. Big. wet meadows. June. green.

Sison.

canadense. *L.*
Myrrhis canadensis. Nutt.
damp woods. July. white.

Sium.

1. latifolium. *L.* wet meadows. Aug. white.
2. lineare Mx? swamps. Aug. white.

Conium.

maculatum. *L.* road sides. July. white.

Myrrhis.

dulcis. Eaton. dry woods. June. white.

Cicuta.

1. maculata. L. wet meadows. July. white.
2. bulbifera. L. borders of streams and ponds. Aug. white.

Smyrneum.

aureum. L. meadows. June. yellow.
Thaspium aureum. Nutt.

TRIGYNIA.

Viburnum.

1. Opuloides. Muhl. borders of streams. June. white.
2. Lentago. L. woods. May. white.
3. Lantanoides. Mx. woods. May. white.
4. cerifolium Willd. woods. May. white.
5. dentatum L. wet woods. June. white.
6. nudum. L. swamps. June. white.

Sambucus.

Canadensis. L. hedges. May. white.

Rhus.

1. typhinum. L. woods. June.
2. glabrum L. mountains. July.
3. copallinum. L. with the last July.
4. vernix. L. swamps. June.
5. radicans. L. climbing in woods, &c. June

PENTAGYNIA.

Aralia.

1. racemosa. L. shady woods. July white.
2. nudicaulis L. among rocks. May. green.

Drosera.

1. rotundifolia L. In swamps; particularly in the spagnous swamps of Cranberry pond. July. white.
2. longifolia L. with the last. Aug. white.

HEXANDRIA.

Monogynia.

Caulophyllum.
thalictroides. Mx. thickets. May. green. very rare.

Prinos.
verticillatus. L. swampy woods. July, green.

Hypoxis.
erecta L. meadows. May. yellow.

Allium.
tricoccum L. damp woods. June. green.

Pontederia.
cordata. L. near ponds. Aug. blue.

Enythronium.
Americanum Im.
Dens-Canis. Mx. wet. woods. April. yellow.

Lilium.

1. Philadelphicum. L. pastures. July. red.
2. Canadense. L. July. meadows. orange.

Canvallaria.

1. pubescens. Willd.
   Polygonatum pubescens. Ph.
   rocky woods. May. June. white.
2. multiflora. L.
   Polygonatum multiflora. Desf.
   rocky woods. July. whitish.
3. umbellulata Mx,
   Polygonatum umbellata.
   Dracaena borealis Eaton.
   Clintonia ciliata Rafinesque.
   wet woods. May. yellow.
4. racemosa L.
   Smilacina racemosa Desf.
   woods. June. white.
5. stellata. L.
   Smilacina stellata Desf. Wet meadows. June. white.

6. bifolia. L.
Smilacina bifolia DESF. Wet woods. June. white.
Uvularia.
1. perfoliata. L. woods. May. yellow.
2. sessifolia. L. with the last. May. yellow.
3. rosea. Muhl.
Streptopus roseus. PERS. moist woods. May. pink. spotted.
Acorns.
calamus. L. ponds. June.
Juncus.
1. effusus *L.* wet grounds. July.
2. acutus *L.* borders of the Lake. July.
3. nodosus. MUHL. Gram. swamps June.
4. polyaphalus. M. swamps. Aug.
5. acuminatus. Mx. swamps. July.
6. tenuis. MUHL. Gram. streets. June
7. pilosus. *L.* pastures. May.
Lugula pilosa Wild.
8. campestris. Auct.
Lugula campestris Willd. with the last. May.

TRIGYNIA.

Gyronica.
virginica Nutt.
Mideala virginica. *L.* woods. June. yellow.
Veratrum.
viride. Willd.
album. Mx. swamps. May. green.
Helonias.
dioica PH.
Veratrum luteum. *L.* pastures. June. white.
Trillium.
1. pictum PH. pine woods. May. white.
2. erectum. Willd. near shady rocks. May. purple.
Rumex.
1. crispus. *L.* meadows. July.
2. obtusifalius. *L.* meadows (very rare.) July.
3. Brittanicus. *L.* swamps. Aug.
4. Acetosella. *L.* dry fields and rocks.
Lapathum acetosellum Eaton.

POLYGYNIA.

Alisma.
Plantago. *L.* ditches. July. white.

HEPTANDRIA.

Monogynia.

Trientalis.
Europaea. *L.* pine woods. May. white.

OCTANDRIA.

Monogynia.

Oxycoccus.
murocarpus Pers.
Vaccinium oxycoccus. Mx.
Cranberry pond meadows. June. red.

Epilobium.
1. lineare. Muhl. swamps. Aug. purple
2. coloratum. Muhl. with the last. Aug. purple.
3. spicatum. Muhl.
   angustifolium. *L.* borders of woods. July. purple.

Oenothera.
1. biennis. *L.* fields. July. yellow.
2. chrysantha. Mx.
   pumilis. Bigelow pastures. June. yellow.

Acer.
1. rubrum. *L.* woods. April. red.
2. saccharinum. *L.* woods. April. yellow.
3. striatum. Mx. rocky mountains. May. green.
4. montanum. Willd.
   spicatum. Limp. sides of hills. May.

Dirca.
palustris. *L.* woods. April. yellow.

TRIGYNIA.

Polygonum.
1. aviculare. *L.* road sides. May—Oct. white.

2. punctatum Ell.
   Hydropiper. Mx. ditches. Aug. white.
3. mite PERS. swamps. Sept. white.
4. virginianum. *L.* by the Bantum. Aug. white.
5. coccineum. swamps. Aug. red
6. persicaria. *L.* cultivated grounds. Aug. red.
7. pennsylvanica. *L.* on Chesnut hill. Aug. red.
8. sagittatum. *L.* swamps. Aug. white.
9. arifolium. *L.* swamps. Aug. white.
10. scandens. *L.* cultivated fields. Aug. white.
11. ciliuode with the last. Aug. white.

ENNEANDRIA.

MONOGYNIA.

Laurus.
1. Benzoin. *L.* near creeks. April. yellow.
2. Sassifras. *L.* woods. June. yellow.

DECANDRIA.

MONOGYNIA.

Baptisia.
tinctoria Ell.
Podalyria tinctoria Willd.
sandy fields. Aug. yellow.

Cassia.
Marylandica. *L.* sandy roads. Aug. yellow.

Pyrola.
1. rotundifolia. *L.* pine woods. July. white.
2. secunda. *L.* sandy woods. July. white.

Chimaphila.
1. maculata. PH.
   Pyrola muculata. *L.* dry woods. July. (rare.)
2. umbellata Eaton.
   Corymbosa. PH.
   Pyrola umbellata. *L.* dry woods. July.

Andromeda.
1. polyfolia. *L.* Cranberry pond swamps. May. pink.
   (for a plate of this plant, see American Journal of Science, Vol. III. No. 2.)

2. paniculata. Mx. non. *L.*
   ligustrina Ell. pastures. June. white.
3. calyculata. *L.* bog meadows. May. white.

Kalmia.

1. latifolia. L. pine woods. June. white.
2. angustifolia. L. woods and swamps. June. red.
3. glauca. L.
   var. rosmarinifolia. PH.
   Cranberry pond meadows. May. red.

Vaccinium.

1. dumosum Curtis. Cranberry pond swamps. June. white.
2. frondosum. L. woods. June. white.
3. resinosum. L. woods. June. red.
4. corymbosum. L. woods. June. white.

Epigela.

repens. L. rocky hills. April. white.

Gualtheria.

1. procumbens. L. pine woods. July. white.
2. hispidula. MUHL. pine swamps, not seen in flower.

Monotropa.

1. hypopithys.
   Hypopithys Europaca Nutt.
   wet woods. Aug. yellowish white.
2. lanuginosa. Mx.
   Hypopithys lanuginosa. Nutt.
   woods. July. yellowish white.
3. uniflora. L. woods. July. white.
   var. erceta.
   morisoniana Big. with the last.

DIGYNIA.

Chrysosplenium.

oppositifolium. L. in brooks. April. yellow.

Saxifraga.

1. virginiensis. Mx.
   vernalis. Bigelow. rocks. April. white.
2. Pennsylvanica. L. meadows. May. green.

Tiarella.

cordifolia. L. rocks. May. white.

Mitella.

diphylla L. wet. woods May. white.

Seleranthus.
annuus. L. roads in sandy soils. July.

TRIGYNIA.

Stellaria.
1. media. Sm.
alsine media. L.
cultivated ground. May. Nov. white.
2. longifolia. Muhl.
graminea. Big. ? wet meadows. June. white.
3. palustris. Eaton ? ditches. July. white.

PENTAGYNIA.

Penthorum.
sedoides. L. wet places. July. green.
Oxalis.
stricta. Willd. pastures, &c. June. yellow.
Spergula.
arvensis. L. cultivated fields. June. white. Introduced ?
Agrostemma.
Githago. L. In cornfields. July. purple. Introduced.
Cerastium.
vulgatum. L. fields. May. white.

DECAGYNIA.

Phitolacca decandria. L. borders of fields. July. white.

[*To be concluded in our next.*]

* * * * *

Gossipium—Cotton.

[Communicated by Professor Jacob Green, Sept. 1821.]

I think it probable that the Cotton Plant (Gossipium) may be cultivated in the U. S. much farther to the N. than is generally supposed. A kinsman of mine residing in the neighbourhood of Princeton, made a very successful experiment on this subject. A quantity of seed procured from some undressed cotton purchased for domestic purposes, was planted in a garden, having a N. W. exposure. The plants came to maturity rather better than was expected, but the staple was very fine and abundant, so that articles of domestic use such as stockings, gloves, &c. &c. were manufactured from it. It is probable that if these plants had received proper attention and been placed in a favourable situation, the produce would have been much greater.

ZOOLOGY.

Art. VIII.—*Observations on the Pennatule flèche (P. sagitta of La Marck,) in the cabinet of Dr. Mitchill.*—By James E. Dekay, M. D.

Dr. Mitchill was so obliging as to submit to my inspection an animal found adhering, to the Diodon pilosus of that gentleman. From its feathery appearance it was referred to the Pennatula of La Marck, species Sagitta, but it neither corresponded to the character of the order (Polypi natantes) nor to that of the genus.

It appears that La Marck had described it merely from a figure by Esper. He mentions that Pallas was so doubtful with respect to its place in this genus, that he had not described it. Its want of an " axe organique" or internal bony substance was probably the cause.

Linneus had placed this animal under the genus Lernea, but Cuvier pronounces perhaps too decisively, that it must be considered as belonging to the genus Calygus of Müller, which is included under Order Crustacea Branchiopodes: this is so palpable a blunder that it is very evident he had never seen the animal.

In another part of his work, speaking of this and another animal he says, " Ces sont des animaux parasites, voisin en partie des Calyges, en partie des Lernèes mais nullement de pennatûles, Le pennatule sagitta d'Esper est tout autre chose que celui de Linnè peutêtre est, ce, un Nephtys." This however, it cannot be from its want of Gills and horny jaws.

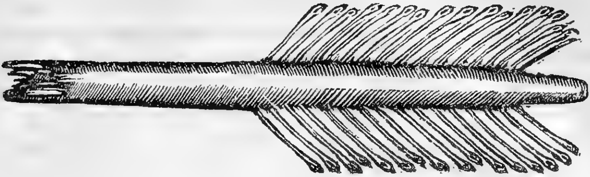
Thus we have seen, this animal has been first ranked as a Lernea, a parasite, then considered as a pennatule or polype, afterwards placed in the genus Calygus as a crustaceous animal, and finally, it has been decided that it shall occupy a new genus as an Annelide. So much difficulty with respect to its proper place, clearly proves that with the exception of Pallas and Esper, they are completely ignorant of the animal under consideration.

DESCRIPTION.

Body one inch in length, coriaceous, cylindrical, of a purple color and inserted $\frac{1}{3}$ of its length, underneath the skin of the fish to which it was attached, all the part beneath the skin white, mouth terminal, irregular, presenting a granulated appearance, with several minute holes.

Plumulæ on each side, nearly equal in length, and sixteen or seventeen in number on each side—cylindrical, their free extremities bulbous, in which a black speck was just visible under the microscope. The Plumulæ commence about $\frac{2}{3}$ of the distance from the mouth and terminate one 16th of an inch from the extremity, which is rounded. The teguments consist of two membranes, the outer thick, purple and coriaceous; the inner pale and delicate. I observed nothing internally except some whitish fibres, running in a longitudinal direction and converging towards the upper extremity; neither stomach nor ovary was apparent. From these few, and I am sensible imperfect observations, we may be satisfied that it does not belong to any genus as yet established.

Since De La Marck commenced his "Animaux sans vertèbres," Savigny has presented to the Institute a memoir upon a new class of polypi, among which our animal must finally be placed. De La Marck has embodied these under the order of Polypes tubifères, containing four genera. The animal under consideration belongs to this order; but a more accurate examination of its anatomical structure is necessary before we can decide upon its place among the genera. In the mean time, the following may serve for its specific character. "Stirpe coriaceo cylindrico inferne nudo, superne pinnato; pinnis distichis, extremitatibus crassioribus."



Its natural size, is but little more than half an inch long; the above figure is about six times magnified.

J. E. DEKAY.

ART. IX.—*Falco Leucocephalus—Bald Eagle.*

[Communicated by Professor JACOB GREEN, Sept. 1821.]

December 23d 1820, I saw a large *bald eagle* shot in this neighbourhood. He measured seven feet and nine inches from the tip of one wing to the tip of the other; three feet and four inches in length, and weighed sixteen pounds four or five weeks after he was killed. This is larger than the one mentioned by Wilson, which measured seven feet from tip to tip, was three feet in length and weighed thirteen pounds. The bird shot here was probably not of full growth, as there was not the appearance of a white feather on the back of his head. This bird is usually called the *Grey Eagle;* it is very uncommon with us, and so large a one I think has never been described. If the accurate biographer of American Birds had not assured us that the Grey and Bald Eagle were of the same species, differing in colour only on account of age, I should have considered this of another species. When first seen, the Eagle was in company with a flock of birds on the ground, near some stacks of grain within a few yards of the road. He exhibited no signs of fear, and even ruffled his feathers as if to make an attack. After a short time, he rose with difficulty and flew a short distance —when shot he clung by his talons to the branch of a tree upon which he was sitting for about a minute, and then as he was falling to the ground made a last effort with his wings, and moved from the place some yards; he was not quite dead when approached—but he made no resistance upon being taken up.

The Eagle sometimes flies about in the night. On one occasion I recollect that he was seen hovering for a considerable time, high in the air, over the flames of a building, the light of which was discovered at the distance of twenty miles.

PHYSICS, MECHANICS, CHEMISTRY AND THE ARTS.

Art. X.—Ward's *Alternating Steam-Engine. Some account of a Steam-Engine, called the Alternating Steam-Engine, invented by* Minus Ward, *of South-Carolina.* In a Letter from the Inventor to the Editor.

Columbia, (S. C.) June 1, 1821.

Sir,

It has long been a desideratum in Mechanics, to produce, by means of steam, a direct rotary motion. It has, as long, been the received doctrine, that to produce a rotary from a rectilinear motion, is attended with much loss of power, owing to what has been called the *reciprocation* of the moving mass: and " it was," therefore, to borrow the language of Mr. Sullivan,* " probably perceived to be a great object to get rid of the reciprocating movement of large masses, on the well known mechanical principle, that it consumes power to check momentum, as well as to give it—to drag an inert mass into motion rapidly, in opposite directions,"—or, as it has been more fully expressed by another writer, " to drag the inert mass from a state of rest to a state of motion, and from this state of motion to a state of rest."

To obviate this disadvantage, Mr. Watts in England, and Mr. Curtis, after him, in this country, endeavoured to give to the axis of the cylinder a direct rotary movement; but owing, in a great measure, to the impossibility of confining the steam by packing upon corners, their attempts proved abortive in practice; and Mr. Morey, at last, in-

* Am. Journ. S. and A. Vol. I. p. 161.

vented a Revolving Engine, which, it was supposed, had completely triumphed over the difficulty of *reciprocation.*

It may seem hardy to question a dogma, which has remained so long unquestioned ; but I hold it equally pusillanimous never to think ourselves at liberty to examine received doctrines ; and I hope you and your readers will, therefore, excuse my presumption, in endeavouring to show, contrary to the received theory, that there is no loss of power in the reciprocating movement of the common steam-engine, and that the well known principles of mechanics have been applied to the subject, under a misconception of the facts.

It is necessary, in the first place, to reduce to some more definite meaning, the phrases, "dragging the inert mass in opposite directions," and "dragging it from a state of motion to a state of rest." How and where does this "dragging" take place ? The language here used, can only mean, that the power of the steam, being exerted upon the reciprocating mass, in a direction opposite to that, in which it is moving, overcomes its momentum, and causes it to stop. At what point, then, in the revolution of the crank, is the power of the steam thus exerted, and this cessation of movement affected ? Supposing the crank to start from the upper dead-point, no such operation can take place at any point in the first half of the revolution ; for nobody ever disputed, that during this half, the power of the steam continues to be exerted, and the reciprocating mass to move, in the same directions, which they respectively took at the commencement. That such a cessation of movement cannot be effected in the other half of the revolution, that is, after the crank has passed the lower dead-point, is equally clear, from the same considerations. And if, therefore, it takes place at any point, in the whole revolution, it must be at the dead-point.

Thus explained, then, the theory above mentioned, is this,—That, at the dead-point, the power of the steam, being exerted upon the reciprocating mass, in a direction opposite to that, in which it had been previously exerted, "checks its momentum," and causes it to stop. This proposition evidently assumes two facts : 1st. that, at the dead-point, the power of the steam is in full operation ; and 2ndly, that, at the dead-point, the reciprocating mass possesses momentum, and indeed, all the momentum, which the power of the steam could give it, in the semi-revolution. Both of these assumptions, I undertake to deny.

1. In their speculations on this subject, philosophers seem to have overlooked the mode, in which a steam-engine must necessarily be made, if intended for any useful purpose. It is of the very essence of its construction, that not a particle of steam can enter the cylinder, when the crank is at the dead-point, either on one side of the piston, or the other. And if there be no additional expenditure of steam, how can there be a further exertion of power? But, without resorting to this topic, is it not undeniable, as a general principle, founded in the very nature of things, that no power can be *reversed*, in its direction, as it is here, without first ceasing to act? And, as the power of steam is confessed to act, both before and after, the crank arrives at the dead-point; where else can it cease to act but at the dead-point, or which is the same thing, the point of its reversion ?—At the dead-point, therefore, the Engine must be perfectly impotent.

2. The disproof of the second assumption seems to follow, as a corollary, from that of the first. It is acknowledged by all, that the reciprocating mass *does* stop at the dead-point; and what is this, but another mode of saying, that it has ceased to have momentum?

If, then, the momentum of the reciprocating mass be not overcome by the power of the steam, how, and by what, is it overcome? The true explanation of these points will be found in the connexion of the fly-wheel with the reciprocating mass, by means of the crank. Supposing no other inert body to be connected with the Engine,—since we have just seen, that the momentum of the reciprocating mass cannot be overcome by the power of the steam, of course, there is nothing else which can overcome it, but the inertia of the fly-wheel. And the *modus operandi*, I take to be this:—The reciprocating mass and fly-wheel being connected through the medium of the crank, it results, from the principles of the crank, that the reciprocating mass is regularly and alternately accelerated, and retarded: This retardation is gradual, and finally ends in total rest; after which the accumulation commences, and continues gradually, until it arrives at its maximum. Now, during the retardation, the whole of the momentum, which existed in the reciprocating mass, at the time of its greatest velocity, is gradually transferred to the fly-wheel: and, in like manner, during the acceleration, this same quantity of momentum is again transferred from the fly-wheel to the reciprocating mass.* It is this gradual transference of all the momentum of the reciprocating mass to the fly-wheel, and not the power of the steam "dragging the mass in an opposite direction,"—that "checks" its motion, and causes it to stop.

It seems to me, therefore, a work worse than nugatory, to waste ingenuity in devising modes of avoiding the *reciprocating movement*; and it has, I believe, invariably happened, that men of genius, while striving to shun this phantom, have encountered or overlooked real difficulties, which, if not fatal, have proved so serious a disadvantage to their respective inventions, as to render them entirely useless in practice. If there be any exception to this remark, it must be in favour of the Revolving Engine, invented by Mr. Morey. Much, however, as his ingenious machine appeared, at first, to promise, I apprehend it will be found, upon a short trial, that *he*, too, has neglected to provide against substantial difficulties, while endeavouring to get rid of such as were merely imaginary.

The great disadvantage in transferring momentum from a straight line to the circle, arises from the friction, which necessarily attends the operation. When, for instance, the piston-rod is made to play in what are called *parallel guides*, and a connecting-rod, attached to the cross-piece of the slides, gives motion to the crank, there are but two points, in which the original direction of the power, and its direction, as applied to the crank, coincide with one another. In all other points, the connecting-rod forms an angle with the guides; and this angle varies, from the smallest, which the construction of the Engine will allow,—being greater, as the crank-piece is longer, and less, as you increase the length of the connecting rod. In all but two points, therefore, the power reacts obliquely upon the guides; and, when the angle is the largest, the strain and friction are so

* This is also the opinion of Oliver Evans Vid. "Abortion of the Young Steam Engineer's Guide;" published in 1815.

great, as not only to occasion a very serious loss of power, but to wear away the guides, and by increasing the play of the sliders, to destroy, in a short time, the parallelism of the motion. The only mode of obviating any part of these disadvantages, was, by having a short crank-piece, and a long connecting-rod. The greatest angle would then be small: the friction, of course, lessened; and the engine will stand a considerable length of time without need of repairs.

What, then, as it appears to me, will be found a serious, if not a fatal, disadvantage in Mr. Morey's plan, is, that he is obliged to retain this parallel motion by guides. His engine, indeed, so far as this principle is concerned, is precisely the same with the common Engine, which has the parallel motion by guides; the only difference being, that the point of action in the one is the point of re-action, in the other—a difference, however, which, in this respect, must be merely nominal, so long as action and re-action are equal. There is a real difference, in another respect, that, in Morey's Engine, the connecting-rod is necessarily so very short, and the angle of action so great, that, though it may answer the purpose, for a short time, yet the loss by friction, and the frequent necessity of repairs, will more than counterbalance its neatness of construction and compactness of form.

Having devoted my life to the study of mathematics, both pure and mixed, and being a mechanic in practice as well as theory, I was led to examine the various methods, which have been devised to render the power of steam subservient to the purposes of human life; and it occurred to me very early, in the course of my investigations, that the received supposition of a loss occasioned by the *reciprocating movement*, was founded in error. Quitting, therefore, the idle pursuit of expending my time and the ingenuity I might possess, in contriving ways to overcome a difficulty, which did not exist, I was left to direct my undivided efforts to the invention of some machinery, which would avoid the real disadvantages of the old steam-engine, namely, its friction, bulkiness, complication, weight, and expense. To simplify and avoid friction were my sole objects; and I believe I have at length succeeded, in combining the indispensable parts of the Steam Engine, in such a way as to get rid of all the abovementioned disadvantages.

In this Engine, the piston-rod is also the connecting-rod.* When applied to water-wheels, in propelling boats, the cylinder is placed within the water-wheel. Two centre-pieces, firmly fixed to the boat, one on each side of the recess in which the wheel is placed, serve as axes to the wheel, the boxes of which turn on necks prepared to receive them; the centre-pieces, after traversing the boxes, are turned at right angles and extend, within the wheel and towards its circumference, a distance equal to half the sweep of the piston; at this distance from the centre of the water wheel, boxes are inserted in the centre-pieces to receive the gudgeons of the cylinder; the cylinder revolves on those gudgeons about its centre of gravity. The steam is conducted to and from the cylinder, by means of a double pipe; so that the centre-piece answers the quadruple purpose of an induction-tube, an eduction-tube, a bearing for the water-wheel, and a bearing for the cylinder.

The steam is alternately let into each end of the cylinder, by a contrivance similar to what was first used, I believe, in the Double Cylinder Steam-Engine of Mr. Hornblower; and which will be easily comprehended from the following description, taken from Rees' Cyclopædia: "The cocks of this (Hornblower's) Engine are composed of two circular plates, ground very true to each other, and one of them turns round on a pin through their centres: each is pierced with three sectorial apertures, exactly corresponding with each other, and occupying a little less than one half of their surfaces. By turning the moveable plate so that the apertures coincide, a large passage is opened for the steam; and by turning it, so that the solid part of the one covers the aperture of the other, the cock is shut."† Instead of three sectorial apertures, which Hornblower's Double Cylinder required, the cocks of my Engine have but two, which take up the same space, by being nearly ninety degrees in length each. These cocks are placed by the side of my cylinder, the gudgeon of which answers to the "pin"

* I have thought the description would be more readily understood, if the alphabetical references were kept separate from the text. See the figure and its references.

† Rees' Cyc. Art. STEAM-ENGINE.

in Hornblower's valve : the moveable plate is attached to the cylinder, and is turned by it; while the other plate, being attached to the centre-piece, remains stationary. The steam-tube, after passing from the boiler along the centre-piece, arrives at the cocks, and enters one of these sectorial apertures, from the back, in the plate attached to the centre-piece. In like manner, the eduction-tube extends from the bottom of the opposite aperture in the same plate, through the centre-piece, to the condenser ;—or, if the engine be made without a condenser, the tube terminates in the open air, and the steam escapes. A tube extends from the bottom of each aperture, in the plate attached to the cylinder, to each end of the cylinder, and there enters its cavity. The revolution of the cylinder and the moveable plate attached to it, brings the aperture belonging to each end of the cylinder, alternately to the aperture in the stationary plate, through which the steam enters; while, at the same time, the aperture belonging to the other end of the cylinder, is passing the aperture belonging to the eduction-tube.

The outer end of the piston-rod is attached to a cross-piece, which is supported by gudgeons, moveable in boxes in the arms of the water-wheel. From the middle of this cross-piece, and perpendicular to it, proceed two wings, one on each side, from the ends of which two rods extend, playing through steps on the sides of the cylinder. These rods are necessary in order alternately to overcome the inertia, and resist the momentum, of the cylinder, encountered in consequence of the irregularity of its motion.

The operation of this engine is as follows :—The steam, by means of the piston, alternately drawing and pressing upon the cross-piece, which works in the arms of the water-wheel, forces the wheel around, at the same time that the cylinder itself is carried round, by reason of its connexion with the cross-piece; the reaction being sustained by the gudgeons of the cylinder, resting on the centre-pieces.

As the cylinder revolves on a different centre from that of the wheel, the radii of its angular motion vary from the radii of the wheel, coinciding with them in two opposite points only, which is at the moment the engine is passing the dead-points. If the revolution of the wheel be supposed uniform, the revolution of the cylinder will be irregular, being accelerated during one half of the revolution, and retarded during the other half; but its revolving motion is continual, moving always the same way. The celerity of its revolution, or velocity of its angular motion, regularly and alternately increases, during one half of its revolution, and falls off just as much, during the other half: but, for reasons similar to that, which I gave above, this operation is attended with no disadvantage; for the momentum, which the cylinder, during its acceleration, receives from the wheel, it returns again to the wheel, during its retardation; so that it accelerates the wheel as much, during its own retardation, as it retarded the wheel, during its own acceleration. It is this peculiarity of motion in the cylinder, (namely, its regular and alternate acceleration and retardation,) which induced me to distinguish my Engine by the name of *The Alternating Steam-Engine.*

To dispense with the fly-wheel, it was long ago suggested, that, if two cranks were used in such a way as that one should be at its greatest action, while the other was at the dead-point, the motion would be very nearly regular; and Mr. Brunel, in England, constructed, not many years since, an engine upon this plan, having two cylinders, which acted on two cranks at right angles to each other on the same axis. In my engine the same thing is done, by having two cylinders, which act upon two cross-pieces at right angles to each other. The cylinders are suspended side by side in the water-wheel, between the same two centre-pieces, their contiguous sides having, the one a box, the other a gudgeon inserted in the box: and they are further supported by a bridge, extending from the ends of each around the other, embracing the opposite gudgeon. The cocks are placed on the outsides of the cylinders in the manner above described; the steam being conducted to and from each cylinder, through each centre-piece.

It will be seen, at a glance, that my engine,—like all others, that have been turned to any account in practice,—acts upon the principle of the crank; or, in more general terms, upon the principle of a perpetually varying lever. In addition to the supposed loss of power, arising from the reciprocating movement, it has long been the settled doctrine, that the crank is also chargeable with another disadvantage, in consequence of this perpetual variation in its leverage.

The first of these notions, I think I have already disproved; and that the last is equally founded in error, I must be allowed the boldness to aver.

Mathematicians have computed this loss at $\frac{4}{11}$ of the power used. But, in estimating the effect produced, they seem to have lost sight of the power consumed. In comparing the effects produced, when the steam is made to act, at all points, wholly in the direction of the tangents at those points, that is, at right angles to the crank, with the effects produced, when, as in the common mode of applying the crank, the direction of the force is at an angle to it, continually varying from a right angle to a coincident line, men of science appear never to have considered, that, where the force is always applied, as in the first instance, at right angles to the crank, the distance passed over by the piston, that is, the length of piston-rod protruded, is equal to the *semicircumference* of the circle described by the crank; whereas, when applied, as in the last case, at a perpetually varying angle, the length of piston-rod protruded is equal to the *diameter* only of the same circle. Now, all other things being equal, the power consumed is proportional to the length of piston-rod protruded; and the semi-circumference of the circle being to its diameter, as 11 is to 7, it follows, that, when the power is applied wholly in the direction of the tangents, its quantity is expressed by 11, while, when applied as in the common crank, its quantity is expressed by 7 only. So that, if the effect produced, when the power is applied in the tangents, be four-elevenths greater than when applied by the crank, the reason is, not that, in the latter case, four-elevenths of power are lost, but that four-elevenths less power are consumed.

The same truth may be demonstrated in another way. Suppose the force to be applied in the tangents of a circle, the semicircumference of which is equal to the diameter of that which is described by the crank. Then, of course, the length of piston-rod protruded, during the semi-revolution of this reduced circle, is equal to the length protruded, when the crank is used; and the quantities of power consumed in each will be equal. That the effects produced will also be equal, may be shown by taking a quadrant of the circle described by the crank,—dividing it into a number of equal parts,—and comparing the effects produced by the impulses at these points of division, with the effects produced by a like number of impulses at the circumference of the reduced circle. The pressure of the steam upon the piston being uniform throughout the stroke, it follows that the impulses at all points are equal to one another; and this being the case, it is equally a matter of course, that the effects produced at the several points of division of the quadrant, are as the perpendiculars respectively from those points to the line of force. The sum of the effects, then, will be equal to the sum of these perpendiculars: but these perpendiculars are as the sines of the angles at the several points of division; and, if the reader will take the trouble of adding together the natural sines for every degree in the quadrant, including radius, he will find their sum to be as nearly equal to ninety times the radius of the reduced circle, as the imperfection of our circulating decimals will admit. The formula would be this:—

Let the radius of the circle described by the crank $= 1$.

Then $$\frac{\frac{1 \times 2 \times 2}{3.1415926 \text{ \&c.}}}{2} = .6366 \times 90 = \text{the sum of the}$$ natural sines of the quadrant for every degree including radius.

As an objection particularly applicable to my engine, it has been suggested by some, who have seen the model, that the power is exerted at a disadvantage, from the circumstance, that the centre of reaction is within the circle of motion. Nothing is easier than to show, however, that, supposing, as we must in all such comparisons, the length and diameter of the cylinder, and also the elastic force of the steam, to be equal in each, the effect produced in my engine is equal to that produced in the Lever Engine.

Let the line DB (Plate III. Fig. 1.) represent the elastic force of the steam; the point D be the point of reaction; and the circle BKZ, the circle of motion. The force DB is resolvable into DE and EB, parallel and perpendicular respectively to the radius AB; and that part of it, which is exerted in the direction of the tangent, will be represented by the line EB. This is the force exerted in the Lever Engine.

In my engine, B is the point of reaction, and LDM, the circle of motion. The force BD, in this case, is resolvable into BH and HD. parallel and perpendicular respectively to the radius AD; and that part of it, which is exerted in the direction of the tangent, will be represented by HD.

These two tangential forces EB and HD, are to each other inversely as their distances from the common centre of motion A. For, in the two triangles, ACD and AFB, the angle at A is common; and the angles AFB and ACD being right angles, the remaining angles ABF and ADC are equal, and the two triangles similar. Therefore, BF (or HD) : DC (or EB) : : AB : AD. And inversely, HD : AB : : EB : AD.

But, from the properties of the Lever, forces which are to each other inversely as their distances from the fulcrum, or common centre of motion, counteract each other, and produce an equilibrium. The two forces, HD and EB, therefore, would counteract each other, or, which is the same thing, produce equal effects.

The error on this subject has arisen from supposing an engine to operate upon the larger circle LDM, from without its circumference, when, of course, the sweep of piston would be equal to the diameter of the circle LDM; and then comparing this engine with one on my plan, fixed at B, and with a sweep of piston, equal only to the diameter of the small circle BKZ. Taking it for granted, that both engines would be of equal power, it was easy to show, that the one on my plan would loose as much more power than the other, as the diameter of the large circle was greater than that of the less; but it was overlooked, that the two engines would consume steam and fuel exactly in the same proportion,—that my engine would consume as much less steam and fuel as its sweep of piston was less than that of the other,—that, in a word, the power consumed by my engine would be equal only to AB, while that consumed by the other would equal AD.

The advantages of my engine over the Lever Engine, may be enumerated as follows: 1. The alternate transfer of momentum from the reciprocating mass to the fly-wheel, and vice versa, as above described, occasions a strain upon those parts of the engine, which connect the alternating with the rotary parts; and this strain increases exactly in proportion as the time, in which it takes place, decreases; for, as you lessen the time, you increase the velocity, and, of course, the momentum. In the lever engine, this transfer takes place four times, during every revolution; that is, the beam is accelerated and retarded, during the first half of the revolution, and again accelerated and retarded, during the other half. In my engine, the transfer takes place but twice in the whole revolution; that is, the cylinder is accelerated during one half, and retarded during the other. If, then, we suppose the revolution, in each case, to be performed in the same time, it follows, that two transfers of momentum occur in the lever engine, in the same time that one only takes place in mine; and that the velocity and momentum and strain, at each transfer, are twice as great as in mine. The strain is also greater from two other circumstances; first, because the weight of the cylinder, which is the body accelerated and retarded in my engine, is not so heavy as the beam; and secondly, because it is placed nearer the centre of motion than the parts of the beam.—2. As the steam contained in the tubes, extending from the cocks to the ends of the cylinder, is necessarily lost at each revolution, the shorter these tubes are, the better; and the cocks being placed, in my engine, on the sides of the cylinder, the aggregate length of these tubes is no greater than the length of the cylinder itself.—3. The friction is much diminished, both because fewer pieces of machinery are employed, and because the action and reaction are sustained by gudgeons, which always revolve the same way,—except those of the cross-piece at the head of the piston-rod, which have a vibratory motion. 4. There being less use of steam, of course less fuel will be necessary; and this is not only a saving of expense, but of room also, and freight; since it is well known, that the bulk and weight of the wood consumed, in the common steam-boats, cause a material drawback on the profits of those establishments.—5. Many of the old pieces of machinery being got rid of, my engine is less bulky, a great deal lighter, much less expensive, and more durable than any other.—6. There is a very great saving of room in placing the engine within the water-wheel.—7. If there be a water-wheel on each side of the boat, with steam tubes extending to each, the boat may be turned about with great facility, by merely shutting the throttle valve belonging to the one wheel or the other, according as you wish to turn to the one side or the other.

I have not thought it worth while to protract this article, already extended to a tedious length, by specifying the many little practical matters, which will occur, in the construction of my engine; such as the mode of supplying the pails with oil, of casing the cylinder, so as to exclude it from the water of the wheel, &c.

It scarcely needs to be added, that I have secured this invention by patent.

References to the figure, Pl. III.

a—piston-rod.
bb—cylinders.
cccc—water-wheel.
dd—adjacent parts of the boat.
e & f—parts of the centre piece.
g—gudgeon of the cylinder.
h—neck on which the water-wheel turns.
i & k—beginning and end of the induction tube.
l & m—same of eduction tube.
n—stationary part of the cocks.
o—moveable part of the same.
p—cross-piece attached to the piston-rod.
q—gudgeon of same.
rrrr—arms of water-wheel.
ss—steps for rods playing through steps in cylinder.
tttt—rods.
uuu—steps.

Art. XI.—*Memoir on Navigable Canals, considered in relation to the rise and fall, and the distribution of their Locks: by* M. P. S. Girard.

[Translated from the French as published in the "Annales de Chimie"—July, 1820: by J. Doolittle.]

The expense of water in a navigable canal, during a given time, is composed:

1st. Of a certain volume of water, evaporated from the surface:

2dly. Of that which is lost by filtration through the bottom and sides of the canal; and

3dly. Of that which is necessarily expended at the locks in raising or lowering the boats.

Evaporation is a natural effect, and which no art can counteract: the loss arising from this cause is therefore inevitable.

Whatever be the nature of the ground through which a canal is intended to pass, the loss by filtration may always be greatly diminished, or even entirely prevented, by recourse to suitable means.

There remains then the expense occasioned by the movements at the locks, and this portion is generally greater than the losses by evaporation and filtration together: therefore when the subject of making a canal is under consideration, it is necessary, in the first place, to make sure of a sufficient quantity of water on the most elevated point of its direction, to supply the uses of that navigation to which it is destined. The impossibility of fulfilling this first condition has often prevented the execution of canals, which, could they have existed, would have contributed powerfully to the advancement of agriculture and the prosperity of commerce in certain provinces. We have seen other canals which answer but imperfectly the object for which they were intended, because the water collected for their use could suffice for their wants only during a few months of the year. For this reason many engineers and mechanicians, both in France and England, have endeavoured to discover some means of obviating the difficulty of a deficiency of water in navigable canals. Thus the moveable locks of *Solages*, the inclined planes of *Fulton*, the wheel boats of *Chapman*, the floating gates (ecluses á flotteur) of *Bettancourt*, and more recently the Pneumatic locks of *Congreve*, have been successively imagined; but, however ingenious these means may appear in theory, they require in practice, the application of a force with which we may always dispense, wherever the boats can be kept naturally afloat, and can circulate in the canal without any other obstacle than that of passing the locks as they were first invented.

On the other hand, these inventions are practicable only on small canals; and, where fuel is plenty, the least expensive mode of supplying a deficiency of water, is to raise from the lower locks to the upper ones, by means of the steam engine, the water which has been expended by the passage of the boats.

It would then be rendering an eminent service, and hasten the developement of a general system of inland navigation in France, if we could point out any means by which the expense of water could be diminished, without changing the common mode of construction of the locks, which is founded on so simple a law of Hydrostatics that we must perhaps despair of ever being able to substitute any thing more perfect in its stead.

From the first period of the invention of locks and gates, it was easy to calculate the quantity of water necessary to be drawn from an upper level or reservoir, to raise or lower a boat, when once the difference of levels between two contiguous locks or basins was given.

Subsequently, the French engineers agitated the question of determining in what manner the expense of water from the reservoir of distribution was modified, when several locks were placed in immediate succession one after another. The different suppositions that were made, by changing the state of the question, gave rise to many different opinions, of which Mr. Gauthey first rendered an account, in a memoir published in 1783, among the memoirs of the Academy of Dijon, and which is also inserted in the 3d Vol. of his works.

The engineers of the canal of Languedoc, who were deeply interested in the exact appreciation of the expence of the dividing reservoirs of that canal, and who had every facility for repeating the experiments, in the two hypotheses of single locks, and of several locks contiguous to each other, occupied themselves specially with the subject, and gave divers solutions of the problems, as may be seen in a memoir of Mr. Ducros, inspector general of Civil Engineering (Ponts et Chaussèes,) published in the year IX. After having pointed out, as Mr. Gauthey had done before him, the order in which the boats which ascend and descend a canal, should succeed each other in order to occasion no useless waste of water, Mr. Ducros gave some formulæ to express the expense of water on the passage of a boat, either in ascending or descending through any number of adjoining locks ; General Andréossy, author of the *History of* *the Canal of Languedoc*, attributes these formulæ to Mr. Clauzade, one of the engineers of that canal; they were generalized by Mr. de Prony, in a report made to the General Assembly of civil engineers, on Mr. Ducros' memoir, in such a manner as to give an easy method of calculating, in all cases, the quantity of water expended by the passage of one boat or more through a system of locks, the falls of which are severally known.

But does there not exist a necessary relation between this fall, the quantity of water expended for the passage of boats, and the draft of water of the boats which ascend or descend through the locks?

This is a question which, notwithstanding its importance, has never yet been treated, and which I propose to resolve.

To reduce the question to its most simple expression, we shall suppose; 1st, that the boat is to pass from one level to another by a single lock.

2dly, That the boats are of a prismatic form, and that their dimensions are such that the interval which separates their sides from the sides of the lock, when compared with the space occupied by the boat, may be neglected without sensible error.

Let S represent the horizontal section of the lock and the boat;

x, the lift of the lock, that is, the difference of level between the two basins which it unites:

$t_{,}$, the draft of water of a boat which ascends the lock.

$t_{,,}$, the draft of water of a boat which descends.

The manœuvre of passing a boat from a lower to a higher level consists in

1st, Drawing the boat into the lock through the lower gate, which is closed when the boat is in.

2d, Introducing, by no matter what means, from the higher basin into the lock a quantity of water sufficient to bring the two surfaces to the same level;

3dly, Opening the upper gate of the lock, and passing the boat through into the upper basin.

Hence we see that, to effect this passage, and in order to raise the surface of the water in the lock to a level with that in the upper basin, it is necessary to draw from that basin a prism of water $= Sx$, whose base is equal to the horizontal section of the lock, and whose height is represented by the lift of the lock.

Furthermore when the boat passes from the lock into the basin, its place in the lock is necessarily supplied by a quantity of water $= St_{,}$, equal to the volume of water which it displaces, and which flows from the basin into the lock.

Thus the quantity of water expended to bring things to their present state, may be expressed by $Sx + St_{,}$.

Let us suppose that, the communication remaining open between the upper basin and the lock, another boat is ready to descend, the manœuvre is reduced to

1st, Introducing the boat into the lock, and shutting the upper gate ;

2d, Emptying the lock until its surface is on a level with that of the lower basin ; and

3dly, Opening the lower gate and passing the boat into the lower basin.

The introduction of the boat from the upper basin into the lock has caused a reflux from the lock into that basin, of a volume of water $= St_{,,}$, equal to that displaced by the boat.

In letting off the water from the lock to lower its surface to a level with that of the lower basin, things are replaced in the same state as they were before the ascent of the first boat.

This operation, which we shall denominate *a double passage*, has caused an expenditure of water, represented by

$$Sx - S\,(t_{,,} - t_{,}) = Sy',$$

since the quantity of water expended may always be represented by a prism whose base is equal to the horizontal section of the lock, and whose height is represented by an indeterminate line y'.

Dividing this equation by the factor S, common to all its terms, it becomes

$$y' = x - (t_{,,} - t_{,}),$$

which belongs to a right line of simple construction. It expresses moreover, between the lift of the lock, the draught of water of the boat, and the quantity of water expended, relations which, notwithstanding their extreme simplicity, have not hitherto been remarked.

It follows from this equation that the expense of water, y, will be positive, null or negative, according as we have:

$$x > t_{''} - t_{'}$$
$$x = t_{''} - t_{'}$$
$$x < t_{''} - t_{'}.$$

Thus it appears that the expense of water from any level may not only be diminished at pleasure, but that it may be rendered null, and that a certain quantity of water may even be raised from a lower to an upper contiguous basin.

If two other boats successively pass the same lock, and if their respective drafts of water be represented as follows, $t_{'''}$ for the ascending boat, and t_{iv} for the descending one, the expense of water occasioned by this double passage will be represented by

$$y'' = x - (t_{iv} - t_{'''})$$

In the same manner we shall have for the expense of a third double passage

$$y''' = x - (t_{vi} - t\ )$$

The total expense of the upper level of a lock, for any number n of double alternate passages will therefore be

$$y' + y'' + ''' + \text{\&c.} = nx - \Big((t_{''} + t_{iv} + \ldots t_{2n}) - (t_{'} + t_{'''} + t_{v} + \ldots t_{2n-1}) \Big)$$

designating by odd numbers the drafts of water of the ascending boats, and by even numbers those of the boats which descend. Therefore, if we make the sum of the drafts of water of the first $= \mathrm{T}'$, the sum of those of the latter $= \mathrm{T}''$, and the total expense of water $y + y' + y'' + \text{\&c.} = \mathrm{Y}$ we shall have,

$$\mathrm{Y} = nx - (\mathrm{T}'' - \mathrm{T}').$$

The expense of waters for any number n of double passages through the same lock, will therefore be positive, null or negative, accordingly as we have

$$x > \frac{\mathrm{T}'' - \mathrm{T}'}{n}$$
$$x = \frac{\mathrm{T}'' - \mathrm{T}'}{n}$$
$$x < \frac{\mathrm{T}'' - \mathrm{T}'}{n}$$

And as the drafts of water of the boats always represent their weight and that of their cargoes, it follows that, in order to determine the lift proper to be given to the locks to fulfil one of these three conditions, it is necessary to know, not only the number of boats which will navigate a canal, but the nature and quantity of importations and exportations, which will take place on that canal; thus the improvement of this species of navigation requires the immediate application of certain statistical knowledge, which, at first view, appears to have but a very remote connection with the art of projecting navigable canals.

This succession of boats which meet at each lock, and which are alternately raised and lowered, by taking advantage of the state in which the lock is left by the ascension or the descent immediately preceding, is evidently the best fitted for economizing in the expenditure of water; but the movement of boats on a canal may take place in a different order; it may sometimes happen that, for certain reasons, it becomes necessary to pass the boats in files, or convoys, in such manner that all the ascending boats shall follow each other immediately, and all the descending boats shall also follow each other at a different hour of the day.

The ascension of the first boat will require the introduction of a quantity of water $= Sx$, into the lock, to raise it to a level with the upper basin.

The boat in leaving the lock is replaced by a volume of water $= St'_{,}$.

Thus the passage of the first boat of the ascending convoy, from the lower to the upper level of the lock, has occasioned the expence of a volume of water $= S\ (x+t'_{,})$

The second boat finds the lock filled, and the first operation consists therefore in letting off the water which it contains, until its surface comes on a level with the lower basin, when the lower lock-gate is opened and the boat introduced into the lock, and, to raise it to the upper level a volume of water $= S\ (x+t'_{\,})$ must be drawn from thence. The ascension of the third boat will occasion an expense of water $= S\ (x+t'_{v})$. Therefore, the number of boats in the ascending convoy being represented by n', there will have been drawn from the upper level a volume of water represented by

$$S\ (n'\ x+t'_{,}+t'_{,,,}+t'_{v}+,\ \&c.)$$

Let us now examine the operation of the ascending convoy.

The first boat finds the lock filled, and on entering it, forces back into the upper basin a volume of water equal to that which it displaces. The first expense is therefore negative, and $= -St'_{,,}$.

The water being let off from the lock the boat is taken into the lower basin.

The second boat finds the surface of the water in the lock on a level with that of the lower basin. Water must therefore be let in from above to raise its surface to a level with the upper basin, this requires a volume of water $= Sx$, which, after the introduction of the second boat is reduced to

$$S\,(x - t'_{\text{iv}}).$$

The expense of water for the third boat is

$$S\,(x - t'_{\text{vi}});$$

And the expense for the whole convoy, if we denote by m' the number of boats of which it is composed will be expressed by

$$S\left(x\,(m'-1) - t'_{,,} - t'_{\text{iv}} - t'_{\text{vi}} - \&c.\right)$$

The expense of water for a second convoy composed of a number m'' of ascending boats will be

$$S\,(m''x + t_{,}'' + t''_{,,,} + t_{\text{v}}'' +, \&c.)$$

That of a second descending convoy composed of m'' boats will be

$$S\left(x\,(m''-1) - t_{,,}'' - t''_{\text{iv}} - t''_{\text{vi}} - \&c.\right)$$

Therefore if we designate by Sy', Sy'', Sy''', &c. the partial quantities of water expended by each ascending convoy, and by Sz', Sz'', Sz''', &c. the partial quantities expended by each descending convoy, we shall have, for the whole quantity expended from the upper level of a lock for any number K of convoys of boats ascending and descending alternately:

$$\begin{aligned}
S\,(y' + y'' + y''' +, \&c. + z' + z'' + z''' +, \&c. = \\
S\,(n'x + t'_{,} + t'_{,,,} + t'_{\text{v}} +, \&c \\
+ S\,(n''x + t''_{,} + t''_{,,,} + t_{\text{v}}'' +, \&c. \\
+ S\,(n'''x + t_{,}''' + t_{,,,}''' + t_{\text{v}}''' +, \&c. \\
\cdots\cdots\cdots\cdots\cdots\cdots \\
\cdots\cdots\cdots\cdots\cdots\cdots \\
+ S\,(x\,(m'-1) - t'_{,,} - t'_{\text{iv}} - t'_{\text{vi}} -, \&c.) \\
+ S\,(x\,(m''-1) - t''_{,,} - t''_{\text{iv}} - t''_{\text{vi}} -, \&c.) \\
+ S\,(x\,(m'''-1) - t'''_{,,} - t'''_{\text{iv}} - t'''_{\text{vi}} -, \&c.)
\end{aligned}$$

Or, making the whole number of boats which ascend $= N$; and the whole number of descending boats $= M$; the sum of the quantities

$$y'+y''+y'''+, \&c.+z'+z''+z'''+, \&c =Y,$$

And preserving the denominations T′ and T″ for the sum of the drafts of water of the ascending and the descending boats respectively, we shall have in a more simple form, after dividing by S:

$$Y=x(N+(M-K))-(T''-T').$$

Therefore, the total expense of water from an upper basin of a lock, through which a certain number K of convoys shall alternately pass, will be positive, null or negative, according as we have,

$$x>\frac{T''-T'}{N+(M-K)}$$

$$x=\frac{T''-T'}{N+(M-K)}$$

$$x<\frac{T''-T'}{N+(M-K)}.$$

By recurring to our general formula

$$Y=x(N+(M-K))-(T''-T')$$

we may remark that the first term of the second member is at its *minimum* value when $M-K=o$, that is, when the descending boats are equal to the number of convoys which they form, or, which amounts to the same thing, when they go singly.

In this first hypothesis the formula becomes

$$Y=Nx-(T''-T')$$

as we have already seen.

The term $x(N+(M-K))$ of the general formula arrives, on the contrary, at its maximum value when $K=1$, since the number of convoys ascending or descending cannot be less than one.

In this second hypothesis we have

$$Y=x(N+(M-1))-(T''-T');$$

an equation which applies to the particular case where all the boats which pass the lock should form but two convoys, one ascending during a certain time, and the other descending during another period of time.

The last equation becomes

$$Y=x(2N-1)-(T''-T')$$

when the number of boats ascending, is equal to the number of boats which descend; this supposition being more simple than any other, it is that to which we shall confine ourselves.

Now it is evident that if any number n of boats pass the lock one by one, ascending and descending alternately, the condition of no expense of water will be expressed by

$$x=\frac{T''-T'}{n}.$$

If, on the contrary, the same number of boats go in two convoys, the same condition will be expressed by

$$x=\frac{T''-T'}{2n-1}.$$

Which signifies that the lift of the lock will approach so much nearer to

$$\frac{T''-T'}{2n}$$

as the number n of boats become greater; whence it follows that the two quantities

$$\frac{T''-T'}{n} \text{ and } \frac{T''-T}{2n}$$

are the two limits between which the lift of the locks of a canal should be confined, in order that the expenditure of water from the upper level should be null, in whatever number of convoys the given number of boats successively ascend and descend.

If therefore, we give to the locks a lift which is an arithmetical mean proportional between the heights which render the expenditure null in the two extreme cases we have supposed, that is to say, if we make

$$x=\tfrac{1}{2}\left((T''-T')\right)\frac{3}{2n}=\frac{3(T''-T')}{4n},$$

this height will be most likely to fulfil the condition which we have proposed, of rendering the expense of water null, or nearly so, on the passage of any quantity of boats distributed in convoys as chance may offer.

This lift is, as we see, $\frac{3}{4}$ of that which would be proper if the boats alternated one by one at the passage of each lock: this last order of passing is the one generally adopted, as far as practicable, in navigable canals, and the preceding analysis sufficiently justifies its maintenance. In what follows we shall therefore suppose it established.

Hitherto we have only considered the actual expense of water, positive, null, or negative, which is occasioned by the passage through the lock or canal; but at every double passage at the lock there is a quantity of movement given not only to the water expended, but also to the ascending and the descending boats. There is produced, then, a certain quantity of dynamical action, which we shall now endeavour to appreciate.

I shall denominate, according to the common custom, *dynamical action* or *effect*, the product of a certain weight by the vertical distance which it goes through, either in ascending or in descending, whether its movement be uniform or uniformly accelerated, during the unit of time.

This dynamical action or effect is always equivalent, as may easily be shown, to the active force (force vive) of a certain mass, which should move with a certain velocity; thus, in other words, it remains for us to determine the expense of active force necessary to raise one boat and lower another, through the lock of a canal.

The general equation which expresses the relation between the lift of a lock, its expense of water, and the draft of water of the boat, is, as we have seen above,

$$y = x - (t'' - t').$$

From this we shall deduce the value of the dynamical action employed at each double passage for each of the three cases, where the expense y of water is positive, null, or negative.

1°. The quantity y being positive, it is evident that the volume of water $x - (t'' - t')$ which it represented, descends from the upper to the lower level, that is, from the height x: the dynamical action of this volume of water is therefore

$$x\,(x - (t'' - t')).$$

Moreover the boat t'' descends the same distance: its dynamical action is consequently $= t''\,x$.

The sum of these two actions which operate downwards, estimated in a vertical direction, is therefore:

$$x\,(x - (t'' - t')) + t''x.$$

The only mass which is raised by this operation is that of boat t', which passes from the lower to the upper level: its dynamical action, upward, is therefore $t'x$.

But these opposite dynamical effects, although successive, operate in equal times, and according to the same laws; for they are effected while the lock is filled or emptied; and this filling and emptying takes place exactly in the same length of time, as may be immediately deduced from the formulæ which express those of spouting fluids in contiguous vases, separated by vertical diaphragms, whence it follows that the difference of these dynamical effects is the rigorous expression of the active force lost in producing them.

This loss is therefore

$$x\,(x-(t''-t'))+t''x-t'\,x=x\,x.$$

2dly, When the expenditure of water y, is null, it is evident that the dynamical effect downward is reduced to $t''x$, the product of the mass of the boat multiplied by the fall of the lock.

The dynamical effect upwards, as in the preceding case, is represented by by $t'x$.

Consequently the difference of these dynamical effects, or the loss of active force is

$$x\,(t''-t')=x\,x\,;$$

because when $y=o$, we have always $x=t''-t'$.

3dly, When the expenditure y of water is negative, or, which is the same thing, when by the passage of the boats, ascending and descending, a certain volume of water is raised from the lower to the upper level of a lock, we have

$$-y=-x+(t''-t').$$

The Dynamical action downward remains equal to the product of the boat multiplied by the height of the fall, and the dynamical action upward becomes equal to the product of that same height multiplied by the sum of the masses of the boat and the water raised, or

$$t'x+x(-x+(t''-t'))\,:$$

The loss of active force is therefore

$$t''x-t'x-x(-x+(t''-t'))=xx.$$

Therefore, whatever be the expenditure of water, the lift of the lock, and the draft of water of the boats which pass through it, the loss of active force, indispensable in effecting the double passage of the boats, is always in proportion to the square of the height of the lift.

Therefore, if we designate by h the whole rise of a canal from its lowest to its summit level, and if this rise be divided among a certain number of locks whose lifts are respectively $x_{\prime}, x_{\prime\prime}, x_{\prime\prime\prime}$ &c. we shall have

$$x_{\prime}+x_{\prime\prime}+x_{\prime\prime\prime}+\dots x_{(n)}=h\ ;$$

And for the loss of active force on the whole length of the canal, the sum of the squares :

$$x_{\prime}^2+x_{\prime\prime}^2+x_{\prime\prime\prime}^2+\dots x^2_{(n)}$$

which will diminish in proportion as the number n of the locks increases.

The particular case where all the locks have an equal lift gives :

$$x_{\prime}=x_{\prime\prime}=x_{\prime\prime\prime}=\dots x_{(n)}=\frac{h}{n}.$$

In which case the loss of active force becomes :

$$\frac{n\,h^2}{n^2}=\frac{h^2}{n}$$

If the total rise of the canal be divided into any other number n' of equal locks, that loss becomes $\frac{h2}{n'}$; the losses of active force, in the two hypotheses are therefore :

$$::\frac{1}{n}:\frac{1}{n'}::n' : n$$

that is, they are in inverse proportion to the number of locks employed to obtain a given height.

Designating by y and y' the positive expenditure of water in the two suppositions, we have :

$$y=\frac{h}{n}-(t''-t')$$

$$y'=\frac{h}{n'}-(t''-t')$$

Whence we see that the expenditure of water is so much the less as the number of locks is greater, or as their lift is smaller.

It becomes exactly proportional to the lift when the ascending and the descending boats have the same draft of water, the only supposition which has been tacitly admitted hitherto ; for in this case we have :

$$y=\frac{h}{n}$$

$$y'=\frac{h}{n'}$$

If we only consider the distribution of the locks of a navigable canal in relation to the expense of water, which is to be supplied by the higher levels, the preceding analysis shews the great advantages that will result from diminishing the lift of the locks. The principles on which this conclusion is founded are evident; the calculations which justify it are simple and easily verified. And yet it appears to have hitherto escaped the attention of engineers who have occupied themselves in projecting or in constructing canals.

It is in the natural progress of our mind, and in the slowness with which certain branches of knowledge are propagated, that we must look for the cause of the seeming abandonment in which the questions which form the object of the present memoir have remained.

The first inventors of canal locks, as well as those who first constructed them, captivated as they must have been by the effect of this ingenious contrivance, attributed to it so much the more merit as it served to surmount a greater difficulty at a single step.

If, as we are assured, the first locks were constructed in the Venetian States, on a canal derived from the Brenta, no apprehensions need have been entertained of a want of water, since the canal was supplied by a river; besides, to make any exact calculations of the expense of water at the passage of the locks, it was necessary that the physical sciences should have progressed farther than they had done before the days of Galileo, and that the imperfect notions then possessed of those sciences should have been more generally disseminated among the mechanics of those times.

It is easier to imitate what has been already done in hydraulic constructions, than to improve them, or even to account for certain practices which usage seems to have approved and consecrated.

Every one knows that one of the principal obstacles to the execution of the canal of Languedoc, was the difficulty of collecting on the summit level a quantity of water sufficient for the service of the locks, and the navigation of the canal. It was therefore of the highest importance to economise the water that could be procured. The means were easy, and consisted only in diminishing the lift of the locks. Nevertheless we learn from Mr. Gauthey that the first locks constructed were of so great a lift that it was necessary to demolish them, and substitute others of a less lift in their stead, even before the navigation of the canal was opened, and this because the great pressure of water which they had to support, subjected all their parts to too much damage. The economy of water did not enter at all into the calculation which produced this change; although this would have been the most powerful motive had the expense of water at the locks been submitted to a rigorous analysis.

The most celebrated Engineers of France and England have continued to contribute to the maintaining of ancient practices in this species of construction.

We read in a memoir of Mr. Perronet, on the canal of Burgundy, that the greater or less space occupied by a boat in the lock of a canal, has no influence on the quantity of water expended for the passage, either in ascending or descending, and that there is therefore no reason for diminishing the lift of the locks, which, he says, is generally eight, ten or twelve feet.

This opinion, advanced by an engineer so justly renowned, has never been contradicted; and if we may be permitted to judge from the canals which have been constructed since, it has been continually admitted without discussion or examination.

It is true that Mr. Gauthey, in the memoirs above cited, remarks that the locks of a canal which has a summit level, should not be of equal lift, that the smallest lifts should be nearest the summit level, and that their height may be augmented as the facility of supplying the expense by feeders increase. But Mr. Gauthey has not formally distinguished in what precise circumstances, nor under what restrictions this variation may take place; and although his idea indicates some notion of the existence of a certain relation between the lift of the locks and the quantity of water required for their service, he did not turn his attention to the exact determination of that relation.

He merely observes that the greatest lifts in common use are generally of the height of the 3^{m} 90^{c} (12 feet 9 inches, English or thereabouts,) and the smallest 1^{m} 30^{c} (4 feet 3 inches). Whence he concludes that the most eligible height is 2^{m} 60^{c} (about 8 feet 6 inches) as being an arithmetical mean proportional between the two extremes in common use: this is the only rule on the subject which he has deduced from his enlightened and extensive practice, and from the numerous observations with which his important work is filled.

Let us now establish the principles which should serve us as a basis for the distribution of the lifts of any number of contiguous locks on a canal.

Since the expense of water, from any basin, necessary for a double passage of boats in the lock which joins that basin, is always proportionate to the lift of the lock, when, according to the supposition generally adopted, the draft of water of the ascending boat is equal to that of the boat which descends, it is evident that, if we continue the same supposition, the reciprocal condition of a proper distribution of the locks consists in adapting their lifts to the quantity of water that the adjoining reservoir destined to supply water, can furnish without inconvenience.

This principle established, let us admit that the highest lock of a canal is constructed in conformity to it, it is clear that if the canal, from this point downward to its lowest level, experienced no loss of water by evaporation, or filtration, all its locks should have the same dimensions as the first; for then the water drawn from the first level, would pass to the second, thence to the third, and so on successively to the last and lowest.

In case of a negative expenditure, the same volume of water would ascend through all the locks in succession, from the lowest to the summit level.*

Thus, whatever might be the number of locks, the descent of one boat and the ascent of another, throughout the whole length of the canal, would only require the positive or negative expense of water necessary for the double passage of those boats through any one of the locks.

But the above supposition does not hold good in practice. Each successive level of a canal loses, necessarily, a certain quantity of water by evaporation, and is more or less exposed, according to the nature of the ground, to lose another portion by filtration; therefore the volume of water drawn from an higher to a lower level by the first lock, cannot be

* The expense of water can be negative only while the boat descends, and must always be positive when the boat ascends the lock; hence the negative expenditure begins by flowing from the highest lock into the summit level, from the second lock into the first, from the third to the second, and so on to the last and lowest level. The positive expense begins at the upper lock, when caused by the descent of a boat, and at the lower one when caused by the ascent, and follows in the same succession. The author of the Memoir has already explained this principle at the commencement, but has here fallen into an erroneous expression.—*Translator.*

wholly applied to the use of the following lock. Hence it becomes necessary to diminish either the lift of the second lock, or the depth of the water it contains.

The preservation of a given depth of water in each stage of a canal is an indispensable condition of the existence of such canal as a means of communication. The lift of the second lock from the summit level must therefore be less than that of the first.

For the same reasons the lift of the third lock must be less than that of the second, and go on diminishing in like manner till the last and lowest.

Therefore when the locks of a canal can only be supplied with water from the summit level, the lift of the locks respectively, should diminish as they recede from that level; and if the ground be homogenous, these diminutions should be in exact proportion to the length of the level which precede the locks respectively.

When, on the contrary, fresh supplies of water can be provided to replace the water lost by evaporation and filtration, as the canal descends in the plains, it is evident that the supply of water from the first feeder will allow the lock immediately below it to have a higher lift than the one which immediately precedes the introduction of such supply; from this point to where another feeder can furnish a fresh supply of water, the lift of the locks must diminish as before, from the first feeder to the second; from the second to the third, and so on to the lowest level; whence we see that, taking into account the losses occasioned by evaporation and filtration, a navigable locked canal should be considered as a system of partial canals, each extending from one feeder to another, and in each of which the lifts should diminish from its highest to its lowest level.

The locks situated at the origin of these partial canals may have a greater lift in proportion as they are farther from the summit level, in all cases where the quantity of water they receive from their feeder is greater than their loss by evaporation and filtration; the locks at the origin should, on the contrary, have a smaller lift when these losses are not compensated by fresh supplies.

In general, if we suppose all the levels of a navigable canal once filled with a sufficient depth of water to float the heaviest loaded boats, in order to maintain that depth constantly, whatever be the degree of activity of navigation, the lift of each lock must be proportioned to the sum of the volumes of water furnished by the summit level and by all the collateral feeders above the lock in question, after deducting therefrom the sum of the losses by evaporation and filtration throughout the same extent; now as the quantities of water acquired and lost in a given length of canal, are exceedingly variable according to the localities (and the seasons?) it follows that the equality of lift recommended to be established in all the locks of a canal, is reduced to a simple rule of practice that is not justified by any theory, and which can find no reasonable application except under a concurrence of circumstances rarely to be met with.

We have just seen according to what laws the lifts of the locks of a navigable canal should be made to vary in a given case, abstracting, as we have done, the consideration of a difference in the draft of water of the boats. It would be easy, taking that difference into account, to deduce from our *formulæ* the law of variability of those lifts in similar circumstances. The simplicity of these calculations renders their application here unnecessary.

The quantity of dynamical action, or active force expended in manœvreing the locks, has not yet fixed the attention of any engineer. I shall now proceed to demonstrate in what manner the consideration of this expense may lead to the improvement of navigable canals.

I shall begin by recalling this incontestable principle: that active forces and dynamical actions, from whatever source derived, and in whatever manner they are disposed of, can always represent the useful effect of some machine. The economy of these forces, by the adoption of appropriate means, will therefore leave a greater portion of them free to be disposed of; for example, if we regulate in a proper manner the rise and fall of the locks of a navigable canal, the quantity of active force economised may be applied to the use of mills on the banks of the canal, or to any other useful purpose.

In the second place, I shall recal this principle, that the expense of active force, indispensably incurred at the passage of a lock, in raising one boat and lowering another, is always proportionate to the square of the lift of such lock, whatever be the expense of water, and the draft of the ascending and the descending boats.

But we have already concluded from the equation which expresses the relation between these quantities, that if the lift of the lock be made equal to the difference in the drafts of water of the two boats, the expense of water from the upper level is null.

In this particular case, the expense of active force necessary for the passage of the two boats is therefore as it were repaid by the descending boat, in the same manner as if this boat, in descending on an inclined plane, drew the other boat up along the plane, at the same time, by means of a chain passing over a pulley. In the same manner, when the lift of the lock is less than the difference of draft of water of the two boats, we have seen that a certain volume of water was raised from the lower to the upper lavel ; in this case the active force of the descending boat is not only employed in raising the other boat but in raising at the same time a certain quantity of water, precisely as if the two boats were still connected by the chain and moved on an inclined plane, and a certain volume of water was added to the weight of the lightest boat.

We must also observe that the quantity of active force expended by the descending boat to raise a mass of water into the higher level, is not deducted from the useful effect of the lock considered as an ordinary machine ; for the descent of the boat, by means of the lock is itself a part of the effect which we expect from it. Hydraulic locks then, classed among machines proper for the transmission of movement, offer this singular advantage, to the exclusion of all other machines, that the expenditure of active force necessary to the production of movement is in itself a portion of the useful effect which the machine is intended to produce.

To obtain this advantage, it is true, the following conditions are necessary ; 1st. That the draft of water of the boats which descend should be greater than that of the boats which ascend ; 2ndly, That the rise and fall of the locks should in no case exceed that difference of draft of water.

It is evident that the last condition can always be fulfilled whenever the first shall exist : and, although in determining the quantity of water necessary to supply a canal, it has always been supposed that the navigation in the two opposite directions was equally productive ; a moment's attention to the subject will suffice to shew that this supposition is not conformable to reality, that the weight of articles transported downwards is far greater than that of the merchandize which ascends the canal ; and that this difference is likely always to exist wherever civilization is sufficiently advanced to render canal communications necessary between different sections of a country.

The greatest population of a country always fixes itself at a point where the articles of first necessity which it consumes, and the raw materials which it employs in its manufactories, can arrive with the greatest facility. Navigable rivers offer so great natural advantages for this object that they have drawn to their banks a great number of inhabitants ; in this manner the valleys are covered with cities, and the capital of a country is generally situated on the banks of the largest river which passes through its territory.

When the population of the valleys through which the navigable rivers run, becomes so dense that those valleys can no longer furnish sufficient means of existence, recourse must be had to the more elevated plains to supply the deficiency, and sometimes certain productions of the earth are drawn from the mountains to be employed by the hand of industry. In these circumstances artificial canals become necessary for the transportation to the place of consumption, and without greatly enhancing the price, of grain, drink, wood, timber, and other materials for construction, as well as pit-coal and iron castings, those two sinews of manufacturing industry. But these productions of the earth, which descend to the valleys, are incomparably heavier than the manufactured objects for which they are given in exchange. Thus we see that the boats which transport coals and castings from Birmingham to London, descend the canals deeply laden and return empty to seek new cargoes ; and, without going out of our own country for examples, is it not the same on the canal of Givars in the vicinity of Lyons ? and do we not every day see that the boats which supply Paris, arrive with full cargoes, and, after discharging them, ascend the Seine or the Marne almost entirely empty ? A great number of these boats, especially those which come from the centre of France by the canal of Briare, do not return, but are broken up in Paris, and the materials of which they are constructed sold under the name of *boat wood.*

It would be superfluous to adduce any further proofs in support of this opinion. It is easy to conceive that the boats which should arrive at Paris from the most elevated points of the department of the Ardennes, or of the department of the Côte-d'Or would not return with so weighty cargoes as those they should have brought. We may therefore consider it as an established principle that, in a well regulated system of internal navigation, the total weight of articles which descend the canals will always be much greater than that of the objects which ascend them.

This principle once admitted, the volume of water necessary for the navigation of canals will be greatly reduced; and the difficulty of accumulating it in sufficient quantity on the summit levels of those canals, will be no longer an obstacle to their execution, since, according to our formulæ, the lifts of the locks may always be regulated in such manner as to expend but a given quantity of water by the passage of boats, and even in case of need, they may be made to raise a certain volume from the lowest to the highest level of the canal.

To give an example of this manner of proceeding, let us suppose that the draft of water of the boats which descend a canal be $1^{m}\ 20^{c}$=(3 feet 10 $\frac{1}{4}$ inches nearly,) and that of the boats which ascend 30 centimeters (11 $\frac{1}{2}$ inches) only.

Let us suppose further, that the expenditure of water in the canal cannot exceed $\frac{1}{4}$ of the weight of the boats which pass the locks in both directions; substituting these numerical quantities in our general formula we shall find the proper weight of the lifts to be 1^{m}, 275^{c} (4 feet $2\frac{1}{8}$ inches.)

If, instead of drawing this volume of water from the upper level, it were necessary to raise the same quantity from the lower level to the upper one, the proper lift of the locks will be found 0^{m} 675 (2 feet $2\frac{6}{10}$ inches.)

Finally to render the expenditure null, the height of the lift would require to be 90 centimetres (2 feet $11\frac{1}{2}$ inches.)

I proposed, in this memoir, to indicate the means of supplying a deficiency of water which might in some instances prevent the opening of useful canals; but other, and not less important advantages will naturally accrue from the establishment of the relation here assigned between the draft of water of the boats and the lift of the canal-locks. By augmenting that draft of water, and by diminishing that lift, it will be possible to transport the same quantity of goods on narrower canals; the ground occupied by the canals will therefore be less, and consequently cost less purchase money,* while the loss of water by evaporation will diminish in the same proportion.

The manœuvreing of the gates will be much easier, and may be confided to the boatmen, as is practised on the small canals in England, by which means the wages and lodgment of the Lock-keepers may be saved.

The pressure of water on the sides and bottoms of the locks being much less will cause less damage, and consequently render the repairs less frequent and costly. By this means canal navigation will be no longer exposed to those frequent and long interruptions which have heretofore been necessary for the purpose of repairs.

Finally, narrower boats with a greater draft of water, will offer less resistance when tracked,* and as they may be decked, their cargoes will be more secure than in ordinary flat-bottomed boats.

In a future memoir I shall develope more fully the last advantages which I have here pointed out. In concluding this, I shall only remark that the discovery of lock navigation is still a recent discovery, which has been less appreciated by the general results of its application to water communications, than by its visible result of a difficulty overcome. The mind requires some reflection to seize the advantages of a system of small locks placed one after another at greater or less intervals, while the imagination is forcibly struck by the manœuvreing of a lock of a considerable lift.

In the fourteenth century, when artillery was first invented, they began by making cannons to throw balls of two to three hundred pounds weight. Notwithstanding their prodigious effect, their unwieldly mass soon compelled the abandonment of their use. There now remain none of

* Perhaps this advantage will be counterbalanced by the extra cost of excavation.—*Translator.*

* This proposition does not yet appear to be clearly demonstrated, and before giving it entire credence, I am disposed to wait the further illustrations of the author.—*Translator.*

those old cannon except in Turkey, and in some few fortresses of Europe, where they are preserved as monuments of the art in its infancy. The dimensions of all the pieces of artillery have been successively reduced, and that arm has only been really improved in proportion as it has been made lighter; or in other words, its greatest perfection consists in making it produce the greatest possible effect with the least possible expense of active forces.

It is true that since the invention of gunpowder opportunities have not been wanting to study and improve the form and size of artillery: this circumstance has necessarily rendered the progress of that arm much more rapid than the improvements in Hydraulic Architecture. Hence in the latter species of construction we are still at the large pieces.

ART. XII.—*An account of a remarkable storm which occurred at Catskill, July* 26, 1819.

[Read before the Catskill Lycæum.]

TO PROF. SILLIMAN,

Dear Sir—Agreeably to your request, I now transmit to you an account of the great storm, which occurred here on Monday afternoon the 26th July, 1819. At that time I was absent on a journey, in the state of Pennsylvania. Of course I am indebted to others for that class of facts which relate to the immediate phenomena of the storm. I reached home on the following Monday; and during that week spent much of the time in collecting facts relative to it; and have since from time to time, visited various places, where uncommon ravages were occasioned, and have spared no pains in obtaining all the information of an interesting nature which could be collected. Every fact communicated by others, or observed by myself, was immediately committed to writing. The manuscript has lain by me about fifteen months. I have more than once, visited several of the places, where peculiar ravages exist, and believe the account to be in no degree exaggerated.

I am respectfully, yours, &c.

BENJAMIN W. DWIGHT.

Catskill, February 5, 1821.

ACCOUNT OF A STORM, &c.

In several places in the mountainous country of New-England, it has been supposed by many of the inhabitants, that *clouds have in various instances burst*, or suddenly discharged great quantities of water. As the phenomena indicated by this phraseology have, in almost all instances, in which they have occurred, in that section of the country, existed in thinly settled regions, or in the night, in consequence of which the accounts given of them are imperfect; I suppose that it may be gratifying to some of your readers, to see a detailed account of the storm, which occurred here.

This storm exhibited phenomena analagous to those, which have occurred from what is called the bursting of a cloud, and in some respects more remarkable than any, of which I have heard.

To render the description more intelligible, a few explanatory observations may be useful.

The *township* of Catskill is situated on the West side of the Hudson, and is bounded on the East by that river; on the North by the township of Athens; on the West by Cairo; and on the South by Saugerties. The *town* is estimated to be about one hundred and twenty miles north from the city of New-York. Three rivers, or creeks, as they are here customarily called, have their courses in part, through this township; the Kistatom, the Kaaterskill, and the Catskill. The Kiskatom rises, if I am correctly informed, between the Catskill mountains and the Round Top,* a mountain in Cairo; and runs about five miles in the township of Catskill, and empties into the Kaaterskill. The Kaaterskill is a fine mill stream, which rises in the Catskill mountains, and empties into the Catskill, about two miles from the mouth of the latter stream.

The Catskill, which I shall usually denominate the *Creek*, rises in Middleburgh, in Scoharie County, and empties after a course of about forty miles, into the Hudson. The Catskill mountains lie westward from the town, and are distant from it in their nearest part, about seven or eight miles. *The town* is situated along the creek, and commences at

* The highest peak of the Catskill mountains is also called Round Top.

the point of land, formed by the junction of that stream and the Hudson. The principal buildings are situated along Main-Street, which commences about a quarter of a mile from the Hudson, and lies on the east side of the creek, to which it is in a good degree parallel, throughout its whole course. Several dwelling houses, stores, and other buildings, are situated on Water-Street, nearer to the creek; and several on the hill, east of Main-Street; and others elsewhere. There are a number of streets, and lanes, which intersect these streets at right angles, and pass to the creek. The hill rises abruptly to the height of about one hundred and fifty feet. Main-Street is estimated to be about thirty or forty feet above low water mark.

From the point of land formed by the junction of the Hudson and Catskill, a wharf has been extended, about one fourth of a mile, to a small island, in the Hudson, formed by the opposing currents of the two streams. To the south end of this island there have been considerable additions of *made land.* The whole of this ground is now called the *Point.* On it several dwelling houses, stores, and other buildings, have been erected.

At the north end of Main-Street the Catskill and Susquehannah turnpike commences, and runs in a W. N. W course about eighty-eight miles, to the Susquehannah river. From two to two and a half miles from the Point, is situated along this road, the small village of Jefferson. About two miles further, on the same road, is the village of Madison; and two miles beyond Woolcott's mills.

The village of Jefferson is built on an elevated plain, lying on the north side of the creek, and is about three fourths of a mile in length, and nearly half a mile in breadth. The land rises abruptly from the interval, which borders the creek, to the height of about one hundred and fifty feet. The margin of this plain, or hill, which faces the Southeast, was probably in antient times, the border of a lake, which at some remote period burst its barriers, and emptied its waters into the Hudson. At Madison there was a large lake, the banks of which are distinctly visible, at a considerable distance, and strikingly so from the south end of Schuneman's mountain. The dam existed at the mill seat of the late Ira Day, Esq.

The state of the weather previously to the commencement of the storm was as follows :—

The sky was cloudy, *the air thick*, (to adopt common language) and very sultry ; the clouds were low and heavy, the wind blew from the S. W Debility and languor were generally complained of. No thermometrical, or barometrical observations were made, within my knowledge.

About half past 3 o'clock P. M. three distinct clouds, dense and black, arose in the southeast, in quick succession. A brisk shower followed. A fresh wind blew for a little period ; but before 4 o'clock a calm ensued, which lasted nearly an hour. A short suspension of the rain took place soon after 5 o'clock. The whole quantity which had descended between this time, and the commencement of the storm, was considerable. About half past five, another dense and black cloud accompanied by a fresh wind, arose from the S. W. Shortly before the cloud reached the zenith, three vivid streaks of lightning issued from it, appearing like branches of the same flash. These were followed by three very sharp peals of thunder, instantaneously succeeding each other.

About the same time, or immediately after, a very thick and dark cloud rose *up* rapidly from the N. E. They met immediately over the town. At this instant a powerful rain commenced. The air soon after became so obscure, that trees, and buildings, and other large objects, could not be discerned at the distance of a few yards. The obscurity did not appear to arise from a fog, of the usual kind ; but from the abundance of the rain, and the low descent of the clouds, which appeared to rest upon the ground, or to hang a little above it. After the clouds met, the wind became very variable, and blew for short periods from almost every point of the compass. At times it came with so much force as to drive the rain in a very unusual manner, through the crevices in doors and windows, and the roofs of dwelling houses. Many houses which had never before been known to leak, at this time admitted great quantities of water. In several instances the wind suddenly abated, and a calm of a few minutes ensued. The lightning and thunder were unusually severe. The thunder frequently resembled a violent crash, and was as sudden, and of as short continuance, as the sound occasioned by the firing of a cannon, or by the snapping of a whip. The rain decended at times in very large drops ; and at times in streams, and sheets.

During the storm four or five intermissions each of about eight or ten minutes occurred, also in the rain. In each instance it excited a hope that the storm was approaching its termination ; but this hope was soon dissipated, by the appearance of fresh torrents. The extreme violence of the rain terminated before half past six o'clock, though it continued to descend with considerable briskness until about nine ; and moderately until about ten ; and it did not entirely cease until about eleven. The quantity which fell from the commencement to the termination of the storm, it is difficult to ascertain with exactness. It seems probable from the facts herein after mentioned, that it exceeded fifteen inches on a level. Some remarkable phenomena occurred in various places.

At the Point, just before the clouds met, two sloops were observed sailing before the wind, under a full press of sail, one sailing rapidly up stream, the other more rapidly down. They met near the north end of the island, when the N. E. wind prevailed. About the same time the sloop Admiral started from the lower wharf for New-York. At the moment of starting two persons on board, received slight electrical shocks, from one of the three streaks of lightning before mentioned. Several panes of glass were also broken in a store, situated a few feet distant. One of these persons, immediately after the shock noticed strong luminous flashes, or sparks, on one of his arms, and felt a jar throughout his frame, and a sensation similar to that which is experienced, when the hand or foot is asleep ; the other felt a jar similar to that occasioned by a smart blow, upon the breast. No other injury was done to the store, nor any whatever to the vessel. When the sloop had proceeded on her course about three fourths of a mile, the air had become so obsure, that those on board were unable at the distance of a few yards, to discern any objects. At this time, another flash of lightning was discharged about the vessel, and one of the persons before mentioned, received a much more powerful shock, which occasioned his falling down instantaneously upon the deck. He was at this time drenched in water, and from this cause probably, soon revived, so far as to get up, and find his way into the cabin. In a little time he felt no other inconvenience from the shock, than a sensation of numbness, which affected his arms for an indefinite period. While he lay upon the deck, a young gentleman standing near him, observed numerous flashes, or sparks, of light, about his body, strongly resembling those issuing from a firebrand, when whirled swiftly round. They were accompanied by a crackling, or snapping noise. Another person on board, experienced a lighter shock, which occasioned so much numbnes in one of his arms, that for a few minutes, he was unable to use it. There was an iron spindle at the top of the mast, for suspending the colours; but no lightning rod. No injury however was done to the vessel. Was that part of the cloud, from which the lightning issued, lower than the top of the mast? Several of those who where on the deck observed that, at this time the rain descended in streams, and sheets. The young gentleman above mentioned states that, at one period the water on the quarter deck accumulated so rapidly from the rain only, as to be higher than the tops of his shoes.

A gentleman, who was in the south store, at the Point, feeling much anxiety for his friends on board the sloop, observed the phenomena of the storm, with more exactness, than any other person, with whom I have conversed. His account is as follows. When the two clouds met, they appeared to fall down upon the river, between the store and Livingston's wharf, upon the east bank. The cloud rested upon the water in such a manner, that he could discover no space between them. As it came over it appeared extremely dark at the bottom, and as white as a snow bank at the top. The air suddenly became so obscure, that he was unable to see any part of a large perriauger, which lay at his wharf thirty feet distant, except that he could barely discern the poles. He particularly noticed that, he could not see any appearance of drops of rain; but the water appeared to descend in large streams, and sheets. The descent of rain was most copious between a quarter before 6 o'clock, and a quarter after 6. In this half hour he estimates the descent of water to have exceeded twelve inches upon a level. At an inn, thirty rods northward, the family were unable to see a large sloop, lying in the creek, at the distance of twenty rods. At another inn, in the near neighbourhood, a man, who stood for a considerable period at the front door, was unable to see any part of a large barn, only four rods distant. Some time after the clouds met, two different persons residing in this house, distinctly observed a water spout, rising up from the river, and nearly opposite, with a broad bottom, and ascending with a whirling motion to the clouds, in form of a pretty regular cone. The innkeeper some time in the afternoon, noticed two other water spouts, from three fourths of a mile to a mile up stream. These rose up in like manner, with broad bottoms, and terminated in points, as they reached the clouds. At what period these phenomena occurred, they could not distinctly recollect. The whole quantity of water which fell at the Point, is estimated to have exceeded fifteen inches upon a level. I am persuaded that this estimate is not too large.

The rain extended with equal, or greater, violence about eight miles west, from the Point, about three miles north, and about seven miles south. On the east side of the Hudson, at a little distance, it did not descend with peculiar violence, or in a very unusual quantity. At Athens, four miles north, it was far less severe, than in Catskill; and at Cairo, ten miles west, it was light. Should we then estimate the whole tract, on which the rain descended with peculiar violence, and in quantities never before known, in this section of the country, since its first settlement at eighty square miles, we probably should not be very wide from the truth; and on this whole tract, I am persuaded that, the water fell full fifteen inches upon a level. On a considerable part of the tract, there is reason to believe that, the quantity exceeded eighteen inches.

In proof of the correctness of this estimate, I alledge the following facts.

Main-street was flooded to such a degree that, notwithstanding the descent to the creek is rapid, a sloop's boat might have sailed, in many parts of it, without difficulty, and for a considerable time.

A large tub, measuring twenty-six inches across at the top, in the inside, and very nearly as large at the bottom, and fifteen and a half inches deep, was standing in an open yard, about thirty rods west of the south end of Main-street, and north of the dwelling house of Mr. J. D. It was empty when the rain commenced, and before sunset it was filled, and had run over. Several persons, who had examined it from time to time, were of opinion, that no water could have fallen into it, except that which descended directly from the clouds. In front of the house, on the south side, is a large court yard. From the gate to the front door is a gravelled walk, several rods in length. This walk is raised higher than the adjoining grounds on each side. The owner returning home a little before sunset, found the water on this walk, from six inches to a foot deep. The water at this height must have been constantly and rapidly passing off into the creek. It is not known that water has been accumulated here from any other rain, to the depth of half an inch.

About forty or fifty rods N. W. from this place, a small wash-tub, standing in open ground, being twelve inches in depth, and having two inches of water in it when the rain commenced, was observed about sunset to be full and running over. How long it had been filled is not known.

Two empty potash kettles, each of the capacity of ninety gallons, standing on the west sides of a high and spacions building, about the middle of Main-street, the one about twelve, the other about sixteen feet from the building, so situated that they probably caught no water, except that which descended perpendicularly from the clouds, were nearly or quite filled. Much of the rain descended in a very slanting direction.

A common sized pail, in a yard fifty rods north, and a wash-tub, in another yard, were both filled, and ran over, before sunset.

A large bathing-tub, situated on the west side of a high building, and so posited that it could not probably have caught more than two thirds as much as it would have done in open ground, had thirteen inches of water in it.

At Mr. John Ashley's farm, five miles west from the court house, a common sized wash-tub, standing in open ground, was filled, and ran over, before sunset.

I have been credibly informed that, at Madison, in a field, lying north of the turnpike, a large tub, estimated to be sixteen inches in depth, and an iron kettle, of the capacity of twelve to fifteen gallons, both empty when the rain commenced, and both standing many yards distant from any building, were filled, and ran over.

About six miles south of the court house, an empty barrel, standing in open ground, caught eighteen inches of water.

At Woolcott's mills several persons compared the descent of rain, to water running through a riddle.

The *effects* produced by the storm, were such, as were never known to have occurred, in any other instance, in this vicinity.

There were no remarkable ravages at the Point, nor in the village. From the banks of a brook, which crosses the turnpike road, about one quarter of a mile above the north end of Main-street, and empties into the Creek, some thousands of tons of earth, and stones, and rocks in solid masses, were washed out, and borne, chiefly on to the flats, or left remaining within the present banks. This ravage did not exceed a third of a mile in length. Near the mouth of this brook the ascent up the hill, to the Jefferson plain, commences. Near the top of the hill several large gullies were formed, on the south-western edge of the road. These are now greatly altered in their appearance. At the cross-roads, in the village of Jefferson, the rain was so abundant, about 6 o'clock, and the cloud so low and dense, that one of the inhabitants, a man of observation, was unable to discern a pretty large dwelling house, only four rods distant from his own door, where he was standing. On Jefferson plain the water covered the ground generally, to such an extent, that it ran into the doorways of many barns, and covered the floors, to the depth of several inches. On a field lying south-west from the turnpike, and containing about thirty acres, it was supposed by several of the inhabitants, that the water sometime before sunset, stood about eighteen inches deep on a level. As the plain is nearly level, it seems improbable that much water should have run from other grounds, on to this. This estimate, therefore, I suppose is too large. The water from this ground is conjectured to have passed off chiefly in one place. On the south-eastern margin of the plain (which formed at some remote period, as I suppose, the bank of a lake,) about thirty rods distant from the turnpike road, there was previously a gulley, of considerable extent, worn down in the progress of ages by the current of a small spring, at the bottom, and by successive rains. The exact dimensions of this gulley cannot now be ascertained. Its length, from the margin of the plain north-westward, towards the old post-road to Albany, which runs at right angles to the turnpike, somewhat exceeded one hundred and fifty feet. At the west end it was of inconsiderable extent; near the margin of the plain, (which in reference to the creek, and its intervals, is a sharp hill, of about one hundred and fifty feet in height,) it was wide, and deep. The water from the abovementioned field is supposed to have passed off into this gulley. Whatever the fact may have been, the gulley was at some period during the storm enlarged in an astonishing manner in length, breadth, and depth. The ground here, and throughout the plain, is composed of sand, covered by a rich bed of soil. In this place it was well turfed with short grass, and had as I suppose, never been dug, or ploughed. It was also, to some extent, covered with forest trees. The dimensions of the present ravine as measured by myself, in company with a friend, by means of a line, August 1819, were as follows. At the west end, where it extends across the old post-road to Albany, into the field abovementioned, it terminates in a point. At five paces from the west end it was thirty-six feet wide; at seventeen paces fifty feet; and at thirty-two paces, seventy-five feet. That part of the ravine which was almost wholly formed at this time, extends from the west end about one hundred and ten paces. The width in this place is about one hundred and fifty feet, and the depth about eighty. From this place to the margin of the plain the distance is about fifty paces. Throughout this distance the ravine gradually widens, and grows a little deeper. The width near the margin is about one hundred and ninety feet.

About sixty or eighty rods northward from the turnpike, on the old post road, another gully was formed, of about eight or ten rods* in length, and in some places ten or twelve feet deep. This has been to a considerable extent, filled up, and the adjoining grounds lowered. About one hundred rods distant from this place, in a north-western course, a large and deep ravine, having several branches, was excavated, being about ninety paces in length, and from two to six rods in width. Generally, it was from two to four rods in width, and in some places thirty or forty feet deep.

At Woolcott's mills, two large gullies were formed, about ten or twelve rods apart, one six or eight rods east, the oth-

* This I believe is an American word substituted for the rood, pole, or perch of 16½ feet, which it is used to express.—*Ed.*

er three or four rods west, of his store. I have repeatedly examined this place. The eastern gulley is estimated to be about twenty rods in length. Near its commencement it is ten or twelve feet deep on the western side, and about six feet on the eastern. The average width is about two rods. Throughout a considerable part of its course, a ledge of red sandstone, horizontally stratified, forms the bottom. Here it is less deep. It crosses the turnpike, and terminates at the bank of the creek. When this gulley was formed, the current of water ran directly by the side, and against a part of a dwelling house situated on the south side of the turnpike. A Mr. June, whose family occupied the main part of the building, in assisting to remove a sick woman in the evening, from that part which had become partially undermined, stepped from the door into the water, which was supposed to be about two feet deep. But such was the impetuosity of the current, which had already worn a channel ten feet deep, that in spite of every effort he was carried into the creek, and drowned. His corpse was found a day or two afterwards, about three quarters of a mile down stream. A vast quantity of earth, of stones, and rocks in rolled masses, some of them supposed to weigh a ton or upwards, were washed out, and forced into the creek, where they now remain, forming a new bank, of about one hundred feet in length, of about seventy feet in breadth, and of about eight or ten feet in height, above the former bed of the stream. There was no stream in this place previously to the storm.

The western gully was occasioned by the prodigious rise and enlargement, of a small brook, which runs at its bottom. The usual width of this brook does not exceed a yard; its depth is inconsiderable. It crosses the turnpike road, and is crossed by a small bridge, at a little distance from which it empties into the Catskill. About six or eight rods south of the bridge stood a pretty large distillery; a few rods north of the bridge and near the mouth of the brook, was situated a plaster mill, a little further north was situated a spacious grist-mill, on the south bank of the creek. The water, during the storm, rose to such a height in the brook, that it undermined the distillery. This lodged against the bridge, which soon gave way. The whole mass, together with the large tubs of the distillery, and a prodigious quantity of earth and stones, which accompanied them in their descent, crowded away the plaster mill. The whole was precipitated down the bank into the creek, and broke through a part of the grist mill, which soon became so far undermined, that it tumbled down, a day or two afterwards.

The quantity of earth, and stones, and rocks in rolled masses, carried into the creek, from the brook, is greater than from the eastern gulley. The length of the heap, (which unites with the lower one,) and forms a new bank, interior to the old one, is about one hundred and eighty feet; the width about one hundred: and the average height above the former bed of the stream, as much as five or six. Among the stones and rocks in rolled masses, washed out from these two gullies, and lying before hid under the soil, are several superb specimens of petrified marine shells, some of them agglutinated in considerable masses, and having an argillaceous, and calcareous cement.

About one mile westward, on the same road, is a small brook, usually containing not more water, than might pass through a cylindrical tube of six inches in diameter. Here the water accumulated to such a degree, that the brook overflowed all its banks, and became of the size and force of a large and rapid mill stream. A blacksmith's shop standing a little westward from the brook, was carried off, and a large ravine excavated. Generally, ravages occurred here, similar to those which existed at Woolcott's mills; and a considerable number of rocks, estimated to weigh from half a ton to a ton each, were driven by the current many rods into the creek. It will be recollected, that a mile west from this place, the rain was moderate.

In the neighbourhood of Madison, the storm produced ravages not less remarkable. At no great distance northward from the village is a mountain, estimated to be six hundred feet perpendicular height, above the plain below. The south end of this mountain, which abuts upon the flat, which I mentioned as having probably been the bed of an ancient lake, is about one mile north north-west from Madison church. The brow of the mountain here, is about half the elevation of the summit. There is at this place a ledge of horizontal rocks, running a considerable distance, and terminating abruptly, with a perpendicular precipice of twenty or thirty feet. The surface of the mountain descends from some distance back to this place. The water accumulating from above, poured down the precipice with such impetuosity, as to uproot all the trees in its course, down to the bottom, a distance of several hundred feet. The descent is rapid from the foot of the precipice to the bottom of the mountain. Throughout this distance a large ravine was formed. All the trees, and earth, and stones beneath, were washed away down to the solid rock, which lay below ; and the whole mass except the trees was precipitated beyond the road, which winds near the base, upon a tract of arable and meadow land which it covered as I was informed by Mr. S. a gentleman who had examined the ground with attention, to the extent of two acres, and to the depth of from six to ten feet. No water, if I am not misinformed, has been known to run in this place, heretofore. The descent of the water down the precipice occasioned a loud roaring sound, like that of distant rolling thunder, and excited no small astonishment at the distance of a mile.

On the eastern declivity of the same mountain, about two miles north of Madison church, a portion of ground about forty-five feet in length, and of about the same breadth, was entirely removed to the average depth of four feet. This ground, and all that adjoining to it, was previously covered with forest trees. The trees on this plat were all borne away. It seems remarkable that the excavation commenced suddenly, being of the full width, and depth, at the top. Neither was there any appearance of water having run from the grounds above, the decayed leaves and brush wood being in place. I have not examined this spot, but received the above particulars from a respectable farmer, residing in the neighbourhood.

In a south-western course from Madison, distant from one to two miles, there is a high and sharp ridge, on which are several similar ravages. This ridge or mountain, which is upwards of four hundred feet in perpendicular height, above the plain below, was throughout, so far as can be seen on the eastern side, covered thickly with forest trees. The eastern acclivity is as steep generally, as the sharp roof of a dwelling house. The largest excavation is about two hundred and thirty feet wide at the bottom. Owing to the steepness of the acclivity, I could not measure its length, or the width at the top. I estimated the height to exceed three hundred feet. Tracing it from the bottom up the acclivity, about one hundred and fifty feet, it becomes forked, or divided into two branches, with a tongue of land between, which is covered with trees and shrubs. Below the fork, all the trees except two small ones, and the shrubs, were torn up by the roots, and carried by the force of the waters to the bottom. The ground which was composed of soil of a moderate thickness, and of gravel and stones underneath, was washed away to the depth of four, five, or six feet in most places; and in some instances to the depth of ten feet or upwards. Below this are ledges of horizontal rocks, which have been laid bare to a considerable extent, and which were before invisible, rising tier above tier, and receding from below upwards. A great quantity of earth and stones were washed into the plain below, together with a part of the trees, and shrubs, and carried to the distance of ten, twenty, and in some instances thirty, rods. A much larger mass lies immediately at the bottom. The trees have been since chiefly removed. There are two or three other similar excavations not far distant. They may be seen at the distance of fifteen or twenty miles, on the high grounds eastward.

South of this ridge, at the distance of one or two miles, is another of less elevation, presenting on the eastern declivity similar ravages, in two or more places. These I did not examine particularly.

Generally, it may be stated that, within the limits of this township there are nine or ten similar excavations on the sides of mountains, and sharp ridges, which were occasioned by this storm; that in each instance there exists no reason to believe that the water was accumulated from the neighbouring grounds; that the ravages commenced suddenly, and are large and deep at their commencement; that the dead leaves and brush lying immediately above, and at the sides, do not appear to bear any marks of a change of position, nor to have been in any manner disturbed from the flowing of water; and that the configuration of the ground is in each instance such, as to forbid the supposition, that the water might have accumulated from the adjoining ground. Did a cloud highly surcharged with water, rest upon each of these places, till its contents were emptied? Did waterspouts discharge themselves here?

In the same range further south, the storm raged with great violence, and produced ravages not less remarkable. On the west side of the Kaaterskill, about three and a half miles from the town, a small brook empties into that stream. This brook is usually from one to two feet in width, and does not contain more water than might pass through a cylindrical tube of six or eight inches in diameter. The distance from the source of the brook to its mouth is about three quarters of a mile. The country bordering it is hilly. In the afternoon and evening of the storm the brook was enlarged to a surprising extent. For half a mile from its mouth upwards, it became from two to four rods in width, except in certain places, where it was six, eight, and ten rods wide. In some places it was twenty feet deep. The quantity of earth, and stones, and rocks in rolled masses, washed out of the banks, during the afternoon, was prodigiously great. It has been estimated by several judicious persons, to exceed a hundred thousand tons. The average width of the ravine, I estimated to be four or five rods. I am not confident of the exactness of these estimates, nor are they intended to be very exact particularly as relates to the quantity. In some places, huge rocks washed out of the banks, have been heaped up by the waters, to the height of from ten to fifteen feet, and several rods in width. A considerable number of these rocks are estimated to weigh from six to ten tons each. I measured one, which was ten feet in length, seven feet in breadth, and eighteen inches in thickness. This rock, which is a mass of compact carbonate of lime, is almost wholly made up of organic remains.* Several others are considerably larger. To strangers examining this ground hereafter, it may be satisfactory to know that, before the rain commenced, all the ground from the mouth of the brook upwards, to the place where the banks become steep and high, and the ravine suddenly narrower, was level, and covered with a good bed of soil, well turfed over, with a few forest trees interspersed. The trees and soil have all disappeared, and huge rocks, and smaller stones, now occupy

* I visited this ground Sept. 1, 1820, in company with James Pearce, Esq. of New-York, (now of Catskill.) During our rambles up and down the ravine, Mr. P. discovered a smaller mass of organic remains, having an argillaceous base, and containing superb specimens of Orthoeerites, madreposes, tubipores, pectinites, terebratulas, &c. He also discovered in the western bank a bed of good marl.

the place. Thousands of tons of earth, and stones, were also carried into the fields, south-west, south, and east, from the road, (the Kaaterskill turnpike,) which crosses the brook from twenty to forty rods above its mouth. A considerable tract of valuable arable land was ruined by this cause.

About half a mile further up the Kaaterskill, and four miles from the town, the turnpike road, (called the little Delaware Turnpike,) to the Catskill mountains, crosses the stream. On the western side of the stream, at the distance of several rods from the bridge, is situated a pretty large well built dwelling house. Before sunset the water rose in the creek, at this place, nineteen feet above its usual level. The creek here is several rods in width, and the banks generally pretty high. The water overflowed the banks so far as to surround the house to a considerable depth, and to threaten in the opinion of the owner, who is a judicious farmer, the safety of his family. Under this apprehension he removed them to the high grounds a little west, where they remained in an open waggon, till the flood began to subside. Further up the Kaaterskill much mischief was done to several farms, along the banks. A large amount of hay was destroyed, much grain was injured, many sheep feeding on the intervals, and some neat cattle, were drowned; and various tracts of valuable land covered with earth and stones.

About one mile westward from the bridge which crosses the Kaaterskill, at the place last mentioned, and along the same turnpike road, a brook of inconsiderable size exists. It heads about a mile distant, in a north-western direction, and after crossing the road, runs about three quarters of a mile further, in a circuitous course, when it empties into the Kaaterskill. Previously to the storm the bed of the brook was one or two yards in width. In the course of that day the water rose to such a height, and ran with such impetuosity, that it wore a wide and deep ravine, extending throughout almost its whole course. It now resembles the bed of a considerable river, and is said to be in many places about one hundred feet in width. Large ledges of rocks before invisible, and lying several feet under the soil, were laid bare. They generally run at right angles to the current. Huge portions from these ledges were undermined, and broken off, by the force of the accumulated waters, and carried down stream to considerable distances. I measured one, which was twelve feet in length, upwards of four feet in width, and two and a half in thickness, which was disengaged from its former position, and carried down stream, upwards of one hundred and twenty feet. It now lies crosswise to the current. The descent in this place is not very rapid. A few yards distant ftom this is another, which is supposed to have been originally united to it, and measuring seven feet in length. It is considerably wider and thicker than the main portion. At some distance below there is a fall in the brook, of fifteen or twenty feet, over a ledge of rocks, and several rods in width. Before the storm it was of inconsiderable magnitude. At the bottom of the fall a large cavity was formed in the rocks of between one and two rods in length, several yards in width, and estimated to be six or eight feet deep. A huge rock, which appears to have been formerly imbedded in this cavity, was disengaged by the impetuous force of the waters, and carried down stream several rods, and near to the opposite bank. It lies lengthwise, or parallel to the current, a direction opposite to that, which it originally sustained. This rock is upwards of twenty-one feet in length, six feet in width, and four in thickness. This fall is about a quarter of a mile in a southern direction from the turnpike road. Below the fall the bed of the stream is worn several yards deeper, than before the storm. Some remarkable ravages, as I am informed, were ocoasioned by the storm between the fall and the mouth of the brook, and between the road and the source of the brook. A number of the foregoing assertions are made on the authority of Mr. Anthony Abeel, a respectable farmer, who resides in the near neighbourhood, and who accompanied me to the spot when I visited it.

In most of the places, where the foregoing ravages exist, it seems probable that a greater quantity of rain descended than in the town ; and this is the general opinion of the inhabitants, residing in those neighbourhoods.

The whole amount of damage occasioned by the storm, in the township, was estimated by judicious persons, to have exceeded fifty thousand dollars.

During the same afternoon there was a remarkable descent of rain, in the township of Chester, in Massachusetts, and in some portion of the adjoining country. From the great rise which took place in the waters of Chester river, the effects of which I observed in the following September, while riding along its banks, and which will be visible for a century to come; and from the many large collections of stones, and rocks in rolled masses which were tumbled down the hills, from the sudden gushing of the water, in momentary brooks, and larger streams, and from the account published in the newspapers, I concluded that the quantity of water which descended in that region was as great, as at Catskill. It would be gratifying, if some gentleman in Chester would give the public, a detailed account of that storm. Between Catskill and Chester, which is upwards of fifty miles eastward, there was not in most places at the same period, an unusual quantity of rain, and in many places there was little or none.

On the same afternoon, I rode on horseback, from Montrose, in Pennsylvania, distant from Catskill, in a south-western direction, about one hundred and thirty or one hundred and forty miles, to the Great Bend. About half past three o'clock, dense black clouds accompanied by lightning and thunder, rose up slowly from the south-west. At four o'clock a violent shower commenced, which continued about an hour. As the clouds drew near I observed that they moved much more rapidly than I had supposed, and that they rolled along the hills below the tops of the forest trees.

It would seem from these facts, that there was an unusual state of the atmosphere, operating in a greater or less degree, over an extensive tract of country.

It is worthy of notice that on Thursday afternoon the fifteenth of July, only eleven days before, an uncommon shower occurred at Catskill. I left home that afternoon on horseback, on a journey to the westward. It had been cloudy through the day: the air was very close and sultry. I had not proceeded more than a mile before I was obliged to stop, on account of a very sudden shower, which came up from the south-west, attended with sharp lightning, and heavy thunder. The rain poured down in torrents. It was of a short continuance; but fell full six inches deep on a level. I thought at the time, that it was the most powerful rain which I had ever witnessed. An empty pail, standing in a garden near to my house, caught about six inches of water in it. Considerable rain fell at other periods, during the month of July. I believe I am authorsed in the conclusion therefore, that the whole quantity which fell in this town, during that month, exceeded twenty-four inches on a level.

I have not the means of determining whether similar rains have, or have not, occurred in other countries. It is stated in the Christian Observer, that the mean annual quantity of rain is at Rome thirty-nine inches; in England thirty-two; and at Petersburgh sixteen. It is also stated in the same work, (Vol. 8th, page 733,) that "the quantity of rain which fell in September (1818) was equal to four inches in depth, a quantity, perhaps, unprecedented at the like season, in the metrorological annals of this country, (England.) The depth of rain in the two preceding months was likewise unusually great, having exceeded seven inches." In many tropical regions the mean annual quantity greatly exceeds that, which exists in the countries above mentioned.

Art. XII.—*Letter from* Robert Hare, M. D. *Professor of Chemistry in the University of Pennsylvania, &c. &c. to the Editor, in opposition to the conjecture that heat may be motion; and in favour of the existence of a material cause of calorific repulsion.*

Dear Sir,

In two memoirs published in your Journal, I have endeavored to shew that caloric and electricity, are collateral agents in galvanism, the ratio of the former to the latter, in quantity, being as the extent of the operating superficies to the number of pairs into which it may be divided. In those publications I assumed, that the causes of heat and electricity are material fluids. Although this view of the origin of calorific repulsion is taken by a great majority of chemists, it has been combated, both by Rumford, and Davy: the former famous for his ingenious, instructive and laborious experiments; and the latter distinguished by the most splendid discoveries. With the utmost deference for the authority of these great men, especially the latter, I send the following remarks made in answer to his hypothetical views which I shall here quote from his elements in order to introduce the subject more intelligibly.

"It seems possible" says the illustrious author "to account for all the phenomena of heat, if it be supposed, that in solids the particles are in a constant state of vibratory motion, the particles of the hottest bodies moving, with the greatest velocity and, through the greatest space; that in liquids and elastic fluids, besides the vibratory motion, which must be conceived greatest in the last, the particles have a motion round their own axes, with different velocities, the particles of elastic fluids moving with the greatest quickness; and that in ethereal substances, the particles move round their own axes, and separating from each other, penetrate in right lines through space. Temperature may be conceived to depend upon the velocities of the vibrations; increase of capacity on the motion being performed in greater space; and the dimunition of temperature, during the conversion of solids into fluids or gases, may be explained on the idea of the loss of vibratory motion, in consequence of the revolution of particles round their axes, at the moment when the body becomes liquid or aeriform; or from the loss of rapidity of vibration, in consequence of the motion of the particles through greater space.

"If a specific fluid of heat be admitted, it must be supposed liable to most of the affections which the particles of common matter are assumed to possess, to account for the phenomena; such as losing its motion when combining with bodies, producing motion when transmitted from one body to another, and gaining projectile motion when passing into free space; so that many hypotheses must be adopted to account for its agency, which renders this view of the subject less simple than the other. Very delicate experiments have been made, which show that bodies, when heated, do not increase in weight. This, as far as it goes, is an evidence against a subtile elastic fluid, producing the calorific expansion; but it cannot be considered as decisive on account of the imperfection of our instruments. A cubical inch of inflammable air requires a good balance to ascertain that it has any sensible weight, and a substance bearing the same relation to this, that this bears to platinum, could not perhaps be weighed by any method in our possession."

These suggestions of Sir H. Davy's are to me unsatisfactory.

It is fully established in mechanics, that when a body in motion is blended with and thus made to communicate motion to another body, previously at rest, or moving slower, the velocity of the compound mass after the impact will be found, by multiplying the weight of each body, by its respective velocity, and dividing the sum of the products, by the aggregate weight of both bodies. Of course it will be more than a mean or less than a mean, accordingly as the quicker body was lighter or heavier than the other. Now according to Sir Humphrey Davy, the particles of substances which are unequally heated are moving with unequal degrees of velocity: of course when they are reduced by contact to a common temperature, the heat, or what is the same (in his view), the velocity of the movements of their particles, ought to be found by multiplying the heat of each by its weight and dividing the sum of the product by the aggregate weight. Hence if equal weights of matter be mixed, the temperature ought to be a mean; and if equal bulks, it ought to be as much nearer the previous temperature of the heavier substance as the weight of the latter is greater; but the opposite is in most instances true. When equiponderant quantities of mercury and water are mixed at different temperatures, the result is such as might be expected from the mixture of the water, were it three times heavier; so much nearer to the previous heat of the water, is the consequent temperature. It may be said that this motion is not measurable upon mechanical principles. How then, I ask does it produce mechanical effects? These must be produced by the force of the vibrations, which are by the hypothesis mechanical: for whatever laws hold good in relation to moving matter in mass, must operate in regard to each particle of that matter; the effect of the former, can only be a multiple of that of the latter. Indeed, one of Sir Humphrey Davy's reasons for thinking heat to consist of corpuscular motions is that mechanical attrition generates it. Surely then a motion, produced by mechanical means, and which produces mechanical effects, may be estimated on mechanical principles.

In the case cited above, the power of reciprocal communication of heat in two fluids, is shown to be inconsistent with the views of this ingenious theorist. If we compare the same power in solids, the result will be equally objectionable. Thus the heating power of glass being 443, that of an equal bulk of lead will be 487, though so many times heavier; and if equal weights be compared, the effect of the glass, will be four times greater than that of the lead. If it be said, that the movements of the denser matter are made in less space, and therefore require less motion, I answer, that if they be made with equal velocity, they must go through equal space in the same time, their alternations being more frequent. And if they be not made with the same velocity, they could not communicate to matter of a lighter kind, a heat equally great; since, agreeably to experience, no superiority of weight will enable a body, acting directly on another, to produce in it a motion quicker than its own. Consistently with this doctrine, the particles of an aeriform fluid, when they oppose a mechanical resistance, do it by aid of a certain movement, which causes them effectively to occupy a greater space than when at rest. It is true, a body, by moving backwards and forwards, may keep off other bodies from the space in which it moves. Thus let a weight be partially counterbalanced by means of a scale beam, so that if left to itself it would descend gently. Place exactly under it another equally solid mass, on which the weight would fall unobstructed. If between the two bodies thus situated, a third be caused to undergo an alternate motion, it may keep the upper weight from descending, provided the force with which the latter descends, be no greater than that of the movement in the interposed mass, and the latter acts with such celerity, that between each stroke the time be too small for the weight to move any sensible distance. Here then we have a case analagous to that supposed, in which the alternate movements or vibrations of matter enable it to preserve to itself a greater space in opposition to a force impressed; and it must be evident that lengthening or shortening the extent of the vibrations of the interposed body, provided they are made in the same time, will increase or diminish the space apparently occupied by it, as the volume of substances is affected by an increase or reduction of heat. It ought however to be recollected that in the case we have imagined, there is a constant expenditure of momentum to compensate for that generated in the weight by gravity, during each vibration. In the vibrations conceived to constitute heat, there is no generating power to make up for this loss. A body preserves the expansion communicated by heat in vacuo, where, insulated from all other matter, the only momentum, by which the vibrations of its particles can be supported, must have been received before its being thus situated. If we pour mercury into a glass tube shaped like a shepherd's crook, the hook being downwards, the fluid will be prevented from occupying that part of the tube where the air is in such position as not to escape. In this case, according to the hypothesis in question, the mercury is prevented from entering the space the air occupies, by a series of impalpable gyratory movements; so that the collision of the aerial particles against each other, causes each to occupy a larger share of space in the manner above illustrated by the descending weight and interposed body. The analogy will be greater, if we suppose a row of interposed bodies alternately striking against each other, and the descending weight; or we may imagine a vibration in all the particles of the interposed mass equal in aggregate extent and force to that of the whole, when performing a common movement. If the aggregate extent of the vibration of the particles very much exceed that which when performed in mass would be necessary to preserve a certain space, it may be supposed productive of a substance like the air by which the mercury is resisted. But whence is the momentum adequate in such rare media to resist a pressure of a fluid so heavy as mercury, which in this case performs a part similar to that of the weight, cited for the purpose of illustration? If it be said that the mercury and glass being at the same temperature as the air, the particles of these substances vibrate in a manner to keep up the aerial pulsations; I ask, when the experiment is tried in an exhausted receiver, what is to supply momentum to the mercury and glass? There is no small difficulty in conceiving under the most favourable circumstances, that a species of motion, that exists according to the hypothesis as the cause of expansion in a heated solid, should cause a motion productive of fluidity or vaporization, as when by means of a hot iron, we convert ice into water, and water into vapour.

How inconceivable is it that the iron boiler of a steam engine should give to the particles of water, a motion so totally different from any it can itself possess, and at the same time capable of such wonderful effects, as are produced by the agency of steam. Is it to be imagined that in particles whose weight does not exceed a few ounces, sufficient momentum can be accumulated to move as many tons? There appears to me another very serious obstacle to this explanation of the nature of heat. How are we to account for its relation in vacuo, which the distinguished advocate of the hypothesis has himself shown to ensue? There can be no motion without matter. To surmount this difficulty, he calls up a suggestion of Newton's, that the calorific vibrations of matter may send off radiant particles, which lose their own momentum in communicating vibrations to bodies remote from those, whence they emanate. Thus according to Sir Humphrey, there is radiant matter producing heat, and radiant matter producing light. Now, the only serious objection made by him to the doctrine which considers heat as material, will apply equally against the existence of material calorific emanations. That the cannon, heated by friction in the noted experiment of Rumford, would have radiated as well as if heated in any other way, there can, I think, be no doubt; and as well in vacuo, as the heat excited by Sir Humphrey in a similar situation. That its emission in this way would have been as inexhaustible as by the conducting process cannot be questioned. Why then is it not as easy to have an inexhaustible supply of heat as a material substance, as to have an inexhaustible supply of radiant matter, communicating the vibrations in which he represents heat to consist?

We see the same matter, at different times, rendered self-attractive, or self-repellent; now cohering in the solid form with great tenacity, and now flying apart with explosive violence in the state of vapour. Hence the existence, in nature, of two opposite kinds of reaction, between particles, is self evident. There can be no property without matter, in which it may be inherent. Nothing can have no property. The question then is, whether these opposite properties can belong to the same particles. Is it not evident, that the same particles cannot, at the same time, be self-repellent, and self-attractive? Suppose them to be so, one of the two properties must predominate, and in that case we should not perceive the existence of the other. It would be useless, and the particles would in effect, possess the predominant property alone, whether attraction or repulsion. If the properties were equal in power, they would annihilate each other, and the matter would be, as if void of either property. There must, therefore, be a matter, in which the self-repellent power resides, as well as matter in which attraction resides.

There must also be as many kinds of matter, as there are kinds of repulsion, of which the affinities, means of production, or laws of communication are different. Hence I do firmly believe in the existence of material fluids, severally producing the phenomena of heat, light and electricity. Substances, endowed with attraction, make themselves known to us, by that species of this power, which we call gravitation, by which they are drawn towards the earth, and are therefore heavy and ponderable; by their resistance to our bodies, producing the sensation of feeling or touch; and by the vibrations or movements in other matter, affecting the ear with sounds, and the eye by a modified reflection of light. Where we perceive none of these usual concomitants of matter, we are prone to infer its absence. Hence ignorant people have no idea of air, except in the state of wind; and when even in a quiescent state designate it by this word. But that the principles, the existence of which has been demonstrated, should not be thus perceived, is far from being a reason for doubting their existence. A very slight attention to their qualities will make it evident, that they could not produce any of the effects, by which the existence of matter in its ordinary form is recognized. The self-repellent property renders it impossible that they should resist penetration; their deficiency of weight, renders their movements nugatory. When in combination, *they* are not perceived, but the *bodies* with which they combine; and it is only by the changes they produce in such bodies, or their effects upon our nerves, that they can be detected.

ART. XIII.—*Chemical Examination of some Morbid Animal Products : by* JAMES FREEMAN DANA, M. D. Professor of Chemistry, &c. in Dartmouth College.

IN the spring of 1820 I had an opportunity of analysing the extensive collection of Urinary and other calculi belonging to the Anatomical Museum of Harvard College ; this collection was presented to the College by the late Dr. NICHOLS of London, and for the privilege of examining it, I am indebted to the politeness of the Professor of Anatomy in that College, Dr. J. C. WARREN, of Boston.

The examination of these Calculi was commenced with a view to ascertain the relative numbers of the different species in this collection, but it became very interesting in its progress, as I found calculi which contained *Urate of Ammonia.* Calculi containing urate of ammonia were noticed by Fourcroy and Vauquelin, but as this substance was not detected in the extensive examinations of calculi by Dr. WOLLASTON, or by Mr. BRANDE, it is well known that its existence as a component part of urinary concretions has been questioned, and it has been supposed that the French chemists were deceived by fallacious appearances. From the experiment of the British chemists, it cannot be inferred that urate of ammonia *never* exists in calculi, but that it is of very *rare* occurrence ; I am peculiarly fortunate in having had an opportunity to examine some calculi of which it is a component part.

The existence of ammonia in calculi is acknowledged by Mr. BRANDE, and his experiments lead him to conclude that it was combined with *muriatic acid ;* I have not yet had an opportunity of seeing a detailed account of his experiments, but his great and deserved reputation as a chemist, has led me in common with others, to place great confidence in his results. When, therefore, I first detected ammonia in these calculi, no doubt was entertained that it was combined with muriatic acid, and accordingly the appropriate tests for that substance were applied, but the appearances presented were so different from those produced by *muriatic acid*, that I was led to a further examination, and found the acid to be *uric.*

1. *Examination of calculi containing Urate of Ammonia.*

Externally of a very light clay colour, or nearly of the wine yellow of Werner, internally of the same colour with a nucleus of a reddish hue; form, rounded and flattened on two or more sides ; size, from that of a large pea to that of a filbert ; appeared to be composed of concentric layers, some of which had the reddish tinge of the nucleus.

Water in which these calculi have been boiled, deposits on cooling, a great number of small brilliant crystals, which are uric acid ; the liquor was separated from the crystals by a filter, and to it was added a few drops of the solution of potash, ammonia was disengaged and was not only evident by forming a cloud with muriatic acid, but also by the smell.

A strong odour of ammonia is evolved when a small quantity of the powdered calculi is rubbed in a mortar with caustic soda.

Nitrate of silver added to the watery solution produces a precipitate, which differs in appearance from that produced by muriatic acid ; this precipitate was *not* soluble in water of pure ammonia ; when boiled to dryness in nitric acid, gave a pink coloured residuum, and when placed on platina foil, and exposed to the heat of a spirit lamp, *the silver is reduced to its metallic state at a heat below redness ;* this fact is not mentioned in any of the chemical authors which I possess, but I suppose that it cannot have escaped the notice of Dr. Henry, in his researches upon the urates. These experiments are sufficient to prove that it is an *urate* and not a muriate of silver which was precipitated.

Alcohol, separates from these calculi a small quantity of urea.

1. Eight grains of this calculus in fine powder were digested in a large quantity of distilled water, and the solution, when cold was filtered.

2. To the clear liquor was added a solution of nitrate of silver as long as it produced a precipitate ; the whole was then thrown on a filter, and the precipitate well washed with pure water. The precipitate was of a yellowish colour, but became black when dry, exhibiting a close texture and a smooth resinous fracture, it weighed 3.85 grs.

3. The precipitate being exposed to heat on platina foil.

was decomposed, and afforded of pure silver 1.54 grs. Now 1.54 grs. of silver are equivalent to 1.65 of oxide of silver, hence the precipitate, urate of silver, consists of

Oxide of silver	1.65	or	42.85	1. proportion	118.
Uric acid	2.20	-	57.15	34? × 5 nearly	170.
	3.85		100.00		

Now 165 of oxide of silver combine with 0.754 nitric acid to form nitrate of silver, and this quantity of acid combines with 0.239 of ammonia to form nitrate of ammonia; this then is the quantity of ammonia which was combined with the uric acid, separated by the silver, by double decomposition; urate of ammonia then consists of

Uric acid,	2.200	90.15	5 proportions nearly, 34? × 5	170
Ammonia,	0.239	9.85	1 proportion	17
	2.439	100.00		

This calculus is composed, according to the above experiments of

Urate of Ammonia	2.439	- -	30.49
Uric acid and Urea	5.561	- -	69.51
	8.000		100.00

These analyses cannot be satisfactorily tried by the theory of definite proportions, because the equivalent number for uric acid is not well ascertained. According to Dr. Thomson, it is 34, hydrogene being 1. According to Brande it is 35, hydrogene being 1, and oxygene 8. Gay Lussac has stated that uric acid contains one atom of azote and two atoms of carbon. Dr. Thomson *supposes* that these are united with one atom oxygene. Dr. Prout, as quoted by Brande, states it to consist of one atom each of oxygene, hydrogene and azote, and two atoms of carbon. If we adopt Gay Lussac's analysis as correct, then the equivalent number for uric acid will be twenty-six, and we obtain also the same number from Dr. Prout, if the oxygene and hydrogene unite and form water when the acid combines with a basis; perhaps this is the fact, and the above analyses and this view of the subject mutually confirm each other, for, By the theory, urate of silver, containing six proportions of acid, consists of

6 atoms uric acid $26 \times 6 = 156$
1 atom oxide silver - - 118.
My analyses gives uric acid - - 157.33
oxide of silver 118—

Urate of ammonia, by the theory consists of
Uric acid, (6 proportions 26×6) 156
Ammonia, 1 proportion - - - 17
My analysis gives, uric acid, 156.4 and ammonia, 17

I regret that circumstances would not permit me to examine a larger quantity of these calculi; they will not be distinguished from uric acid by the general tests proposed by Dr. MARCET, for the detection of this substance, for they are totally volatile before the blowpipe, and give a pink coloured residuum with nitric acid; their colour, and the odour of ammonia developed by an alkali will distinguish them from uric acid calculi; the effect of heat on the precipitate they afford by nitrate of silver, is sufficient to distinguish them.

2. Examination of some concretions found in a box, labelled "*Concretions growing in a Parrot, from Dr. Oliver,* 1759" in the Nichols collection.

Colour light grey, form irregular, rounded; smooth to the touch; splintery fracture; hard; cut without difficulty by the knife, and exhibit a wax yellow colour internally.

1. Exposed to heat, evolve an odour resembling that of burning bread; by continuing the heat, the odour becomes like that of burning feathers; a bulky charcoal of difficult incineration remains. When exposed to the *flame* of a spirit lamp, they take fire and burn with a bright light.

2. Sulphuric acid is blackened by them, and by the aid of heat it chars them; diluted sulphuric acid dissolves them, and the surface of the solution becomes oily on the addition of ammonia.

3. When digested in acetic acid, they become pulpy and transparent, and increased in bulk, and are dissolved in part. The acetic acid solution affords a *white* precipitate by prussiate of potash, hence these concretions consist of

Fibrina. They have a great resemblance to the *Fibrinous calculi of* Dr. Marcet.

3. Examination of some concretions found in a box labelled "*Stones from a Bullock's Tongue,*" in the Nichols collection.

The colour of these concretions is black internally, externally brown; compact radiated fibrous structure, with a silky lustre; soft; do not sink in water.

1. Water boiled on them acquires a yellowish tinge, and frothed much during ebullition. Tincture of galls produced no precipitate in this watery solution.

2. Nitric acid acquired a rich violet colour, and the black portions of the concretions assumed the same hue; the colour vanishes when the acid is exposed to heat; at the boiling temperature of the acid the concretions melted, and on cooling, they congealed into spherical masses of a yellow colour, which were easily rubbed to a fine powder between the fingers.

3. These yellow globules were soluble in solution of potash by the aid of heat; on cooling the greatest part separated, and no precipitate appeared on the addition of acids to the potash.

4. They were readily soluble in boiling alkohol; the alkohol acquired a yellow colour, and on cooling, deposited brilliant white crystals.

5. Exposed to destructive distillation, a white vapour rose from them which condensed into an amber coloured oil, and became a soft solid when cold. A small quantity of charcoal remains, which is spongy and brilliant; ammonia could not be detected in the products of distillation.

These concretions are similar to Gall stones; and if the box which contained them had not been labelled as above, we should pronounce them Gall stones.

4. Two very large calculi composed of *carbonate of lime* are in this collection, and supposed to have been taken from horses. One of them weighs 15 oz. 3 drams, the other 1 lb. 9 oz. 3 drams, the former is of an oval shape, the latter like a flattened pear.

The numerous calculi in this collection were examined in the usual manner, and nothing remarkable was presented. The whole number analyzed amounted to 217, consisting of

Lithic acid, (chiefly) - -	87
Do. with *urate of ammonia* -	7
Bone earth - - - - - -	8
Compound - - - - - - -	13
Alternating - - - - - -	37
Mulberry - - - - - - -	23
Fusible - - - - - - -	31
Fibrinaus, from Parrot - -	3
From bullock's tongue - -	6
Carbonate of lime, from horse?	2
	217

5. Examination of a solid substance found in a singular tumor on the fundus of the uterus.

For this substance, and an opportunity to examine the "subject," I am indebted to Dr. Cyrus Perkins, of New-York, late Professor of Anatomy, &c. in this College. The history of the subject is unknown; the abdomen was as large as in the fourth or fifth month of pregnancy; on opening it the apparently enlarged uterus was resting above the brim of the pelvis; on cutting into the tumor, it was found to be fleshy and filled with spiculæ of a hard bony substance; the tumor was covered with the peritoneum; the uterus on examination was found of its usual size, and the tumor adhering to its fundus. The hard bony matter was found, by the usual methods, to consist of

Animal matter - - -	33.75
Phosphate of Lime - -	66.25
	100.00

Did this singular tumor and osseous matter arise from an extra-uterine conception?

Dartmouth College, Hanover, July, 1821.

ART. XIV.—*On tests for the discovery of Arsenic, in a letter, addressed to the Editor: by* THOMAS COOPER, M. D. *Professor of Chemistry, and acting President in the College of South Carolina; to which are subjoined, explanatory observations, by* Dr. T. D. PORTER, *a tutor in the same Institution.*

REMARKS.

Dr. Porter's dissertation, from which some experiments are cited, Vol. III. pa. 354 of this Journal, was evidently not intended for publication; but, as inaugural dissertations of medical graduates are held liable to publication, and are in most Institutions actually published, the Editor, although Dr. Porter was at the time in South-Carolina, did not hesitate to quote some facts, which appeared to him worthy of notice. He does not regret the step, especially as it has been the means of drawing from Dr. Cooper the following valuable letter. Dr. Porter happening to be here (New-Haven) at the time of its reception, it was thought no more than fair to shew him the letter, and to receive his reply, which is annexed.—*Editor.*

Columbia, South-Carolina, Aug. 13, 1821.

DEAR SIR,

I observe in the May number of your Journal, p. 354, a summary of experiments on the Tests for Arsenic, by Dr. T. D. Porter, one of the tutors of the South-Carolina College here. They are intended to shew, 1st, that the green colour produced by the union of arsenious or arsenic acid and copper, may be produced from copper, by onion juice, by coffee, and more especially by chromat of potash, without the aid of arsenic; of which therefore, that green colour is no exclusive indication. 2dly, That in the production of Scheele's green, by sulphat of copper carbonat of potash and arsenic;—*chromat of potash* may be substituted for the arsenic; producing a precipitate not to be distinguished by the eye from Scheele's green. 3dly, That the yellow precipitate produced in a solution of arsenite of potash, or arsenious acid, by Mr. Hume and Dr. Marcet, may be produced by substituting chromat of potash for the arsenical solution: so that this test also is fallacious. The subject is of importance, and it is well that any mistakes or oversights to which all of us are liable, should be corrected. I have carefully repeated all Dr. Porter's experiments, since I saw your summary of them; and I should have been glad to have repeated them with Dr. Porter himself, applying not only the other tests of arsenic, but also my own test of chromat of potash, which I do not find that Dr. Porter has noticed among the methods of discovering the poison in question. I should have been much gratified to have been made acquainted with the ambiguities which occurred to Dr. Porter, with his dissertation on the subject; for in such case, both his experiments and my own, might have been made more satisfactory.

To the 1st class of Dr. Porter's cases, I object (a) that although a greenish colour may be produced by onion juice and by coffee, with a solution of sulphat of copper, it is so dingy and so different from Scheele's green, and from chromat of copper, that the most inexperienced eye need be under no mistake. (b) That Dr. Bostock's proposal of Scheele's green as a test of arsenic, has never been relied on as decisive by any other chemist of authority. (c) That it is utterly impossible for any *chemist* to be led away by the ambiguity of colour produced by Dr. Porter's reagents, as a single drop of ammonia will instantaneously detect the copper in all these experiments. A source of error so very easily discovered, is in fact no source of error at all.

To the second assertion I object, that the statement in your summary is not quite accurate as a matter of fact. Take sulphat of copper, precipitate by carbonat of potash, add chromat of potash in the way you cite the experiment; a green colour will be produced exactly like Scheele's green: so it will if you add infusion of turmeric or gamboge or saffron, or any other liquor equally yellow with the chromat of potash: but this superinduced yellow colour can be washed away completely, and the carbonat of copper will resume its original blue tint; no chromat of copper is formed, no chemical union has taken place; the colour is a mere optical deception that can impose upon no chemist. *But*, if to a strong solution of sulphat of copper, you add an equal quantity of chromat of potash of the strength usually employed by the manufacturers of chromic yellow, you will produce a green chromat of copper, that will retain its colour unchanged by repeated ablution. Chromat of potash therefore cannot be *substituted* for arsenic, if the experiment be made as Dr. Porter has directed. I acknowledge, however, that I should have remained ignorant of the green colour produced by the admixture of sulphat of copper and chromat of potash, if Dr. Porter's experiments had not led me to it.

To the third statement of Dr. Porter, I object, that it is not conformable to my experience. Take a solution of arsenious acid, or of arsenite of potash, dip a slender glass rod in a solution of nitrat of silver, and another in ammonia, bring them near together, and immerse them in the arsenical solution as Dr. Marcet directs; in this case, a dense yellow precipitate will appear. In lieu of nitrat of silver take chromat of potash as Dr. Porter directs; the result *will not be the same;* a yellow tint will be given to the liquor, owing to the yellow colour of the chromat of potash, but no precipitate will take place. If the arsenical solution be strong, and the chromat of potash be added in equal quantity or somewhat more, the yellow tint will in half an hour become green, owing to the arsenious acid robbing the chromic acid of a part of its oxygen; the arsenious being converted into the arsenic, and the chromic acid into the chromic oxyd. But I aver that it is utterly impossible to confound the dense yellow precipitate produced in Dr. Marcet's experiment, with any of the appearances produced by Dr. Porter's substitute of chromat of potash. Again: take chromat of potash diluted or not diluted as you please. Operate on this chromat of potash as Dr. Marcet directs you to operate on the arsenical solution; that is, dip a glass rod in a solution of nitrat of silver, and another in ammonia, bring them near together, and immerse them in the solution of chromat of potash as you would in an arsenical solution—the precipitate will assume the *brown* tinge of chromat of silver, perfectly different from the yellow arsenite of silver. Dr. Porter may have a method of performing the experiment not suggested in your summary, but if it be intended to form an objection to Dr. Marcet's test, Dr. Marcet's process should be followed.

I used in these experiments, a chromat of potash made in the imperfect and impure way in which Dr. Porter used it; and also another solution made in the usual way. That is, I took two oz. avoird of triturated chromated iron, and added to it, one oz. avoirdupois of triturated nitre : to other two oz. avoirdupois of chromated iron, I added one oz. of dried salt of tartar: I exposed them in separate crucibles to a full red heat for 1^{1} hour (side by side) in a common forge: I washed the contents of each crucible in the same quantity of boiling water, and filtered. On testing them with super-acetat of lead, the yellow produced by the nitrated chromated iron, was of a richer colour than the other ; which last contained not only uncombined alkali, but also a portion of oxyd of iron, which covered the precipitate of lead. But in making the experiments detailed in this paper, I found no perceptible difference of result between the two solutions. In this variance between Dr. Porter's experiments and mine, it is desirable that other persons should repeat them ; and with this view I transmit to you these remarks. The subject ought to be investigated in every point of view, until our chemists are enabled to say before a court and a jury, " we *do* possess sure and accurate means of detecting the poison of arsenic."

Of the methods hitherto proposed for this purpose, the following appears to me the best; deduced from the result of my own experiments, and of the chemists who have preceded me.

Suppose a man suspected of being poisoned by arsenic: let the ejections from his stomach, (and the contents of his stomach, if dead,) be examined carefully with a magnifying glass, to discover the particles of white arsenic in substance, which should be set aside for experiment. If you find no such appearance, let the matter ejected, and contained, be fully dried in a heat of not less than 100° Fah. Take some of the dried matter, triturate it with $\frac{1}{10}$th of its weight of *dry* lamp black, ivory black, or charcoal ; into a glass tube six or nine inches long, half an inch wide, and closed at one end, put as much of this mixture as will fill the tube from half an inch to an inch deep ; stop the open end lightly with a cork ; expose the matter in the flame of an oil or spirit lamp, and if there be any arsenic, it will shortly sublime in black shining metallic particles toward the upper end of the tube. These when collected, will exhibit the white stain when heated with copper, and the garlic odour when thrown upon hot coals, which are peculiar to arsenic. If this appearance takes place in the tube, you need proceed no further, unless to make security doubly sure.

Take another sufficiently large portion of the dried matter: boil it in rain or distilled water for one fourth of an hour in a florence flask, or other convenient vessel. Filter; concentrate the filtered solution, and keep it for experiment. Take of this filtered solution three portions, in three separate wine glasses, or clear watch glasses: drop into one portion a few drops of carbonat of potash to saturate the arsenious acid; then add a drop or two of sulphat of copper; if a green precipitate appears, it affords strong primâ facie evidence of the presence of arsenic.

Take another portion of the filtered solution; drop into it a few drops of chromat of potash; wait half an hour; if a bright grass-green colour is produced, it forms another evidence that arsenic is present. To this green solution, add a drop of ammonia, if no blue colour be produced, *you may rest assured* that the green colour is produced not by copper but by arsenic. I trust with confidence to this test, which detects the twentieth part of a grain of arsenic, whether in powder or solution.

Take the third portion; try it with nitrated silver and ammonia, *in the manner directed by Dr. Marcet.* If a dense yellow precipitate appears, there is surely arsenic. The filtered solution may be tried in the first instance for copper, by a drop of ammonia, which will disentangle you at once from Dr. Porter's ambiguities; for a glass rod dipt in ammonia, like the touch of Ithuriel's spear, will make the copper start up at once in its true colour.

Nor indeed is it likely that the crime of poisoning will ever be attempted with copper, whose decidedly nauseous taste and emetic property, renders it a very inapt instrument of crime. When it is taken accidentally, ammonia will always discover it, if in a quantity to do harm. As to the preparations of chrome, they are so very unlikely to occasion mischief either by accident or design, that they may be considered as quite out of the question; and Dr. Porter's cautions as superfluous in this point of view.

The use of chromat of potash as a test of arsenic, I first ascertained and published in the summer of 1818, among the additions I made to Accum's chemical amusements. In September of the same year, I read a memoir on the subject before the American Philosophical Society, and exhibited the experiments to the members then present. I was permitted to publish the substance of that memoir, before it appeared in their transactions. I did so in my treatise on Medical Jurisprudence published in 1819. I applied it among other tests, with the most perfect success, last winter, to the contents of the stomach of a man suspected of being poisoned by arsenic, before my class here, and Dr. Davis and his students.

The summary of Dr. Porter's experiments contained in your last number, gave me the first information that that gentleman had been pursuing similar researches. I shall, however rejoice, if among us, some useful truths are elicited on a subject of great interest. As you have not probably seen the publications to which I allude, I shall state a summary of the experiments that will enable your readers to detect arsenic by means of chrome. Take five watch glasses, or the bottoms of as many wine glasses, or tumblers. Put on one, two or three drops of a solution of white arsenic; on the second, as much arseniat of potash; on the third, one fourth of a grain of white arsenic in substance; on the fourth, two or three drops of solution of sublimate either aqueous or alcoholic; on the fifth, two or three drops of a solution of copper; add to each two or three or four drops of chromat of potash of the usual manufacturer's strength. In half an hour a bright, clear, grass-green colour will appear in Nos. 1, 2, 3, unchangeable by ammonia. No. 4 will instantly exhibit an orange precipitate: No. 5 a green, which a drop of ammonia will instantly convert to a blue. The acid of chrome is converted into the green oxyd, by the arsenious acid, which is now the arsenic acid.

I am, dear Sir, your friend and servant,

THOMAS COOPER.

Dr. Porter's reply to Dr. Cooper's remarks.

New-Haven, Sept. 4, 1821.

It may be premised that my experiments and remarks were not made with any view to publication, or they would have been more extended; but having come under the observation of Prof. S. he thought proper to make that reference to them which has given rise to Dr. Cooper's letter.

Although I had the pleasure and advantage of attending parts of two of the courses of Dr. Cooper's very able lectures, I have never seen him apply the tests of arsenic, &c. For although I attended whenever my own duties gave me opportunity, it has so happened that the Doctor never spoke of arsenic or of tests for mineral poisons while I was present. A sufficient reason for the fact that Dr. C's "own test" for arsenic was not noticed in my experiments, is assigned, when it is said it had not then come to my knowledge. My object when I wrote, was to call the attention of those gentlemen who were addressed, to the inadequacy of the directions laid down in the *common books*, in the hands of men no more acquainted with the subject, than most of our *physicians* to authorize an opinion, on which life or death should hang—without the actual exhibition of the poison in the metallic state. I believe that in many cases of sudden and apparently violent death, poisoning by arsenic would be immediately suspected, and if by the application of any tests by the rules laid down in the books, results such as were obtained by myself with the chromat of potash, should be observed, without further investigation it would be unhesitatingly said, "This person was destroyed by arsenic." It seemed also if the chromat of potash produced effects in these trials in *appearance* so much like arsenic, the other things either simply or combined *might* do the same, so that caution in deciding was by all means to be *recommended.* As to Dr. C's objections to what he has denominated the first class of my experiments, he has gone on an erroneous supposition; for I not only agreed in his sentiment, that "no *chemist* could be led away by the ambiguity of colour, &c." but *my* very words were, there seems *no possibility* of mistaking the one for the other. "To the second assertion (Dr. Cooper proceeds) I object that the statement in your summary is not quite accurate, as a matter of fact." To this I reply, that all *my* statements were believed to be perfectly accurate—there could be no object to induce an erroneous statement—and although I have not compared them with the "summary," I presume they will not be found to differ. This Prof. S. under whose inspection the results of my experiments were all noted, and their accuracy assented to, will easily decide.

Dr. Cooper next observes—" To the third statement of Dr. P. I object that it is not conformable to my experience." On this it need only be said—the statement is nevertheless correct, unless Prof. S. and myself were greatly deceived, and that the experiments were scrupulously performed " in the manner directed by Dr. Marcet," unless there exists some ambiguity in the instructions (which are not now before me,) that led me astray. It will readily be seen that my paper had no reference to poisoning by the preparations of chrome, of whose action on the system I am ignorant. My real design has already been stated.

As to the case of the man suspected of being poisoned by arsenic last winter, I was not present when the experiments were made, nor did the affair come to my knowledge till some time after, when I was informed, (how correctly I know not,) that a man had poisoned himself, and that arsenic was found in him after death. Then from the length of time which had elapsed since my experiments, and my engagement in other employments, they had entirely passed from my remembrance, as it was not my expectation they would be made known to any persons beyond the circle to which they were first addressed, and of course it is not to be wondered at that they were not mentioned to Dr. Cooper.

TIMOTHY DWIGHT PORTER.

Art. XVI.—*On the Use of Phosphoric Acid in Jaundice.*

Bristol, (R. I.) April 28, 1821.

To Prof. Silliman,

Dear Sir—Seeing in your Journal that you solicit communications, for the promotion of the Arts and Sciences, from the effects I have seen produced from the Phosphoric Acid in the cure of the Jaundice, I am induced to say something of what I know, as I have not seen any mention of this acid as a remedy in that disease.

About six years ago I had a very obstinate case that resisted the common remedies. I was led to use the phosphoric acids on the principle that the acids decompose the bile. I made choice of this on account of its existing in a separate state in the blood.

I directed a large spoonful of the acid as prepared in Murray's Materia Medica in a pint of balm tea to be taken as fast as the stomach would bear it, till it should operate as a diuretic. In twenty-four hours the patient had taken eight pints, and it had operated powerfully as a diuretic. Neither the urine nor the white of the eye was as yellow as before, by a very obvious difference. I ordered a continuance under the same directions and in two days more the urine was of nearly the natural color ; but the skin had not improved in the same proportion. I advised tonics with the occasional use of the acid and my patient shortly recovered.

I have had many of the same complaint since that time and have directed nearly in the same manner, according to the age and condition of the patients and the result has been the restoration of health in a very short time. In general, the yellowness disappeared in three or four days from the urine, but continued a little longer on the skin ; by the use of tonics and sometimes a little of the acid this is however removed in a few days. I have met with only one patient, whose symptoms have not yielded to the above plan. This was a person eighty years of age. Even in this case however, the acid always produced relief ; but the complaint soon returned. My present practice is to give a cathartic of Calomile and Julep or some of the neutral salts, and then the balm tea moderately acidulated with the phosphoric acid, which I direct to have continued till it operates as a diuretic and until the urine becomes clear or nearly so ; this commonly takes place in the course of two days. I have advised other acids when this has not been at hand ; but I am inclined to give the preference to the phosphoric, although I think the others deserve a farther trial.

I might have entered much more into detail, but I am satisfied that it needs only a trial to convince any candid person of the advantage of this acid in the cure of the Jaundice. I have never seen any bad effects from the use of the phosphoric acid, although it is said that phosphorus is poisonous. This I have never used.

I shall be happy to answer any inquiries, and remain respectfully your obedient servant,

CALEB MILLER.

Art. XVII.—*A new Blow-Pipe, by Prof.* Jacob Green *of Nassau-Hall, Princeton.*

[Received in May, 1821.]

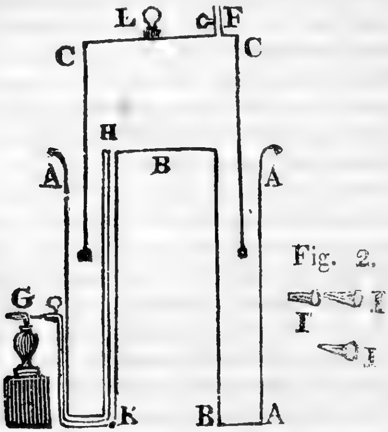
There is scarcely an instrument in the laboratory, which has undergone so many varieties in construction, as the blow-pipe—both the chemist and the artisan are in possession of a number; but the great inconvenience I experienced in using the common mouth blow-pipe, (which is probably the best portable one) occasioned the contrivance I shall presently describe. The power of keeping up a constant stream of air with this instrument, and which is so essential, is with difficulty acquired, and is always fatiguing, if not injurious when continued for a length of time. In those experiments which require the free use of both hands, this cannot be employed, and the enameller's blow-pipe which is then resorted to, is cumbersome and expensive; to obviate these difficulties, to make a blow-pipe cheap and portable, and which may be applied with facility to purposes that require both hands to be left at liberty, has been my design in this communication, and in completing it there will be found but little novelty either in the principle on which it acts, or in the mode of its construction.

Figure 1, represents the instrument made of copper, or tinned iron covered with a thick coat of paint to prevent rust or oxidation. It consists of two principal parts—A. A. A. is a large cylindrical vessel for the purpose of containing the water by which a portion of *atmospheric air* is confined but to diminish the weight which a large quantity of water would occasion a smaller vessel, B. B. close at the top of the same shape as the exterior cylinder is soldered to the bottom of A. A. C. C. is another cylindrical vessel designed to contain the air and made with the bottom open so as to slide easily between the inner and the outer cylinders. A. A. and B. B. a small quantity of water being added to fill up the space between them ; round the bottom of C. C. is a rim of lead to sink the vessel in the water and compress the enclosed air, and on the top there is a stop cock F. From another stop cock G. on outside of A. A. there runs a tube down under the apparatus and then rising through the interior cylinder B. B. and its top at H. (the opening by which it passes being soldered so as to be air tight.) On the outer part of the stop-cock G. is cut a screw, to which can be applied the caps I. I. I. Figure 2, when apertures of various sizes are wanted.

To use the instrument, the cylindrical vessel C. C. is taken out from between A. A. and B. B. and the stop-cock F. shut ; and a sufficient quantity of water poured between the outer and inner cylinders. C. C. is then adjusted in its place, the cock G. being closed. The vessel C. C. decends by reason of its gravity and the atmospheric air is forced by the pressure through the opening H. down the tube H. K. and out of the orifice G. where the stop-cock G. is opened, thus a continued and uniform jet of air may be thrown on the flame of a lamp placed before G. The caps I. I. I. are about half an inch have a female screw at one end to fit on G. and are perforated with different apertures at the other end to regulate the jet of air. When the air in the cylinder C. is exhausted or when it has descended as far as possible, the stop cock F. is opened to admit the air and the vessel is drawn upwards by the handle L. as far as convenient, when F. is again closed. A valve opening downwards may be substituted for F. but though this is more convenient for a time it is more likely to get out of repair. The instrument I use will supply an ordinary jet of air for five minutes, while the cylinder C. descends once. Mr. Pollock an ingenious mathematical instrument maker at Boston has used it with success for some time.

By a little additional apparatus it can be used as a gasometer, by means of which the cylinder C. C. may be filled with oxygen or any other gas ; in this case C. must be suspended by cords over pulleys and counterpoised by a weight. It will be unnecessary to go into a description of the manner of filling this with gas, as in this form the instrument differs very little from the commom gasometer.

Figure 1.



N. B. The upper cylinder should be as long as the lower ones; it was by mistake drawn too short.

Art. XVIII.—*On the material and manufacture of the Italian Bonnets, and the habits and state of society of the manufacturers.—Extract from Chateauvieux's Letters to Pictet; made in consequence of Dr. Mitchill's communication on the Tuscan straw.*

Chateauvieux, in his agreeable and instructive letters written from Italy, to Mr. Pictet in 1812 and 1813, describes the persons who manufacture the Tuscan bonnets, and their state of society. In his sixth letter, which is dated at Florence, are the following observations, (Vol. 1. p. 96.) " The road I travelled was bordered on both sides by village-houses, whose distance from each other did not exceed one hundred paces. They are built of brick, and the architect has bestowed upon them a justness of proportion and an elegance of form, unknown in our climates. They consist of a single pavillion, that has often but one door and two windows in front. These houses are always situated along the road, and separated from it by a supporting wall and a terrace some feet in thickness. Upon this wall usually stand several vases of the antique shape, containing aloe plants, flowers, and young orange trees. The house itself is entirely covered by vine-branches, so that during summer, one knows not whether they are so many pavillions of verdure, or dwellings prepared for winter.

In front of these houses swarms of young country girls are seen, dressed in white linen, with corsets of silk, and straw hats adorned with flowers, inclining to one side of the head. They are constantly occupied in braiding the fine mats, the treasure of this valley, from which the straw hats of Florence are made.

This branch of industry has become the source of the prosperity of the valley of the Arno. It produces yearly three milllons (of livres,) which is distributed exclusively among the women ; for the men never engage in this occupation. Each young girl buys for a few pence the straw she wants ; she then exerts her skill to braid it as fine as possible ; and she sells, herself, and for her own profit, the hats she has prepared. The money she thus earns, constitutes her portion. The father of the family has nevertheless the right to require of the woman belonging to his house, a certain amount of rustic labour on the farm. He receives this labour from the females of the mountains, (the Appenines,) whom the girls of the Plains pay, out of the produce of their hats, for performing the tasks in their stead. One of them can earn from thirty to forty sous a day in braiding her straw ; while she can hire a poor Appenine woman, to do her field labour for eight or ten, and they secure by this commutation of service, the delicacy and flexibility of their fingers necessary for their nice and fine work, and which would be spoiled by such exercises as harden and stiffen the hands.

Such, Sir, are the female peasants of the Vale of the Arno, whose grace and beauty are celebrated by travellers, whose language Alfieri went there to study, and who seem, in fact, born to embellish the arts, and to furnish them models. They are shepherdesses of Arcadia, but they are not peasants ; they possess only the health and freedom from care of that state, and never know its anxieties, its sun-burnings, and its fatigues.

I have been informed that the crop of two acres is sufficient for all the straw of the hat manufacture in Tuscany. This straw is the product of a beardless wheat, harvested before it is quite ripe, and whose vegetation is whitened by the sterility of the soil. This soil is selected among the calcareous hills; it is never manured, and the seed is sowed very thick. These habitations so near to each other, shew of themselves, that the domains to which they belong are very limited, and that property is remarkably subdivided in these valleys. In fact, the extent of these little plantations is only from three to ten acres. They lie around the dwelling, and separated into lots by small canals and rows of trees. These trees are sometimes mulberries, almost always poplars, whose leaves serve to feed their animals. Each of them sustains a vine, whose branches the cultivator entwines in a thousand directions.

These lots, laid out in long squares are extensive enough to be cultivated by a plough without wheels drawn by two oxen. There is one pair of these creatures among ten or a dozen of these tenants; and they are employed in succession for working all the farms in the connection. These oxen come from the states of Rome, or Maremmes; they are of the Hungarian breed; and are exceedingly well kept, being covered with white cloths, decorated with a great deal of embroidery and with scarlet tassels.

Most of these land-laboures, keep a horse of a fine and elegant form. He is harnessed to a small two-wheeled cart neatly constructed and painted red. It serves for all the purposes of transportation on the farm, and more especially to convey the good man's daughters to the mass and the ball. Accordingly, on holidays, the roads are filled with hundreds of these little carts, moving in all directions, and carrying the young girls adorned with flowers and ribbands.

The farms of the valley of the Arno, have not forage enough to support cows; the cultivators therefore raise heifers only. These they buy at the age of three months, and keep them until eighteen when they are sold to the butcher, and younger ones bought in their places. It is from the pastures of Maremmes that the drovers bring the heifers to the fairs in the valley of Arno.

You will comprehend the motive for this practice when I shall have explained to you the cropping system adopted in these vallies. There is no natural meadow. The leaves of the trees, the trash of the legumes, and a little clover, are the only feed for the animals. In this country every thing is reserved for man, whose numbers have augmented beyond measure under the most ancient civilization," &c. &c. The plant, it will be remembered, of which the finest Leghorn bonnets are made is a wheat; varieties of the summer and winter wheat of the Arno.

Art. XIX.—*Notice of the Lithographic Art, or the art of multiplying designs, by substituting Stone for Copper Plate, with introductory remarks by the Editor.*

The reader scarcely needs to be informed that the word Lithography, from the Greek λίθος γράφω according to its strict etymology, signifies the art of *writing upon stone;* it will be seen, by the article subjoined, that in the actual use of the word, it signifies not only the art of writing, but generally that of tracing designs of every description, upon stone, and also of transferring these designs to paper by the use of the press. The great recommendation of lithography is the comparative cheapness and dispatch, with which designs are executed by it; we may perhaps be able hereafter to speak with more precision upon these points. All the drawings in the present number are printed on stone by Messrs. Barnet & Doolittle,* whom we are happy to introduce to our readers as artists in this comparatively new department. Having availed themselves in Paris of a regular course of practical instruction, they have brought to this country, not only the skill but the peculiar materials and press necessary to the execution of the art, and are now establishing themselves in New-York. The designs in this number are, by no means, presented as *chef-d'œuvrès* in lithography, but merely as accurate representations of the objects, with sufficient neatness for designs of the class to which they be-

* Their establishment is at No. 23 Lumber-street, and orders are addressed to them there, or through Messrs. A. T. Goodrich & Co. Booksellers, Broadway, New-York.

long. Messrs. Barnet & Doolittle have in their possession, a great variety of lithographic prints, which sufficiently evince the adaptedness of the art to an elegant as well as common style of execution. The finest things done in this way are really very beautiful : and they possess a softness which is peculiarly their own. Still Lithography is not *a rival*, it is merely *an auxiliary* to copper plate engraving, which, especially in the higher branches of the art, must still retain the pre-eminence which it possesses.

But the regular introduction of Lithography into this country must still be a subject of congratulation; and we trust the American public will give this fine art vigor by an adequate patronage.

Lithography.—This art which within a few years has made very rapid progress in different parts of Europe, was first discovered by *Aloys Sennefelder*, of Munich, in Bavaria, a singer in the theatre of that place, and was due to one of those fortunate hazards which sometimes so materially affect the comforts and well-being of society.

Mr. Sennefelder, wishing to print some music, and not being able to defray the expense of engraving it in the ordinary way, or even to purchase metallic plates for the purpose, bethought himself of using a species of stones from the quarry of *Solenhofen*, near Pappenheim, in Bavaria, and which, in that country, are much used for floors in houses, he found these stone plates to answer a tolerable purpose as a substitute for metallic ones.

It was in 1796 that Mr. Sennefelder first attempted to engrave on stone; and in 1799 he by accident discovered the principles of the art now termed *Lithography*, which consists in making a drawing on the stone, with a sort of ink, or crayon, or both, composed of resinous substances, and of printing from that drawing without any other engraving. This species of printing is founded on the principles of chemical affinity. Thus, the stone is wet all over with water, that part of the surface which is covered with the drawing will not imbibe the water, while the other parts of the stone, being wet, repel the ink which is afterwards applied to the stone; thus prepared, an impression is struck off, and the operation repeated as often as may be desired. This method has the advantage, over every other species of printing of giving exact *fac-similes* of the original work of the artist ;

he cannot complain of the inaccuracy of the engraver, since no engraver is employed. For Landscapes and natural History it is equal, if not superior to copper plate, besides being much cheaper, and for portraits it is exceedingly handsome.

The facility with which a manuscript, written on paper, and with ink prepared for the purpose, is transferred to the stone where it serves as a plate to print others from, giving *fac-similes* of the original manuscript, renders it very convenient for circular letters, blank forms, &c. &c.

Lythography, which has had but a few years of existence, and which is hardly known, even by name, in this country, has already taken a very distinguished rank among the fine and useful arts in Europe.

The best stone hitherto employed for this purpose is a carbonate of lime, about the colour of the light side of a razor hone, of a fine grain, a conchoidal fracture, perfectly homogeneous, very hard, and susceptible of a high polish. It is a little remarkable that no stones have been found of a superior quality, to those first employed by Mr. Sennerfelder, and few so good.

Much has been said about a species of *cartons* or pasteboard which Mr. Sennefelder has prepared as a substitute for the stone, but, however desireable an acquisition this might be to the art, on account of the greater facility of transportation, the utility of these cartons has not yet been established by any regular series of experiments ; and it is certain that, however highly they may be spoken of by the learned societies of Paris, where Mr. Sennefelder now resides, they are not adopted by any of the Lithographers of that city.

Art. XX.—*The Tempest of Sept.* 3d, 1821.—Editor.

Some particulars connected with this tempest seem worthy of being preserved, for although they are not unprecedented, they are not so common as to be generally familiar.

The gale which blew at this place, (New-Haven,) from the S. E. and eventually from the S. and S. W. gradually increased from noon till dark, when it raged with tremendous violence, and continued till nearly midnight. It terminated very abruptly, and passed in a very short time, from a hurricane to a serene and star light night. Near midnight a loud report was heard at the house of the writer, as well as by the citizens, and it was observed that the wind ceased immediately after the report. The cause of this report is not known.

Dr. Beck, (Vol. I. pa. 388, Am. Jour.) has given us an interesting account of salt storms, and among them has enumerated that of Sept. 23d, 1815, which we also witnessed. Both that tempest and the late one produced vast destruction of life and property. It is not, however, our design to record those events, however interesting to benevolent feelings, but to advert to the effects produced by the late storm upon vegetation.

The wind was without rain, till it had blown some hours, when water (then supposed to be rain,) was dashed against the windows with great violence. From the effects that were exhibited the next morning, there is great reason to believe, that this was merely the spray of the salt water. For when the day light returned, the windows were found covered with salt, to such a degree that they were sensibly white, and the light was also sensibly obscured in its passage through them. It was necessary to wash them thoroughly upon the outside.

The trees soon exhibited a blasted foliage—in a few hours the leaves on the windward side began to shrink and dry up—the trees appeared as if struck by a sudden and severe frost, or by heat, or lightning, and in a few days the dry leaves fell, and were carried about by the wind in great abundance, and the trees, in the second week of September exhibited the appearance which they ordinarily do in the latter part of November. The evergreens alone—among trees—escaped, and even they, when situated within a few yards of the sea shore, were blasted. The cherry trees—the pears, the elms, and the willows, were particularly affected.

Now, (October 10) more than a month after the tempest, the weather having been generally mild—the trees exhibit, in part, the appearance of spring. On the windward side, new leaves have appeared—they are particularly verdant and beautiful on the willow, the lilac, the locust, and the elm, and possess a freshness which probably, on account of novelty and contrast, appears almost superior to that of spring. Blossoms have put out, also, in considerable numbers. Many pear, plumb, cherry, apple, and some peach trees, are covered with them; the lilac, the straw berry, and the horse chesnut, exhibit fresh blossoms; and the bean* and other garden vegetables have at the same time expanded their flowers; the watermellon and cucumber have not only put forth new blossoms from the old vines, but the new fruit has appeared; the melons have acquired the size of a nine pound cannon ball, and the cucumbers have been repeatedly served up for the table; the apple blossoms are fragrant as in spring, and we have observed a lady decorating her flower pots with the autumnal blossoms of the lilac; *they* also emit their own peculiar odour. It is said, that in some instances, the mature fruit is found on the same tree with the new blossoms. These effects are more or less conspicuous along the sea shore, but decrease as we go inland. Dr. Peters informed us that the morning after the tempest, the leaves were perceptibly saline to the taste at Hebron, thirty miles from the ocean, and it is asserted to have been the fact, even at Northampton, which is more than double that distance.

We have been recently put in possession of some manscript letters, addressed about sixty or seventy years since, to the late celebrated Dr. Jared Elliot, of Killingworth in Connecticut. Some of them are interesting, either on account of their subjects or their authors, and we may occasionally give them publicity. The annexed extract is given, at this time, because it contains an account of a storm which occurred, sixty-seven years ago, and which resembled extremely that upon which we have been remarking. The letter is dated Halifax, Sept. 17, 1754, and is signed James Monk. Some of the author's remarks will not be considered, at this day, as very correct, but we allow them to stand unaltered.

"We have lately had a violent storm of wind, attended with some rain, and the effects of it are very remarkable, for in less than twenty-four hours after it, some of the trees appeared as much affected by it as they would have done from a violent frost: and within forty-eight hours all the

* October 19, the Lima beans and peppers, of the second crop, have come almost to perfection.

forest trees, (except the evergreen,*) appeared scorched up fully as much as I have seen trees that have been struck with lightning in New-England. During the storm I happened to be on an island, and observed the wind took up the salt water that was extended by the breaking of the waves, and seemed rather to elevate the particles of salt water, then force them in a horizontal direction, and carried them over the land. This I conceived to be the reason of the blast; (for as such it appears,) especially as those trees that stood nearest to the salt water, seemed first to decay. The islands of this country that are clothed with hard wood, such I call maple, beach, and birch, are generally surrounded on the edges with alders—and those alders that stood on the windward side of the islands, shewed the first symptoms of decay. I should be glad to have your opinion whether it is probable my conjectures are right? that the salt water being in such quantities, (for the force of the gale lasted twelve hours) lodged upon the branches of the trees, was the occasion of the blast? or whether it is more likely that the air was impregnated with such glutinous particles as is commonly the case where fields of wheat and other grain are said to be mildewed or blasted by unwholesome fogs, when in the milk? and whether it is not probable, had there been fields of English grain standing where the trees are blighted, they would have undergone the same fate; especially as the potatoe tops, Indian beans, and other tender garden plants were affected; but the cabages and carrots are unhurt. The islands of this country and the land near the sea shore, are rather low than high land, and consequently will, I fear, be subject to further inconvenience of this kind, that may prove a discouragement to our cultivating them for any other use than the production of grass."

Art. XXI.—*Natural Ice Houses.*—Editor.

That ice is perpetual in some climates is notorious. That it is so even in those of the torrid zone, upon mountains which rise to the height of three miles, is also well known. It is however a rare occurrence, even in cold climates, that ice is perennial on ground which possesses no more than the common elevation.

* By evergreen, I mean the spruce, fir, and pines.

An instance of this kind has however recently come to our knowledge, and appears worthy of a brief notice. It exists in the state of Connecticut in the township of Meriden—midway between Hartford and New-Haven. This natural Ice-House,* is situated in about 42 degrees of north latitude, nearly twenty miles from the sea and at the elevation of probably not more than two hundred feet above its level.

The country is a part of the secondary trap region of Connecticut,† and is marked by numerous distinct ridges of green stone, which present lofty mural precipices, and from their number, contiguity and parallelism, they often form narrow precipitous defiles, filled more or less, with fragments of rocks, of various sizes from that of a hand-stone, to that of a cottage. These fragments are the detritus or debris of these mountains, and every one in the least acquainted with such countries, knows how much they always abound with similar ruins.

In such a defile, the natural Ice House in question is situated. On the south western side, there is trap ridge of naked perpendicular rock, which, with the sloping ruins at the base, appears to be four hundred feet high; the parallel ridge which forms the other side of the defile is probably not over forty feet high, but, it rises abruptly on the eastern side, and is covered by other wood, which occupies the narrow valley also. This valley is moreover, choked, in an astonishing degree, with the ruins of the contiguous mountain ridge, and exhibits many fragments of rock which would fill a large room. As the defile is very narrow, these fragments have, in their fall, been arrested here, by the low parallel ridge and are piled on one another in vast confusion, forming a series of cavities which are situated among and under these rocks. Many of them have reposed there for ages, as appears from the fact that small trees, (the largest that the scanty soil, accumulated by revolving centuries can

* A convenient point of departure to visit this natural Ice House is from the Inn of Dr. Isaac Hough in Meriden. This inn is the usual dining place, between New-Haven and Hartford, and the very intelligent and respectable man by whom it is kept, will cheerfully direct the enquiring traveller, or furuish him with a guide. The distance is not over two miles from Meriden Meeting-House. There is also near the same place a wild romantic pass through the Gorge of the mountains which is well worth seeing; it is known in the vicinity by the ludicrous name of the Cat Hole.

† A sketch of which is given in the Tour between Hartford and Quebec, page 27.

support) are now growing on some of these fragments of rock. Leaves also and other vegetable ruins have accumulated among the rocks and trees, and choked the mouths of many of the cavities among the ruins. This defile, thus narrow and thus occupied by forest, and by rocky ruins, runs nearly N. and S. and is completely impervious to the sun's rays, except when he is near the meridian. Then indeed, for an hour, he looks into this secluded valley, but the trees and the rocks and the thick beds of leaves scarcely permit his beams to make the slightest impression.

It is in the cavities beneath the masses of rocks already described, that the ice is formed. The ground descends a little to the South, and a small brook appears to have formed a channel among the rocks. The ice is thick and well consolidated, and its gradual melting, in the warm season, causes a stream of ice-cold water to issue from this defile. This fact has been known to the people of the vicinity for several generations, and the youth have, since the middle of the last century, been accustomed to resort to this place, in parties, for recreation, and to drink the waters of the cold-flowing brook.

It was on the 23d of last July, in the afternoon of a very hot day when the thermometer was probably as high as 85° of Farh. that under the guidance of Dr. Hough we entered this valley. After arriving among the trees, and in the immediate vicinity of the ice, there was an evident chilliness in the air and very near the ice, the air was, (compared with the hot atmosphere which we had just left) rather uncomfortably cold. The ice was only partially visible, being covered by leaves, and screened from view, by the rocks, but, a boy descending with a hatchet, soon brought up large firm masses. One of these, weighing several pounds, we carried twenty miles to New-Haven, where it was exhibited to various persons, and some of it remained unmelted during two succeeding nights, for it was in being on the morning of the third day.

The local circumstances which have been detailed will probably account for this remarkable *locality* of ice, and scarcely need any illustration or comment.

This is not the only instance of the kind existing among the trap rocks of Connecticut. There is a similar place seven miles from New-Haven, near the Middletown road, in the parish of Northford, and township of Branford. The ice here also, (as we are assured) endures, the year round. This place we have not visited, but we are informed that it is at the bottom, or on the declivity of a trap ridge. Several years ago we had the ice of this place, brought to us, into New-Haven, in the hottest weather of mid-summer. Like that of Meriden it is very solid, but like that also it is soiled with leaves and dirt, and although it is unfit to be put into liquids, which are to be swallowed, it is as good as any ice for mere cooling.

These instances naturally induce the impression that other natural ice houses may exist in various parts of the trap region of Connecticut, and of Massachusetts, and very possibly in other districts, abounding with precipitous, rocky and woody defiles, although the geological formation may not be the same. We should be obliged by any information respecting similar facts existing elsewhere.

It is perhaps worthy of being mentioned in this connexion that an artificial ice house within the knwoledge of the writer is situated on *the top* of a ridge of trap in Connecticut. The excavation was made, simply by removing the loose pieces of trap rock which are here piled in enormous quantities, but composed of fragments of very small size. These loose pieces of stone, with the air in the cavities are better non-conductors of heat than the ground, which usually surrounds ice houses, for the ice keeps remarkably well in this elevated ice-house. Perhaps this will aid us also in explaining the phenomena of the natural ice houses that have been mentioned.

It may not be useless, before dismissing this article, to mention, that the roof of an ice house should be painted white, and that it should be thatched with straw beneath the ordinary wood roof :* the surface of the roof thus becomes reflecting, and non-absorbing, and the subtance non-conducting, in relation to heat ; we can speak from experience of the efficacy of this arrangement.

* A thatched roof as is well known will answer without any wood, bu-is less enduring and more exposed to fire.

Art. XXII.—*Apparent Conversion of a part of two cannon balls into Plumbago.—Editor.*

In July, 1779, a British squadron and army, from New-York, invaded the coast of Connecticut, and during this invasion, visited New-Haven. The shallowness of the water in the harbour did not permit their large ships of war to get up to the town, but some of the lighter vessels, to favour the movements of the army, which had landed, entered the harbour, and kept up a cannonade, both upon the town and the redoubts, on and near the shores of the harbour. During the late tempest, (Sept. 3d,) a part of a low bank. on the eastern side of the harbour, a little north of the fort, was undermined, and discovered a cannon ball, which, there can be no doubt, was fired into this bank on the occasion mentioned above, and had therefore, in all probability, lain, undisturbed, more than forty-two years. The ground in question, is, in fact, only a part of the natural embankment of a very small creek, dividing a salt marsh, which lies so low that the tide very often overflows it, and the place where the ball lay is little else than a salt morass.

The ball, when first found, was thickly incrusted with a shapeless, rusty, brownish substance, which, when removed, brought into view the proper shape of the ball, which is a six pound shot.

All these circumstances are only introductory to the main fact. The outside of the ball is changed into a substance, so resembling plumbago, or what is commonly called black lead, that it cannot be readily distinguished from that substance. The diameter of the ball is 3.87 in. By means of a common saw, a section was easily made through the plumbaginous coat, which at the place of the incision, was half an inch deep, and supposing the coating to be equally thick, one inch of the whole diameter would be occupied by it. This is however not exactly the fact. The change is less complete in some parts than on others. In one place the surface differs little from the common condition of cast iron, but is sensibly softer, being easily cut by a file ; and it is impressible, even by a knife, and there is gradation in the softness, till it becomes so soft, that it is cut with the same ease as common black lead crayons. It has then the same lustre—the same crystaline grain, and the same semi unctuosity when rubbed between the fingers. It gives the same streak on paper, and when rubbed on leather or on cast iron, it produces the same lustre, and it polishes and sharpens steel instruments just like plumbago. No one could by the eye distinguish them. The magnet, however, takes up this substance readily, while it produces no effect on black lead. This substance is not altered by the blowpipe, only it grows firmer. The cannon ball, by lying three days in a dry room, where there is a fire, has grown less soft, but retains all the other properties. Where it has been cut or powdered, it rusts, superficially, in the course of a day or two.

Is the change in this ball to be attributed to a substitution of carbon derived from the vegetable matter of the salt marsh for a part of the iron—the carbon combining with the remainder of the iron? The substance is only partially soluble in diluted sulphuric acid—hydrogen is evolved, and a black insoluble matter remains, which appears to be carbon.

Since this occurrence has been talked of in New-Haven, an old gentleman, resident here, mentions a similar instance, as having occurred within his observation; a cannon ball, long immersed in salt water, and covered with shells, was found to have undergone a similar change. We are not aware that the occurrence has been mentioned elsewhere.

New-Haven, Oct. 17, 1821.

P. S. Since the above notice was written, we have obtained from Capt. Daniel Goffe Phipps, of New-Haven, the person alluded to above, the following statement.

Capt. Phipps was in Georgia about twenty years ago, and being in a boat, at a place called Rumley Marsh, visited the wreck of a vessel, which lay principally in the mud, but with the ribs protruding into view. From this wreck he took a very large bunch of oysters, which adhered to a six pound cannon ball, and this lay on what had probably been the ballast of the vessel; it was not only under water, but probably buried in mud, and the vessel's wreck appeared as if it had been there many years. The oysters were knocked off, and the ball, by rolling about the deck of the vessel to which Capt. Phipps belonged, had become smooth and clean. The oysters had adhered to the ball at only one place; this place which was about two inches in diameter, was observed to be soft, and when cut, presented every appearance of perfect black lead, exactly like that in the New-Haven ball which Capt. Phipps has examined. He found no difficulty in boring into the ball, quite to the centre, where he found it solid, as it was also in every other part. The perforation which he made, was funnel-shaped, or conical, two inches wide at the outside and tapering to the vertex in the centre. He is firmly persuaded that the oysters had produced the change, and thinks that there must have been oysters adhering to the ball recently found at New-Haven. Of this there is no direct evidence, although it is said there were shells in the bank where it was found. Both balls were evidently found under circumstances considerably similar, and carbon might possibly have been afforded to the iron, both by the mud and the oysters. The facts are curious, and we have thought them worth preserving.

Captain Phipps farther states the following circumstance, which is not easily explained upon the suggestions made above. He was employed during the war of the American revolution, to clear an old cannon, which was covered outside and in, with oyster shells adhering firmly to it. On removing them, the metal was discovered to be perfectly sound, and no change had occurred similar to that in the cannon balls. But it is obvious that this cannon must have lain long under the salt water, although it might not have been in mud, for it was not known whence it was brought.

A circumstance occurred during the cleaning of this cannon, which was very remarkable. As one means of detaching the shells, a fire was built around the cannon, and it was elevated, and directed *in sport* at the chimney of a common man, ludicrously called *the Governor*, with a threat to *blow the Governor's chimney down.* At the end of two hours the cannon actually went off with a great report, and knocked the chimney down. It would seem that the cannon must have been loaded, and probably spiked, by which means and the wadding, the powder, although wet, was kept in its place, until by the heat, it became sufficiently dried to explode, and carried the ball against the chimney. It is scarcely necessary to add that it effectually cleared the cannon of the oyster shells.

SUPPLEMENT TO THE ZOOLOGY.

ART. XXIII.—*The Proteus of the North-American Lakes; announced in a Letter from* SAMUEL L. MITCHILL, *President of the New-York State Medical Society, Surgeon-General of the Militia, &c. &c. to Professor* CONFIGLIACCHI, *of Pavia, dated October, 7, 1821.*

[Read before the Lyceum of Natural History, October 8, 1821.]

SIR,

I hope my answer to your obliging letter and its accompaniments, has reached you. It was despatched early in June. It contained as correct an opinion on the Proteus and Siren, as I had, at that time, been enabled to form. I have now the pleasure of mentioning to you an animal from Lake St. Clair, which has not probably been placed before you. It was brought hither by my friend Major Delafield, who, in addition to his professional accomplishments, is a zealous promoter of natural science.

This creature is a *reptile*, and according to the modern classification, belongs to the order of *Batraciens*, that is, of animals having a heart with a single auricle and a single ventricle, and in most other respects an organization analagous to the toad and frog family.

He grows as I am informed, frequently to the length of two feet; and is thick and chubby. The present specimen is not more than half that length; one of the smallest having been selected for the greater ease of transportation. He is sometimes caught by the hook as fishes are. This has happened at Black-rock, near the north-eastern extremity of Lake Erie. Not long ago, a man carried one of them in a tub of fresh water, from house to house through Lower Canada, and took money for the exhibition of so extraordinary a creature; entertaining the people with a spectacle resembling an eel, with four legs and ruddy gills on the outside of his neck.

From the duration of his life, and the size to which he grows, there is reason to believe the reptile under consideration is not a larva or tadpole, but that he performs the functions of a perfect animal.

He has three rows of external gills, (as the French say *en forme de houppes*,) on each side. They are situated on the posterior edges of flesh projections or processes, and resemble fringe of the nicest texture. Between these gills are two slits or passages, through which water can pass, as in the case of cartilaginous fishes.

The tail is compressed laterally, and is broad and strong.

There are four slender legs; the anterior and posterior which have each four fingers distinctly articulated, without nails or claws. They resemble little hands, destitute of thumbs. The fore-legs are connected with the body, a short distance behind the gills, and the hind-legs about an equal space before the anus.

There are two eyes covered by the common skin, without either openings or lids. They seem adapted to his way of life, requiring in the deep bottoms where he lives, but a few rays of light.

There are two nostrils near the extremity of the snout.

There is no appearance of external ears.

The teeth are arranged in two rows in the upper jaw, and in one row in the lower jaw. In both they are small, close-set, and pointed; but there are neither laniaries nor grinders.

The skin is smooth, and scaleless. It is dark brown, interspersed with spots of a yet darker colour, over the sides and belly. There is a groove of depression along the middle of the back.

The head is broad and flattish. The snout blunt. The upper jaw has lips like the Labrus.

The heart has but one ventricle and one auricle; and blood vessels proceed from the former directly to the gills.

The intestines had been removed; so that it was impossible to trace satisfactorily the other parts of the internal structure. A whimsical opinion prevails that this reptile is very poisonous. He is shunned and abhorred accordingly. Measures have nevertheless been taken, to procure more and larger individuals, which, it is expected, will enable a series of complete dissections to be made.

To throw light upon this inquiry, we have in our collection, the Proteus anguinus of Carniola, with a description by the learned Schreibers of Vienna.

We have the elaborate monography of the same animal, with drawings and figures of every part, by yourself,* and the profound inquiry into the history of the Water-Salamamander and its larvæ by your colleague, Professor Rusconi, is also in our hands.

From such a survey as I have been capable of making, I am inclined to consider him a Proteus; but of a species different from that known to European naturalists.

The Genus, as constituted by Laurenti and Cuvier, consists of a single species, the subaqueous reptile of Carniola. The one I introduce to you, must be considered a second species of that genus, unless a further examination shall render it necessary to constitute him a new genus.

You may expect to receive additional information on this subject, as soon as it shall be in my power to give it. In the mean time I intreat you to accept favourably this humble contribution to the great works in which you are engaged.

SAMUEL L. MITCHILL.

Art. XXIV.—*Detection of a mistake into which Naturalists have been led, in relation to the Mus bursarius, or pouched Rat of Canada: by* Samuel L. Mitchill, *President of the Lyceum of Natural History, Professor of Botany and Materia Medica, &c. &c. &c. in a letter to* J. Milbert, Esq. *Corresponding Member of the Society of the Museum at the Royal Garden, &c. in Paris; dated New-York, 7th October*, 1821.

[Read before the Lyceum of Natural History, October 8, 1821.]

My Dear Sir,

Sometime ago, a small quadruped was brought to me from the country beyond Lake Superior, which I immediately knew to be the *Canadian Rat*, with large pouches on the sides of his neck.

* We have Professor Green's memoir on the amphibia of North-America, printed in the Journal of the Philadelphia Academy of Natural Sciences, (Vol. I. part 2. p. 358.)

In the 5th volume of the transactions of the Linnæan Society, p. 227, is a description of this creature, called the *mus bursarius*; done from a drawing communicated by Major-General Thomas Davies, F. R. and L. S. The figure is of the natural size; and represents the turgid bags projecting from the sides of the neck. They are so enormous, that the animal must have been very much incommoded by them, both in travelling and in eating.

Afterwards a dead specimen was sent to England by Lady Prescott, from Canada, where he was killed by an Indian in 1798. A description of this preparation was made by George Shaw, M. D. and inserted with figures in his General Zoology, part 1. vol. 2. p. 100. In those drawings, the sacs are delineated as distended like two blown bladders, giving the Canada Rat, as he is called, a very grotesque appearance.

Notwithstanding all this testimony, doubts were entertained in France, concerning the real existence of such an animal.

To remove these doubts, of the article in my possession, a just drawing thereof, was forwarded to Paris, for the great zoologists there. A paper containing an account of his character and appearance, was published in the Medical Repository for January, 1821, p. 249—250. The pouches are very conspicuous in both.

What could be plainer than all this? It would seem there was no room for a deception. Yet in this very case a material error exists, which it is the object of this communication to expose.

I had supposed the sacs as they appeared in the dried specimen, were natural; and that the openings into them were from the throat, somewhere between the cheeks and gullet. But when Governor Cass and Professor Douglas, from whom I received the article, were discoursing with me about it, a few days ago, the former gentleman observed that the pouches did not appear externally in the living animal; that they were concealed within the skin; that the orifices were on the outside of the neck; and they had been inverted, like pockets turned inside out, for the sake of preserving them from the knife when the skin was taken off, and of drying them more effectually in the stuffed preparation. On learning the manner of disfiguring, transforming, or caricaturing the animal, I became immediately satisfied that he had no pretensions to be considered an undescribed or a distinct species. For in most other respects, he seems to agree with the Hamster of Georgia, called by some the *Gopper*, which was described by me in 1804, and published that year, with a figure, by A. Anderson, in the New-York edition of Bewick's General History of Quadrupeds, (p. 525.) For President Meigs's and Governor Milledge's exertions to investigate the history of this shy and troublesome little animal, you may consult the 5th volume of the Medical Repository, p. 89.

The chief use of his bags or pouches is to carry earth and sand. He is a great digger and travels much under ground. To enable him to make his excavations more completely, he fills his bags with earth, and brings it up. He empties them by pressing out their contents with his fore paws. It does not appear that they are the receptacles of food; for they have no connexion whatever with the mouth. Let me entreat you to explain this matter as soon as you can, to your correspondents, that this travestied rat may no more appear in the books of zoology; and let me at the same time solicit the continuance of your good will.

SAMUEL L. MITCHILL.

INTELLIGENCE AND MISCELLANIES.

I. *Domestic*

1. Opinion of Professor Buckland of the University of Oxford, respecting certain features of American Geology.

Extract of a letter to the Editor, dated Shrivenham, near Farringdon, Berks, (Eng.) June 4, 1821.

Sir,

I having lately received, from my friend, the Rev. Professor Buckland, the annexed interesting detail respecting the Geological Analogy recently discovered to exist between the two great Continents of the old and the new world, (as they are called.) I have determined at once to direct to you the transcript in question from Professor Buckland's Letter to me which is as follows.

COPY.

"I lately received a very valuable box of specimens collected by Major Delafield from the Lakes of North America; chiefly lime stone, full of organic remains; and both stone and shells so precisely similar to those of the transition limestone of Dudley and Longhope, that it is quite impossible to distinguish them. Octhoceratite, Chain cord Encrinites, Terebratulites, (No. 42. pl. 13. vol. 2, of Parkinson's Organic Remains,) and millions of minute and almost microscopic millepores crowd all these specimens, and prove decidedly the masses whence they are taken to be the transition lime stone of England.

"Similar specimens were sent to London by Lieut. Franklin from Cumberland House, where he quartered last winter, in his way to the Copper mine River; and by Captain Perry from his new Islands, within Barrow's Straits.

"The same limestone, containing the same shells, occurs largely in Sweden, and the Islands of Oland, Gothland, and Bankolm, and in the country round Petersburgh; there and in England, the rock is characterized by containing also the Dudley fossil, and trilobite, of which no specimen is sent in the small set (only 15) which I received from the American Lakes.

"No doubt, however, it will be found there. Thus the transition limestone assumes an immense importance in thus extending (with precisely the same features) from the old to the new world, under nearly the same parallels of latitude, and containing at such great distances the same organic remains! The specimens sent, were chiefly from Drummond's Islands, and Thessolar Island, on Lake Huron."

Mr. Buckland adds in his letter, from which the foregoing is an accurate copy, "Perhaps the above circumstances of the interesting and important analogy in the formation of Northern Europe and America may be worth communicating to Professor Silliman, for his Journal, which I hope may be continued as ably as it is begun."

2. *Massive yellow Oxid of Tungsten.*—On page 52 of the present volume and number, we have already mentioned a yellow pulverulent oxid of Tungsten, which occurs, as an incrustation, upon the ferruginous and manganesian oxid of that metal (wolfram) found in Mr. Lane's mine at Huntington. We have now discovered the massive yellow oxid of Tungsten among some specimens brought us for examination by Mr. Lane.

The colour of this mineral varies, from orange yellow, and chrome yellow, to yellowish grey; it is brittle, fracture between conchoidal and small foliated, lustre adamantine; it has very much the appearance of broken sulphur or of broken massive carbonat of lead; it is without smell or taste, is infusible and unalterable by the blow-pipe; specific gravity of the purer specimens 6. water being 1. insoluble in acids, but by digestion in nitric acid, the powder, which is greyish, assumes a very brilliant yellow colour, and would probably afford a fine pigment.

It is readily soluble in warm liquid ammonia, and is precipitated white by acids; the precipitate, by standing, re-acquires the yellow colour.

The gangue is quartz, and minute veins of this substance and of what appears to be the ferruginous tungsten are disseminated through some of the masses; the specific gravity of the impure specimens falls between 5. and 6. We have one specimen engaged in quartz and much broken, which, (we say it however without laying much emphasis upon the impression,) appears to be *part of a crystal*; we conjecture *an octahedron;* this fragment is about one inch in diameter.

We understand from Mr. Lane that this mineral is found in tolerable abundance in his mine.

REMARK.

After digesting acids upon the powder of this oxid of tungsten, we examined the liquid for lime, but, without discovering any; at present therefore, we do not see that it ought to be confounded with the calcareous tungsten, which indeed appears very differently: A more accurate examination than we have been able to make would be necessary in order to decide whether the tungsten is in this case combined with any foreign substances. This massive variety and the pulverulent variety mentioned at page 52, appear to constitute a new species.—*Editor.*

3. *New locality of Fluor spar*.—This interesting mineral, which Patrin,* a French mineralogical traveller said some years ago had not been found on the Western Continent, appears, on the contrary, to be of frequent occurrence. We have already announced several new localities—three in the present number, and we now add another.

Fluor spar occurs at Putney,† Vermont, and was discovered by the Rev. Elisha D. Andrews of that place. His letter to the Editor states that it occupies the fissures in ledges of slate that the principal vein is six or eight inches wide and that after being followed four feet it decreased to one or two inches and had every appearance of running out.

Geological and Mineralogical Notice.—From specimens transmitted by Mr. Andrews we are enabled to state that the rock in which this fluor spar occurs is a primitive slate which appears to be a mica slate, just passing into a clay slate : the tortuosity and lustre of the mica are still discernible while it has lost its elegance. In primitive slaty regions, rocks of this middle character are of frequent occurrence, but we do not remember that fluor spar has ever been found in them or in any slaty rocks before.

This fluor spar is of a grass or emerald green with here and there a tinge of purple ; but green is almost the sole colour and in this respect it is remarkable this being rather a rare colour of fluor spar and not found, we believe in this country, except near Northampton by Dr. David Hunt.

The Putney fluor is not crystalized, although it has the usual crystaline structure and exhibits on its surfaces an evident tendency towards crystalization. Its phosphorescence is very lively and agreeable ; on a hot shovel in a dark place it exhibits violet light besides other shades ; some pieces emit nearly pure white light ; large pieces easily become luminous and remain distinctly visible after being brought into the day light.

We have still another locality of this mineral ; it is found in Ontario County New-York, but we have mislaid both the

* See his mineralogical travels.

† Putney is on the west bank of Connecticut river, thirty-three miles south of Windsor, and ninety-three north of Hartford.

mineral and the label describing its location more distinctly. It is crystalized and its colours are deep purple almost black. Dr. Hunt of Northampton, furnished the specimen two years ago.—Ed.

4. *Black Oxid of Manganese.*—Respecting the locality of this mineral, mentioned on page 54 of this volume we have received some additional particulars from Mr. *Calvin Prescott*, (in the other memorandum, called my misnomer Calvin Pease,) his letter is dated Sept. 10, 1821, the following is an extract:

"*Sir*,—The Manganese is situated on both sides of a rivulet descending from a large mountain on the east side of the town of Sheffield, County of Berkshire in Massachusetts. It is formed partly in a stratum of rusty sand and partly disseminated through a rock in veins and bunches. It is uniformly of the same quality as the sample which I sent to you, and though the ore is not very abundant at present, yet it will pay well for digging."

5. *Geological Survey of the County of Rensselaer, State of New-York.*—We mentioned (page 239, Vol. III.) that a Geological survey of the County of Albany, with a particular reference to the improvement of agriculture had been made by Dr. Beck and Prof. Eaton.

We are informed that a similar survey, is now making of the County of Rensselaer. The efforts are very creditable to those by whom they are directed, and among them, certainly no one has stronger claims on public approbation and gratitude than *the distinguished individual*, at whose sole expence, we are informed, both these enterprises were undertaken.

6. *Cure for the Bite of the Rattle-snake*, by means of the Uvularia perfoliata, mentioned at pa. 61 of this Vol.

Extract of a letter to the Editor, from Professor D. B. Douglass, of the Military Academy at West Point.

Will it afford yourself or Dr. Ives any pleasure to see a specimen of the genuine plant with which the Indians perform the cure of the Rattle-snake bite—it is perhaps well known to you?—I have, however, preserved some stalks, though not being able to see it in the flowering season, they will only enable me to know it again when I see it. It resembles very much the plant called *Solomon's seal,* only that the leaf *embraces* the stalk. As to the cures I have been witness of those in having been, during greater part of the summer in the tour of 1819, in a region most fruitful of those reptiles. The water snakes were *not quite* as numerous as in Carver's time, but the great water lilly, upon whose floating leaves that traveller saw them basking, was growing in great perfection.

Remark.—The above fact was considered important on account of Prof. Douglass having been a personal witness of the cures ; he alludes to these facts in his letter, on pa. 57 of this Volume. It is to be hoped that he will state his observations more at large.—*Ed.*

7. *Notice of Morse's New Gazetteer.*—A New Universal Gazetter, by J. Morse, D. D. and R. C. Morse, A. M. in one alphabet, and in one large 8vo volume, of more than 800 pages, has just been issued from the press in this city. It is believed that this is the only Gazetteer yet completed in the English language, in which Europe is described according to its modern divisions. The common Gazetteers published in Great Britain take no notice of some of the most important changes introduced at the Congress of Vienna. The basis of the present work, so far as relates to the Eastern Continent, is the New Edinburgh Gazetteer, now nearly completed in six volumes, and executed with industry and ability by six different authors of literary eminence, each taking a different department. Much assistance, especially in the more complicated parts of European Geography, has also been derived from the works of German Geographers. The portion of the work relating to the United States, is unusually full, and has been prepared with great labour from information collected by extensive personal travels, and by correspondence with intelligent gentlemen in the various states, as well as by a cousultation of all the valuable works which have lately appeared, illustrating the geography of the different parts of the country. At the close of the work is an Appendix, containing an account of the monies, weights and measures of various countries, with tables illustrating the population, commerce and resources of the United States, and also in a tabular view, a summary result of the researches of the senior author, in re-

lation to the number and position of the various Indian tribes in this country.

The excellent typograpical execution of the work on a good paper, gives it an attractive appearance, and is very creditable to the publishers as well as to the authors.

8. *Notice of Morse's New School Geography and Atlas.* p. 368. Richardson & Lord, Boston, 1820. Price $1,75.—This is the twenty-second edition of the School Geography, and is published by Jedidiah Morse, D. D. and Sidney E. Morse, A. M. The present edition, with much labour and care, has been taken into a new draft, and all the modern improvements of importance have been introduced. In this work the world is represented under three distinct views.—1. An Introductory view of each quarter or grand division of the globe; 2. A view of each country in detail; 3. General Views or recapitulations. The General views occupy about one third of the work, and constitute the feature which particularly distinguishes it from former editions, and which give it a decided preference over other school geographies. All that is important relating to the population, commerce, literature, religion, &c. of the countries of the world, is here condensed, explained by remarks, and accompanied by questions, so as to render it easy for the youth to understand. The General views are followed by about fifty pages of questions on the maps of the Atlas. The Atlas contains 8 maps, viz. Of the globe; Europe; Asia; Africa; North-America; South-America; The United States; and the British Islands. These are corrected by the Authors, and are very neatly engraved and coloured.

This Compend of School Geography, we understand from the published Report of the Superintendant of Schools in the State of New-York, has been examined by him, and recommended for general use in the Schools throughout that State. So far as our knowledge extends, we think his judgment and decision wise, and that the work will prove extensively beneficial.

9. *American Geological Society.*—The annual meeting of this Institution was held in the Cabinet of Yale College, on the evening of September 12, and the officers of the last year were all re-elected.

In addition to the donations to the Cabinet, a box was announced from Professor Samuel Brown, of Transylvania

University ; it contained organized remains from Tennessee. A second box, from Prof. Dewey, of Williamstown, has also been received.

Some fine crystals of the North-Carolina Zircon from Dr. T. D. Porter, and some fine specimens of sappar, &c. from Chesterfield, Mass. presented by Dr. Alfred S. Monson, were reported, besides a box of mineralogical and geological specimens from James Pierce, Esq.

II. *Foreign Literature and Science.*

[Communicated by Professor Griscom.]

The following premiums are offered by the "Society for the Encouragement of National Industry" in France.* Premiums for 1821.

MECHANIC ARTS.

1. For the construction of a Hydraulic press, particularly adapted to the expression of olive and grain oil, and the compression of grapes and other fruits. Two thousand Francs.

2. For the construction of a water-mill, which shall not obstruct the current of rivers, nor impede navigation, floatage or the irrigation of meadows. One thousand Francs.

CHEMICAL ARTS.

3. For perfecting the materials employed in engraving *en taille-douce.*—The conditions to be fulfilled are, 1. a procedure by which the copper plates may be prepared of a density suitable to the wants of the art, and arising from the nature of the metal and not from the violent pressure of the smoothing process. 2. To perfect the varnish and the manner of applying it so as to prevent its scaling, as well as the accidents which frequently happen when the plates are corroded.

* We have imagined that our readers will be gratified in the perusal of this list as it serves to shew the warm interest which is felt in a nation, with whom we are on terms of friendly and profitable intercourse, in the advancement of the useful arts. The generous labours of the "*Societé d'encouragement*" of Paris afford a powerful stimulus to national industry and talents. The premiums which they offer and the annual exhibitions of the finest productions of the manufactories which they superintend, we should be glad to see extensively imitated in each of the United States, having no doubt of the efficacy of such institutions upon national prosperity.

4. To show the effects of various acids on copper plates, both pure and mixed and of different degrees of strength. Fifteen hundred Francs.

5. *For the fabrication of Russian Leather.*—There is reason to believe that the pyrolignous acid derived from astringent bark, may be very advantageously used in this process. It appears evident from the writings of Pallas, and others that *Whey, and Tannin* derived from the bark of the willow or the leaves of the *Statice Limonium* and the oil of birch bark and the smoke of the branches of that tree are constantly employed in the process followed in Russia.

Two premiums, one of three thousand and the other of fifteen hundred francs are offered for the two best specimens of leather of cow, veal, sheep or horse skin, (one of each kind) prepared with pyrolignous acid, as it issues from the wood, or after the separation of its constituent parts.

6. For the discovery of a metal or an alloy of metals, much less oxidable than iron and steel, and suitable to be employed in instruments for dividing soft animal and vegetable substances, used as food in domestic economy in many of the rural arts. Instruments used for pounding, cutting, rasping, grating, &c. are those alluded to; and of which iron and steel from their great liability to rust are often very objectionable. Three thousand francs.

ECONOMICAL ARTS.

7. For the discovery of a substance which can be moulded like *plaster* and capable of resisting the air as well as stone. Two hundred francs.

8. For the preservation of meats by drying. Five thousand francs.

9. For the discovery of a vegetable substance, either natural or prepared, which may be substituted with advantage for *mulberry leaves* in the feeding of silk worms. Two thousand francs.

10. For the best elementary and practical instruction upon the art of sounding or boring for water, so as to determine the existence of sufficient and permanent springs. Two premiums of three thousand and of fifteen hundred francs.

11. For the best cultivation of oleaginous plants. Twelve hundred francs.

12. For the best sowing or planting of the northern pine, known under the name of *Lariceo.*

13. Do. for the best Scotch pines (Prius Rubra.) Fifteen hundred and one thousand francs.

Premiums transferred to the year 1821.

14. For the construction of a machine for shaving skins employed in *hatting*. One thousand francs.

15. For the fabrication of steel wire fit for needles, that shall be equal to those imported; six thousand francs, provided the quantity of wire produced in the manufactory by the first of May shall have amounted to ten thousand francs.

16. For a process for dying wool with madder of a deep scarlet without employing Cochineal. Six thousand francs.

17. For the preparation of flax and hemp without steeping. Fifteen hundred francs.

18. For the preservation of Alimentary substances by a process analogous, to that of Appert. Two thousand francs.

19. For the discovery in France of a quarry of stone suitable for lithographic printing. Six hundred francs.

20. For the construction of a mill for cleaning buckwheat. Six hundred francs.

Premiums for the year 1822.

21. For the construction of a machine for working optical glasses. Two thousand five hundred francs.

22. For the construction of a mill for grinding and pounding grain which may be adapted to all kinds of rural necessities. Four thousand francs.

23. For perfecting the art of preparing animal intestines for cat-gut, strings, &c. Fifteen hundred francs.

24. For the fabrication of bar copper for the use of gilders. Fifteen hundred francs.

25. For wool best adapted to the use of hatters. Six hundred francs.

26. For the best memoir on the most advantageous mode of raising merino sheep, and of cross breeding with those that are indigenous to France, a gold medal of the value of three hundred francs.

27. For the fabrication of sewing needles. Three thousand francs.

28. For the application of the steam engine to the art of printing. Two thousand francs.

29. For tinning looking glasses by a method different from that in common use. Two thousand four hundred francs.

30. For the preparation of animal charcoal with other substances than bones and the purification of animal charcoal that has been already employed. Two thousand francs.

31. For the preparation of fish glue. (Ichthyocolla.) Two thousand francs.

32. For the construction of a hand mill for shelling leguminous seeds. One thousand francs.

33. For the preservation of woollen stuffs. Three thousand francs.

34. For the preparation of paper from the bark of the paper mulberry. Three thousand francs.

35. *Potatoe.*—Don Joseph Pavou, author of a Flora of Peru, has found the potatoe in a wild state in the province of Lima and in Chili, where it is called *Papas.* It was likewise discovered in 1809, in the environs of Santa-Fe′ de Bogota.

36. *Caràibes Insects.*—M. Geoffroy de Velleneuve has lately sent to Paris a small quantity of insects, of a species of Caràibes, with the following note : Being in the village of Postudal, some leagues from St. Louis, occupied in collecting insects, and having the negroes to assist me in my researches, one of them brought me a van containing many thousands of little insects of the kind called Caràibes. On questioning the negroe I learned that this insect is used in the making of soap. He shewed a piece of it of a blackish colour, but of a quality as good as European soap. I was assured afterwards that this insect is used for the same purpose along the whole Senegal coast. The insect is black, with corselet edges ; the wings have a reddish colour ; the claws and the antennæ are of a pale colour.

37. *Hospital at Hamburgh.*—The Magistrates and Burgesses of Hamburgh have assessed themselves in the sum of eight hundred thousand thalers current, (about three millions two hundred thousand francs,) destined for the erection of a new hospital for the sick poor. The citizens of Ham-

burgh have long been distinguished for the exercise of charity, and on this occasion they have evinced so much zeal and liberality, as to deserve the most honourable mention. No poor person is found among them without food, clothing and fire; no sick person without assistance. Mendicity is unknown in Hamburgh, and every person in a condition to labour finds the means of employment.—*Rev. Encyc.*

37. *Munich.*—The German Journal entitled Morgenflatt gives the following view of the actual state of public instruction in Munich. The College and the Lyceum are both devoted to classical instruction, containing at the commencement of the present year about one thousand students. The elementary and popular schools were frequented by five thousand two hundred children. The gratuitous Sunday schools established within twenty-five years for female servants and other young girls who have received no elementary instruction nor learned to work with the needle. These schools of such vast moral utility, had above one thousand pupils. The school of the same character for boys, when they learn not only to read, write and calculate to teach also the elements of drawing and practical mechanics, were frequented by thirteen hundred and eighty apprentices, and three hundred and fifty of them companions of all professions. From this view it is evident no individual remains in Munich without instruction, since in a population of forty thousand, near nine thousand attend the public schools.

37. *Vaccination a remedy for the plague.*—Dr. Strubon at Constantinople and Dr. Lafond at Salonica, have made many experiments which tend to prove that vaccination is an excellent preservative against the plague.—*Rev. Encyclo.*

38. *College of Chios.*—The college of *Chios* in the Mediterranean, continues to prosper. The physical and mathematical sciences, Belles Lettres, the Greek, Latin, and French language, moral philosophy, drawing, &c. are successfully taught. The number of students is four hundred and seventy-six. Many of them are from Peloponnesus, Cephalonia, and the Islands of the Archipelago; and what is remarkable, two young men have come from America to study the language of Homer in the Capital of Chios, one of the seven cities which contend for the glory of having given him birth. M. Varvaki, a native of Ispara, not far from Chios, and a rich Greek merchant, has contributed six

thousand dollars, for the use of the college, beside a great number of books.

39. A translation of the works entire of Sir Walter Scott, preceded by a historical notice of the author, and ornamented with his portrait, is about to be published at Paris.

40. *M. Bonpland*, the distinguished naturalist, who accompanied Baron Humbold in S. America, has established himself with his family at Buenos Ayres, where he is engaged in forming a garden of rare and curious plants. He has already collected a great number. His researches have brought to light a plant which grows in water, and which contains a great quantity of tannin. He proposes to profit by it in forming a tannery at Parana.

41. *Lithographic printing of MSS.*—A society has been formed at Munich, for printing by the Lithographic process all the best manuscripts of the Turk, Arabic, Persian, and Tartar languages, and to spread them throughout the East by way of Trieste. The introduction of printing has been constantly opposed in those countries by the interested efforts of copyists, but still more by the difficulty, and indeed impossibility of imitating by common types the various ornaments which the Turks and Arabs are accustomed to attach to their manuscript books.

Lithography affords the means of imitating them in perfection, and there is reason to believe that the very moderate price at which lithographic copies may be furnished, will procure for them an extensive demand in the East, and contribute much to extend the light of knowledge in those regions.

42. *Vienna*—The Emperor has given orders for the erection in this city of a temple, exactly similar to that of Theseus at Athens. The celebrated group of Theseus by Canova, is to ornament the interior of this edifice.

43. *Sculpture.*—Ceccarini, a young Roman sculptor, and a pupil of Canova, has expressed his gratitude to his distinguished master, by executing his statue of a colossal size. Canova is seated before a torse of Jupiter, the work of which he appears to admire.

This group is greatly admired for dignity of expression, as well as for its originality, and the skill with which the drapery is disposed.

44. *Natural History.*—M. Drapier, Professor of Chemistry and Natural History, and one of the editors of the "Annales generales des sciences physiques," has substituted with success, in lieu of the poisonous matters employed in preserving objects of natural history, a soap composed of potash and fish oil. He dissolves one part of caustic potash in water, and adds to the solution one part of fish oil: he rubs the mixture till it acquires a pretty firm consistence. When it is completely dry he reduces it to powder, with a rasp. One part of this powder is employed in forming a soft paste or liquid soap, by means of an equal quantity of a solution of camphor in musked alcohol. This liquid soap is well rubbed upon the skin of the bird, previously cleared of its fat, and the other part of the soap and powder is plentifully scattered between the feathers. Thus prepared, the bird is placed in a moist situation in order that the particles of soap may soften and attach themselves perfectly to the feathers, the down and the skin. It afterwards is put in a dry place. By this means it completely resists the attacks of larvæ, and has neither the danger nor the inconvenience of arsenical preparations, which, as is well known, stain and spoil the extremities of the feathers and down.

45. *Anatomical model, representing particularly the myology of the human body.*—M. Ameline, Professor of Astronomy of the School of Caen, has just invented and composed an anatomical model of a human body, of the natural size. This model is formed, 1st, of real bones, which constitute the skeleton. 2d, of muscles made of pasteboard, which after being softened and fashioned true to nature, are covered with fine blades of hemp, so as to imitate the muscular fibres, and afterwards painted of a natural colour. 3d, of threads and cords of cat-gut, covered with coloured varnish, so as to resemble arteries, veins, and nerves. 4th, of real hair on those parts to which it belongs. By means of this exact image of the structure and colour of the organs which compose the human body, students may examine with facility parts which it is very difficult to observe accurately in a dead subject. This model presents the parts under their various aspects, admits of their being handled, detached and separately studied without altering their natural forms. It serves too for demonstration when the heat

would not admit of dissections, and especially to persons who have a natural repugnance to these operations.

46. *Schools of Mutual Instruction.*—This system continues to spread rapidly in almost every part of Europe. In Italy, Spain, Portugal, and especially in France, it is making a most encouraging progress. The society of Paris is active in its exertions. Agreeably to the statements presented to that society, there are now in the single department of *Seine Inferieure* thirty schools in full activity, containing two thousand scholars, viz. within the district of Rouen eight schools, one of which is of girls; Neufchatel five; Yacetot three; Dieppe four; Havre nine. This progress is due to the zeal and protection of the Baron Maonet. Dr. Hamel who has been commissioned by the Emperor Alexander to travel over Europe, to examine all the schools of mutual instruction, has remarked on the Register of that of Rouen, that it was one of the handsomest and best kept that he had yet visited.

47. *Razors.*—A paste or powder for Razor Strops, very superior to Emery, plumbago and other things commonly used has been discovered in Paris by M. Merimée. It is the crystalized tritoxide of iron, called by mineralogists, *Specular Oligiste Iron.* It is a mineral substance, but an artificial oxide of equal fitness for the purpose may be made thus. Take equal parts of sulphate of iron, (green copperas) and common salt. Rub them well together, and heat the mixture to redness in a crucible. When the vapours have ceased to rise, let the mass cool, and wash it to remove the salt, and when diffused in water, collect the brilliant micaceous scales which first subside. These when spread upon leather, soften the edge of a razor, and cause it to cut perfectly.

48. *Geneva-Museum.*—The halls of this natural establishment, due entirely to the patriotism of the Genevese, (which dates only a year since its commencement,) will soon be insufficient to contain the donations which are daily received. It has already been found necessary to construct an additional hall for the reception of the black Elephant, killed at Geneva at the beginning of the year 1820.

Botanical Items communicated by Dr. Torrey.

49. Prof. Hooker, of Glasgow, has in the press a Flora Scotica, and Mr. Gray is printing a new Flora Brittanica in Natural orders. The first volume of the latter work is already done, and the second nearly ready for publication.

50. R. A. Salisbury, Esq. has finished his great work on Natural Orders and Genera, with quite new locations.

51. W. Swainson, Esq. of Liverpool, has finished the 9th No. of his Zoological Illustrations, containing lithographic figures, and descriptions of new and rare animals, particularly in the departments of Conchology, Eutomonogy, and Ornithology. The drawings and engravings are executed by himself.

52. The 1st volume of Prof. Agardh's Species Algarum, has been received. It embraces the Order TUGOIDEÆ, containing fourteen genera which were all included in the Genus Fucus of Linnæus.

Prof. Agardh spent a part of the last winter in Germany and France, whither he went for the purpose of examining collections of Algæ for his work. The Inspectors of the Royal Museum of Paris, and Baron Humboldt have committed to Prof. A. all their new or undescribed Algæ aquosæ, for description.

53. The sixth volume of the new Systema Vegetabilium, commenced by Roemer & Schultes, and continued by the latter since the death of his colleague, has recently been published. It finishes the class PENTANDRIA. The UMBELLIFERAE are arranged by Sprengel, according to his new system.

54. Prof. Fries, of the University of Lund, in Sweden, has published the first volume of his SYSTEMA MYCOLOGICUM, according to a new natural method.

In the press—A description of the island of St. Michael, comprising an account of its geological structure, with remarks on the other Azores or Western Islands, with maps and plates. Originally communicated to the Linnean Society of New-England. By J. W. Webster, M. D.

APPENDIX.

Notice of the Galvanic Deflagrator of Professor Robert Hare, M. D. *of the University of Pennsylvania, in a letter to that gentleman from the Editor.*

Yale College, October 23d, 1821

My Dear Sir,

I was much impressed by your account of the Galvanic Deflagrator, and of the fine experiments which you performed with it, as described in the 3d Vol. (pa. 105) of this Journal. By means of your kindness in sending me your original apparatus, (the only one which, as far as I am informed, has hitherto been constructed,) I had it in my power, early in the month of June, to repeat your experiments in my public course of lectures. Large numbers of intelligent persons attended, in addition to the classes, and the results gave great pleasure and satisfaction. My health being, at that time, very feeble, it was not in my power to pursue the subject to the extent which I had intended, and expecting to resume it, I had postponed the writing of a notice of your instrument, hoping that by and by, I could do it more to my own satisfaction. But as no one else appears to have repeated your experiments, I have concluded, even at this late moment, to throw a hasty notice into the Journal, although it has not been in my power to add any thing to the experiments performed in June.

I can say with truth that I consider your Deflagrator* as the finest present made to this department of knowledge, since the discovery of the Pile by Volta, and of the trough by Cruickshanks. The vessels being filled with the fluid, before hand, prevents any haste or confusion, and the advantage which your arrangement gives the operator, of immersing, at one quick movement, the whole of an extensive series, is very great. Being perfectly ready, and with the poles in his hand, the teacher only giving a signal to his assistant to immerse the coils, instantly directs the whole power to the desired point, and produces results, which both in brilliancy and energy, totally surpass any thing be-

* Your Calorimotor I have never possessed.

fore effected by the same surface of metal, arranged in the same number of combinations. This will appear the more remarkable, when it is remembered that your apparatus produces these effects without insulation. Although through your civility I have just received the glass jars by which you insulate your coils, I have not yet been able to use them, and can therefore speak only of the results obtained without them.

With your eighty coils of fourteen inches by six, for the copper, and of nine by six for the zinc, I obtained effects which, as to every thing that related to intense heat and light, and brilliant combustion, far surpassed the powers of a battery of the common form of six hundred and twenty pairs of plates—one hundred and fifty pairs of which, of six inches square, are insulated by glass partitions—one hundred pairs of the same size, and three hundred of four inches square, are insulated by resin, and the rest, either by Wedgwood's ware or by resin, making in the whole a battery with a surface of thirty-six thousand eight hundred and eighty square inches. Your's has a surface of only twenty-two thousand and eighty square inches, *but even without insulation* it is incomparably more powerful than the other with that advantage. This is the most singular circumstance connected with your new apparatus, and which goes far to shake our previous theoretical opinions, if not to support your own.

I repeated every important experiment stated in your memoir, and with results so similar, that it is scarcely necessary to relate them. The combustion of the metals was brilliant beyond every thing which I had witnessed before, and the ignition of the charcoal points was so intense, as to equal the brilliancy of the sun; the light was perfectly intolerable to eyes of only common strength. If I were to name any metallic substance which burned with more than common energy, it would be a common brass pin, which, when held in the forceps of one pole, and touched to the charcoal point on the other, was consumed with such energy, that it might be said literally to vanish in flame.

The light produced between the charcoal points when immersed beneath acids, oils, alcohol, ether, water, &c. was very intense, and platina melted in air as readily as wax in the blaze of a candle. It is a very great advantage of your

Deflagrator that we can suspend the operation at any mo ment, with the same facility with which it was commenced. A look, directed to the assistant, is sufficient to raise the coils out of the fluid. All action instantly ceases—neither the metal nor the fluid are wasting any farther, and the lecturer is therefore at ease while he illustrates and reasons, and when he is ready and not before, he proceeds to his next experiment. In the mean time, the instrument, during a certain period, rather gains than loses strength, by the raising of the coils. It seems as if the imponderable fluids, partially exhausted from it by its continued action, had time again to flow in from surrounding objects, and thus to impart new energy. I found the power of the instrument to last for several days, although declining, and the same charcoal points, when well prepared,* would also continue to operate for several days. When the coils, after immersion, had been suspended, for some hours, in the air, a coating of green oxid or carbonat of copper always formed on one part of the outside of the copper coils, and on the same part in all, but no where else. If I do not misremember, it collected next to the negative pole, but was, of course, always removed by the next immersion, though it was formed again at the next suspension.

One circumstance occurred during these experiments, which demands farther attention.

In the hope of uniting the power of your Deflagrator, with that of the common galvanic battery, I connected your instrument with the powerful one mentioned above. Both instruments, *when separately used*, acted, *at the time*, with great energy, producing both their appropriate and common effects, in a very decided manner; but, on connecting by the proper poles, the battery of six hundred and twenty pairs, with the deflagrator of eighty coils, I was greatly surprised and disappointed, at finding the power of both instruments so completely paralyzed, that, at the points where a moment before, and when separate, a stream of light and heat, hardly to be endured by the eye, was poured forth—now, when connected, both instruments could scarcely produce the minutest spark. On separating the instruments, they both resumed their activity ; on again connecting them, it was again destroyed, and so on, as often as

* By igniting pieces of mahogany beneath sand in a crucible.

ie experiment was made. While they were in connexion, provided the coils were lifted out of the acid, so as to hang in the air merely, then the power of the common galvanic battery would pass through the Deflagrator, which appeared to act simply as a conductor, and as might have been expected, when so extensive a conductor was used, the power of the common battery was, in this case, considerably diminished, while that of the Deflagrator did not act at all.

If, while things were in this situation, the coils of the Deflagrator, without being plunged, were lowered so far as merely to dip their inferior extremities, say only one fourth of an inch in the acid, the communication was immediately arrested, and all effect destroyed almost as completely, as when the coils were wholly immersed. Thus it appears that the inability to act, in connexion with the common galvanic battery, depends upon the relation of the fluid and metal, and not upon that of the metals merely. These experiments should be repeated, with the aid of the insulating glasses, placed so as to receive the coils of your machine. I should be very curious to know whether the effects would be the same ; and as I now have the glasses, I shall, as soon as possible, try this experiment. We must look to you, Sir, for the explanation of this singular incompatibilty between the two instruments. At present, I confess myself unable to explain it. It may, very possibly, lead to important results, and may have a bearing, such as I have not now time to discuss, on your own peculiar theory.

I would state that the mode of connecting the two batteries was varied in every form which occurred, not only to myself, but to several able scientific gentlemen, who were present at these experiments, and who were equally with myself surprised and confounded by their results.

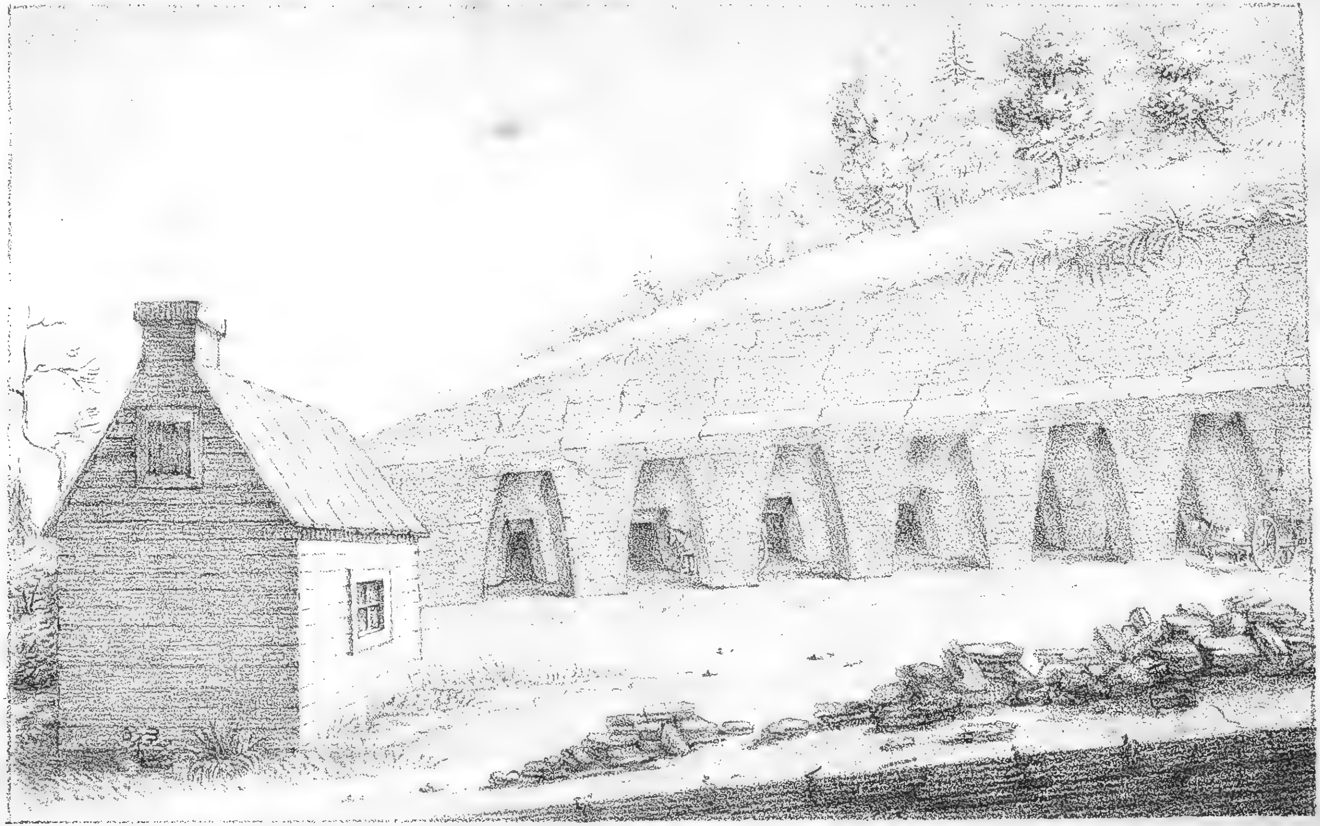
I congratulate you upon the brilliant additions which you have made to our experimental means, in this department of knowledge ; along with your invention of the compound blowpipe, they fairly entitle you to the gratitude of the scientific world, notwithstanding the uncandid attempts which, in relation to the blowpipe, I am sorry to see, are still persevered in, to deprive you of the credit which you so richly deserve.

I remain, as ever, your friend and servant,

B. SILLIMAN.

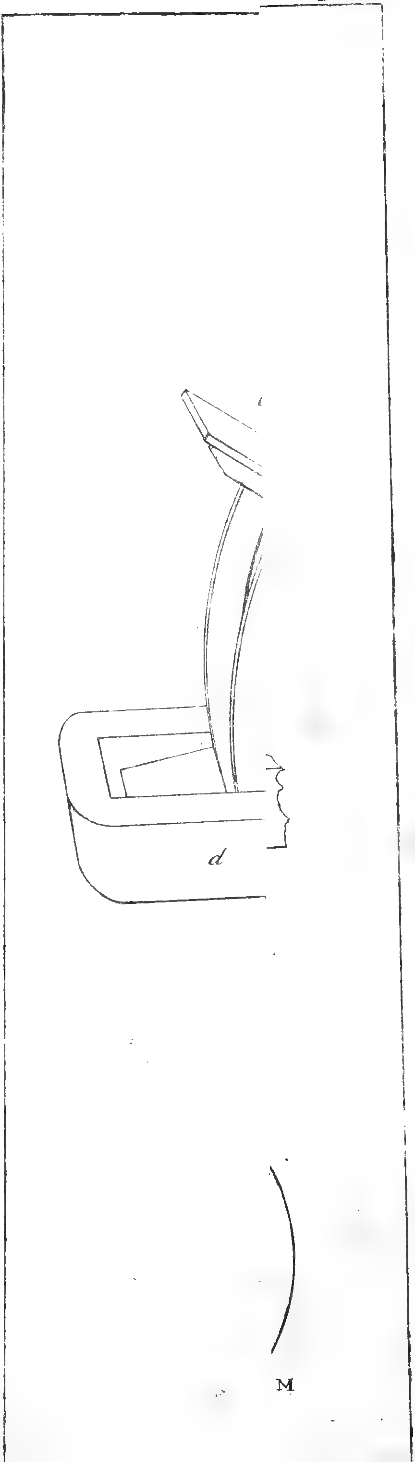
Prof. Robert Hare, M. D.

Pl. I.



VIEW of SMITH's COAL-MINE LUZERNE COUNTY, PENNSY[a]

Pl. III



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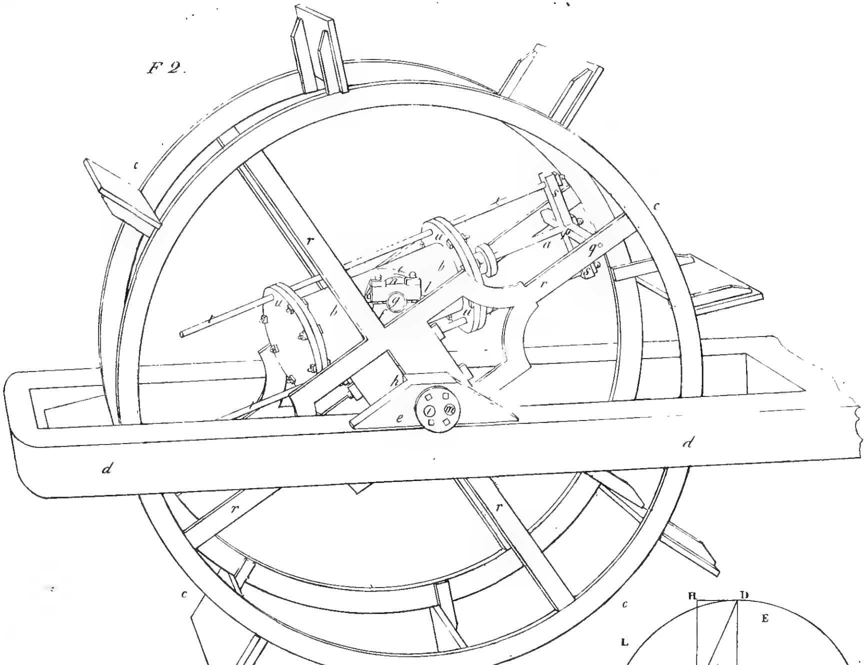

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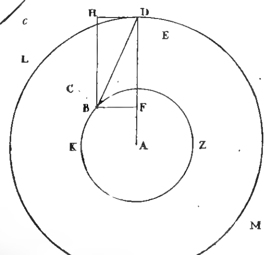
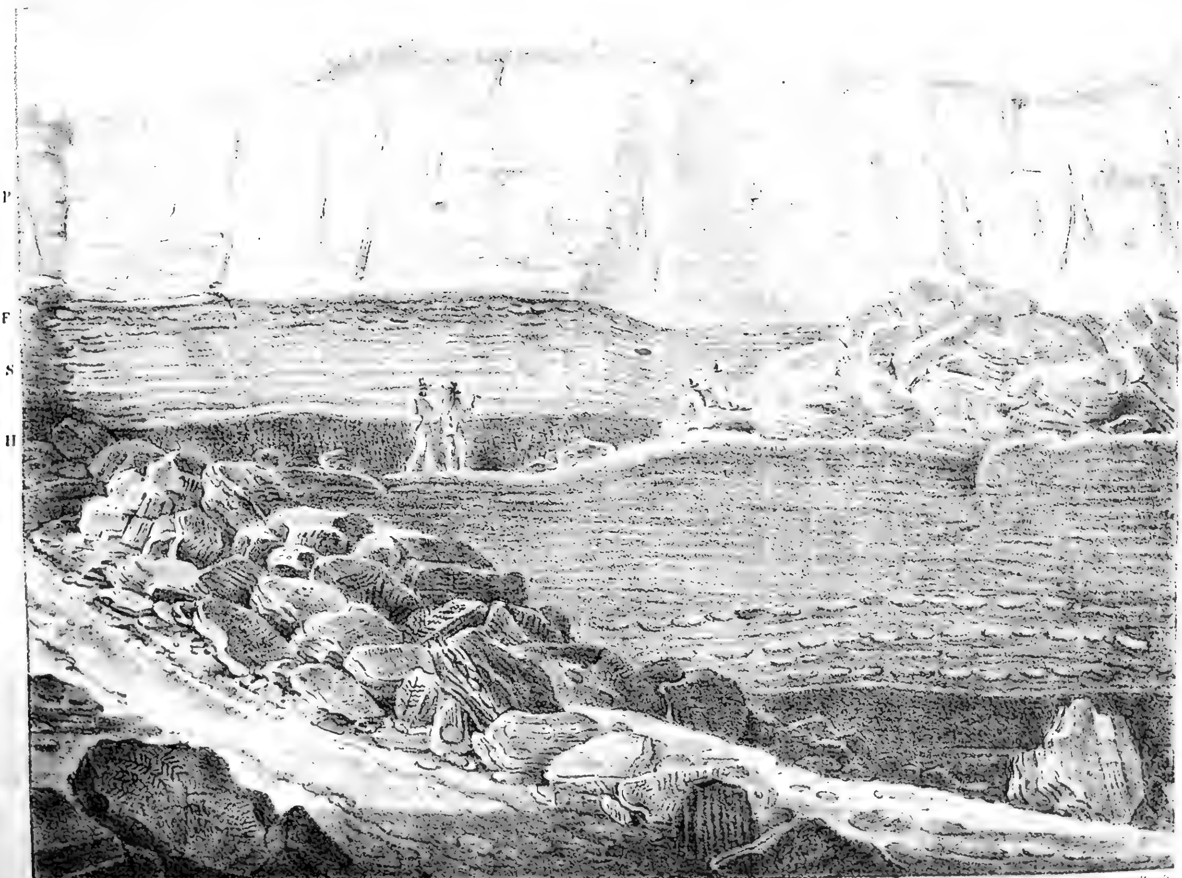


WARD'S STEAM ENGINE.



J. Millert del

Coal-Mine of Treuil, near S^t Etienne department of the Loire

Shewing in P. the large vegetable Stalks in their vertical position.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

GEOLOGY, MINERALOGY, &c.

Art. I.—*On Volcanoes and volcanic substances, with a particular reference to the origin of the rocks of the flœtz trap formation, by* Thomas Cooper, M. D. President of the College of South-Carolina.

[Read in the American Geological Society, December 3, 1821.]

Columbia, (S. C.) Nov. 1, 1821.

Professor Silliman,

Dear Sir,—I send you my Lecture on Volcanoes and Flœtz trap, delivered in my course here, this fall. I think the current of opinion in this country is against mine, and therefore the subject will probably give rise as it ought, to some discussion. I strongly suspect your sentiments on the subject do not at all agree with mine; so much the better: the more able my opponents, the sooner will truth be elicited. I shall draw out a full syllabus of my course of Lectures on Geological Mineralogy, forming the elements of that science for the use of my class, this winter, and shall probably publish it early in the summer.

I am, Dear Sir,

Your friend and servant,

THOMAS COOPER,

President S. Car. College.

My volcanic and flœtz trap collection consists of

One case (about forty specimens) neighbourhood of Rome.
One Do. Italy and Spain.
Two Do. France.
One Do. Germany.
One Do. Great-Britain and Ireland.
One Do. The volcanic Mediterranean isles.
One Do. The volcanic African Islands, with the Isle of Bourbon.
One Do. The West-India Islands, and Ferro.
One Do. Miscellaneous.
One Do. Minerals imbedded in volcanic matter.
One Do. Zeolytes of various kinds, and imbedded prehnites.
One Do. Pseudo-volcanic products.
One Do. American flœtz trap, supposed volcanic; North-East of New-York.
One Do. New-Jersey, Pennsylvania and Carolina.

Which I mention, for the purpose of shewing that I have taken much pains in collecting specimens, to ascertain the identity of origin, of volcanic ejections and the flœtz trap formation.

ON VOLCANOES AND VOLCANIC SUBSTANCES.

On examining the structure of the strata that compose the crust of the earth, we find manifest proofs of deposition from aqueous mixture in some cases, and ejections from igneous fusion in others. Effects may have been produced by the agency of magnetic polarity, or Galvanic electricity; but as we cannot point out any known appearances ascribable to these causes, we must reject them. We can explain phenomena that are doubtful, only by means of phenomena that are known: nor is it allowable in our philosophical reasonings, to take for granted the actual existence of any agent, from the mere possibility of its existence. *A posse, ad esse, non valet consequentia.*

Hence as we are unacquainted with any geological phenomena appertaining to the strata that form the crust of the earth, except such as are owing to the agency of water, or the agency of fire, or the agency of both these causes combined—we must confine ourselves in the present state of our knowledge, to these, the only known sources of explanation that we at present possess ; all others are conjectural only ; without foundation in known facts.

To enable us therefore to explain, any geological phenomenon whose cause is doubtful and obscure, we must accumulate and review the known facts that are manifestly connected with water as the agent ; and also the known facts that are manifestly connected with fire as the agent ; and apply the indubitable and the probable conclusions which these facts afford us, to any case of difficulty presented for our examination.

There are only three ways within our knowledge in which water can have acted upon the stones and earth that form the crust of the globe.

1. By dissolving them.

2. By suspending them.

3. In torrents and in floods, by removing masses of rock from one place to another.

It may be assumed, that

Earth forms not quite $\frac{1}{3}$, and water $\frac{2}{3}$ of the surface of the globe : look at any general map of the globe with this view.

Taking the average depth of the sea, with La Place, at twelve miles, it will not suffice as a *solvent* of the primitive strata alone. In travelling from Richmond to Charlottesville in Virginia, at the foot of the south mountain with Mr. Vanuxem, a distance of seventy miles and upwards, it appeared to that gentleman and me, that we travelled over the edges of the primitive all the way till we came to the transition country. We had not an opportunity of taking the angles made by the strata respectively with the horizon, but we can hardly be much beyond the fact in stating the lowest depth of the primitive there, at fifty miles. But the mineral substances of which the strata of the earth are composed, are upon the average nearly three times the weight of water under equal bulks.

Further, to make a chemical solution of the earths as they are usually found in combination, as *alumine*, in clay slate, mica, and slate clay : *Lime*, in carbonat, sulphat, and fluat, of Lime : *Silex* in quartz, hornstone, agate, &c. *Barytes and strontian* in their carbonats and sulphats : *Magnesia*, in soap stone, serpentine, and chlorite : *Zircon*, in the Hyacinth Zirconite, and Jargon : *Glucine* in the Emerald : *Yttria*, in the Yttriolite—will require upon the average seven hundred and fifty parts by weight of water to one part of the substances in question. But the known quantity of water on the preceding data will be to the primitive formations in, absolute quantity as 18 only to 150: whereas to dissolve them chemically would require six thousand times the weight of water known to exist.

Chemical solution therefore can extend but a very little way, even with the aid of subterranean heat. I acknowledge these calculations are not accurate: but they are founded on the present state of our knowledge; and in such a calculation, minute accuracy is not necessary to the conclusion deduced; which is that the primitive crystalized rocks, constituting so large a portion of our present globe, so far as its strata have been exposed to our view, have not been chemically dissolved, formed, and crystalized in the mass of waters at present or at any time actually known to us.

It may be supposed, that the oceanic waters are less in quantity now than formerly: but this supposition is entirely gratuitous. It may be supposed, that the solvent powers of the water were increased by heat: this also is gratuitous. Nor does it appear certain that the silex is separated from the Geyser spring in crystalized masses. Nor is there any evidence, however slight, that the waters of the ocean ever reached deeper than their present bed: had they held in solution the ancient and lowest granite, they would have been exposed to the direct action of subterranean fires, that burn now, and for ought we know, have never ceased to burn.

The inferences are that the crystalized form of the old Granite and the other crystalized primitive rocks, has always been, and is independent of any aqueous solution in the waters of the present ocean: and we can have no evidence of any other.

But 2dly. The present Strata may have been modified in the component parts and in their present disposition, by having been mechanically mixed with and suspended in the waters of the ocean, and from thence mechanically deposited: and there is sufficient evidence from present appearances to induce us to believe that this has been the case.

The transition and secondary strata, bear such manifest marks of subsidence from a state of suspension in a disturbed and turbulent aqueous fluid—there is throughout the whole of them, such an earthy, aspect ; such a fragmentous and pasty texture—and so many marks of the bottom of the ocean having been violently torn up, from the frequent mixture of oceanic remains in these strata, that there can be no reasonable cause of doubt, as to the mode in which they have been formed.

The torrents and inundations that have thus mingled the earth and the water, are fairly ascribable to convulsions in the strata that support the ocean ; the effect of subterranean fires beneath : because such convulsions have been repeatedly observed as the consequence of earthquakes and volcanoes on the coasts and in the islands of the Mediterranean, and elsewhere.

But all depositions of substances suspended in water, being in a soft state with respect to their mass, in falling down, assume an horizontal deposition—a deposition conformable to the strata on which the soft mass is thus gradually deposited. We see this, in the stratified rocks of the globe ; and this is a known law of the deposition of dust and fragments from aqueous suspension. The direction of these depositions, will be regulated by the force and direction of the inundation, which will also modify the effect of the specific gravity of the substances thus hurried on. A mixture of sand and pebbles with water, in an inclined trough, will sufficiently illustrate the form and character of such deposits.

3dly. Torrents washing away the adjacent soil, and ice-floods enveloping large masses, will nearly account for, the boulder stones, and other masses out of place that are so frequently found : such as the boulder stones on the Rhone Kidd's Geol. Essay, 170—the boulders of Limestone at Keningre in Ireland, and of granite in the Ohio : the masses out of place observed by De Luc and others in the Alps and on Iura, probably arise from these causes. That we must recur to them to account for the rock masses on the main land of Scotland, similar to those found on the islands in the immediate vicinity, appears from Dr. M'Culloch's statements. But we must wait for more light ere we obtain a satisfactory explanation.

Torrents such as these, will account for the long and narrow deposits of surface blocks of Basalt, and other trap stones, that we find extending for many miles in length, and a few yards comparatively in breadth.

Those who have witnessed the fall of trees in the American woods by the effect of hurricanes, extending fifty or sixty miles in length, and from a quarter to half a mile perhaps in breadth, with borders exactly defined through the whole length, will find no difficulty in applying the force of fluids acting in torrents of limited direction and limited extent. For, what happens when forests are levelled by currents of air, happens also when rocks are hurried on by the still greater momentum of torrents of water.

The present observations leave it uncertain in what way the primitive rocks have been crystalized. Until we see how a granite stone can be formed by solution in water, and subsequent crystalization, or how by means of aqueous solution, granite veins can shoot into and permeate newer rocks, we must hesitate in admitting aqueous solution as the cause: and we shall lose nothing in the mean time by confessing our ignorance.

From the laws of action of aqueous fluids thus laid down, it will follow, that the deposits of solid matter from aqueous *solution*, must be more or less crystalline; and from aqueous *mixture*, they must be soft, pliable and pasty. Hence, it will be impossible for mountain masses, amorphous, and rising into peaked or abrupt eminences to be thus formed: for while in their soft state, they will of necessity fall down and subside in strata of comparatively even and uniform surfaces: it is manifest you cannot form an abrupt peak, or a mountain-mass, out of mud.

It will follow also, that as all muddy depositions must assume a plane and uniform surface, so far as the subjacent rock will admit of it, no abrupt mountain mass can have been formed by deposition from aqueous mixture: and the mountain eminences on the surface of our globe, must be accounted for on some other principle. But we have no other principle left to account for them except the action of subterranean fire; to which alone, if this reasoning be legitimate, we must ascribe their elevation: unless indeed we consider them as the waves of a fluid mass turning on its axis; but even this supposition will account for no mountain nob, or peak, or any abrupt eminence: such a cause would produce round-backed mountains but no other. For, this reasoning is conformable to matter of fact within our knowledge.

1. The flœtz or horizontal strata, bear indubitable marks of having been deposited, from aqueous suspension.

2. We know of innumerable mountain eminences owing to the indisputable action of subterranean fire : volcanic mountains raised in continents, and islands out of the ocean : and peaks of lava-basalt formed by sudden cooling.

Being bound therefore to explain the unknown phenomena, by the known, we are compelled to acquiesce in the reasoning here advanced. With these preliminary remarks, I proceed to shew, that *The Flœtz-Trap* formation of the Wernerians, is of igneous origin, and comes under the head of volcanic ejections.

VOLCANOES, are natural vents in the crust of the earth, made by subterranean fires, to afford an exit for the gasses, vapours, and solid substances that have been exposed to the action of intense heat in the bowels of the earth.

Volcanoes are *active*, or *extinct*.

Active volcanoes may be considered as those which have manifested conflagration and discharge of ignited matter within a century of the present time. Prof. Young in a very interesting article on volcanoes in Rees' Encyc. expresses the opinion that the number of active volcanoes is near one thousand. Werner reckoned them at one hundred and ninety three. Brieslak, after M. M. Leonhard, Kopp, and Gaertner in their prospectus of mineralogy in 1817, at one hundred and eighty-seven only : viz. fifteen in Europe, sixty-two in Asia, ten in Africa, ninety-four in America, six in Australasia ; of which one hundred and eighty-seven, ninety five are situated on continents, and ninety-two on islands. 3 Breis. 403. D'Aubuisson reckons up two hundred and five, of which one hundred and seven are on islands. But from Lieut. Gov. Raffles' account of Java, and his remarks on the Celebes and Philippine islands to the east of Java, there is good reason to believe we may add to that number ; but we are not yet able to enumerate more from actual observation.

The seat of volcanoes, by common consent of the latest and best observers, is within or below the oldest granite. 2 Spalanz. trav. 164, 165, at Montemulo 3 *ib.* 235. Faujas St. Fond Volcan's eteints 169. 187. Humbold. relat. d'un voyage I. 90, and in the transl. of his pers. narr. v. 1 p. 238. Breislak. Inst. de Geol. § 203. Desmarets Mem. Ac. Sc. 1771. Pallas's speech to the Imp. Acad. Petersb. 1771. Desaussure voy-aux Alpes ch. 5. § 181. Padre Torrè. Abbe Ordinaire (Dallas's transl.) on volcanoes p. 48. Mem. Geol. Soc. Cornwall, p. 48. Bakewell's Geol. 72.

Because, (*a*) they are frequent in primitive countries, as Auvergne, &c. Brieslak. § 203. 585. (*b*) they are seen to cut through Granite ; forcing their way upward; as at Red Rock, F. de St. Fond Volc. et. 365; and index to the same book titles Basalt, and Granite. At Teneriffe, 1 Humb. pers. nan. 94. 238. Eng. trans. Ger. de Sonlavie § 409. 757. 759. 780, who mentions the village of Antraigues built on basalt which has forced up enormous masses of Granite. A basalt Dyke ten or twelve feet thick, cutting through the chief granite mountain of Arran from bottom to top. The basaltic evidences to be sure are premature as yet, but they may be borne in mind. (*c*) Granite is thrown out with lava in numberless instances, even at Vesuvius, Brande's Jour. No. 10, page 29; as by the Gros Morne near the source of Trois Rivieres mentioned by Humbold in his personal Narrative, V. I. p. 235, 240. (*d*) Many specimens of lava have been observed and are found in cabinets, enveloping, and enveloped by Granite. 1 Humb. pers. nar. 236. Ger. de Sonlavie § 757, 758, 759, 780, &c. &c. Dr. M'Culloch in No. 19, p. 29 of the Journ. of Sciences by Brande, Basalt veins in Granite Brande's Catalogue of Minerals of the Roy. Inst. 145, 165. Wacke vein in the old Granite, at Rocky Run, one mile from Columbia, South-Carolina. (*e*) Cordier has ascertained that the component parts of Lava and of Granite are the same, Felspar, Amphibole, Mica, Pyroxene, Peridot, Titaniferous oxyd or Iron, and oligistic, or oxydulated Iron. See Cordier's paper, sur les substances dit en masse que entrent dans la composition des roches volcaniques de tous les ages.

Volcanoes are usually situated in the vicinity of the ocean, and sometimes sea water breaks into them. (Ree's Ency. Volcano.) Lakes also break into them and fish are ejected according to Humbold Pimelodus Cyclopum (H.) It does not appear that any characteristic effect of Volcanoes depends on their proximity to the ocean. Breisl. § 644 et seq.

Volcanic eruptions usually co-exist with Earthquakes. 1 Humb. per. nar. 227. 2 Ib. 226. Breisl. § 567. Bakewell's Geol. p. 234. 51 Phil. trans. pt. 2 p. 566 ann. 1760. 49 Ib. 1755 p. 351 to the end of the volume. Art. Volcano and Earthquake, Rees' Encyc.

The exit for the ejected matter is usually the top or sides of a conical mountain, of which the top opening is the Crater. In process of time, the craters of mountains that have long ceased to be active, fall in, by being undermined, or by atmospheric action, and are gradually obliterated; in which case the volcano becomes extinct, and the traces of its existence rest upon the evidence of the volcanic character of the ejections in its vicinity.

A volcano in operation, gives out smoke and flame. Bibl. Britan. tom 30. derived from its contact with coal strata; for we know of no substances capable of combustion and of giving out smoke and flame from the Granite or beneath it, till we arrive at Werner's independent coal formation.

It is usually accompanied by electric light; I know not from what source derived.

The ejections are Lava, consisting of fluid, or half fused, or softened minerals, or stones ignited only, and stones unacted on, from the Granite rock below through the whole series of formations whose edges are exposed to volcanic action. What has taken place at Chaud Coulant, between Buzene and Fraissinet in Auvergne. 2 Soulav. § 1166, must take place more or less in every active volcano. "You find ejected spongy basalts, solid basalts, granite, calcareous rocks, mud lava, and confused mixtures of all kinds of matter in the valley below: calcareous matter in Lava, in all degrees of vitrification, and all kinds of substances volcanic and non-volcanic mixed together.

The Lava is glass (Obsidian) or partly fused and imperfect glass as the resinites, Spalan. tr. 250. V. 3. or porcelanous substance, or cinders, or rough hackly slag or scoria, or columnar basalt, or vesicular basalt, or compact basalt; with stones of various kinds acted on by fire in various degrees.

The basaltic Lava, is often columnar, both in the sea, and in places where no water could have reached; in figurate prisms of 3, 4, 5 or 6 sides: rarely more; generally of

5. The cause of the columnar and prismatic figure of volcanic basalt is as yet undetermined.

Basalt affords strong suspicion of its having been formed out of primitive, or transition Hornblende rocks: from its appearance—from hornblende accompanying it—from its analysis Lavas however, have been found by Cordier after mechanical examination by means of a microscope, to be composed chiefly of felspar, and black augit or pyroxene and oxyd of Iron. This mineral (augit) of other colours than black, is found occasionally in primitive strata, but the black crystals of augit seem to be peculiar to Lava, and characterize it. Hence, augit has been considered as an igneous product of volcanic action; a conjecture that derives strength from the fact that Dr. Thomson found crystals of augit sublimed in a chimney of a house on Vesuvius that had been exposed to a current of Lava. Insulated crystals of augit, are thrown out by volcanoes in prodigious abundance. Breisl. 675. so, near Rome and at Frescati crystals of Leucite are thus thrown out, from the extinct volcanoe of Mons Latialis. Ib. The chemical analysis of Hornblende and Augit is so much alike, that I cannot help suspecting a common origin; and that black pyroxene may have been formed by the igneous fusion of primitive trap or hornblende rock. The oxyd of iron in Lavas may amount on the average to about 20 per cent: it is frequently titaniferous, indicative of a primitive origin. When the Felspar prevails in Lavas, the fusion is comparatively more easy. Lavas may be considered generally as felspathic, (Trachytes) or augitic and amphibolic. Lavas are also, fibrous obsidian or pumice; or they are earthy and lithoid; or friable and hard as Tufas; or decomposed into an ocreous substance as Puzzuolana or Tarras; or into an earthy blackish argillaceous substance as the wacke of the Germans. In fact, Lavas will have different appearances in proportion to the degree of heat they have undergone—the continuance of the heat—and the nature of the stone itself and its relations to caloric. Lavas consisting of Felspar, Augit and Iron, as their general component parts, have been observed also as containing or enveloping, crystals of mica, of Hornblende, of Petrosilex.

Fragments of Granite and other primitive rocks not apparently acted on by fire. 1. Spalanz. trav. 78. Crystals of black augit, of Leucite, volcanic hornblende, nepheline, Meionite, sommite, Idocrase. Doubts have been entertained whether these were pre-existent crystals, or the effect and product of igneous fusion, or the effect and product of subsequent filtration into the cells, vesicles and cavities of the Lava containing them. See Borkowsky on Sodalite. Breislak found a chrystal of Augit inside a chrystal of Leucite. Inst. § 682.

Beside these chrystals, the following have been found accompanying Lava ; Garnet, Hyacinth, Zircon, Sapphire, Spinelle, Peridot, Epidot, titaniferous sidero-calcite, Tremolite, Gyps, Hauyene, Zeolyte, Sodalite, Tafelspar, Topaz, Humite (Bournon.) In fact, we need not wonder at finding the minerals which accompany primitive rocks, accompanying Lava also ; sometimes changed, sometimes unchanged. I Spalan. 78. In the vesicles or cells of Lava, the minerals commonly found, are Leucite (in Italy) Peridot, Zeolyte of various kinds, Prehnite carbonat of lime as at Ætna, at Lipari, 3 Spalan. 228, in Iceland. 7. Ed. Trans. 90. Quartz, Agate, chalcedony, green earth. Forming amygdaloids, toadstones and geodes ; the crystals in the cells are probably infiltrated. Various specimens of these, are in every cabinet of tolerable extent. The Lavas containing crystals more or less perfect, of Felspar, are porphyritic Lavas. Lavas containing Zeolite, Prehnite, Agate Chalcedony, mentioned nouv. Dict. d'hist. natur. Tome 17, p. 390. Lavas cut through all metallic veins, and rarely envelope any metalline substance. Galena is said to have been found in whin (Kidd 102.) but such a case is accidental and rare, though very possible. Vegetable and animal remains have been found adhering to Lava and enclosed in it. Breisl. § 700. 1 Humb. Pers. Narr. 241, see the question discussed in 3 Breisl. p. 251. I have a shell adhering to the slag of an iron furnace.

Lavas are sometimes very extensive. Dolomique notices one of ten leagues. A stream from the north side of Ætna, according to Recupero, extended forty miles. Lord Winchelsea mentions another in 1669, fifteen miles long by seven broad. Pennant states the current from Hecla in 1784 at ninety-four miles one way and fifteen another, and from eighty to one hundred feet thick. The currents in the Isle of Bourbon produced thirty million toises cube of Lava. Breisl. § 669 note. Suppose for the moment that the disputed district of Auvergne and its vicinity is volcanic, there are 35 ½ millions of prisms of columnar and figurate basalt, according to Soulaive in that district, beside amorphous basalt and cellular basalt, on the surface. Taking in the depth, he calculates the basaltic matter at two thousand one hundred and eighty-seven millions of cubic feet French. 3 Soul. 358.

Currents of Lava are often slow. Dolomieu cites one which ran but twelve thousand and five hundred feet in two years. M. de Buch however saw one descend from Vesuvius, twenty three thousand feet in three hours and reached the sea. In the eruption of Ætna of 1787, (Ætna is sixty miles in circumference) the whole crater was full of Lava, which flowed over the top and filled an opening of ten thousand feet high, by six thousand feet diameter. There are several mountains of Lava round Ætna, each of them, larger than Vesuvius. In the eruption of Ætna of 1669, the Lava flowed for four months afterwards and was hot eight years afterwards. Ferrara's Hist. of the eruptions of Ætna. Journ. de Physique Mai. 1819. Some Lavas from Ætna smoked twenty-six years. S. W. Hamilton thrust a stick into a mass of Lava, two leagues from the opening in Vesuvius, three years after it had been ejected, and the stick took fire.

Among volcanic ejections are *mud* Lavas, (moia.) They are noticed by S. W. Hamilton and Spalanzani, both from Ætna and Vesuvius. Menard de la George says they are frequent in volcanoes near the sea.

The earthquake at Lima in 1746, was accompanied (according to Ulloa) by a mud eruption from Monte de la Conception at Lucanas, which covered an immense space of ground. According to Humbold in 1698, the volcanoes of Carguarazo near Chimborazo, covered eighteen square leagues with mud. Such also are the eruptions of Peru and Quito. In 1797 the village of Pilleo was inundated with a mud eruption, which when dry was combustible. (Humbold.) There is a mud volcano at Salsa, at Montegibbio, in the duchy of Modena; another at Querzola; another at Mendola; and another at Sigillo in the Appennines. Cadell's trav. into Carinthia and Italy vol. ii. p. 55. A mud volcanic mountain at Macalonba in Sicily, (Dolomieu.)

It ejected mud two hundred English feet high. Many small ones near Modena. They are mentioned by Pallas and Von Humbold. (D'Aubuisson's Geol.) Pallas notices one at Taman in the Crimeda which in 1794, burst out into flames with an ejection of bituminous mud in a current of about half a mile in length.

Flames from bituminous matter are common in the eruptions of Vesuvius. Breisl. § 602. Humbold observed the same in two caverns in a limestone hill at Cumana. These must arise from the independent coal formation. Boiling mud springs in Java. Penang Gazette Feb. 10, 1816.

As to the distance to which volcanic ejections have been carried, Anno. Dom. 472, according to Procopius, the ashes of Vesuvius were wafted as far as Constantinople, two hundred fifty leagues: this requires stronger evidence. In Asia and America, they are said to have been carried one hundred leagues: this also I have no precise authority to establish. In 1794, Calabria was covered with a thick cloud of ashes fifty leagues distance from the volcano. They have been certainly wafted from Hecla to Glaumba, one hundred thirty miles. In 1812, from St. Vincents to Barbadoes, fifty miles, when a white handkerchief could not be seen at six inches distance. According to the Abbè Ordinaire, the ashes from the eruption of Vesuvius in 1794, passed Tarento and Otranto, and were lost in the Mediterranean, four hundred miles from Vesuvius, p. 128 of Hist. of Volc. Stones of many tons weight have been thrown out of Ætna and Vesuvius to the distance of a quarter of a mile.

Earthquakes and volcanic eruptions are concomitant. The earthquake at Lima in 1746, was accompanied with a mud eruption from Monte de la Conception, at Lucanas, which covered an immense space of ground; as before noticed from Don Ulloa. The earthquake at Lima, Nov. 1, 1755, may be said to have extended throughout most of the habitable globe. See the numerous accounts that fill up the volume of the Philosophical transactions for the year succeeding, and 1 Humb. per. narr. 227, and the facts collected by Dr. Kidd, Geol. Es. 249. It took nine days to travel to North-America: it was felt at Philadelphia, New-York and Boston. At the latter place four hours after the shock at Philadelphia. Flames broke out at Scituate, about thirty miles south of Boston. After the earthquake at Lisbon, Europe, Africa and America, were for some time repeatedly agitated by subterranean explosions. Ætna, which had been in a state of profound repose for eighty years, broke out with great activity. In 1812, the earthquake of the Caraccas, was followed by the volcanic eruption of St. Vincents, before mentioned, in thirty-five days. Humb. per. narr. ii. 226.

Many clear and indubitable volcanoes once in action are extinct. There are eleven in Rome and the Campagna of Rome, according to Dr. Sicklu's topographical view of that district, viz. solfaterra. Lake Gabinus, Regillus, Albanus, Nemorensis, near to Ariccia, Juterna, Castello Gandolfo, Nemi, San Juliano, Baccono, Brecciano, Lago Morte, Anagni. Breislak counted thirty-five extinct volcanoes in the space of five or six leagues by two leagues, about Naples. The Lava appears to be from one hundred to one hundred fifty feet deep, as appears in digging wells; in which case the workmen have to dig that depth before they come to the newest or most recent Lava. Rocca di papa two thousand six hundred feet high is volcanic, so are the hills about Frescati and Albano. There is a space of near six hundred square leagues about Rome, covered with Lava of various kinds. The ancient volcanoes of Sicily, extend from Cape Paclino to Ætna, and *are covered by, and alternate with,* shell Limestone: hence they were submarine. To the same purpose Mr. Leckie in Bakewell 216, 2d Ed. This alternation of submarine volcanic ejections with limestone of marine origin is noticed by our own mineralogist Mr. W. M'Clure, in his account of the West-India Islands: the facts are so curious, that I shall copy them from the trans. of the Philadelphia Academy of Sciences, p. 142 at seq.

Dominica. A bed of coral or Madrepore Limestone with shells, lies horizontally on a bed of cinders, about two or three hundred feet above the level of the seas at Rousseau, and is covered by cinders to a considerable height.

St. Christophers. p. 147. Brimstone hill is a stratification of Madrepore limestone with shells, at an angle of upwards of 50° from the horizon, reposing on a bed of volcanic cinders, and partly covered by volcanic irruptions, making a fine specimen of the alternation of the Neptunian and volcanic formations, which for aught we know, may be repeated twenty or thirty times in the foundation of these islands; as every current of lava that runs into the sea, is liable to be covered with corals madropores, &c. and again covered with Lava, until it comes above the surface of the sea.

St. Eustatia Ib. on the South East side of the large hill towards St. Christopher, there is a stratification of madrepore Limestone alternating with beds of shells similar to those found at present in the sea. The whole of this marine deposition dips to the South West at an angle of upwards of 45° from the horizon, resting upon a bed of cinders, full of pumice and other volcanic rocks; and is immediately covered by a bed of Madrepores, sand and cinders mixed together with blocks of volcanic rocks, so disseminated that there can be no doubt of the volcanic origin of the substance above and below the madrepore rock, which may be from five to six hundred yards thick.

Saba. p. 148. The madrepore and coral rocks mixed with shells, partly similar to those at present found in the sea, alternate with the cinders and other volcanic rocks, presenting much the appearance of the whole having been ejected from the bottom of the ocean.

He concludes, that all these islands were probably thrown up from the bottom of the ocean, and that the seat of combustion was in the primitive, because the transition formed the islands of the Eastern group. Great attention is due to the opinions of this very experienced Geologist. That Islands should be thus raised is so common that without voyaging to those of the Eastern Archipelago, we may refer to the eleven mentioned by Pliny, to the following noticed by Forber 127. Ischia, Nistia, Santorini: Monte Nuovo, Monte Gauro or Barbaro, Monte di Camaldoni, St. Elmo, Capo di Chino, Pizzo-Falcone, (the ancient Echia,) Ib. Attempts have been made to ascertain the ages of different volcanic eruptions, from the quantity of soil formed upon them; but this is manifestly an inaccurate mode of computation, owing to the very different states of fusion in which Lavas have been ejected, and the different kinds of stones of which they are composed. Count Borch has observed that in December, 1776, the Lava of Ætna poured out in 1157, had a coating of twelve inches of earth. 1 Spal. tr. p. 205.

One of 1329 had a coating of		8 inches.
One of 1669	- - -	1
One of 1766	- - -	none.

In Italy, they are of opinion that the Cactus opuntia is better fitted than any other vegetable, to reduce the surface of Lava to earth.

Lavas are either submarine, or terraneous. Where they repose on, and alternate with strata, manifestly of marine origin, they may be considered as submarine. The volcanoes that elevate islands—those that alternate with madrepore strata as in the West-India islands. The strata at the base of Ætna consisting of Limestone with shells, Lava, then Limestone, and Lava are doubtless submarine; for the shell limestone on Lava must be a marine deposit.

Other Lavas bear marks of being poured out originally on dry land, provided flœtz basalt should prove to be Lava; as the hill of Meisner, so Ger. de Soulavie says, he found wood cut with an axe, under a mass of Lava (Basalt) at Butaressa in Auvergne. The same kind of occurrence is noted by M. Cocquebert at Meisner, where the Basalt three hundred feet thick covers a stratum of charred and bituminous wood in some places sixty or ninety feet high. Some of it cut in lengths with the marks of the Axe and the Saw. Journ. des Mines No. 22. Breislak. § 701.

Saulavie says, that in *upper* Vivarais none of the volcanoes were submarine, but lower down there are marks of the action of waves and the craters are obliterated. 2 Soul. 353. A line of craters in that part of France, traced for sixty miles.

The streams of Lava, fill up valleys and hollows.

They are not conformable to the surface over which they flow, longer than this fusion continues. They accumulate in thick and deep incumbent masses, frequently from sudden congelation, exhibiting peaked eminences, like the ice congealed in our great rivers.

They break through from below, and they cover from above, every stratum of rocks without discrimination, that they happen to come into contact with. They produce the effects and marks of fire on the substances contiguous to them.

The great mass of Lava streams consists of *Basalt*; amorphous, tabular, columnar and figurate, compact, porous, porphyritic or amygdaloidal. This is accompanied by stones fused, half fused, ignited, heated, or warmed, acted on by fire so as to affect their appearance, or not so, according to the degree and continuance of the heat, and the nature of the stones thus acted on. This statement requires no proof to persons accustomed to look at volcanic regions, or even cabinet specimens of well selected volcanic productions.

All these characters, belong to the Basalt of France and Germany, and to the whin and toad stone of Great-Britain. They belong to no other class of rocks. Every known character that Lava possesses, is possessed also in like manner, and under like circumstances, by the *newest flœtz trap* of Werner. Werner himself was aware of it, for when on a visit to Paris a few years before his death, he was invited, and urged to pay a visit to Auvergne, he steadily declined it. He had already put the detached masses of Saxon Basalt into his Neptunian formations, finding them to repose upon, and to alternate with rocks decidedly of Neptunian origin. He called them, rocks of the newest flœtz trap formation.

Newest because they were found covering the alluvial, and the most recent of his secondary formations.

Flœtz, because, covering the flœtz or horizontal rocks, they appeared to belong to that series.

Trap, from the hornblende character so observable in Basalt. He does not seem to have distinguished between Augit and Hornblende, as being decisive of the character of igneous rocks.

The rocks usually ranked as flœtz trap, by the Wernerians, are Basalt, Porphyry, Amygdaloid, Greenstone, Pitchstone, Obsidian and Pumice. It is hardly necessary at the present day, to prove that the three last of these rocks are igneous in their origin. I shall take it as conceded that they are so.

I proceed then to shew,

1. That the columnar, prismatic, figurate basalt, so common among these disputed rocks, is common also among the best known active volcanoes, which abound in basalt of all kinds.

2. That Basalt leaves decided marks of fire on the substances contiguous to it.

3. That it passes into and is accompanied by porphyries and amygdaloids like Lava.

4. That the other characteristics of Lava, belong also and in equal degree to Basalt.

As to the *first*. Ætna is a porphyritic mountain surmounted by columnar basalt. 1 Humb. per. narr. 237 note. Prismatic columnar basalt forms the base of Ætna: it is found in compact lava on the sides of Ætna. The rocks called the Cyclops opposite Catania, consist of columnar basalt. This is common also at La Frezza, at Monte Finoches, at Monte La Motta, Santa Anastasia, on the eminence at the town of Acireale, and below La Scala. Spalanzani. Ferber. All these are Sicilian and Vesuvian basalts.

Spalanzani found pentagonal columnar Lava in the crater of Volcano, one of the Lipari Isles. 3 Spal. tr. 195. Much columnar basalt formed of Lava at its entrance into the sea in the Eolian Isles, Ætna, and Ischia, according to Dolomieu, ib. p. 202. Prismatic basalt from Catania to Castello di Saci, ib. At Felicuda ib. p. 202. Observed also by Colonel Imrie. Figurate basalt at the summit of Ætna, even within the inside base of the crater, ib. 208. Much figurate, columnar basalt at Monte Rosso described by Sir I. Strange 65 Phil. trans. see also 3 Spal. tr. 232, 315. Gioeni says he has frequently found polyhedrous basalt in the artificial excavations of Ætna on the sides of it. 3 Sp. tr. p. 208. Presque habituelle dans les pays volcaniques. 1 Brogn. Min. 472. Basaltic prisms for a great extent on a bed of volcanic ashes and pumice at Bolzena and Ronca. Ferber's tr. 238.

Much columnar basalt on Montesomma, adjoining Vesuvius, according to Lord Winchelsea. The basalt of Monte Somma, not to be distinguished from that of County Antrim. 3 Geo. tr. 233.

Sir W. Hamilton in his letters on the volcanoes of Italy, p. 257, mentions the columnar Lava that flowed from Vesuvius in 1632. He compares the prismatic columns at Calastro, to those of Bolsena, and the Giants Causeway. Prismatic basalt found at the foot of Vesuvius itself, Brongniart art. Basalt, Nouv. Dict. de l'hist. naturelle. On the same authority they are found in the Vincentin, and in many of the isles of the Greek Archipelago. The face of Monte

Somma (an ejection of Vesuvius,) is exactly like the cliffs of Antrim, from Bengore head, to the river Bush. 1 Geol. trans. 234. The Paduan, (Euganean,) and Vincentin hills, and the Varonese Lava hills, such as Mont St. Luca, Mount Rose, Monte di Diavolo, Ronca, are columnar in whole or in part; and so is Radicofani. Ferber. tr. p. 61, 63, 230, 241, 148. In this he is corroborated by Desmarets, and by Sir John Strange in his paper on the columnar basalt of the Venetian state. 65. Ph. tr. for 1775, part I.

Von Buch having examined the current of Lava, from Vesuvius in 1794, declares it impossible to be distinguished from the Basalts of Bohemia, Silesia, Hesse, and Saxony. Breislak, § 688. This Lava, is exactly like that of Ætna and the Eolian Isles; of Hecla and Teneriffe. Ib. § 689. So says Raspe, Ferb. tr. 61.

Columnar basalt common in Iceland, according to Dr. Henderson's trav. in that country. Dr. Geo. M'Kenzie says that the cavernous Lava of Iceland abounds in columnar basalt.

The eruptions of Teneriffe in 1794 and 1797, were Obsidian and Basalt. Cordier and Humbold found columnar basalt plentiful at Teneriffe. So did Mr. Henry Bennet at Madeira. 1. Geol. Transac.

M. Bory de St. Vincent, found the ground strewed to a great extent with columnar Lava (basaltic prisms) very regular, at the Isle of Bourbon.

The accompanyments of Basalt of disputed origin, are the same as those of Lava. Thus at Murol in Auvergne, we find scoriæ, cinders and puzzuolana above; next compact basalt not to be distinguished from compact Lava; then figurate, columnar, prismatic basalt of a fine grain, very compact fifty or sixty feet high; then tabular Basalt, then shistose Basalt. Breisl. § 693.

Like Lavas, they cut through without enclosing any metallic substances. It is said that Galena has been found enveloped in Basalt, which may well be the case, but this is anomalous and accidental, just as vegetable and animal remains may be found adhering to any slag that meets them in its way.

I proceed next to shew that Basalt like Lava, exhibits marks of igneous origin, by its effect on the substances it encounters.

Basalts burn contiguous substances. M. Voight in his mineralogical journey to the mountains of Hesse, says that between the coal and basalt is a thin argillaceous layer; but the coal has manifestly been acted on by the heat of the incumbent Lava. Breisl. § 703. Sand stone acted on by and converted into Jasper for ten feet, by pervading and superincumbent basalt just like that of the iron surfaces. Haussman. Ib. § 704. Same phenomena observed in an agillaceous stratum, by Messrs. Conybeare and Buckland. Ib. Also by M. Hoff near Suhl: and by Prof. Playfair at Salisbury Craig. The same circumstance observed also by Whitehurst in relation to the Derbyshire Toadstone. See Theo. of the Earth, 197, 198. The same observations by Brande as to the coal at Fairhead. Cat. of the Min. of the Roy. Inst. p. 184, 185.

Basalt burning coal and also contiguous limestone, 4 Geol. trans. 102. See also to the same purpose, 3 Geol. trans. 99, 201, 205, 213, 257. Sandstone converted by Basalt into Hornstone and black shist into black lydian stone. Ib. To the same purpose Brande's Catalogue, p. 171, 179, 184.

Hard chalk converted into granular marble for upwards of ten feet. 3 Geol. tr. 172. So, of Lias Limestone. Ib. 213. Coal deprived of its bitumen and charred through a layer of interposed sandstone. Ib. 257. Limestone chrystallized by the Cleaveland Dyke. Bakewell, p. 272. The same effect produced artificially by Sir James Hall: Edin. tr. v. 6.

The basalt dyke on the Yorkshire coast, forty feet thick, running sixty or seventy miles on the surface from Cockfield, fell in the County of Durham, to the river Tees, near Preston, Lancashire. Then entering Cleaveland in Yorkshire, is traced to the coast where it is lost about Blea Hill, near the upper end of Harewood Dale. It rises perpendicularly to the strata. It is found in oblong blocks or masses parallel to one another lying in the vein. The fracture is rough, granular, of a blue colour, containing shining crystals. The seam of coal in Durham, where the dyke cuts it for some feet distance, is turned into a sooty substance, which becomes a cinder, as the distance from the whinstone, (Basalt,) increases, until at fifty yards it assumes the appearance of coal, 214 Tillock's Mag. for March, 1818. Greenstone, deprives contiguous coal of its bitumen, even through a layer of sandstone three feet thick at Birch hill Colliery in Staffordshire. 3 Geo. trans. 257.

At Tividale, the coal is completely charred under the Rowley Rag, which there, (Tiviotdale near Derby, Shropshire,) is thirty-five feet thick.

In the third place, I have to shew that Basalt like Lava, graduates into, and is accompanied by Porphyries and Amygdaloids.

I have already observed after Humbold, that Ætna is a porphyritic rock, surmounted by columnar basalt. I know the ambiguity that attends the name Porphyry : but I trust that my geological reader will acknowledge, that porphyritic lava, and flœtz trap porphyries are in general sufficiently distinct from primitive trap porphyries. If I saw a porphyritic stone crystallized throughout, I should refer it to the primitive porphyries ; but the confused and rounded specks that porphyrize a basaltic or volcanic stone, are easily recognized. The volcanic and basaltic porphyries are too similar to each other, and too dissimilar to primitive porphyries, to occasion frequent mistakes to an experienced eye.

Hence the porphyries concerning which I speak, so far as I can collect from the authorities, shall be basaltic porphyries only. I have well considered Humbold's fourfold division of Porphyries ; his second class alternates with basalt, pitch stone and obsidian ; his third class includes the amygdaloids of Oberstein, which I should certainly ascribe to volcanic origin ; and his fourth class consists of the flœtz trap porphyries now under consideration.

Porphyries of this class, alternate with decidedly volcanic products in volcanic districts, even according to Jameson. 3 Geognos. 192, and Humbold says it forms the summit of many of the volcanic mountains of the Andes. 1 Pers. Narr. 115—218.

Porphyry and Amygdaloid accompany basalt. 5 Geol. trans. part 1, p. 277.

Basalt passing into greenstone, and porphyry slate. Kidd. 136.

The general range of the Andes, which are fifty volcanic according to Humbold, granite, gneiss, mica slate, and clay slate ; but these are seen surmounted by porphyry. Bakewell's Geo. 65.

Clinkstone passing into trap porphyry in Sky. 3 Geol. trans. 66. Basalt passing into porphyry. Ib. 80, 189, 191, 192.

Porphyritic volcanic mountains, noticed by M. Arduini in the Vincentin territory ; at Bresciano, and at Bergamesco. They repose on slate. Ferb. tr. 37. Porphyritic volcanic hills between Walshonickel and Newmack. Ib. 325. They continue to Brandsol, and split into prismatic and columnar forms. Ib.

The porphyry called Serpentino, verde antico, found in large blocks near Ostia, where the Egyptian ships used to unload, contains cells filled with agate. Ib. 225.

Trappean porphyries intimately connected with volcanic productions. 1 Humb. pers. narr. 94, 212. Clinkstone porphyry covers the basalt of the Bohemian volcanic mountains. Ib. 211. Amygdaloid covers the basalt, at La Punta di Nager at Teneriffe. Ib. 214. The Lava in the plain of Retama at Teneriffe, very similar to the resinite porphyry of Tribrick in Saxony. Ib. 215. The porous basalt of the Island of Gratiosa, passes into Amygdaloid or Mandelstein, according to Humb. I. 91.

Pitchstone Lavas, near Teols and Bajamonte. 3 Spal. tr. 250, 251.

Porphyry with agate opal. Brande's Catal. p. 171, 179.

As to the Amygdaloids of this formation, we can account for their cells and pores, only as we account for the cells and pores of Lava and other igneous stones ; and for the agates, quartz, carbonate of lime, prehnite and zeolyte found in them, as we account for the same substances found under like circumstances : in volcanic amygdaloids : for in no case can we legitimately reason to a disputed subject, but from what we know of similar circumstances undisputed.

Hence then it appears, that the Porphyries, the Greenstones, the Amygdaloids and the Pitchstones, are equally common to known volcanic formations, and to the rocks now considered. For a further consideration of the general fact, and of the reasoning here adopted, I refer to Dr. McCulloch's paper on the Granite of Aberdeenshire, in No. 19 of Brande's Journal.

I have next to shew that the other acknowledged characters of Lava, belong in an equal degree to the Basalt of the Flœtz trap formation.

And first, let us describe basalt; wherein, I profess to give the most usual discriminating characters of this Rock, and I offer it, as equally true of the basalt of acknowledged volcanic origin, and of the basalt of disputed origin; and so submit it to the mineralogical reader. In fact, as Brongniart, (who in 1807, was a vulcanist,) says, it is difficult to explain la presence presque habituelle des Basaltes prismateques, dans les pays evidemment volcaniques. Min. v. i. p. 472.

Basalt, whenever found as a Lava, or as a member of the flœtz trap formation, is a compound stone of sp. gr. from 2,85 to 3. When exposed to the air, generally covered with an ochry crust on the outside. Withinside, it is of a blackish brown, a greyish or a greenish black according to the predominance of felspar in its mixture with the hornblende or augit, that constitute with oxyd of iron, the remaining bulk of the stone. When polished and melted it assumes a bluish aspect.

It is sometimes porphyritic with crystals, or with obtuse, oblong, or rounded grains of felspar. It is sometimes stellated, as the Abbe Fortis found it in the Vincentin. It is very often amygdaloidal, (as the same observer remarks,) with carbonat of lime, as at Castagnamoro; and as the toad-stone of England and Scotland often is, and as the basalt of mount Holyoke in Massachusetts is. It is thus found at Ætna, at Lipari. 3 Spal. tr. 228. In Iceland, 7 Edin. trans. 90. At Monte Somma. Breisl. § 707.

It is often granular: but the component parts are sometimes so intermixed as to appear homogeneous; at other times the component parts are distinguishable by the naked eye. When viewed steadily through a good magnifying glass, the black portion appears in small dull, irregular, short crystals, whose angles are generally obliterated, They are not flat and shining like the crystals of augit or even of hornblende. The white part of the grey and blackish varieties is felspar, often petrosiliceous in its aspect. When broken into minute fragments, (not dust,) according to Cordier's directions, the character of the component parts is much more apparent through the microscope.

The fracture of the compact varieties tends to conchoidal; with an approach to radiation, especially in the grey black, and blackish varieties, where the hammer has struck it. The aspect when bruised is white and dusty.

The compact fine grained variety is hard and very tough; hence it is used for the gudgeons of mills to run it; bearing a fine polish. But it is often porous and hackly to the touch, as well as smooth and compact. Generally it gives fire with steel; a property attributable to the accidental presence of silex, or to the indurating effect of fire. Generally also it acts on the needle; it is something polar: but these properties depend much on the quantity and state of the iron contained in it, and vary in different specimens and often in the same specimen. The iron is usually in the state of a black oxyd within, and yellow oxyd without.

It is fusible before the blow-pipe; more easily in proportion to the felspar it contains. In a glass furnace, it runs into a greenish or greenish black, bottle glass, adhering with some difficulty to the glass blowers' rod: the colour of the glass is lighter in proportion to the felspar contained in the stone.

It is not acted on by acids.

Basalt is always massive, sometimes stratified. The masses assume different forms: sometimes they form high and rugged peaks: often they are prismatic and columnar, with four or five sides; less frequently with three or six, seven or eight: occasionally but very rarely with nine. This figurate basalt, as it is often called, has the external appearance of crystallization; but the sides are not of any determinate number; the angles have no regularity in their dimensions; the inside of the stone has no distinct crystallization in the mass; no nucleus or primitive crystal can be traced by means of any natural joint or fracture. Hence, the form of the prismatic figurate or columnar basalt, has been ascribed to the contraction that takes place on cooling, in a *heated* or in drying, in a *moist* mass.

There are also shistose (feuilletè Fauj. St. Fond. 156) tabular, and globular basalts; it is found also concentric-lamellar. The two last varieties approach so much to crystallization, that the arguments of M. Patrin, who ascribes the columnar form to this property are difficult to be refuted, though not generally adopted. The experiments of Mr. Gregory Watt, shew, that fused basalt sometimes crystallizes in spheroidal masses; and that figurate or prismatic basalt may be and actually is formed, when these masses press against each other: hence, the question of the *crystallization* of columnar basalt, is not in my mind fully settled. Phil. trans. 1804, p. 279.

Basalt is found, sometimes in plains and in some measure conformable to the supporting stratum—sometimes filling up vallies—sometimes in compact amorphous, unconformable masses—sometimes in figurate and columnar masses, sometimes breaking through the hardest rocks in jets, and forming peaked hills and knobs—sometimes forcing up the stratum from below; as at Antraigues in Auvergne, which is built on curved basalt that supports enormous masses of granite. 2 Soul. § 716. Sometimes in Dykes reaching to great distances and of unknown depths, disrupting and displacing the strata through which the dyke has violently broken. The great coal Dyke of the North of England of this kind extends from sea to sea. (Whitehurst-Bakewell.) These Dykes burn, char, fuse, or indurate all contiguous substances, and break through and dislocate all metallic veins, as we have already seen.

Vegetable organic remains (Humbold,) and animal also, (Brugnatelli, Dr. Richardson,) have occasionally, though rarely been found in Basalt, adhering to, or enveloped in it: so has charred wood.

These organic remains are not found in the prismatic or figurate, and only in the tabular Basalt, which has met with them in its course. I have a shell imbedded in the fused slag of an iron furnace. Metallic substances, excepting iron, and titaniferous iron, are rarely found in Basalt.

Columnar basalt has been found with water in its cells: perhaps owing to steam, that not escaping, has cooled into water. Jamieson's Geognosy, 1808, p. 186, and 3 Soulavie § 1402.

Basalt hills are much subject to rents and fissures; and are often found with fragments of all shapes and sizes at the bottom and sides; assuming a breccious structure; and cemented to the subjacent rock as at La Spisso, Reconro, &c. Ferber Trav.

Basalts are frequently found covering, passing into, and connected with granitic and porphyritic rocks, which Werner calls Wacke, Grunstein and Porphyritic shist, so that it is frequently impossible to mark the line of distinction between these rocks and the basalt connected with them. Dolomieu remarks the same, as to the basalt and greenstone of Egypt: some very important observations to the same purpose have lately been made by Dr. M'Culloch in his paper on the granite of Aberdeenshire. The vulcanists say, these are not different formations, but one connected and continued series of ejections, under different degrees of heat operating on them; and they apply this reasoning to the sienitic granite of Christiana, observed by Von Buch and Haussman: Cellular, or vesicular basalt, often incloses in its cells, peridot, carbonat of lime, Zeolytes of various kinds, prehnites, green earth, &c. In the large cells of Geodes (as at Oberstein) we find Agate, Chalcedony, Quartz. The cells are sometimes round, and sometimes elongated in one direction.

Until lately, on the suggestion of M. Cordier, the presence of Augit has not been particularly noticed in basalts; which are sometimes augitic, and sometimes amphibolic; but within my own experience more commonly indeterminate. Observers with good eyes and a good microscope, breaking the basalt into minute fragments, but not into dust, may often determine this very important point.

Analysis of basalt.	Bergman.	Klapr.	Kennedy.
Silex	50	44 50	46
Alumina	15	16 75	16
Lime	8	9 50	9
Magnesia	2	2 25	0
Oxyd of iron	25	20	16
Soda		2 60	4
Ox. Manganese		12	
Mur. acid		5	1
Water		2	5
Loss		2 23	3
	100	100	100

The varieties thus analyzed appear to be of the Flœtz trap formation.

Analysis of common Hornblende.			Augit (Frascati.)	
Silex - -	42		48	
Alumine - -	12		5	
Lime - -	11		24	
Magnesia - -	2	25	8	75
Oxyd of Iron -	30		12	
Manganese -		25		1
Water - -		75		
Trace of potash -				

The black basalts wherein either hornblende or augit predominates, do not decompose by the action of air and moisture so easily as the greyish trachytic varieties which contain more felspar. The olivine or peridot of the cellular basalt, also decomposes easily into an ochreous powder. By long exposure, all kinds of basalt gradually decompose into a yellowish fertile soil. Terras or Puzzuolana is generally regarded as decomposed Lava, or decomposed basalt, containing much iron: and argillaceous iron ores have been found of equal value for like purposes.

Basalt Lavas, and Basalt flœtz trap, moreover agree in other particulars, noticed by M. Conybeare, 3 Geol. trans. 208. The newest formations are the lowest—the least elevated among the strata: they occupy vallies, plains, the foot of mountains: but Lavas, and flœtz-trap porphyries and basalts are found covering high mountains as in Saxony and other parts of Germany, and in South-America.

Among the decided volcanic formations, the least ancient, are the least elevated; but the flœtz trap surmounts all others. Of all other formations, the degree of consolidation decreases, as they are of later origin: thus the most crystalline are the primitive: next come the transition which are sub-crystalline; then the compact, coarse, and earthy: while in the flœtz trap, even where it rests on chalk, the crystalline character of the older rocks often appears.

Whin-Dykes which belong to the flœtz trap basalt, and amygdaloid, differ from all other mineral veins, by traversing all rocks indifferently as Lava does; while other mineral veins are associated with particular rocks.

No difference in appearance can be pointed out between the basalts of Saxony and Lavas, as has been before observed.

No difference has been shewn in the chemical, or in the mechanical characters of basaltic Lava, and basaltic flœtz trap.

Cordier's paper on the substances that compose the mass of volcanic rocks of all ages, has shewn that augit, hornblende, felspar, and titaniferous iron ore, are the component parts equally of flœtz trap and of Lava-basalt. Journ. de Phys. Tom. 63.

The more the flœtz trap regions are examined, the more decided marks of former craters are discovered. Until the numerous craters in and about Rome were discovered, this volcanic region would have passed for a country covered by flœtz trap ; just as Auvergne yet is, notwithstanding the numerous craters of extinct volcanoes, traced and noticed by Soulavie and others.

It is impossible to account for the pores in basalt, but from the violent extrication of air, or steam while in a soft or fluid state, as we do for the pores in Lava : or for the carbonat of Lime, prehnites, zeolytes, agates, &c. that are formed in those pores, as we do for similar substances gradually infiltrated and crystallized in the pores of Lava.

The experiments of Sir James Hall, Mr. Gregory Watt, and Dr. Hutton, on Whin-stone, and Rowley Ray, confirm the volcanic origin of these stones as they now appear. Hence then it appears, stated briefly, that

Lavas	The Flœtz-trap formation ;
Contain as their greatest proportion, rocks not to be distinguished *in any way ;* from flœtz trap basalts.	Contains as its greatest proportion, rocks not to be distinguished from basaltic Lava, in appearance, in physical properties, or in chemical or mechanical composition.
They pass into and are accompanied by porphyries, amygdaloids, and porous stones filled up by infiltrated minerals of various kinds.	So are flœtz trap Basalts.
They are accompanied by granite, gneiss, mica slate, sienite and other primitive rocks of various sizes and in various quantities.	Such is the case also of flœtz trap basalt. See particularly Dr. M'Culloch's paper on the Granite of Aberdeen-shire, and his remarks on the sienite of the Scotch Isles. So, when Von Buch and Haussman were at Christiana in Norway, the exclamation was, sui'je en Auvergne.

Lavas.	The Flœtz-trap Formation.
They pierce through and bear away before them all rocks indiscriminately of whatever description.	So does flœtz trap basalt.
They cover indiscriminately all rocks in their way.	So does flœtz trap.
They rarely contain or envelope, vegetable, animal, or metallic substances save titaniferous iron.	Such is the case with flœtz trap.
They charr contiguous coal; they burn all the rocks in contact with them.	So does flœtz trap.
They are not associated with any rocks or any veins in particular.	Such is the case with flœtz trap.
They are unconformable to the rocks on which they are poured, unless while in a state of great fluidity.	Such also are the flœtz trap.
They form columnar masses when slowly cooled.	So does the flœtz trap.
These columnar masses, impossible to be distinguished in any way from the columnar basalt of flœtz trap, are surely and undisputedly attributed to cooling after ignition.	No other way remains to account for the forms of figurate basalt of flœtz trap.
They have been found abounding in countries where craters have been traced but recently.	The same is the case with flœtz trap basalt.
There is no possible mode of conjecturing from known fact how a Lava basalt can be dissolved in water: and we know they have been fused by fire.	The same difficulty occurs as flœtz trap basalt.
It is absolutely impossible to suppose a mass of Lava, in a soft state from aqueous solution or dispersion, to force its way, *upwards* through the whole range of superincumbent strata to the surface. Yet we know this is done.	It is equally impossible to account for Whin-Dykes, where the same appearances exactly take place.
Wherever we can observe this effect from Lava, in our own time, or know it from historical record, it has been caused by igneous, fusion, not by aqueous solution or suspension.	We are bound in the case of Whin-Dykes of flœtz trap, to account for similar effects from the operation of similar causes.
None of the appearances or effects of basaltic Lava, will admit of explanation from the agency of solution or diffusion in water.	Nor will those of flœtz trap basalt, and Whin, or Dykes of toad-stone or Amygdaloid. The difficulty is equal on both sides.

What then are the arguments used by those who oppose the igneous origin of the newest flœtz trap?

It is said,

(*a*) They overlie and alternate with the secondary and alluvial formations, and therefore belong to them.

Reply. So does the Lava of Ætna over shell Limestone; so does the Lava of Dominica, St. Kitts, &c. the Lava covers the alluvial of the shores of the Tibur near Rome.

Further; if Lava and Basalt rocks, are dissociated with, and unconformable to other rocks—following no law of superposition or alternation, as the case is—then there is no reason why they should not cover and alternate with rocks of comparatively recent formation.

(*b*) Basalt and trap rocks afford aqueous vapour on distillation: Lavas do not.

Reply. The newest flœtz trap formation is much older than any modern Lava: and therefore has undergone more exposure to the causes of disintegration.

Also, it is obvious that every rock that admits of infiltration, and where pores are filled with crytals apparently foreign to the rock, must contain moisture. This is the case with porous and amygdaloid Lavas, as well as flœtz basalt.

(*c*) The prismatic figurate form, is common to many porphyries and shists; to gyps, and to compact Limestone, as Raymond observed in the Pyrenees.

Reply. This form may be found accidentally and rarely in the shists, limestones and gypsums mentioned. It is not a common but a very uncommon occurrence. As to the porphyries, it is probable they were of the formation now disputed.

The only instance in which I have observed a figurate form (tetrahedral) that can create any doubt on the subject, is in some primitive traps within two or three miles of Philadelphia. But the jointed, articulated prisms and columns of flœtz trap basalt, are no where else found but among decided Lavas.

(*d*) Streams of Lava are comparatively narrow at their source, and extend in breadth as they flow; they vary in thickness; they are never in very thin, or parallel and horizontal layers. Basalts of the flœtz trap formation, on the contrary are so; and affect an equable thickness in the same, and in different layers.

Reply. All this depends on the degree of fusion. If the heat has been great and the stones fusible, the lava-stream in thin fusion, will extend in breadth as it flows. If otherwise, it will not. Basalts of all kinds and descriptions in this respect, are so fully described by Soulavie, that his account of the part of France he describes from Auvergne, through Velai, Viverais, &c. to the mouths of the Rhone, furnishes replique sans reponse.

(*e*) The summit-basalt of the Saxon and Bohemian range, from Elba to the North, and Franconia to the South, consists of round hills and nodules of granite and other primitive rocks of that formation on the back of which, and on the highest points, we find basalt in the form of Cones, Domes, Plains, &c. These basaltic summits are insulated; they do not consist of more than $\frac{16}{100}$ of the extended chain on which they are dispersed with considerable uniformity; they are covered often with greenstone; they cover gravel, coal, and sandstone. They are prismatic in a great degree, and very solid and regular, as Stolpen, about eighteen miles east of Dresden. Spitzberg, the highest point of the chain, three thousand eight hundred feet above the sea, is full of metallic veins, but the basalt surmounting it, contains none.

Meisner in Hesse, is covered by a table of basalt three hundred seventeen feet thick. The body of the mountain is red sandstone and limestone covered by bituminous red marle, on which rests the basaltic mass. In this chain none of the valleys are filled with basalt, as they would have been, if this rock had been thrown out as a Lava.

Reply. These are probably boulders: the ground has been carried away by the long and repeated action of currents.

Those who have considered the boulders of the Iura, and attended to Mr. McCulloch's suggestions of the sameness between the granite strata of the Scotch isles, and the correspondent boulders of the main land, will not allow this to be an objection of great weight.

Moreover, exactly the same objection applies to its supposed aqueous formation, was the basalt congregated in the small compass of the top of Meisner when it fell there? Who can believe this?

Dr. Richardson's objections are considered at length by Breislak, ch. 113 and seq. but Richardson has certainly ranked petrosilex and hornstone among the basalts by mistake.

I have often had occasion to recur to the old acknowledged rule of reasoning, *we can argue only from what we know.*

We must explain, (if we *do* attempt explanation) a doubtful fact, by its analogies, not to what we may suppose, but to what we know, and to that only.

I take a piece of hard clink stone hackly basalt: I offer it to the reader, I say to him, "you are a chemist: this piece of flœtz trap weighs sixteen ounces avoirdupois: how much water will it take to dissolve it?"

Well: but you urge, the argument does not require solution, only suspension—be it so. How came these pores, in a stone gradually consolidated and indurated from a paste coarse or fine, suspended in water? Did you in any other case ever witness a similar formation of a stone from its parts diffused in water? Is not such a product common in pseudo-volcanoes and in the slag of furnaces?

Again: how can a soft pasty mass, form a rough ragged peak as the summit of a mountain?

Again: how can a pasty mass find its way upward, forcing asunder, forcing one end upward, and another downward of a series of strata of unfathomable depth, till it arrives at the surface as in the case of Whin-Dykes? Read account of Dykes in 4 Geol. trans. and account for them if you can by aqueous solution, or aqueous suspension.

Look at the ice in winter in any of our great rivers, especially at the time of their breaking up in the spring. The exact analogy of peaks, rough summits, prominencies of all shapes and sizes, and in all directions, rough masses formed one over another, the result of great presure à tergo of liquid masses suddenly congealed, will strike you at once.

"The fields of extinct Volcanoes which I have had the opportunity of examining (says M'Clure, 1 trans. of the Philad. Academy of Sciences, p. 332) were as similar as possible in their component parts and relative position. An extensive field round Orlot—near Hamila, and at Cap du Gat in Spain—round Rome—between Rome and Florence, and in the Vincentin in Italy—in Auvergne in France—round Andernack on the Rhine—at Cassel in Germany—all of them, leave no doubt on my mind of their volcanic origin. In all of them I found abundance of Basalt; in some of them the greatest part of the solid Lavas was in the form of basalt. The Austrian police prevented me twice from examining Hungary, but I have seen repeated collections of the rocks of that country, and could scarce distinguish them from those collected round Ripler."

Psuedo Lavas. The one described by Mr. Finch, in the neighbourhood of Bradley in Staffordshire, half way between Wednesbury and Bilson, Ann. Phil. May, 1818, p. 342, will suffice as an example. It is about $1\frac{1}{2}$ miles in length by a mile in breadth. It furnishes 1 crystallized sulphur, 2. mineral tar at the cropping out of a thin bed of coal, 3. rotten coal, 4. sulphat of alumina, 5. muriat and sulphat of ammonia, 6. sulphat of zinc, 7. sulphat of lime, 8. porcelain jasper from 5 to 40 feet thick, where the clay has been indurated by the burning of the coal underneath, 9. newest flœtz trap basalt, or Rowley Rag: like the Rowley Rag between Dudley and Oldbury, (described by Kirwan, and operated on by Gregory Watt,) where the village of Rowley in Staffordshire now stands. It encloses crystals of hornblende; breaks into polygonal forms, and decomposes into spheroidal masses.

To account for the cause of volcanic action?

I consider it established, that the chief seat of volcanic agency is under the old Granite; in cavities that communicate very extensively but not universally, under the crust of the earth; for otherwise the phenomena of earthquakes, extensive as they occasionally are, would not be so often local.

To feed these fires there must be combustible matter and oxygen: whence are they supplied?

The theories on this subject are

1st. The decomposition of water by the decomposition of sulphuret of iron.

The objection is, that there is no evidence of sufficient quantity of this substance to produce the prodigious and long continued effect. Lavas contain upon the average about $\frac{1}{6}$ of iron. Sulphur, although common, is not abundant. This suggestion appears inadequate to the purpose.

2. Werner, Spalanzani, and Breislak, recur to bituminous matter.

The objections are, that volcanoes probably existed before coal and bitumen: for nothing but the violent action of volcanoes, producing powerful and destructive currents, could have worn down the primitive, and produced the abraded, fragmentous, muddy intermixture, of which the transition is manifestly formed.

Werner recurs to his independent coal formation; but this is younger and later than volcanic action, which is also seated far deeper than that formation. The coal will be burnt by the ignited matter in its passage upward, but granite cannot be thrown up by a volcano seated among the coal basins.

3. Sir H. Davy's theory of the metallic oxyds (metals? Ed.) of the earths, has been applied to volcanoes: they are supposed to become incandescent by decomposing water, or atmospheric air, and uniting to oxygen.

This source of volcanic action must be renounced; inasmuch as the nucleus of the earth being more than 5 times heavier than water, cannot consist of substances that are as light as ether.

4. Hutton's theory that the whole of our Strata from the primitive downward, have been fused by some igniting cause operating at a remote period, and at present unknown to us: and that the nucleus has not yet had time to cool.

I am aware of all Murray's objections to this hypothesis, but I incline to it for the following reasons, viz:

1. That there is in point of fact, a source of heat below the old granite, sufficient for the fusion or ignition of the substances ejected from volcanoes in the state of fusion or ignition in which we find them; the great mass of which are the hornblende rocks, or primitive trap. Wherever we propose to get the fire for this purpose, there it is.

2. That the late experiments on the temperature of mines in England, Germany, and France, shew that the warmth increases regularly as you descend, in the proportion of *at least* twelve degrees of Fahrenheit's thermometer, in a thousand feet. I would not pretend from about twenty experiments, at various depths, in various mines, of various countries, that we have data enough to assign the ratio to the center of our globe; this would be presumptuous in the present imperfect state of our knowledge: still, these are the facts: there is no getting rid of them: they point directly to a gradual increase of heat in some ratio, and the general phenomena of volcanic action confirm it.

Will this consideration account in any degree for the remains of animals of warm climates found in cold ones?

Were those climates warmer formerly? Has the surface gradually cooled? Will it account for the supposed increase of cold in European summers? Or for the supposed accumulation of ice in the Alps, or in the polar regions?

Of the volcanic region in the United States.

Hitherto it has generally been believed that there is no evidence of volcanic action or volcanic ejection in the United States. I am persuaded otherwise; as may be supposed from my ranking the flœtz trap formation, among the rocks of igneous origin.

I have seen decided specimens of igneous rocks from the Mandan village, but I suspect them as pseudo-volcanic. We have heard also of volcanoes in the western country toward the commencement of the barren that reaches to the stony mountains. Of all this, I know nothing.

I possess compact and figurate pentagonal basalt, with and without pores filled with the carbonat of lime, from Mount Holyoke in Massachusetts. I have never been there: but my collection of volcanic matter from various countries is pretty extensive; and I have no doubt on the subject of this being a real volcanic ejection, if Basalt and Whin be so.

No person accustomed to volcanic specimens can look at the porphyries from the neighbourhood of Boston, in my possession, and doubt of their volcanic origin.

According to the description of Prof. Silliman, in his interesting travels to Canada, the flœtz trap formation described by him as covering the red sand stone through Connecticut, is also volcanic.* So is the basaltic region described by Mr. Eaton, extending in fact from Deerfield in Massachusetts, to New Haven in Connecticut. The basalt, greenstone, and amygdaloid, cover the old redsandstone. At Pine rock in Connecticut, Prof. Silliman found Zeolite; and Mr. Eaton dark brown Augit: indications, I should suppose, sufficiently decisive of volcanic origin. Indeed, Mr. Eaton asks the question, Are basalt and greenstone trap of volcanic origin? (p. 258.) I should venture to say yes: they are.

From the neighbourhood of New Haven and Woodbury in Connecticut, I possess many specimens of flœtz trap with imbedded prehnite. The volcanic region, therefore,

* That is, the facts stated in the work quoted in the text do, in Dr. Cooper's opinion, justify this conclusion—no opinion on this point is expressed in the tour to Quebec.—Ed.

extends southward from Massachusetts near Vermont, to that part of Connecticut. East and west rocks at New Haven, consist of columnar greenstone.

Proceeding southward, the trap or greenstone rocks in New Jersey that form the margin of the Hudson river, described by Dr. Samuel Ackerley, in his geology of the Hudson river, p. 32, and that cover the old red sandstone, are indubitably volcanic; figurate columnar quadrangular, pentangular, hexangular, basalt, with greenstone and amygdaloid.

From thence to the falls of the Passaic, I have had no opportunity of examining personally.

At the falls of Passaic I spent some time in examining the rocks: I have no scruple in pronouncing them basalt of all textures, appearances and composition—compact—porous with prehnite, and carbonat of lime and zeolyte—figurate in trihedral, tetrahedral, but chiefly in pentagonal prisms—some dull when struck, some ringing. This mass of flœtz trap, is poured over the old red sandstone. In very many places, this undermost rock is porous and manifestly burnt at the place of contact and for some inches downward. Of this appearance, among others, I have specimens too decided to leave any doubt of their igneous origin to those who will make an honest use of their eyes.

This trap formation, as it is called, extends about 40 miles from the Hudson toward the Delaware; I entered it at three several and distant places; I collected every where porous basalt with carbonat of lime, prehnite, and occasionally zeolyte; as well as common basalt, greenstone and figurate basalt, all graduating into and connected with each other. I examined this chain, in three places at about ten miles distance from each other, and I am satisfied of the nature of the rock. Whether it crosses the Delaware I do not know, but I think not.

On the road side from Princeton to Brunswick in New-Jersey, is a manifest Basalt formation, consisting chiefly of figurate clinkstone. I have not traced it.

About eleven and a half miles from Philadelphia, descending a hill, on the Ridge turnpike road, there is a formation of about one hundred yards broad, that I have traced from thence across the Scuylkill, for a considerable distance beyond the Gulph mills in Montgomery County. It crosses the river at Matson's ford, about thirteen miles upward from Philadelphia. It cuts through all the strata in its road, to an unknown depth. I have not traced its termination either way. It consists of a confused heap of figurate trap, many of the prisms clinkstones; tetrahedral and pentagonal. The large pentagonal prism which I caused to be brought to the Academy of Sciences in Race Street, from the Gulph mills, and which is now there, is a trap rock; internally bearing no mark of igneous operation. It is more like a primitive than a flœtz trap. It is found cutting through with its companions the limestone stratum of the river Scuylkill about three miles above the Soapstone quarry. This dyke is different from the rocks it adjoins, in all its characters; it is a confused heap of unconformable basaltic prisms. The stone in question, is a pentagonal prism. It has been (from its internal appearance) considered as a primitive trap. Who ever saw a Pentagonal primitive trap? Moreover, the rule of morals, is the rule of Geology, *nosciter à socio.*

I have no other information of any flœtz trap until we come to the basalt wall near the Yadkin in North-Carolina. I have specimens of this; but I never have been at the spot. It is undoubtedly a basalt dyke.

About a mile from Columbia, (South-Carolina) near Rocky branch, a few yards from Dr. Fisher's mill dam in the high road, Mr. Vanuxem found a thin vein of trap, (a wacke as I think) cutting through the old granite. The depth unknown. The vein is about two inches over.

While the flœtz trap formation is referred to aqueous origin, we shall never understand our country: but I apprehend, that opinion has at present few supporters among well informed Geologists in Europe. In this country Werner's theory prevails, but its downfal is not far distant.

Indeed, the igneous origin of our Granite formation in its present form and appearance, has been made so probable by the investigations of Hutton, Playfair, Sir James Hall, and Dr. M'Culloch, that we shall in my opinion be driven to adopt it, notwithstanding the prejudices that as yet stand in the way. T. C.

Appendix.—Dr. T. D. Porter has been so good as to furnish me with the following additional information.

The flœtz trap formation of our north eastern states, extends higher than Deerfield, Massachusetts ; and perhaps to the New-Hampshire line ;* see Mr. Hitchcock'saccount of that region in Prof. Silliman's Amer. Journ. of Science. These rocks contain agates, prehnites, carbonat of Lime, &c. I have specimens. Part of Mr. H's account will be found to afford strong confirmation of much of Dr. Cooper's opinion.

I know nothing of the brown Augit mentioned by Mr. Eaton at Pine rock. The only augit I have seen, as an American specimen, was in the possession of Dr. Bigsby of the British staff from the neighbourhood of Montreal. I think New-Haven is the most southerly point of this formation in Connecticut. East and West rocks in New-Haven, which are said to be miniatures of Salisbury Craig, are composed of Trap rocks based on what is esteemed the old red sandstone. They are columnar, with considerable regularity, containing prehnite in seams and nodules, with Zeolites ; and in one case I met with some quartz crystals. The appearance of these two mounts seems like that of the Palisadoes on the Hudson, which however I have seen only at a distance. The forms of the rock are various ; more commonly trapezoidal : they are used with their natural surfaces exposed externally in building the walls of a church in New-Haven. They are often found in thin Lamina, which in place have their edges vertical, and are excellent clinkstones ; they are frequently irregular.

About two or three miles east in East-Haven, there are numerous parallel ridges of similar rock, but for the most part, without any regular jointed structure abounding in different places with agates, chalcedony, and amethystine quartz geodes,† carbonat of lime, analcime, Prehnite and green earth. In some spots this basalt, if basalt it be, is found in spherical balls. In one or two instances it alternates with the sandstone which has been mentioned ; and where the two come in contact, the sandstone is somewhat altered : whether by heat or not I do not pretend to say.

T. D. P.

Look at Hitchcock's map of the Connecticut river in 1 Sillim. Journ. 105, for the Greenstone breaking through

* It extends a few miles into Vermont not New-Hampshire.—Ed.

† Are not the Geodes of Oberstein, Lava ? T. C.

the red sandstone and conglomerate, disrupting the rock in a narrow dyke: no possible supposition of aqueous agency could have caused this appearance. T. C.

Look at the same volume, p. 134, for the localities of agate, Chalcedony, Zeolyte, Titanium, Prehnite, &c. they amount to proofs of the volcanic character of the country from Deerfield to East-Haven and Woodbury:* for all these substances are thus found as the indubitable accompanyments of rocks whose igneous origin is undisputed (Iceland, Ferro, &c.) and are never thus found in rocks of undisputed aqueous origin. T. C.

P. S. Since writing the above, I have been induced to consider as the source of volcanic fire, the caloric of temperature given out by the condensation of a column of atmospheric air, reaching from the surface below the old Granite. On the same principle as the common condensing tube for firing punk. It appears that the temperature of mines increases about 12 or 14° of Fahrenheit gradually at the depth of one thousand feet. I have not yet had time to give sufficient consideration to the subject, to state any ratio of compression (other than Cotes's) or the quantum of precipitated Caloric by the condensation of the lowest part of the column. I therefore throw out the idea only for consideration. T. C.

Art. II.—*Foreign Notices in Mineralogy, Geology, ancient Arts, &c.; communicated by* Dr. J. W. Webster.

Boston, Nov. 25th, 1821.

To Prof. Silliman,

Dear Sir,

From Thomson's Annals of Philosophy, I extract the results of an analysis of a substance that occurs in the Limestone of Pargas, (by P. A. V. Bondsdorf, Ph. Dr. of Abo.) This substance "occurs in Limestone in a white, radiated form; it was long considered Tremolite—it is accompanied

* Woodbury is an isolated basin of trap surrounded by primitive and separated by many miles of primitive from the great trap region of New-England. Vid. Vol. II. pa. 231 of this Journal.—Ed.

by "granular calcareous spar, blackish sphene, and an amorphous mineral of a reddish colour resembling idocrase or garnet."—It consists of

"Silica, -	52.58,	containing	26.45 of ogigen.
Lime, - -	44.45	"	12.49
Magnesia, -	0.68	"	0.26
Protoxide of Iron,	1.13	"	0.26
Allumina a Trace			
Volatile matter	0.99		
	99.83."		

At a meeting of the Wernerian Society of Edinburgh, "Mr. J. Deuchar read a paper containing observations on the occasional appearance of water in the cavities of regularly shaped crystals, and on the porous nature of quartz, and other crystalline substances, as the probable cause of this circumstance. In this paper he supposes that natural and artificial crystals have a similar origin, and that although the former possess a peculiar compactness of cohesion, and tardiness of solution, which do not belong to the latter, yet that the artificial ones, through length of time, would acquire a similar cohesion and insolubility. Mr. Deuchar holds. that the water of crystallization is in great excess, and that this excess under certain circumstances gradually decreases. He holds that the water escapes by capillary movement through the pores of the salt, till what he supposes to be the neutral state be acquired, when the salt becomes compact and insoluble. When any malformation of the nucleus produces a cavity or partial vacuum in the interior of a crystal, then the capillary attraction may be exerted to that cavity as well as to the surface; but that this is modified by various circumstances. By pouring hot water upon a crack in the mouth of a bottle, about three inches in length, it extended to five inches, but returned again when he stopped adding the hot water ; cracks in pieces of window glass were also extended by pressure, and contracted again upon its removal; hence Mr. Deuchar concludes "that water may enter the void interstices of crystals, when aided by pressure, not only from the porous nature of their particles, but also from their temporary display of rents during the application of a high temperature."

The second part of the 5th Vol. of the Transactions of the Geological Society of London is announced to be published "early in October."

Dr. Macculloch has given the name Chlorophœite to a mineral found in Fife and Rum, (Scotland,) and which has been since found in Iceland, in an amygdaloidal rock. It has the singular property "of being perfectly transparent, and of a bottle-green colour, when taken out of the rock, but becomes opaque when removed from its place, or exposed to the air." From the observations of Dr. Brewster, it appears that this change is a mechanical one. "The cause of this change may be conceived," observes Dr. Brewster, "by supposing a number of prisms assembled in a particular manner and kept together by screws, so as to bring their touching surfaces into that close contact which prevents total reflection at the junctions. The mass of aggregated prisms will be now quite transparent; but if we either diminish the compressing forces by loosening the screws, or suppose some force similar to the disintegrating force of the atmosphere, to act in opposition to the cohesive force represented by the action of the screws, the touching surfaces will be separated, and the whole mass become opaque."

Edinburgh Philosophical Journal, No. 8.

Dr. Fyfe, (of Edinburgh,) has analysed the Hydrate of Magnesia from Hoboken, and found it to consist of 68.57 of Magnesia, and 31.43 of Water, with a trace of Lime. The same gentleman examined the Hydrate of Magnesia discovered by Dr. Hibbert in Ust, one of the Shetland Islands, and found it to consist of Magnesia 69.75, Water 30.25.

From No. 9 *of the Edinburgh Philosophical Journal.*

"*New System of Mineralogy.*—Dr. Brewster is preparing for the press a *Treatise on Mineralogy*, founded chiefly on the physical relations of mineral bodies, and embracing an account of those remarkable phenomena which have been detected in crystallized substances by the agency of common and polarised light. In this work the unerring characters which are derived from optical structure will be substituted in place of the ambiguous distinctions which have been generally employed; and the student will be allured to a knowledge of the science, when he finds that, in addition to the usual qualities of weight, lustre, and external form, minerals possess an internal organization which displays itself by the most beautiful optical phenomena, and exercise functions of a physical nature, not less interesting than those which are exhibited in the agencies of animal and vegetable life. This Treatise will consist of two volumes, 8vo., with numerous plates, and will be preceded by an Introduction, containing a popular account or the action of crystals upon polarised light; an explanation of the new method of determining primitive forms from the number of axes of double refraction; and a description of various new methods and instruments for examining and distinguishing the precious stones and other mineral substances."

"*Discovery of the Fossil Elk of Ireland, in the Isle of Man.*—Some months ago, in digging a marl-pit in the Isle of Man, there was discovered a skeleton of that remarkable animal, the Fossil Elk of Ireland. This specimen, which is the most perfect and beautiful hitherto found, has been placed in the Museum of the University of Edinburgh."

From the Edinburgh Philosophical Journal, No. 8.

"*Notice regarding the working and polishing of Granite in India*; by Alexander Kennedy, M. D. F. R. S. Edinburgh.

The following observations have been suggested by the very excellent paper upon the Temples of Thebes, lately read by Colonel Stratton in this Society. (*The Royal Society, Edinburgh.*) In that paper he had occasion to mention the very high polish still retained by the granite statues, columns, and other remains of Egyptian antiquity; and in illustration of the great hardness of the material of which these are formed, he noticed incidentally the difficulty which had been found in operating upon one of these granite statues now in the British Museum, and the number of tools which had been broken in the process of replacing one of its arms.

That the arts, as well as the religion of the Hindoos, were originally derived from the Egyptians, seems not to admit of any doubt; and among the arts now practised by the Hindoos, that of working and polishing granite, has, in all probability, undergone no change from the period of its first introduction among them. Most probably therefore, the process may be the very same as those by which the materials of the stupendous temples of Egypt were prepared and finished; and as the subject thus acquires an additional interest, I shall subjoin some notices of the manner in which I have seen the hardest granite cut and polished by Hindoo workmen.

The only tools which they employ, are a small steel chisel, and an iron mallet. The chisel is short, probably not longer than twice the breadth of the small hands which work it.* I think it most probable that each of these chissels may be formed of one of the short bars of Berar wootz, described by Dr. Heyne, in his tracts on India; but this is merely conjecture. The chissel tapers to a round point like that of a drawing pencil; and this I believe to be the only shape ever given to the points of their chissels.

The mallet, I have said, is of iron. It is somewhat longer than the chisel; its weight cannot exceed a few pounds. The head, set on at right angles to the handle, may be from two to three inches long. It has only one striking face, in this respect resembling the hammer by which the bell of a clock is struck. The striking face is formed into a pretty deep hollow, which is lined with lead, no doubt to deaden the blow, when these two instruments come in contact.

With two such simple tools, to detach the most massy granite from its native bed,† to have formed, fashioned, and scarped the granite rock which forms the tremendous fortress of Dowlatabad, and to have excavated the wonderful caverns at Ellora, are instances both of the incredible patience and perseverence of the Hindoo, and of the simple and apparently inadequate means by which he accomplishes the most difficult undertakings; for it seems by no means probable that the Hindoo stone-cutters ever worked with any other tools. Accordingly, the traces of the pointed chisel, are at this day as fresh upon the rock of the very

* The smallness of the handle of the Hindoo sword has often been remarked.

† An obelisk of a single granite stone, the shaft of which, as I am credibly informed, is seventy-five feet in length, was erected a few years ago in the neighbourhood of Seringapatam, to the memory of the late Josiah Webbe, Esq. It was quarried in the neighbourhood, and the whole work executed by Hindoo workmen.

ancient fortress of Dowlatabad, as when first cut. Are not traces of the pointed chissel to be seen upon the granite antiquities of Egypt?

Having by these two instruments only, brought the stone to a smooth surface, it next undergoes the dressing with water, in the manner usual with masons. It now only remains to apply the black shining polish, which is done as follows:

A block of granite of considerable size, is usually fashioned into the shape of the end of a large pestle. The lower face of this is hollowed out into a cavity, and this is filled with a mass composed of pounded corundum stone, mixed with melted bees-wax. This block is moved by means of two sticks, or pieces of bamboo, placed one on each side of its neck, and bound together by cords, twisted and tightened by sticks. The weight of the whole is as much as two workmen can easily manage. They seat themselves upon, or close to the stone they are to polish, and by moving the block backwards and forwards between them, the polish is given by the friction of the mass of wax and corundum.

Granite finished in this way is the most common material of which the tomb-stones of princes and great men in India are constructed. As a beautiful glossy black, it is scarcely, if at all inferior. to the finest black marble; and referring both to ancient Indian monuments,* and to the observations

* In the end of the year 1794, I had an opportunity of visiting the ancient city of Warankul, and of seeing a granite gateway, standing within the bounds of the palace; the fine black polish of which appeared to have lost nothing of its original lustre. It was almost the only remains of the royal residence, and we were told had been originally one of four similar gates, which led into a court into the interior of the palace. The other three had been removed for the sake of the materials. This beautiful gateway deserves also to be mentioned for the very durable manner in which it was constructed. The stones were fitted to each other most accurately, so that the joinings were as close as those of a modern marble chimney piece; and as no mortar or cement of any kind, had been employed, it seemed perfectly secure, both against the attacks of vegetation and the influences of the weather. But for these circumstances, it would not have escaped being attacked by the seeds of the banyan tree, and would probably have been entirely subverted long before the time of my seeing it. On the contrary, it seemed quite secure from the attacks of this irresistible enemy of Indian architecture, and was in every respect so perfectly fresh, that, unless by the application of external force, it seemed to be capable of lasting forever.

According to Colonel Wilkes, the city of Warankul was founded A. D. 1067, and captured by the Delhi Patans in 1323, when the dynasty was subverted. The gateway in question could therefore scarcely have been less than 500 years old, and might probably have been considerably older.

of Colonel Straton, it would appear that the polish thus given to granite, may be said to be as imperishable, as the material itself to which it is applied.

I had an opportunity of making these observations while engaged in erecting a granite monument, ornamented with black pilasters. The workmen succeeded most perfectly in giving the black polish to the granite, in the manner I have described."

ART. III.—*Notice of the Geology of the Catskills; by* Mr. D. W. BARTON, *of Virginia—with a Plan.*

THE study of Geology becomes more satisfactory, the nearer approach to perfect uniformity, we discover in the arrangement and stratification of the same minerals in different parts of the world—when they exhibit the same internal structure—the same relation, position, and the same association with other minerals. It is an object of no less importance to be able to establish the geological identity of remote sections of the same country, and to trace particular minerals through an extent of several hundred miles, with little or no interruption of continuity, and invariably accompanied by the same rocks. I have recently examined, with some degree of minuteness, the geology of the Catskills and their vicinity, with a design to compare the northern extremity of the transition region of the U. States with a corresponding section in the south. The result of my observations is exhibited in the accompanying chart. If in some instances I have not given to a stratum of rocks its appropriate designation, the error will be of little consequence, since it cannot materially affect the accuracy of the comparison which I propose:

In addition to this imperfect delineation of the geology of the Catskill Mountains, I am enabled to notice several localities of minerals which have not hitherto been described. 1st, On the side of the Mountain which rises immediately to the north of Kaaterskill clove, and about a quarter of a mile from the dwelling of Mr. Absalom Smith, is a ledge of common argillaceous slate, from which during the winter and spring, issues a small stream, strongly impregnated with alum. On arriving at the surface of the rock, the fluid is evaporated, and deposits the alum in the form of a powder. It is here collected in considerable quantities, and employed without farther preparation as a substitute for the imported alum. I observed sulphur in the fissures of the same rocks; to this no doubt the sulphate of alumine owes its origin. The same substance occurs in many other places, efflorescing from the mineral cavities of the rocks. 2d. In the sandstone about two miles east of the Mountains, I discovered malachite (green carbonat of copper) with its usual associates, quartz and sulphat of barytes. 3d. The *Fer Ologiste* or specular iron frequently occurred in small quantities in detached masses of quartz. 4th. In the channel of a stream, two miles south-east of the Durhan meeting-house, (Greene county,) I found the sulphat of iron distinctly characterized. The same rock in which this occurs, (a coarse variety of slate,) abounds with imperfect vegetable impressions, some of which are converted into coal, and the cavities which the decay of others has left, are occupied by sulphat of iron, which frequently presents the fibres and branches of the original vegetable. The acidification of the sulphur (one of the ingredients of the Pyrites) accounts satisfactorily for the production of the sulphate of iron, as well as the sulphate of Alumine with which it is found in intimate connexion.

References to the Engraved Plan.

No. 1. Ledges of schistose sandstone running in a direction about N. by E. and S. by W. containing numerous petrifactions—position nearly horizontal.

No. 2. A fine argillaceous slate, embracing very few, and these indistinct organic remains. Its inclination is much greater than that of the preceding class, and where I have observed them contiguous, the schistose sandstone has invariably occupied the highest position. The Argillite is evidently of earlier formation.

No. 3. Sandstone similar to that denoted by No. 1.

No. 4. Slate not differing essentially from that of the second class.

No. 5. Ledges of Limestone nearly horizontal and parallel with the strata already described. In some instances there is a sudden and remarkable deviation from this position, and the strata become inclined at an angle of 20° or 30°.

In the rocks which constitute this ledge, are imbedded nodules of flint of almost every variety of curvilinear form. They also abound with petrifactions of shells, &c. &c.

No. 6. Argillaceous slate inclined at an angle of 45°. In every other respect resembling No. 2.

No. 7. An alluvial valley. The soil consists of clay, mingled with a calcareous mould, evidently the result of the decomposition of the rocks in its vicinity.

No. 8. vide No. 2.

No. 9. — No. 5.

No. 10. Limestone. In this ledge the imbedded masses of flint and hornstone are so abundant, as to constitute almost a third.

No. 11. vide No. 2.

No. 12. — No. 5.

No. 13. — No. 2.

No. 14. Immense ledges of carbonat of lime, essentially the same with that described in No. 5. These form the termination of the limestone region, on the E. side of the Catskill mountains. The geology of the intermediate space is perfectly uniform. The rocks are a species of sandstone, so fine as scarely to present the appearance of a conglomerate, and with difficulty distinguishable from some of the coarser varieties of common slate. At the foot of the mountain the slate occurs, extremely well characterized, and continues to be the predominant rock for a considerable distance up the mountain, when the sandstone again appears, and extends uninterruptedly at least ten or fifteen miles to the W. Here my researches terminated.

Art. IV.—*Notice of a New Work.*

"A description of the Island of St. Michael, comprising an account of its Geological structure; with remarks on the other Azores or Western Islands. Originally communicated to the Linnæan Society of New-England. By John W. Webster, M. D. Cor. Sec. L. S. N. E. Boston; published by R. P. & C. Williams."

The Linnæan Society was originally formed by a few gentlemen of Boston, among whom was the author of this work. It has attained a part of the object for which it was instituted, a very extensive collection of specimens in all the branches of Natural History. The Society has lately been incorporated. It has labored chiefly in silence, but has accomplished much. The only publication which has appeared under its auspices, as we believe, is a pamphlet respecting the Sea Serpent.

This work on St. Michael, professes to be a communication to the same Society. We have perused it with much pleasure and satisfaction, and we hope that Dr. Webster's example may excite others to similar efforts.

In the preface, Dr. Webster observes that " it is not a little remarkable that a group of islands, situated as the Azores are, within eight hundred miles of the shores of Europe, should not have commanded the attention of naturalists, nor have induced some one to undertake an excursion to them for the purpose of investigating their geological structure. The only notices we have of them, are brief, tending to excite the curiosity, rather than affording much positive information respecting them." In 1813, a work entitled a " History of the Azores was published in England, which Dr. Webster observes, is said to have been written by the well known Ashe ; a review of this appeared in the Quarterly Review for 1814, from which and from Dr. Webster's account of the islands, it proves to be highly incorrect, and indeed almost utterly *false.*

Dr. Webster adds : as so few naturalists in the United States have enjoyed the opportunity of examining volcanic formations, it was thought that a tolerably minute description of all the geological appearances observed would be interesting to them ; the whole of the original communication has therefore been retained. I have, the author remarks, thought it would be useful to point out the rocks of some well known European localities, which many specimens from St. Michael resemble. A reference to American localities would have been preferable, but I have met with no rocks in this country analogous to those described in this work. It has indeed been said that basalt occurs in the United States, but the rocks which have been thus called, are widely different from the basalts of Saxony, or even those of Scotland and Ireland."*

The "Introduction" to Dr Webster's book, contains an account of the discovery and early history of the Azores, collected and condensed from all the best authorities. The islands included under the general name of Azores, or Western Islands, are nine in number, and are called San Miguel, or St. Michael, St. Mary, Terceira, St. George, Graciosa, Fayal, Pico, Flores and Corvo. The group, in general may be considered as extending from 37° to 39° 45′ of N. lat. and from 25° to 31° of W. long. It is situated in the Atlantic ocean, about eight hundred miles west from Cape St. Vincent, and at nearly the same distance from the shores of Africa and America." St. Michael is the largest of those islands, and is that which has commanded the principal attention of the author. The observations extend to most of those topics which usually arrest the attention of a traveller, and many highly entertaining accounts are given of the customs and manners of the inhabitants, which are in some respects peculiar and appear to be but imperfectly known to the rest of the world.

The following is an account of the general appearance of the island of St. Michael. The view from the anchorage on the south side of the island, where vessels ride about a mile distant from the shore, is uncommonly varied and picturesque. Immediately at the water's edge stands the city of Ponta Delgada, the principal town of St. Michael. It takes its name from the point Delgada, a little to the eastward of which it is situated, and from the uniform whiteness of the houses has, at a distance, an air of great neatness and even of beauty. The buildings rise above each other with great regularity as they recede from the sea, and

* It will be seen from President Cooper's memoir on volcanoes and volcanic productions, that he is of a different opinion. It is obvious however from the citation which he makes of the "Basalt" of Mount Holyoke in Massachusetts, that he uses the word at least in that instance, and in some similar cases in such an extent, as to include greenstone–for such Mount Holyoke decidedly is, if we may rely on our own examination of this mountain. Bakewell and many other writers use the word Basalt, in a loose sense, including under it most of the trap rocks. Restricted to the sense in which Dr. Webster uses the word Basalt, we must say, that we have never seen a specimen of American Basalt. This we know to be the opinion of Col. Gibbs; and a number of years since, we heard the same sentiment expressed by Mr. Maclure.

the general effect is heightened by the numerous towers of the churches and convents scattered in various parts of the city. The land gradually becomes more elevated beyond the town, and clumps of orange trees and other evergreens, here and there intermixed, are more frequent as the eye reaches the open country, where they spread out in rich profusion. Numerous small conical hills are seen in the back ground, which are covered with a short, but verdant growth of heaths and ferns; and the view is bounded on each side by lofty mountains."

The habits of the people are thus described: "In all seasons of the year the men wrap themselves in large cloth cloaks, one corner of which is usually thrown over the left shoulder. With the cxception of the cloak, their dress is simple, and well suited to the mild climate in which they live. It consists of a short jacket and breeches of a coarse blue, or brown, cotton cloth, from beneath which, white linen or cotton drawers hang several inches below the knees, both garments being loose and untied. Boots of unblacked leather reach rather more than half way up the legs, and the head is covered with a blue cloth cap, called "carapuca." "The females of the Azores have not the clear, florid complexion so much admired in some other countries, but their countenances are not devoid of animation, and are often highly expressive. Their feet are remarkably small, and their gait is slow and graceful. Females of the better class are seldom seen in the streets, as it is esteemed highly indecorous for them to appear in public, unless accompanied by their fathers or brothers; even then, their faces are veiled, and they are wrapt in large blue woollen cloaks, or are dressed in a peculiar, and uniform black habit called "manto," which equally protects them from the gaze of the multitude."

Then come descriptions of the Friars, Nuns, religious houses, &c. The superstition of the Azoreans is equalled only by their ignorance. The customs, ceremonies, penances, processions, &c. during Lent are minutely described; we extract the following passage: "In the afternoon of Good Friday, another procession takes place, when all the images which have been already noticed, are again carried through the streets: and in addition, an attempt is made to represent all the circumstances in the denial, condemnation, and crucifixion of Christ, together with many other events recorded in the Scriptures. Men and women, the characters of some of whom are well known not to be the most pure, are hired to perform in this show, and are dressed and painted at the Franciscan convent, where the procession is arranged. Our Saviour is represented by a large wooden image, dressed in a purple robe ; upon its head is a crown of thorns, and the hands, which are tied, bear a reed. Two men, representing Herod and Pilate, march along in red boots, with splendid turbans on their heads, from beneath which an abundance of false hair hangs in graceful ringlets over robes of purple and ermine. Their long trains are held by children dressed as pages. The cock and St. Peter have a conspicuous station, in company with Judas Iscariot. Children, dressed as in the procession described in the preceding chapter, carry silver dishes, on some of which are a sponge, hammer and nails ; on others are human skulls and thigh bones. Following the cross are two persons, representing the two thieves ; they are strangely dressed, and their arms are bound with cords. Their faces are concealed by pieces of black crape, and they are guarded by soldiers on each side. An image of Mary, the mother of Jesus, is carried on a bier ; her eyes are raised to heaven, and tears appear to drop from them, which are conspicuous at the distance of many yards. In another part of the procession are seen Abraham and Isaac, clothed in sheep-skins, Isaac bearing on his shoulder a bundle of faggots."

The eighth chapter contains an account of the climate, agriculture, &c. "The thermometer rarely indicates a temperature below fifty degrees of Fahrenheit's scale, or above seventy-five." The state of agriculture appears to be miserably bad, arising in part from the entailment of estates, and from a natural aversion to labour and improvement in the islands. The remark made by the first adventurers that noxious animals and reptiles do not exist in the Azores is confirmed by the observations of Dr. Webster, who in speaking of the miserable superstitions, of these islanders, very carefully avoids the use of those *harsh* epithets, which they so justly merit.

Chap. IX. "Orange gardens—purchase of fruit—Imports—Gathering and packing the fruit—varieties of lemons and oranges—Grapes—Vintage."——"The orange and lemon trees blossom in the months of February and March."—"The trees generally attain the heighth of fifteen or twenty feet; they are planted with little regularity and are permitted to grow with unrestrained luxuriance."—"The usual produce of a good tree, in common years, is from six to eight thousand oranges and lemons. A few years since, twenty-six thousand oranges were obtained from one tree and twenty-nine thousand have been gathered from another. These quantities have never been exceeded. A singular variety of lemon and orange is described which has "a very irregular, lobulated appearance; and different lobes of the same orange or lemon retain the distinct sweet or sour taste." Some of these are shaped "like a cucumber with numerous long slender processes growing out from the sides; some have a form very similar to the human hand, with projections like fingers; and some hang in clusters, or resemble large oranges or lemons to which smaller ones, of the size of bullets are attached," &c. These are produced by innoculating the common, or sweet orange, with the sour oranges and lemons.

Chap. X. Dismissing the popular topics which however we have found very interesting, we now advert to the Geological features of St. Michael, &c. "The Azores are peculiarly interesting to the geologist, as they exhibit to him at every step marks of their comparatively recent formation, and of the operation of agents the most powerful and terrific." The island is described, first generally, and presents lofty mural precipices, deep ravines, lofty mountains, and isolated conical hills with craters at the top. The principal variety of Lava is of the *basaltic* kind, in applying this term the author observes, he has "followed Daubuisson," and a better authority it would be difficult to find. The structure of the rocks is minutely described. They abound in Olivine and Augite, and sometimes contain Haüyne, basaltic hornblende, Titanite, Felspar, &c. Much of the lava is *cavernous*, an expressive term which has been adopted from Sir George Mackenzie's work on Iceland. The following is an accouut of one of the caverns in the island.

"Having reached a field between three and four miles N. West from the city, we discovered the entrance to the cavern. It is a fissure in the rocks, which here rise only a few feet from the surface, and is about wide enough to admit two persons abreast. The bottom, when viewed from the entrance, for some yards formed a gently inclined plane; but as we proceeded the rocks spread out on both sides, and we soon found ourselves in a spacious apartment, the floor of which was heaped with huge fragments of lava that had fallen from above, and over which our progress was, for some distance difficult and rather dangerous. At the distance of ten or twelve yards from the entrance, we came suddenly upon the edge of a precipice, beyond which it seemed impossible to proceed. Creeping, however, with caution along the edge, we presently came to a point where an accumulation of fragments afforded a natural, but dangerous passage, and, by leaping from rock to rock, we at length reached the bottom.

"The heighth of the precipice was probably not less than thirty feet; and as the torches, with which we were armed, served to illuminate the cavern but feebly, we directed our guide to kindle a fire. From the sound of our voices, we were of opinion that this apartment was of great extent, and the strongest light we could obtain, did not enable us to discern the roof.

"The light of the fire strongly contrasted with, and gradually lost in the surrounding darkness, produced a very picturesque effect, which was greatly heightened by the situation of our party, some of whom were obscurely seen standing upon the huge fragments of rocks, while others were passing and repassing in various directions, exploring a passage to the recesses of the cavern. Having groped about for some time, over and among rocks of all sizes and shapes, which were piled on each other in every possible manner, we at length discovered, on our right, a chasm about two feet in width. Looking into it from above, the space below appeared to enlarge, and the lava on which we stood, to form the roof of another cavern beneath us."——"The floor was covered with fragments of every size, and from the roof hung stalactites of lava; an appearance highly interesting, and which amply repaid me for the danger and difficulty encountered. On breaking the stalactites they were found to be much more porous and vesicular than any lava I had previously seen. The cells were nearly perfect spheres arranged in concentric circles, and most of them were large enough to contain a pea. They were not visible, however, till the stalactites were broken, being covered with a smooth and hard crust. The partitions between the cells were less than the sixteenth of an inch in thickness, and had an imperfect glimmering lustre on the fresh fracture. Most of them contained a loose brown, earthy matter, probably the result of partial decomposition. The stalactites, externally, have a dark iron grey colour, sometimes passing to black, and they are deeply channelled in a longitudinal direction. They occur of all sizes, some of them are less than an inch in length, while others exceed a foot. Their diameter is not less variable but never exceeds six inches at the thickest part. Those which were about a foot in length, were usually from one to three inches thick."

When these stalactites were broken, water fell from them, but externally they were dry. The attraction of the volcanic rocks of this island for moisture is observed by the author to be very great and to this he attributes in a good degree, the fertility of these regions: the same remark holds true of other volcanic regions, and even of *trap* countries although in this respect they are less remarkable.

" The difficulty of penetrating to the last apartment of the cavern, was by no means inconsiderable, and for the last few yards, we were obliged to creep upon the bottom, and advance with the utmost caution, while the sharp points of hundreds of stalactites were in contact with our clothes." Some of the circumstances noticed in the lava of these caverns, are curious, &c. throwing light on the manner in which they may have been formed, the lava appearing like melted lead thrown into water—the walls " in some places seem to be covered with petrifactions or vegetables, and shrubs, retaining the most perfect resemblance to their originals," some specimens resembled bunches of grapes partially flattened, and some were like " coarse lace."

Chap. XII. " Geology of St. Michael continued—Eruptions from the sea." In addition to the facts which the author examined in person, as to the structure of the rocks, &c. he has given the details of the recent volcanic eruptions, all proving these islands to be " among the most recent formations of our globe," but we have not room for extracts from this portion of the work which although highly interesting has been *in part* published before. In this chapter is a letter from Captain Tillard of the British frigate Sabrina, " describing the phenomena attending the eruption from the *sea* in 1811, and which was originally published in the Philosop. Transact. for 1812. The frigate being there at the time, Capt. T. landed on the *new* island and named it " Sabrina," but it disappeared a few days after beneath the waters of the ocean. To the account of Capt. T. succeeds another, first published in the ninth volume of Brande's Jour. of Science and the Arts, of the Royal Inst.

We observe Dr. Webster makes much use of the word Trachyte, which is rather new in this country. This term is now applied very generally abroad to a porphyritic rock, or rather, to many different porphyritic rocks having the general character of containing crystals of glassy felspar. In speaking of this rock, it is observed in the Edin. Ph. Jour. in a paper of Dr. Borré's on the volcanic rocks of Auvergne, that " it is almost impossible to give a definition of such a rock; how could it be otherwise with a volcanic production, which is formed from all the different members of the granite formation ?"

Pumice is described as occurring in vast quantity and it often contains *bituminous wood* resembling the Suturbrand of Iceland. A distinct transition from Pumice to Obsidian was often noticed. The obsidian is always found in St. Michael, in loose pieces and is of the usual black colour, sometimes irridescent, which Dr. Webster attributes to exposure to the air, &c. and always contains crystals of glassy felspar.

In chap. XIV, an interesting account is given of a stupendous crater fifteen miles in circumference, and now embosoming an inland lake which covers one third of the included space, while the rest is occupied by vegetables and a thin population with a small village called by the natives, the seven cities, and the vale is called the valley of the seven cities.

In the XVth chapter a remarkable rock is described as occurring on the mountain of Agoa de Pao. " Some of the pieces were about twice the size of a man's head, and, at first sight, might easily have been mistaken for pieces of granite. They are composed of felspar and hornblende, and contain a few scattered grains of magnetic iron. The felspar is divided into prismatic distinct connections, which are from half an inch to two inches in length, and from an eighth of an inch to an inch in thickness." The angles and edges of these masses were rounded and showed marks of attrition—Angular spaces have been left between the concretions, in one of which, says Dr. Webster, I discovered a portion of transparent quartz having a red tint. The spaces are partially filled by crystals of hornblende projecting into them, and it is probable that they were once entirely occupied by that mineral. A small quantity of black mica adheres to the surface of some of the largest concretions of felspar.

The most singular circumstance in these masses, is the division of each one of them into a coarse and fine grained portion. The latter, composed likewise of hornblende and felspar, intimately mixed, and in nearly equal quantities, forms a nucleus, which is completely enveloped by the coarse concretions. There is no gradual transition from the one to the other, but they are so distinct, that, on the application of a slight degree of force, they separate from each other, and the nucleus, or fine grained portion, presents a smooth and convex surface. The lustre and translucency of the felspar, in all these fragments, is such as evinces that they could not have been subjected to a very elevated temperature." The author then goes on to remark, that " if these rocks had been found on a mountain, composed of the *primitive* rocks of many geologists they would have been described as granite, or sienite, and there is in Dr. Webster's opinion, no reason why they are not, in their present situation, equally entitled to the name."

Perhaps we do not exactly apprehend the author's meaning. He evidently does not intend that the specimens resembling granite and sienite (and this resemblance has appeared to us on inspection of the specimens to be very striking) indicate that the immediate region in which they are found is primitive, for this is disproved by the whole tenor of his observations. If he means nothing more than that the pieces in question have such indicia as prove their origin from primitive rocks, this conclusion contains nothing improbable, for fragments of primitive rocks are not uncommon among volcanic ruins, and the mechanical analysis of lava by Cordier, is said to discover principally primitive minerals. We would ask Dr. Webster whether he is warranted in inferring that his supposed primitive specimens, "could not have been subjected to a very elevated temperature," because they retain "their lustre and translucency," for the glassy felspar which he mentions as being found so commonly in the lava and even in the obsidian and pumice of St. Michael is still more remarkable for lustre and translucency, and in the lava of Vesuvius, we often find transparent and brilliant crystals of leucite, not to mention the beautiful olivin which abounds so much in the lava of the Azores.

The author next adverts to the occurrence of fragments of similar rocks, in the vicinity of volcanoes *now* active, and states his opinion that the specimens observed by him could not have been carried up the mountain, or have come there by design, or accident as in the case of ballast stones, &c.

"These stones were not found in the immediate vicinity of any buildings, near the sea shore, nor at the base of the mountain, but at an elevation of not less than one thousand feet above the level of the sea, and in a ravine, probably, never before trodden by human being." We freely assent to the author's observation that "in examining any tract of country, the geologist cannot too often call to mind the remark of Humboldt that "he is exposed to a thousand errors if he loses sight of the changes, which the intercourse between nations produces on the surface of the globe."

The whole of the lower part of the island is composed of "tuff," which also forms a small island, or more properly *crater* in the sea in front of the town of Villa Franca. This *islet* appears from its structure to have been formed by an eruption like that of 1811. Hot springs occur in various places in St. Michael—those of "the valley of the Furnas" are most interesting and curious.

Chap. XVIII. The Valley of the Furnas, &c. &c. "The hot springs of the Valle das Furnas,"* render this the most interesting spot in St. Michael. The valley is nearly twelve miles in circumference, and is bounded on every side by mountains of various height. Its form is like that of the other enclosed vallies, which have already been described, is nearly circular, but its surface has considerable irregularity, rising here and there into small hills. A part of it is under tolerable cultivation, and it is inhabited by a few

* The Portuguese word "Furnas" means caverns.

peasants. It is watered by many streams that wind through the plantations, till they unite to form a small river, called "Ribeira Quinte," or warm river. After a circuitous course the Ribeira Quinte flows through a deep ravine and empties itself into the sea on the southern side of the island at the base of Pico da Vigia.

The mountains surrounding this valley are composed chiefly of pumice, but compact lava and rocks of the trachyte family are seen on the face of many of the precipices. The columnar structure and vertical arrangement of these rocks are quite distinct in some places; in others, beds of the porphyry and pumice appear to alternate. They are sometimes separated by layers of fine sand or ashes. A few pieces of slaggy lava and scoriæ, are occasionally found at the foot of the mountains, but there are no large collections or beds of them.

"The hot springs are continued towards one extremity of the valley, beyond a few cottages composing the village of Trunnas. They are not seen at any distance, being surrounded by small hills, some of which, there is great reason to believe, owe their origin in part, if not altogether, to the springs themselves. They are generally covered with short shrubs, but some of them are wholly devoid of any traces of vegetation. They are composed of clay of different degrees of compactness, which is variously, and often beautifully coloured by iron under different degrees of oxidation. The clay is intermixed with fine pumice and masses of siliceous sinter. As we pass along the narrow road from the village to this spot, the gradual change from a fertile to a barren soil is observed, and within a few yards of the hot springs nearly all traces of vegetation are lost. At the extremity of the road the ground is almost snow white, and then acquires a reddish tinge; this increases in intensity and brightness, and finally passes through an infinite variety of shades to a deep brown. Here and there patches and veins of a brilliant yellow and purple colour add to the singular aspect of this remarkable spot. The clay is in some places so much indurated as to retain an imperfect slaty character but most of it is soft and has an earthy aspect. It does not feel perfectly smooth when rubbed, but is full of hard grains, which are exceedingly minute; and when a mass of it is diffused in water, a quantity of fine siliceous particles is apparent. It has many of the characters of Tripoli It is used by the peasants as an external application for cutaneous diseases, and is undoubtedly beneficial in some particular cases, from the quantity of sulphur it contains."

"The vicinity of the springs is indicated by the increased temperature of the earth, a sulphureous odour, and the escape of vapour or steam from every crack and fissure in the ground. The temperature of the clay continues to increase as we advance, and a greater quantity of vapour is at last seen slowly ascending from the springs themselves. The volumes of smoke and steam rolling upwards from the surface to a great height; till they are gradually diffused through the atmosphere, or mingle with the heavier clouds that crown the summit of the mountains, produce a striking effect. The confused, rumbling, and hissing noise, that is heard for some time before we arrive in sight of the springs increases at last to an incessant and terrific roar, and seems to issue from the very spot on which we stand. The earth returns a hollow sound, and great caution is required to avoid stepping into the pools and streams of boiling water, with which its surface is covered.

The quantity of hot water discharged through the innumerable orifices in the ground is prodigiously great, and the different streams unite, forming a small river that, still hot, joins the Ribeira Quinte. The largest springs are termed "caldeiras," or boilers, and a shallow basin of earthy matter has been formed round each of them, by depositions from the water. Much of the water is constantly retained within these reservoirs, and its surface is more or less agitated by the escape of sulphuretted hydrogen gas, and the ejection of the water from below. The temperature of some of these springs on the second of December, between three and four o'clock P. M. the thermometer standing at 63° Farhr't. the barometer at 29, 4 was as follows :

207°—200°—96°—137°—203°
190°—134°—170°—73°—114°
184°—94°—122°—171°—147°

The basin of the largest spring, particularly designated as "*the caldeira*," is circular, and between twenty and thirty feet in diameter. "The water in this, boils with much greater violence than in any other caldeira, and distinct loud explosions occur at short intervals, which are succeeded by a very perceptible elevation of the body of water within the basin. This is attended with a loud hissing noise and the escape of great quantities of sulphuretted hydrogen gas, steam and sulphurous acid vapour." The water of these springs is used in bathing houses erected near them and found highly beneficial in many complaints.

"Wherever the water has flowed, depositions of siliceous sinter have accumulated, and circular basins, composed entirely of this substance, have been here and there formed round a spring. The siliceous matter rises, in many places, eight or ten inches above the level of the water, and is often exceedingly beautiful. Vegetables, grass, leaves and similar substances which have been exposed to the influence of the water are more or less incrusted with silex, and exhibit all the progressive steps of petrifaction; some being soft, and but little differing from their natural state; while others are partly converted into stone, or perfectly consolidated." All these masses are more or less abundant in sulphur, often crystallized and constituting splendid specimens. Much of the sinter resembles that of the geysers of Iceland—much is represented as being far more beautiful. One variety which has been described in a former number of this vol. Journal, pa. 26 is distinguished by its structure and chemical composition (containing 16.35 per cent of water) and Dr. W. proposes to designate it by the name "Michaelite." Silex occurs in the cavities of the massive sinter in stalactites, some of which are covered with "small, brilliant *crystals* of quartz."

Near the springs is a remarkable breccia formed of fragments of lava, pumice, sinter and *obsidian*, cemented by siliceous matter. From observing the ferruginous deposition of some springs of *cold* water within a few inches of the hot springs, and from the occurrence of pebbles having a metallic stain, Dr. Webster suspected the existence of sulphuretted iron and caused an extensive examination to be made. At a considerable depth below the surface, his conjecture was verified by "the discovery of an abundance of sulphuretted iron; a great quantity of which was thrown up. Most of the pieces were as large as a man's head, with an irregular globular form." These pieces had all the characters of iron pyrites and in the author's view, the existence of this bed of pyrites, enables us at once to account for all the phenomena in this spot, especially the sublimation of the sulphur, the heat of the water, and the chalybeate properties of the springs. We cannot but think however, that although the pyrites may be and doubtless are active in producing these remarkable phenomena, the cause is scarcely adequate to such continued and grand effects which must probably be ultimately referred to the general and deep seated cause of the volcanic activity which so signally distinguishes all the Azores.

Chap. XIX. Contains an account of the chemical and medical properties of the waters of these springs, from which it appears they contain Carbonic Acid, Carbonate of Potash, Muriate of soda, Iron in the state of Carbonate—a trace of manganese and silex.

In an Appendix is given a general sketch of the remaining islands of this group—it is very brief, and consists chiefly of the scattered facts collected by the author from different journals, travels, &c. He did not visit these islands and therefore does not pretend to give any thing more than a sketch of them. There is in the Appendix a very interesting account of an eruption in the island of St. George in 1808, by J. B. Dabney, Esq. American Consul at Fayal.

Dr. Webster's volume is neatly printed and is fully illustrated by the following engravings executed in a correct and elegant style.

1. A general map of the Azores.
2. A particular map of St. Michael.
3. A scale of the Barometer and Thermometer at Ponta Delgada, Oct. 1817 to March 1818.
4. A view of the Eruption on the N. W. coast of St. Michael, June 13, 1811.
5. Appearance of the Island Sabrina, S. W. one mile from St. Michael.
6. View of Pico and St. George from Fayal.

We have extracted so largely from Dr. Webster's volume that the reader will now be able to form a competent opinion for himself. But in closing this article we cheerfully add, that we have rarely perused a volume of equal extent which has presented more valuable and interesting information conveyed in a chaste, unostentatious and perspicuous manner. The work is both popular and scientific; but readers of both classes may, and we presume will peruse the whole with pleasure and advantage. It is a valuable addition to our stock of foreign travels and does credit to its author.

Art. V.—*Notice on Vegetable Fossils, which traverse the Layers of coal formations; by* Alexander Brongniart, *Member of the Royal Academy of Sciences, Chief Engineer of the Royal Corps of Miners, &c.*

Extracted from the "Annales des Mines, for 1821."—Translated by Isaac Doolittle.

The presence of organized remains in the midst of the solid strata of the crust of the globe, and which sometimes are found at great depths, is one of the circumstances most worthy of exciting the curiosity, and fixing the attention of observers.

These remains of former worlds, often very numerous and but slightly altered in their form and structure, although entirely changed in their nature, seem to have been so well preserved, solely in order to afford us the only documents which we can ever hope to possess respecting the Natural History of these various periods: these ancient remains are like scattered sentences of that history. The more we can collect of them, the stronger will be the hope that we shall one day re-establish it, if not perfectly, at least in its most essential points. The fact which I am about to mention is not new, though instances of its having been observed are still rare. It is, moreover, so remarkable, so important to the theory of one of the formations of the earth, the most interesting in every point of view, that too many instances cannot be noticed.

That which is the subject of this notice is the most complete, the most clear, and the easiest of observation; it will, therefore, be one of the most authentic. In this publication I claim no other merit than that of having described and designed, and by that means, inscribed on the registers of Science, a fact which the Engineers of mines of the Department of of the Loire, (Messrs. Beaunier & Gallois,) pointed out to my notice.

It has been long known that the deposits of Fossil coal are accompanied by large quantities of vegetable remains: it was also long ago observed, that plants having a strong resemblance to our ferns, and the stalks of other plants, unlike any that are now known to exist, were most common in those regions; but it is not a long time since it was first remarked that the entire system of those vegetable remains was different from the entire system of vegetable remains which are found in the more recent strata of the earth; and it was not known until within a few years that these remains were not always laid down in the fissures, or on the surface of the layers, and parallel to their stratification, but that in some places they intersected those layers, passing through several of them, being sometimes perpendicular to them, and sometimes in a vertical position, natural to all phanerogamous plants.

Most assuredly, if these notions had been more general, if the facts which confirm them had not been considered as exceptions due to chance, we should not have seen in recent periods, theories proposed on the formation of coal, which theories are in evident contradiction with these facts.

The vertical stalks which we are about to describe, have already been noticed by Mr. de Gallois; they are seen in the most distinct manner at the Mine of *Treuil*, at 1000 metres (1094 yards,) north of the city of St. Etienne, in the department of the Loire.

This coal mine unites two circumstances very rare, and at the same time highly advantageous for observation, the strata are almost perfectly horizontal, and the mine is so situated that it is worked wholly open from above, in the usual manner of working quarries; in this manner an opportunity is offered of observing a natural and complete section of the different rocks and minerals which compose the superstructure, and of representing them with a degree of clearness, and throughout an extent that is wholly impossible where mines are wrought by subterranean galleries.

This natural section of the ground is highly interesting, not only from the circumstance of the Vegetable Fossils, that form the principal object of the present notice; but also from the presence of compact carbonate of iron, so constantly found to accompany coal, and which will soon become in France, as it has long been in England, a source of great profit, and of a branch of industry hitherto unknown to us.

Confining ourselves to the examination of that part of the mine of Treuil which is represented in the plate, we may remark, in proceeding from the lower terrace to the surface of the ground:

1st. A stratum of a micaceous coal slate, "Phyllade charbonneuse pailletée" S, which is soon followed by a bed of coal, H, which is about 15 decimeters (near 5 feet) thick;

2nd. A second layer of the same schiste and Phyllade S, but thicker than the former, and containing in its lower regions, and very near to the bed of coal, four beds of compact carbonate of iron, in flattened nodules, F, of different sizes, and completely separated from each other; or in large plates, swelled towards the middle, accompanied, covered, and even penetrated by vegetable remains;

3rd. And, as the second terrace above this bed of schist, another bed of coal which is from 46 to 50 centimetres (18 to 19½ inches) in thickness, and which is covered with a bed, composed of schistose clay, S, similar to the lower one, of four or five thin layers of coal, and, near its upper part, of three or four very thin and closely connected beds of compact carbonate of iron, F, in every respect similar to those above described.

The schists and the iron ore are accompanied by a great number of vegetable impressions which cover and follow all the *contours* of their surfaces;

4th, and lastly. Here terminates the coal formation by presenting a bed 3 to 4 metres (10 to 13 feet) in thickness, of micaceous psammite, sometimes offering simply fissures in different directions, sometimes very distinctly stratified and even passing to the structure of large laminæ.

In this bed, and throughout a very large extent, are found a great number of trunks, placed in a vertical position, traversing all the layers of the bed, only a small portion of which are seen in the plate which accompanies this notice. It is a real fossil forest of monocotyledonous vegetables, in appearance resembling bamboos or the large *equisetum*, petrified on the spot.

Although the strata are, in this place, almost perfectly horizontal, it may, nevertheless, be perceived that a movement of translation has taken place since the precipitation, and even since the consolidation of the upper layer of psammite; this movement, it is true, was not extensive, though sufficient to break, in several points, the continuity of the stalks or trunks, so that their upper parts are, as it were, pushed aside, and do not correspond with the lower ones.

It does not enter into my plan to describe these plants, nor to endeavour to determine to what family they may belong: this is a very important and a very difficult subject, and one which cannot be treated cursorily. My son, aided by the counsels of Mr. Decandolle and the assistance of the geologists, commenced, a long time ago, a separate work on that branch of Botany, which has for its object the study of fossil vegetables: for in giving names to this species of vegetables, too rapidly and too superficially, there would be danger of propagating, relative to their genus, opinions which might prove to be erroneous. But, although I here speak only of the position of the stalks, and not of their nature, I cannot refrain from offering, on this last head, a few observations which relate immediately to those of St. Etienne, which I have just described.

At the mine of Treuil there are two distinct sorts of stalks, the one cylindrical, articulated, and striated, parallel to their edges; these do not offer, in their interior, the least sign of organized texture, their cavity, *probably* fistular, is entirely filled with a rocky substance of the same nature as those which compose the layers they traverse. These stalks are the most numerous, and differ much from each other in diameter, from only 2 to 3 centimeters ($\frac{3}{4}$ to $1\frac{1}{4}$ inches) to 1 or 2 decimeters (almost 4 to 8 inches) and perhaps more. Their greatest length appears to be 3 to 4 metres (10 to 13 feet.) Their surface is often covered with a ferruginous, and even a carbonaceous crust or deposit.

The other vegetables, less common, are composed of hollow cylindrical stalks, which diverge towards their lower extremities, and seem to be divided in the manner of roots, but without *the least ramification*.*

It does not appear that any of these trunks can be ranked with the trees of the family of the Palm tree. This result, which I simply announce, will be developed and preceded

* The plate shews these diverse circumstances.

by the reasons which lead to its admission in the special work which my son will publish on this subject.

I stated, at the commencement of this notice, that the fact here described was not new to geologists. Among the instances which have been noticed of the stalks of fossil vegetables, traversing several strata, or being placed vertically in the bosom of the earth, I shall call to recollection those which appear to me to have the strongest analogy with the example of the mine of St. Etienne: these citations will contribute to establish the resemblances equally real and remarkable which the coal grounds of all countries offer, in every particular, as well of their formation as of their structure.

Mr. Mackensie observed in the coal grounds of Scotland, near Pennycuik, ten miles from Edinburgh, a vertical trunk of the length of about 12 decimeters (4 feet), which was composed of carbonaceous sandstone (psammite) and the bark or the substance that here replaces it is composed of coal. This trunk was not only striated longitudinally like the stalks of St. Etienne, but was divided like them by transverse sections or articulations.*

A fact, very similar to the above, appears to have been observed in the coal ground of South Shields.†

Mr. de Schlotheim also cites instances of vertical stalks at Kiffhaüser, in Hartz,‡ in the mines of Maneback, near d'Ilmenau, &c.

But the instances which have the strongest analogy with that which I have described, are those observed in Saxony by Werner, by Messrs. Voigt and d'Aubuisson, in the coal grounds of the environs of Haïnchen, and by Messrs. Habel and Noggerath, in the coal mines of the country about Saarbruck.

* *Bibliothique Universelle* V. VIII. p. 256. The figure which is there given represents this trunk with roots, and as rising above the surface of the soil; but it has been found that this was an error in the design, and that behind it should have been represented the layers in which it was, and remained engaged.

† *Ibid.* V. VIII. p. 234. This fact, presented in a very vague manner, can hardly be given as an example from which useful consequences can be deduced.

‡ In *Leonhard Taschenbuch für die gesammte*, &c. 1813, 7th year, p. 40

In the first of the above named places, four or five stalks from twenty to 30 centimetres (about eight or twelve inches) in diameter, which Mr. d'Aubuisson calls trunks of trees, are seen standing in a vertical position in the micaceous sand stone (psammite) of the coal ground. All the accompanying circumstances are similar to those which attend the vertical stalks of St. Etienne.*

Similar facts have been observed in the environs of Saarbruck, in several coal mines, particularly in that of Rohwald, where the trunks measured two metres (six and a half feet) in height, and six to eight decimetres (two feet to two feet seven inches) in diameter, and in the mine of Wellesweiler: the trunks, found in the latter mine, remarkable for their conic form, for their diameter from forty-five to thirty-six centimeters (seventeen and three fourths to fourteen and a quarter inches) and for their length which exceeded three metres (ten feet) have been lately described, and elucidated by plates, by Dr. Noggerath.†

These trunks, which cannot be classed with any known vegetable, and which appeared to differ from those observed at Haïnchen and at St. Etienne, traversed several layers of psammite, as well sandy as schistose, and were situated between two beds of coal.

Mr. de Charpentier cites a similar instance which he observed in the psammite coal-ground situated north-west of Waldenburgh, in Lower Silesia. He says that in 1807 there was discovered in that mine a fossil tree, in a vertical position, traversing several strata, and having the forms of its roots and of some of its branches in a good state of preservation, while their nature was changed to a fine grained quartz of a greyish black, but the structure was not *recognizable:* the bark and the small branches were changed to coal. This trunk was four decimetres (fifteen and three quarter inches) in diameter, and there remained of its length about four metres (thirteen feet.)‡ The presence of the

* See *Journal des Mines,* V. XXVII. page 43, and more especially d'Aubuisson, *Géognosie* V. 2, p. 292.

† *Ueber aufrecht in gebirgsgestein ingeschloffene fossil Baumstamme,* &c von Dr. Jacob Noggerath. Bonn, 1819.

‡ *Bibliotheque Universelle,* 1818. V. IX. p. 256.

branches, of which there seems to be but little doubt, establishes a remarkable difference between this case, that of St. Etienne, and those of which we have made mention.

Finally, Mr. Habel has observed, in these same mines, vegetable stalks placed in an almost vertical position, and which were in every respect similar to ours; they were from two to two and a half metres (six and a half to eight feet) in height, and twenty-five centimetres (ten inches) in diameter; they were articulated, regularly fluted, and covered with a thin coat of coal. These stalks traversed the beds of the formation which contains the earthy carbonate of iron.

There has been lately found in the standstones (these are probably the psammites) which cover the coal formation of Glasgow, to the north-west of that city, the trunk of a tree in a vertical position; this trunk was six decimetres (one foot eleven and a half inches) in diameter, its transverse section presented a figure inclining to oval; like those already described it was entirely filled with rock of the same nature as those which surrounded it; but the bark, (that is to say the external part of this vegetable, for nothing proves that it had a real bark,) was converted into coal. It was disengaged throughout an extent of about one metre (thirty-nine inches,) and no branches were discovered, yet, it is said, roots were formed at its lower extremity, particularly four large ones which plunged into the earth like the roots of common trees. We cannot, says the author of the notice, class this with any kind of trees now known. (Thomson, *Annals of Philosophy*, 1820, *November*, *page* 138.)

I say nothing of the stalks and trunks of trees, properly so called, not only fossil but petrified into silex, which have been found in formations absolutely foreign and always posterior to that of coal; these instances of petrified wood are very numerous, but their geological position distinguishes them entirely from those which are the object of the present notice.

It is probable that examples of stalks traversing the layers of coal-grounds are also very frequent, and that, if only a small number have been described, if so few have been engraved, this circumstance is owing chiefly to the manner in which the coal-mines are generally worked. They are almost always deep and can be approached only by shafts and galleries which are never very large. In digging these subterranean passages, they always endeavour to avoid passing through the psammite, which would cause much expence without any profit to the miner; and it is these rocks which appear to contain the far greater number of the vertical stalks. These obstacles have much restricted the number of cases favourable to the discovery and to the complete and easy observation of those stalks; but we are led by analogy to believe that, if urged on by the same motives of interest which induce the search for iron ore, those stalks would be found in the coal-grounds as commonly as the coal itself. Now if these stalks, still retaining their vertical position, announce that the coal-grounds of St. Etienne, Saarbruck, *&c.* have been formed and deposited in the places where these vegetables once lived and grew, we may, we ought even from analogy, to come to the same conclusion in relation to the other coal-grounds. We must then no longer go to seek beneath the torrid zone for arborescent ferns, and all the vegetables of a tropical aspect that we find buried in the coal-grounds, and bring them into our latitudes by means of strong currents, or great commotions. This hypothesis, which is now almost entirely abandoned, is, as Mr. Noggerath has judiciously remarked, incompatible with a vertical arrangement so regular, so clear, and so uniform.

Nevertheless, Mr. de Charpentier, in the notice above cited relative to the vertical trunk of a tree found at Waldenburgh, offered some very just remarks on the difficulty of imagining that those stalks could have grown in such ground as that which now surrounds them, and that this earth could have been deposited amongst them during their growth, without partially destroying, overturning, or at least deranging them. He supposes that these vegetables, adhering to the soil by large and deep roots, were removed, with the soil which supported them, and left in the places where we now see them. He supports this explanation by a circumstance which fell under his observation on the breaking out of the waters of the lake of Bagne. In that terrible catastrophe large trees with their roots were transplanted by the current, and deposited vertically in the plain of Martigny. This observation leads us to admit that the vertical position of a stalk is not a certain proof that it grew in the same place where we find it; but it appears to me that such cases must be extremely rare, whereas instances of stalks being found in a vertical position are very frequent. In those cited by Mr. Noggerath and by ourselves, there was not merely a single trunk, of a large tree, but there were many trunks ; and in the mine of Treuil, which forms the principal object of the present notice, it is, as it were, a forest of slender stalks which remain parallel to each other. Besides, the nature of the soil to which the vegetables would adhere by their roots should be different, or at least, very distinct from that of the rocks which enclose them. It is perhaps more difficult to imagine that these sandy rocks should envelope them after their transposition, without deranging them, than that it should have been deposited among them in the place where they grew, and where they were solidly fixed in the earth. And if we even suppose that these vegetables may have been transplanted thither, without losing their vertical positition, we cannot admit that they were brought from a great distance ; and the insurmountable objection against the hypothesis which would bring these vegetables from the tropical regions into our climate, would still exist.

Nevertheless the facts cited by Mr. Carpentier, and his observations thereon, tend to throw a degree of uncertainty over the primitive situation of those vertical stalks, which ought to engage us to continue our observations and our researches, and teach us that we cannot yet draw from these facts any absolute and general conclusion.

Art. V.—*Miscellaneous Notices relating to American Mineralogy and Geology.*

1. *From Prof.* Dewey *of Williams College, addressed to the American Geological Society.*

Crystalized Steatite.

This rare mineral was found by Dr. E. Emmons in Middlefield, county of Hampshire. The crystals usually occur in groups on masses of Steatite. On a piece three inches long and two broad are more than forty crystals, most of which are pyramids projecting from the mass, but a few are horizontal. Though most of the crystals are small, some are three-eights of an inch in diameter and more than half an inch in length. I have one which is double the dimensions just mentioned. The surface of the crystals is of a brown colour, produced by the action of the weather. But when the crystals are separated, their faces are of a yellowish white colour. When fractured, the crystals present an uneven surface, with a structure inclining to the fibrous. The same fibrous appearance is seen on some parts of the Stéatite which is destitute of crystals. The crystalline structure is exceedingly indistinct, except near the surface.

The predominant *form* of the crystals is a six-sided prism, terminated at one or both extremities by a pyramid of the same number of sides. The truncations are numerous,—sometimes on the edges of the prism or pyramids, and at others on the angles, or at the vertex of the pyramid, forming very different faces. In one case, the face produced by truncation is of the kind, which the Abbe Haüy designates by the term, *Rhombifère.* These crystals agree generally with the description of the prismatic crystals of Steatite, found in the Principality of Bareuth. "Mineralogists are not agreed respecting these crystals, some considering them as true crystals, others as false ones." Jameson considers them decidedly *pseudo-morphous*, the prismatic crystals having been formed in moulds made by crystals of quartz. See Rees' Cyc. The crystals found in Middlefield very much resemble some rock-crystals. But when this group of crystals is examined, there seem to be insuperable objections to the hypothesis, that they are *pseudo-morphous.* No *mould*, formed by imbedded crystals which had fallen out, could approximate so nearly to the form required for the production of the group under consideration. The crystals, too, sometimes separate from each other, and the contiguous faces are perfectly smooth and regular, neither of which faces could have been formed by a mould, for no part of the mould could have intervened without remaining between them. But no trace of the substance of the mould is to be seen. The supposition that they were first formed in moulds, and afterwards fell into their present situation, is totally absurd, and, when this group is considered, is ridiculous. The crystallization appears more perfect near the surface of the crystals, and the imperfect crystallization extends to the depth of half an inch, terminating in a kind of seam where it is connected with the mass of Steatite. In both these respects, there is a close resemblance to some crystallizations of quartz, which are not pseudo-morphous. Steatite must, therefore, be considered as a mineral, which is crystallized, as well as amorphous.

Zoisite.

This variety of Epidote is found in abundance in Wardsborough, Vt. in quartz. The crystals are prismatic, generally much flattened, sometimes rounded, often aggregated, of a gray or greenish-gray colour, and varying in magnitude to a foot or more in length and one or two inches in breadth. They are distinctly striated, and have a pearly lustre. They much resemble the bladed crystals of Tremolite, but have a different and higher lustre, and the cross seams are nearly perpendicular to the sides. Before the blowpipe, the crystals are easily distinguished. Zoisite is fused by the compound blow-pipe into a black glass.

Foliated Chlorite.

This mineral is found in the same masses with the Zoisite. Colour a very dark green, folia very distinct and often in cylindrical masses. It occurs also in large aggregates, like common chlorite, and seems to be passing into the common variety.

The three preceding minerals have not, I believe, been found in any other places in our country.

Silico-calcareous Oxyd of Titanium.

A new locality of this mineral exists in Dummerston, Vt. It is disseminated in Granite, sometimes in crystals, sometimes in grains or masses. The crystals are not very distinct. Many of them seem to be six-sided prisms, appearing to be formed by placing a triangular prism on one pair of the opposite sides of a four-sided prism. This triangular prism is separated by cleavage from the sides, having a four-sided prism, whose ends are oblique to the sides of the prism. Their colour is a dark brown, or dark chesnut.

Before the blowpipe they are partially fused, when a small fragment is employed. By the compound blow-pipe they are fused into a black glass, and burning particles are thrown off in various directions, resembling the scintillations of burning iron. Repeated digestion with nitric acid separates a little lime. Melted with carbonate of potash, and the compound dissolved in boiling water, a dense white precipitate is separated, which is soluble in the stronger acids. The specific gravity of the crystals is from 3.31 to 3.37.

2. Mr. D. W. Barton *on the Virginia Fluor Spar.*

TO THE EDITOR.

Dear Sir,

I once gave you an imperfect description of the locality of Fluor in this vicinity. (Vid. V. 3, pa. 243 of this Journal.) Having lately examined it with more minuteness, I am enabled to communicate some additional facts which may not be wholly uninteresting. I visited the spot, accompanied by two of my former classmates, (Messrs. Boyd and Rockwell, of Winchester, Ct.) for the purpose of excavating the ground, and ascertaining the position, extent, direction, and other circumstances of the vein. We penetrated to the depth of four or five feet, when we arrived at the original uninterrupted vein of Fluor and crystallized Carbonat of Lime promiscuously united. The inclosing walls consist of a soft, earthy, calcareous rock resting on a stratum of hornstone with which the fluor is frequently connected. The vein is not so extensive as the number of detached masses near the surface induced us to believe. To the depth we have explored it, it is not more than twelve or fifteen inches wide. I am inclined however to believe, that it gradually enlarges as it descends, and that what we have discovered is only the clue which may serve to conduct the future adventurer to one of nature's rich and magnificent store-houses. With regard to the length of the vein it is impossible to form any other than a vague estimate. It may terminate within a few yards of its commencement—It may traverse a considerable extent of country.

The Fluor is found here of almost every variety of colour which the mineral ordinarily assumes—white, greenish-white, red, violet and dark blue, approaching, when in larger masses, near to black. I have obtained many well defined crystals, and I have little doubt that more diligent research would discover specimens which would grace even your splendid collection.

A few miles east of the fluat of Lime is an extensive stratum of crystallized carbonate of lime, much of which is remarkably transparent, equalling in beauty the Iceland spar. It possesses the property of double refraction in a very perceptible degree. I found many detached masses of the same substance, which by the attrition of water had been worn into a spherical form. These from their translucence exhibit externally the appearance of the Scotch pebble. The outer coating is beautifully tinged by the oxide of iron, and a fracture presents an elegant succession of fine colours.

There is another mineral which exists abundantly in the neighbourhood of Winchester. It is a species of iron ore very distinctly crystallized. These crystals are probably octahedral, as the projecting half (the only visible part) is a four sided pyramid; the angles of whose base are very unequal. The value of this mineral may make it worthy of a more minute investigation, and on some future occasion I may communicate a more particular account of it. As soon as a convenient opportunity occurs, I will forward to you specimens of the two last minerals with some others, which are not worthy of earlier notice. I will only mention that I find the Cornu Ammonis abundant in this valley.

Permit me, Sir, on this occasion to express my gratitude to you for inspiring a fondness for those sciences, which however imperfectly cultivated, already constitute a fruitful source of rational amusement.

Yours with respect,

D. W. BARTON.

November, 1821.

3. *Notices of the Sulphate of Strontian of Lake Erie and Detroit, River.*

Extract of a letter to the Editor from Major Delafield.

New-York, November 12th, 1821.

Dear Sir,

I have the pleasure to present you two specimens of the Sulphate of Strontian, from Strontian Island, Lake Erie. The one, a large crystal* of the bluish white variety, in parts transparent and irridescent, and having its termination perfect. The other the foliated and fibrous variety. I also send you its gangue, or a piece of the lime stone, in which the Strontian is found.

Is not this lime stone like the lime stone used in the masonry of the canal of this State as a water-proof cement? I take for granted you have seen the stone thus used. The lime stone of the west end of Lake Erie, and the Detroit River, is generally like the specimen forwarded. I have made no experiments,but their external characters are so very similar,that the suggestion readily occurs. When the Lake Erie lime stone is not impregnated with Strontian, its specific gravity seems to agree with the water-proof cement lime stone in question.

The Sulphate of Strontian is from a small Island near the well known Put-in-Bay Island, Lake Erie, and from a locality first noticed by myself and party in 1820. Circumstances then required, that no delay should happen to my voyage through the Lake, and we left this interesting discovery, without opportunity to explore to my satisfaction, its extent or character. Some one of the party had, however, noticed every variety; and were spectively procured exceedingly fine specimens. This visit has enabled the gentlemen who accompanied me, to give a just description of the locality as far as it was then known, and the accounts that have met my eye are substantially correct.

During the past summer I revisited the place, and had leisure to explore it. The vein is in a perpendicular cliff of lime stone, about fifty feet high, and mid way between its base and summit. The vein as now exposed, commences with a thickness of four feet, extends about fifty feet, nearly

* Five inches in diameter in its extreme dimensions and two thick.—Ed

parallel to the surface of the Lake, and terminates at a thickness of one foot. Where it begins it consists of the compact crystallized variety, but the direction of the crystals is so irregular, and their combination so close and diversified, that distinct crystals cannot be obtained. The vein terminates in the foliated and fibrous variety, of which the accompanying specimen is a part.

In the massive end of the vein was a small opening that led to a cavity filled with distinct crystals. I enlarged it sufficiently to admit light, and obtain its contents. The cavity was of about three feet diameter and circular. Its arch was beautifully jetted with pendent crystals differing in size and lustre.

From all other parts of the cavity they were detached. I found them mixed with some dirt, and in a greater quantity than it would seem could have been required to cover the circumference of the cavity. They varied in weight from six ounces to six pounds; in transparency from the perfectly transparent, to the opaque; in lustre from the dull to the resplendent; in colour from the snow white to the dark blue and greenish blue.

The tabular crystals of six sides with summit of four sides prevail, and are the most transparent.

The specimens* I send you, will, I believe, shew this mineral in all its varieties as there found, and give I trust, a satisfactory view of its form, colour, lustre, and cleavage.

I hope they may reach you in safety, and prove of some interest. Be pleased to accept them with my most respectful remembrances, and believe me

Your very obedient servant,

JAS. DELAFIELD.

To B. Silliman, Esq.

Extract of a letter addressed to the Editor, from Dr. John J. Bigsby, M. D. *of the British Medical Staff.*

Four miles from Put-in-Bay harbour at the upper end of Lake Erie, and at a similar distance from the nearest main-

* Prof. Douglass discovered this mineral upon the same Island in 1819; but did not, I think, notice the great vein. The Sulphate of Strontian is found in all parts of this Island, and others of the Basse Islands; on the neighbouring main shore; and on some of the Islands in the Detroit River.

J. D.

land, stands a solitary islet, oblong, with precipitous sides of about sixty feet high. It may be a third of a mile in length, and lies nearly north and south.

At the south end it is tolerably well wooded; but scantily at the other.

The rock of which it consists is Limestone, of a pale greyish straw colour. It is soft, of an earthy conchoidal fracture, having a granular structure. I do not recollect its stratification at this isle, but in the neighbouring districts it is placed in thick horizontal slabs, little prone to slatiness.

About the middle of the east side, and in the face of the cliff is a mass of Sulphate of Strontian, about four yards by three in extent, ramifying every where, but most plentifully in the horizontal direction. It is in the form of promiscuously aggregated bundles of crystals united laterally, of a white or bluish white colour, imperfectly transparent and from one to four inches long. Although the confused manner of their crystallization has obscured their figure, yet the compressed six sided prism is to be distinctly traced. Drusy cavities are numerous in the mass. Here the crystals are perfect and of enormous size. Major Delafield, (agent under the 6th and 7th Art. Treaty of Ghent,) met with one weighing six pounds.

Professor Douglass has described them mineralogically.

Foliated Celestine also occurs on the island of Celeron and Grosse isle at the mouth of the Detroit river, where it appears to have combined in some places with the lime stone, increasing the specific gravity of the latter.

This lime stone prevails over a considerable district of country—it is found at Sandusky, lines the shores of the Lake, nearest the bed of Strontian just described, and flooring the river Detroit near Amherstburgh is discovered in the interior on both sides of that river, and is quarried for building. Excepting on the south and south-east, it is surrounded by alluvial country of some hundred miles radius.

It is curious to observe that the foreign matters in this rock are deposited in fields or districts, and to a certain extent do not intermix. I observed no organic remains on Moss island—no Strontian on the adjacent main, but multitudes of imbedded shells, orthoceratites (small) and a beautiful form of trilobite—together with various madrepores wrought in lime stone, especially a stellular radiated species. There is not a single shell in the Strontian deposits of Grosse isle—and neither shell nor Strontian in the floor of the contiguous river, while the extensive quarries two miles behind Amherstburgh produce an immense variety of organic remains, animal and vegetable, without a vestige of the rare crystallizations of Grosse Isle.*

JOHN J. BIGSBY, M. D.

4. *Geological Remarks on the Lake regions; from a letter of December* 6, 1821, *addressed to the Editor by Major* Delafield.

Professor Buckland's notice of my present of minerals from the North, through your correspondent, is the only knowledge I have of those specimens having been received. His analogy concerning the lime stones of certain latitudes, is founded on a partial view of facts, and is not altogether satisfactory. The transition lime stone appears in Lake Huron, but I had not considered the shell lime stone to be transition. In truth, in the space of sixty miles you sail from secondary to transition and to primitive formations in the north end of Lake Huron. The organic remains of the lime stone of Lake Huron are I believe, peculiar. Orthoceratites of such size and variety, I have not found described in books. Tribolites are numerous, and partake of the characteristic of the remains of that region, which is that of prodigious size. The shores are *covered principally* with rolled rocks out of place, of very many varieties. Green stone amygdaloids, jasper, and other varieties of trap; breccia, epidote, and others abound. Several of my specimens are pronounced to be of volcanic origin, which if true, is the first occurrence of such appearances to my knowledge east of the Mississippi.

Dr. Bigsby is engaged in the description of the Lake minerals and geology; and has it in his power to impart much information to those who wish to pursue the analogy between American and European Geology. I do not doubt his exertions will prove of interest and value.

Perhaps your friend, who forwarded Mr. Buckland's letter, would like to know that the Trilobite is found in the Lake Huron lime stone.

* The mineralogical sketch of Moss Island is to be considered as only my personal observations. In a studied description of that district, I should embody the remarks of Douglass and Bird.

5. *Notice of a singular ore of Cobalt and Manganese; by* H. H. Hayden, Esq. *of Baltimore, in a letter to the Editor.*

I have now a circumstance to mention, which I consider of a very novel and singular nature. A few days since a gentleman returning from the country into Baltimore, at the distance of two miles, observed some men digging for sand by the road side. Among the sand thrown out of the pit he observed some masses that had the appearance of ore. He brought some of it to town, when on examination, it was found to contain a considerable proportion of oxid of cobalt, combined with Manganese. Excited by no common degree of curiosity, I yesterday, in company with Mr. —— visited the locality of this substance. We found the pit abovementioned by the road side, and which was opened I believe, for the purpose of obtaining plastering sand. The hole or pit was sunk to the depth of about ten feet—the sides presenting to view much of the variety of stratification that occurs in almost every part of our alluvial region, and *in which* this pit is sunk. On examination we found the mineral above mentioned, to occur *upon* or between two veins or strata of hard ferruginous sand, and at different heights—to one or the other of these it adheres. There were a number of masses upon the surface, at the mouth of the pit, however, that did not appear to have had any connection with the ferruginous strata.

This substance occurs in masses of various sizes, and appears to be made up of grains of sand *firmly* cemented together by the cobalt and manganese; so much so as to render its specific gravity perceptibly greater than that of common substances. The masses are somewhat spherical with surfaces inclining to the stalactitic form. The colour is black, inclining to a deep blue.

I know of no instance in which cobalt and manganese occur in this form and manner. It is true that Klaproth in his Essays, mentions a mineral in which these two substances are combined, and which is not described in any other work that I know of. But the substance under consideration appears to me to be an anomaly in the mineral kingdom, at least so far as respects its locality. It is, as before, in a *perfect alluvial bank*, surrounded on all sides by strata of fine sand or sand mixed with aluminous matter, and at a considerable distance south of the primitive range. How it was formed or whence it came, is, to me, not easily explained.

Some months since a mineral was received in Baltimore from the western part of Virginia, which on examination was found to contain the oxide of cobalt combined or associated with the ore of manganese. The mineral found in Virginia is essentially different from the one found near Baltimore—the first being the oxide of cobalt, chemically (I believe) associated with the radiated or stellated ore or black oxide of manganese. That found in the alluvial district near Baltimore contains, it is true the same oxides associated, but the appearance of the mass and the situation when found in the sand pits, would incline one to suppose that a solution of these two substances had been formed upon a lump of sand, cementing as it were the whole together. In this state it has a dark bluish appearance, a harsh rough sandy texture, and is somewhat weighty.

6. *Notice of Minerals in the vicinity of Providence, (R. I.) in a letter to the Editor, dated Nov. 26, 1821, from Mr.* THOMAS H. WEBB.

Sir—

I have forwarded to you in the box sent Mr. George T. Bowen, a specimen of the green talc which I wrote you some time since, was found at North Providence. There are also in the box specimens of silvery talc, from Harris' lime rocks, Smithfield, much better than the one I sent you before. It is found in considerable quantities attached to bitter spar. Among the minerals which have not hitherto been noticed, that occur in this vicinity, and elsewhere, are the following, viz :—

1. White fibrous tremolite,* found in considerable quantities, amongst granular lime stone, at Harris' lime rocks, Smithfield, R. I. It gives out a fine phosphorescent light, when placed on a hot shovel, and also phosphoresces by friction, in a dark room.

2. Earthy tremolite at the same place.

* Mr. Bowen gave you a specimen of this some time ago, I believe.

3. Very fine specimens of bitter spar, occur in great quantities at do. associated with silvery talc.

4. Red hæmatite found on Diamond Hill, in Cumberland, R. I. It is found in an excavation, about forty feet in length, from five to twelve in width, and twenty in depth, which was made some years since in order to procure it. It occurs in botryoidal, mamillary, stalactical and various other forms.

5. Tremolite of different shades of green, near an old iron mine on Tower Hill, Cumberland.

6. Epidote both massive and crystallized, of very fine colour, in quartz, at do.

7. Actynolite in masses associated with tremolite, at do.

8. Native magnet found in considerable quantity, though in small pieces, about a mile from the before mentioned place.

9. Crystallized hornblende at do.

10. Lenticular argillaceous oxide of iron, termed shot ore by the workmen, obtained in abundance from a pond in Sharon, Mass. also an oxide of do. about the size and shape of a cracker, and of a yellowish brown colour, called cake ore, is found there ; both of which are used at the forges in that vicinity.

I found a few very good specimens of double refracting spar at Smithfield, and also one specimen of sulphur attached to the lime rock. Should these notices be considered of any importance, they are at your service.

I am Sir, respectfully yours,

THOMAS H. WEBB.

Prof. Benjamin Silliman.

Art. VI.—*Remarkable Fossil Tree, found about fifty miles S. W. of Lake Michigan, by his Excellency Gov.* Lewis Cass *and Mr.* Henry R. Schoolcraft, *in August,* 1821, *on the River Des Plaines, in the* N. E. *angle of the State of Illinois—extracted from a paper presented by Mr. Schoolcraft to the American Geological Society.*

"The tract of country separating the southern curve of lake Michigan from the sources of the Illinois river, is a narrow plat of table land, composed of a stratum of compact limestone based upon floetz sandstone. This formation, which constitutes the north-eastern angle of the state of Illinois, where the waters of Michigan lake and the Illinois river often approach within a few miles of each other, and actually communicate at Chicago, continues east, and north-east, spreading in its course through Indiana into Ohio, and embracing the entire peninsula of Michigan. It is covered with a deposit of alluvial soil of a productive character, and presents to the eye a series of level prairies, interspersed with occasional forests, and irrigated by numerous small lakes and streams. These features may be considered as peculiarly characteristic of the district of country drained by the rivers Kankakee and Des Plaines, which uniting their channels at the distance of forty miles south of Chicago, produce the Illinois. The junction is effected on the southern slope of table land which confines lake Michigan to the north, at a point where the waters descend with considerable velocity, over a horizontal layer of shelving rock, which produces a series of rapids, and is continually yielding to the action of the water; but there is nothing in the mineral physiognomy of the spot so remarkable as the petrified tree, which is found in the bed of the river Des Plaines about forty rods above its junction with the Kankakee.

"This extraordinary species of phytolites occurs imbedded in a horizontal position in a stratum of newer floetz sand stone, of a grey colour, and close grain. There is now fifty-one feet, six inches of the trunk visible. It is *eighteen inches* in diameter at the smallest end, which appears to have been violently broken off, prior to the era of its mineralization. The root-end is still overlayed by the rock and earth in the western bank of the river, and is two feet six inches in diameter at the point of disappearance; but circumstances will justify the conclusion that its diameter at the concealed end, cannot be *less than three feet.* The trunk is straight, simple, scabrous, without branches, and has the gradual longitudinal taper observed in the living specimen. It lies nearly at right angles to the course of the river, pointing towards the south-east, and extends about half the width of the stream. Notwithstanding the continual abrasion to which it is exposed by the volume of passing water, it has suffered little apparent diminution, and is still firmly imbedded in the rock, with the exception of two or three places where portions of it have been disengaged, and carried away; but no portion of what remains is elevated more than a few inches above the surface of the rock. It is owing, however, to those partial disturbances, that we are enabled to perceive the columnar form of the trunk—its cortical layers—the bark by which it is enveloped, and the peculiar cross fracture, which unite to render the evidence of its ligneous origin, so striking and complete. From these characters and appearances, little doubt can remain that it is referable to the species juglans nigra, a tree very common to the forests of the Illinois, as well as to most other parts of the immense region drained by the waters of the Mississippi. The woody structure is most obvious in the outer rind of the trunk extending to a depth of two or three inches, and these appearances become less evident as we approximate the heart. Indeed, the traces of organic structure in its interior, particularly when viewed in the hand specimen, are almost totally obliterated and exchanged, the vegetable matter being replaced by a mixed substance analagous in its external character, to some of the silicated and impure calcareous carbonats of the region. Like those carbonats, it is of a brownish grey colour, and compact texture, effervesces slightly in the nitric and muriatic acids, yields a white streak under the knife, and presents solitary points, or facets of crystals resembling calc spar. All parts of the tree are penetrated by pyrites of a brass yellow colour, disseminated through the most solid and stony parts of the interior,—filling interstices in the outer rind, or investing its capillary pores. There are also the appearances of rents or seams between the fibres of the wood, caused by its own shrinkage, which are now filled with a carbonat of lime, of a white colour, and crystallized.

"There is reason to conclude that the subject under consideration, is the joint result partly of the infiltration of mineral matter into its pores and crevices prior to inclosure in the rock, and partly to the chemical action induced by the great catastrophe by which it was translated from its parent forest, and suddenly enveloped in a bed of solidifying sand. With respect to the difference which exists between its external and internal structure, we may suppose that it had partially submitted to decay, and became hollow, before the process of petrifaction commenced, and that the interior substance and the calc spar, were deposits from particles soluble, or intimately mixed with water, previous to the inclosure of the tree in its rocky envelope.

"At the time of our visit (August 13, 1821,) the depth of water upon the floetz rocks forming the bed of the river Des Plaines, would vary from one to two feet; but it will be recollected that it was at a season when these higher tributaries, and the Illinois itself, are generally at their lowest stage. Like most of the confluent rivers of the Mississippi, and their tributaries, the Des Plaines is subject to great fluctuations, and during its periodical floods may be estimated to carry a depth of eight or ten feet of water to the junction of the Kankakee. At those periods the water is also rendered turbid by the quantity of alluvial matter it carries down, and a search for this organic fossil, must prove unsuccessful. But during the prevalence of the summer droughts, in an atmosphere of little humidity, when the waters are drained to the lowest point of depression, and acquire the greatest degree of transparency, it forms a very conspicuous trait in the geology of the stream, and no person, seeking the spot, can fail to be directed to it. Although corresponding in its direction to the apparent course of the formation in which it rests, it forms an acute angle with the natural seams and fissures which chequer the surface of the rock; and from an effect analogous to carbonization, the exterior rind and bark of the tree, have acquired a blackish hue, while the inclosing rock, being a light grey, presents a contrast that is calculated te arrest the attention of the observer."

The sand stone rock in which this fossil tree reposes, "is every where found in a horizontal position, and differing only with respect to hardness, and colour,—points which do not necessarily imply a different formation. The remains of fossil organized bodies in this stratum, are not abundant, or have not been successfully sought; and it appears to be wholly wanting in the various species of concholites so plentifully imbedded in the calcareous formation which rests upon it. It is probable that future observations will prove, that its organic conservata are chiefly referable to the vegetable kingdom. It is certain, that this inference is justified by the facts which are before me, and particularly by the characteristic appearances of the strata in the bed of the river Des Plaines, where the imbedded walnut, is the only species of petrification to be found. At a short distance above, where the bed of the Des Plaines approaches nearer the summit level, limestone ensues, and continues from that point northward to the shores of lake Michigan. In the vicinity of Chicago, where this limestone is quarried for economical purposes, it is characterized by the fossil remains of molluscous, and other aquatic animals.

"There exists a water communication between the head of lake Michigan and Chicago, and the river Des Plaines, during the periodical rises of the latter, but its summer level is about seven feet lower, at the termination of the Chicago portage, than the surface of the lake. From this point to its junction with the Kankakee, a computed distance of fifty miles, the bed of the Des Plaines may be considered as having a mean southern depression of ten inches per mile, so that the floetz rocks at its mouth, lying on a level of forty-eight feet eight inches below the surface of lake Michigan, have an altitude, which cannot vary far, from five hundred and fifty feet above the Atlantic. There are no mountains for a vast distance either east or west, of this stream: it is a country of plains, in which are occasionally to be seen alluvial hills of moderate elevation; but the most striking inequalities of surface proceed from the streams which have worn their deep-seated channels through it; and an oceanic overflow, capable of covering the country, and producing these strata by deposition, would also submerge all the immense tracts of secondary and alluvial country, between the Alleghany and the Rocky Mountains, converting into an arm of the sea, the great valley of the Mississippi, from the Gulph of Mexico north, to the Canadian lakes. We find in the alluvial soil along the Illinois and Des Plaines, blocks of granite, hornblende, and gneiss, exhibiting the same appearances of attrition, and of having been transported from their parent beds, which characterize the secondary table lands along the margin of the great American lakes, the prairies of Illinois, and the western parts of New-York.

"The country along both banks of the river Des Plaines, at the spot where this imbeded fossil tree occurs, is a level and beautiful prairie, covered with a luxuriant growth of grass, and interspersed with small groves of oaks and hickories—the quercus alba, and juglans squarrosa, of the American forest.

"These appearances characterize the river Des Plaines from its source near the Millewacky of lake Michigan to the point of its junction mith the Kankakee. The latter stream also flows, in its whole length, through rich and level prairies and savannahs, where there is scarcely a hill to intercept the view. In some places it is overshadowed by scattering clumps of oaks, which throw a refreshing coolness over its banks, but most commonly its waters are exposed to the direct rays of the sun. Such too, is the rural complexion of the banks of the Illinois, from the confluence of its principal tributaries, at the fossil tree, to the lower extremity of Peoria lake, and if we survey the entire valley of the Mississippi, with all its confluent rivers, for that portion of it which has been distinguished by the hand of nature as preeminently beautiful to the eye, it is this! But it is not alone to the sylvan exterior of the country—to the pleasing variety and succession of prairies, forests, streams, and precipices; or to the geological arrangement of its strata and soils, that we find our reflections irresistibly directed. Every emotion raised by the contemplation of pastoral and picturesque objects, must yield to considerations of the national and domestic purposes, to which it is so admirably adapted by its fine climate, and productive soil. We cannot survey, without a feeling of calm delight, a country prepared for the future abode of millions of the human species who are destined to augment our national resources, and to transmit to posterity the blessings of our republican institutions: and perhaps there are few individual scenes along the valley of the Illinois where the observer will partake of a higher gratification from these sources, than those furnished by the region characterized by the confluence of the Des Plaines with the Kankakee, the conspicuous locality of the subject of this paper.

"It is to the latter class of depositions—to the secondary series, and to the latest, deposits of this series, that we must refer the sandstone of the river Des Plaines, in which we find a walnut, of mature growth, enveloped by, and imbedded in the rock, in the most complete state of mineralization: and since all geological writers who subscribe to the Neptunian origin of the earth, are constrained to employ the agency of oceanic depositions of different eras, in explaining the structure of the earth's surface, it is one of the most obvious and important conclusions, to be drawn from the fact, that such submersions and depositions of rock matter have taken place subsequent to the existence of forests of mature growth; and that the rock strata and beds composing the exterior of the earth are the result of different geological epochs, and of successive subsidencies of chaotic matter,—positions which have been so severely attacked and so often denied, particularly by the disciples of the Huttonian school, that it is not without a feeling of lively interest, I communicate a discovery which appears so conclusive on the subject.

In a letter from Gov. Cass to Mr. Schoolcraft, the following observations are made on this fossil tree:

"The appearance of the wood and bark indicates, that it was a black walnut, the juglans nigra of our forests. The texture of the wood, and the bark and the knots, are nearly as distinct as in the living subject, and the process of decay had not commenced previous to the commencement of this wonderful conversion. Every part of the mass which we could examine, is solid stone, and readily yields fire by collision with steel.

"When we visited the spot, the water of the river was at the lowest stage; but there was no part of the tree within some inches of the surface. The rocky bed of the stream, was formed round, and upon it. We raised from it pieces of the rock, which were evidently in situ, and which had been formed upon the tree posterior to the period of its deposit in its present situation. This rock is a species of sandstone, whose characteristic features must be well known to you.

"There are no mineralized substances, of vegetable origin, in the vicinity of this specimen, nor are there any appearances which indicate, that its present condition has been caused by any peculiar property in the waters of the Des Plaines."

BOTANY.

Art. VII.—*List of Plants growing spontaneously in Litchfield and its vicinity; by Mr.* John P. Brace. *Concluded from pa.* 86 *of this volume.*

Concluded from pa. 86 of this volume.

DODECANDRIA.

Monogynia.

Asarum.
Canadense L Rich woods, May.
Portulacca.
Oleracea L. Cultivated grounds, July. Yellow.
Lythrum.
Verticillatum, L. Borders of ponds, Aug. Purple.
Agrimonia.
Eupatoria, L. Woods, July. Yellow.

Trigynia.

Euphorbia.
1. Maculata, L. Streets, Aug.
2. Depressa, N. Y. Catalogue. Sandy ground, Aug.
3. Dentata, Mx. With the last. Aug.

ICOSANDRIA.

Monogynia.

Prunus.
1. Virginiana, Willd. Woods, May. White.
2. Seratino, Willd. Hedges, May. White.
3. Pennsylvanica, Ait. On hills, May. White.
4. Depressa, Ph. Mount Tom, May. White.

Di-pentagynia.

Crataegus.
Coccinea, Ait. Woods, May. White.

Sorbus.

Aucuparia, Mx.
Pyrus Aucuparia, Lm.
Sorbus Americana, Muhl. Swamps, May. White.

Pyrus.

1. Arbutifolia, Willd.
   Mespilus arbutifolia, L.
   Aronia pyrifolia, Pers. Wet pastues, May. White.
2. Melanocarpa, Willd.
   Aronia arbutifolia, Pers. Wet pastures, May. White.
3. Botryapium, Willd.
   Aronia Botryapium, Pers. Woods, May. White.

Spiraea.

1. Salicifolia, Ait.
   Alba, Muhl. Pastures, July. White.
2. Tomentosa, L. Meadows, Aug. Pink.

POLYGYNIA.

Rosa.

1. Parviflora, Willd. Woods, June. Red.
2. Carolina, Willd. Swamps, June. Red.
   Rabiginosa, Muhl.
   Suaveolens, Ph. Mount Tom, June. Red.

Rubus.

1. Villosus, Ait. Woods and pastures, June. White.
2. Strigosus, Mx. Swamps, June. White.
3. Occidentalis, L. Borders of fields, June. White.
4. Trivialis, Mx. Pine woods, May, White.
5. Odoratus, L. Woods and hedges, June. Red.
6. Saxatilis, L. Rocky hills, May. White.

Dalibarda.

Fragarioides, Mx. Pastures, May. yellow.

Fragaria.

Virginiana, L. Fields, May. White.

Potentilla.

1. Fruticosa, L. Salisbury, (Ives,) July. Yellow.
2. Floribunda, L. Fields, May. Yellow.
3. Canadensis, L. Field, May. Yellow.
4. Simplex, Mx. Fields, May. Yellow.

5. Norvegiea, L. Fields, June. Yellow.
6. Argentea, L. Streets, June. Yellow.

Geum.

1. Virginianum, L. Woods, July. Yellowish-white.
2. Strictum, with the last, July. Yellow.
3. Rivale L. Bog meadows, June. Purple.

Comarum.

Pulustre L. Borders of ponds, purple. June.

POLYANDRIA.

Monogynia.

Actaea.

1. Rubra, Willd. Rocks, white. May.
2. Alba, Bigelow, (secund. Eaton,) with the last. May.

Chelidonium.

Majus, L. Borders of garden spots, June. Yellow.

Cistus.

Canadensis, Willd.

Helianthemum canadense, Mx. Sandy fields and hills, June. Yellow.

Sarracenia.

Purpurea, L. Cranberry pond meadows, July. Red.

Tilia.

Glabra, Ph. Woods, near rivers, June. Yellow.

Sanguinaria.

Canadensis, L. Near rocks, April. White.

Nymphaea.

Odorata, Ait. Ponds, July. White.

Nuphar.

Advena, Ait. Ponds, July. Yellow.

Di-pentagynia.

Hypericum.

1. Perforatum, L. Fields, July. Yellow.
2. Punctatum, Lmk. Meadows, July. Yellow.
3. Parviflorum, Willd. Streets, July. Yellow.

4. Canadense, L. Streets, July. Yellow.
5. Virginianum, L. Wet meadows, July. Reddish.

Aquilegia.
Canadensis, L. Rocks, April. Scarlet.

Polygnia.

Clematis.
Virginiana, L. Hedges, Aug. White.

Atragene.
Americana, Sims.
Glematis hexagona, Eaton.?
Mount Tom, May. Purple.

Thalictrum.
1. Dioicum, L. Woods and Fields, May. White.
2. Cornuti. Wet meadows, July. White.

Coptis.
Trifolia, Salisb.
Helleborus trifolius, L. Pine swamps, May. White.

Caltha.
Palustris, L. Swamps, April. Yellow.

Anemone.
1. Nemorosa, L. Woods, April. White.
2. Thalictroides, L. Shady woods, April. White.
3. Virginiana, L. Borders of woods, July. Greenish-white.

Hepatica.
1. Triloba, Willd.
Anemone hepatica. Rocky woods, April. White.
2. acutifolia.
Triloba, var acuta, Dewey. Hills, April. White.

Liriodendron.
Tulipifera, L. Wet woods, June. White.

Ranunculus.
1. Acris, L. Meadows, June. Yellow.
2. Abortivus, L. Wet woods, May. Yellow.
3. Repens, L. Ditches, June. Yellow.
4. Fascicularis, Bigelow Pastures and wet meadows, May. Yellow.
5. Fluviatilis, Big. Stagnant waters, Aug. Yellow.
6. Flammula, L. Ditches, June. Yellow.

7. Sceleratus, L. Ditches, May. Yellow.
8. Hispidus, Mx.
   Hirtus, Muhl. Ditches, July—Sept. Yellow.
9. Saniculaeformis, Eaton. Wet woods, May. Yellow.

DIDYNAMIA.

Gymnospermia.

Isanthus coeruleus, L. Sandy fields, July.

Lamium.

Amplexicanule, L. Cultivated grounds, May. Purple.

Pycnanthemum.

1. Incanum Mx. Mount Tom, July. White.
   Clinopodium incanum, L.
2. Virginicum, Pers.
   Brachystemum virginicum, Mx. Hills, Aug. White.
3. Aristatum, Mx. Woods, July. White.
   Nepeta Virginica, L.

Nepeta.

Cataria, L. Road sides and in woods, June. White.

Hyssopus.

Scrophulavifolius, Eaton. Hedges, Aug. Pine.

Mentha.

1. Borealis, Mx. Wet meadows, Aug. Purple.
2. Viridis, Watt.
   Tenuis, Mx. Streets, July. Pink.

Galeopsis.

Tetrahit, L. Cultivated fields, Aug. Purple.

Leonurus.

Cardiaca, L. Road sides, July. White.

Marrubium.

Vulgare, L. Road sides, July. White.

Hedeoma.

Pulegioides, Pers.
Cunila pulegioides, L. Dry fields, July. Blue.

Glechoma.

Hederacea, L. Along fences, May. Purple.

Trichostema.
Dichotoma, L. Sandy hills, July. Blue.
Scutellaria.
1. Lateriflora, L. Swamps, July. Blue.
2. Galericulata, L. Swamps, July. Blue.

Prunella.
Pennsylvanica, L. Meadows, June. Blue.
Phryma.
Leptostachya, L. Rocky woods, July. Purple.

ANGIOSPERMIA.

Verbena.
1. Hastata, L. Streets and meadows, July. Purple.
2. Urticifolia, L. Road sides, July. White.

Orobanche.
1. Virginiana, L. Wet woods, Sept. Purple.
   Epifagus Americanus, Nutt.
2. Biflora, Nutt.
   Uniflora, L. Shady woods, June. Yellowish.

Bartsia.
Coccinea, L. Pastures, May. Scarlet.
Melampyrum.
Lineare, L. Woods, July. Yellow.
Antirrhinum.
1. Lineara, L. Road sides, June. Yellow.
2. Canadense, L. Streets, Aug. Blue.

Gerardia.
1. Purpurea, L. Fields, Aug. Purple.
2. Flava, L. Woods, Aug. Yellow.
3. Quercifolia, Ph.
   Glauca, Eddy. With the last yellow.
4. Pedicularia, L. Woods, near the water burg, Aug. Yellow.

Pedicularis.
Canadensis, L. Wet meadows, May. Yellow and purple
Mimulus.
Ringens, L. Standing waters, Aug. Blue.
Chelone.
Glabra, L. Ditches, Aug. White.

TETRADYNAMIA.

Siliculosa.

Thlaspi.
Bursa-pastoris, L. Cultivated grounds, April—October. White.

Lepidium.
Virginicum, L. Road sides, June. White.

Siliquosa.

Arabis.
1. Hastata, N. Y. Cat.
   Turritis laevigata, Willd. Mount Tom, May.
2. Falcata, Mx.
   Canadensis, L. Rocky hills, Woodbury, June. White,

Dentaria.
Diphylla, Mx. Wet woods, May. White.
Erysimum officinale, L. Old fields, July. Yellow.

Cardamine,
Pennsylvanica, Willd. Streams, May, White.
Var tenella. Wet woods, near rocks, June. White.

Sisymbrium.
Amphibium, L. Wet meadows, June. Yellow.

Sinapis.
Nigra, Sm. Cultivated grounds, July. Yellow. Introduced.

MONODELPHIA.

Decandria.

Geranium.
1. Maculatum, L. Fields, May. Purple.
2. Robertianum, L. Rocky hills, Woodbury, July. Red.

Polyandria.

Sida.
Abutilon, L. Cultivated grounds, July. Yellow. Introduced.

Malva.
Rotundifolia, L. Cultivated grounds, June. Pink.

DIADELPHIA.

Hexandria.

Corydalis.
1. Cucullaria, Pers. Wet woods, May. White.

2. Fungosa, Pers. Mount Tom, July. White and red.
3. Glauca, Ph.
   Sempervivens, Pers. Rocks, May, Red and yellow.

Fumaria.
   Officinalis, L. Cultivated grounds, June. Red. Introduced.?

Octandria.

Polygala.
1. Paucifolia, L. Pine swamps, May. Purple.
2. Sanguinea, L. Moist meadows, Aug. Red.
3. Verticillata, L. Dry pastures, Aug. Bluish White.
4. Rubella, Muhl. Sandy hills, July—Aug. Red

Decandria.

Robinia.
   Pseudacacia, May. White. Introduced.

Glycine.
1. Monoica, Willd. Rocky woods, Aug. White.
2. Apios, L.
   Apios tuberosa, Ph. In thickets, Aug. Purple.

Tephrosia.
   Virginiana, Pers.
   Galega Virginiana, L. Rocky hills, Woodbury, July, Purple.

Medicago.
   Cupulina, L. Cultivated grounds, May—Oct. Yellow.

Trifolium.
1. Repens, L. Fields, June. White.
2. Pratense, L. Fields, June. Red. Introduced.
3. Arvense, L. Dry soils, July. White.

Lespedeza.
1. Sessiliflora, Mx. Woods on Mount Tom, Sept. Violet.
2. Capitata, Mx.
   Hedysarum *frutescens*, L. Sundry woods, Aug. Purple.
3. Polystachya, Mx.
   Hedysarum hirtum, L. In dry woods. Aug. White.
4. Violacea, Pers. Woods, Aug. Violet.

Hedysarum.
1. Canadense, L. Woods, Aug. Purple.
2. Nudiflorum, L. Rocky woods, Aug. Violet.

4. Acuminatum, Mx. With the last, Aug. Purple.
3. Rotundifolium, Mx. Rocky hills, near Mount Tom, Aug. Purple.
5. Ciliare, Muhl. Sandy hills, Aug.

SYNGENESIA.

Aequalis.

Leontodon.

Taraxicum, L. Grass plats, April. Yellow.

Prenanthes.

1. Alba, L. Woods, Aug. White and Purple.
2. Cordata, L. Woods, Aug. Whitish.

Lactuca.

Elongata, Willd. Shady places, Aug. Yellow.

Hieraicum.

1. Venosum, L. Shady hills, July. Yellow.
2. Paniculatum, L. Woods, Aug. Yellow.
3. Scabrum, Mx. Sandy woods, Aug. Yellow.
4. Halmii, L. Hedges, Aug. Yellow.

Sonchus.

Oleraceus, L. Waste places, Aug. Yellow.

Krigia.

Virginica, Willd.

Kyoseris Virginicus, L. Sandy hills, May. Yellow.

Liatris.

Scariosa, L. Borders of swamps, (very rare,) Sept. Purple.

Vernonica.

Noveboracensis, L. Borders of Bantum lake, Aug. Purple.

Cnicus.

1. Canceolatus, Willd. Streets and pastures, July. Purple.
2. Altissimus, Willd. Wet woods, July. Purple.
3. Arvensis, Pers. Road sides, (rare.) July.

Arctium.

Lappa, L. Cultivated and waste grounds, Aug. Purple.

Bidens.

1. Cernua, L. Ditches, Aug. Yellow.
2. Chrysanthemoides, Mx. Ditches, Aug. Yellow.
3. Frondosa, L. Cultivated grounds, Aug. Yellow.

Eupatorium.

1. Purpureum, L. Swamps and wet woods, Aug. Purple.
2. Verticillatum, Willd. With the last, Aug. Purple.
3. Perfoliatum, L. Wet pastures, Aug. White.
4. Ageratoïdes, Willd. Rocky woods, Aug. White.

Mikania.

Scandens, Willd.
Eupatorium scandens, L. Near the Bantum, July. Pink.

SUPERFLUA.

Gnaphalium.

1. Plantagineum, L.
   Dioicum, Eaton. Dry fields, April. White.
2. Polycephalum, Mx. Pastures and woods, Aug. White.
3. Margarataceum, L. With the last, Aug. White.
4. Decurrens, Ives. With the last, Aug. White.
5. Uliginosum, L. Wet grounds, Aug. White.

Tanacetum.

Vulgare, L. Road sides, Aug. Yellow. Introduced.

Chrysanthemum.

Leucanthemum, L. Meadows, June. White.

Inula.

Helenium, L. Road sides and by brooks, July. Yellow.

Erigeron.

1. Bellidifolium, Willd. Sides of hills, May. Blue.
2. Philadelphicum, L. In old fields, June. Purple.
3. Purpureum, Aiton. Wet woods, July. Purple.
4. Strigosum, Muhl. In pastures, July, White.
5. Heterophyllum, Muhl. Meadows, July. White.
6. Canadense, L. Cultivated grounds, Aug. White.

Solidago.

1. Procera, Ait. Borders of fields, Sept. Yellow.
2. Serotina, Willd. Borders of Woods, Sept. Yellow.
3. Ciliaris. Woods, Sept. Yellow.
4. Lateriflora, Ait. Old fields, Aug. Yellow.
5. Altissima, Willd. Wet places by hedges, Sept. Yellow.
6. Patula, Muhl. Rocky woods, Aug. Yellow.
7. Recurvata. Woods, Sept. Yellow.
8. Bicolor, L. Rocky woods, Aug. White.
9. Lanceolata, Ait.

Graminea, Nutt. Wet fields, Aug. Yellow.
10. Caesia, Ait. Woods, Sept. Yellow.
11. Flexicaulis, L. Dry woods, Sept. Yellow.
12. Latifolia, L. Woods, Sept. and Oct. Yellow.
13. Puberula, Nutt. Sandy fields, (common) Sept. Yellow.
14. Gigantea, Willd. Borders of fields, Aug. Yellow.

Senecio.
1. Hieracifolius, L. New fields, Aug.
2. Aureus, Willd. Wet meadows, May. Yellow.

Aster.
1. Linariifolius, L.
Inula linariifolius, Nutt. Sandy hills, Sept. Violet.
2. Amygdalinus, Mx
Umbellatus, Ait. Borders of fields, Sept. White.
3. Cordifolius, L. Rocky hills, Sept. White.
4. Corymbosus, Ait. Wet woods, Sept. White.
5. Macrophyllus, Ait. In woods, Sept. White.
6. Amplexicaulis, Mx. Rocky hills, Sept. Blue.
7. Laevis. In woods and borders of fields, Aug. Blue.
8. Puniceus, L. Near streams, Sept. Blue.
9. Conyzoides, Willd. On hills, July. White.
10. Acuminatus. Rocky damp woods, Aug. White.
11. Tradescanti, Eat.? Fields, Sept. Blue. } The same species
12. Recurvatus, Eat.? With the last, Sept. Blue. }
13. Diffusus, Ait. In open fields

Helenium.
Autumnale, L. In the pond meadows, Aug. Yellow.

Anthemis.
Cotula, L. Road sides, July. White.

Achillaea.
Millefolium, L. In fields, July. White and pink.

FRUSTRANEA.

Rudbeckia.
Laciniata, Willd. In swamps, Aug. Yellow.

Helianthus.
1. Divaricatus, L. Borders of woods, July—Aug. Yellow.
2. Trachelifolius, Willd. In copses, Aug. Yellow.
3. Frondosus, L. Borders of woods, Aug. Yellow.

GYNANDRIA.

Monandria.

Orchis.

1. Ciliaris, L. ?
   Beephariglottis, Eaton? Cranberry pond meadows, July. Pure white.
2. Tridentata, Willd. In wet meadows, July. Greenish-white.
3. Spectabilis, L Rocky woods, May. White and purple.
4. Orbiculata, Ph. Rocky woods, May. Green.
5. Fimbriata, Willd. Meadows, July. Purple.
6. Psycodes, Willd. Wet meadows, July. Yellowish-white.

Laura, Mx.

Satyrium.

Bracteatum, Pers. Wet woods, May. Yellowish-white.

Neattia.

1. Tortilis, Willd.
   Aestivalis, Pers. Wet meadows, Aug. White.
2. Cernua, Willd. With the last, Aug. White.
3. Pubescens, Willd. In woods, Aug. White.

Cymbidium.

1. Pulchellum, Sw.
   Limodorum tuberosum, L. Wet meadows, July. Purple.
2. Odontorhizon, Willd. Shady woods, July.

Malaxis.

Liliifolia, Sw.

Ophrus liliifolia, L. Wet streets and pastures, Jnne. Greenish-white.

Arethusa.

1. Ophioglossoides, L. Swamps of the Cranberry pond, July, purple.
2. Bulbosa, L. With the last, May. Purple.

Diandria.

Cypripedium.

1. Pubescens, Willd. In wet woods, May. Yellow.
2. Spectabile, Willd.
   Canadense, Mx. In swampy woods, June. White and red.

3. Acaule, Mx.
   Humile, Wild. In woods, June. Purple.

MONOECIA.

Monandria.

Caulina.
Flexilis, Willd.
Najas canadensis, Mx. In ponds. Not seen in flower.
Chara.
Flexilis. Bottoms of ponds, July.

Diandria.

Lemna.
1. Minor, L. In ditches. July.
2. Trisulca, L. In similar situations, July.

Triandria.

Typha.
Latifolia, L. In pools of water, July.
Sparganium.
Ramosum, Sw. In ditches, July.
Carex.
1. Cephalophora, Wahl. Woods, May.
2. Bromoides, Schk. In wet meadows, May.
3. Retroflexa, Muhl. On dry land, May.
4. Multiflora, Willd.? Swamps, May.
5. Sparganioides, Willd. Wet meadows, June.
6. Rosea, Schk. On dry land, May.
7. Disperma, Dewey, (Mss.) Cranberry pond meadows. June.
8. Scoparia, Willd. In wet meadows, June.
9. Straminea, Willd. In similar situations. June.
10. Festucacea, Schk. Dry land, June.
11. Caespitosa, Eat.? Boggy meadows, May.
12. Crinita. Willd. Borders of streams, June.
    Var. palacea. Wet meadows, June.
13. Acuta, Willd. Boggy meadows, May.
14. Polytrichoides, Willd.
    Microstachya, Mx. On wet ground, May.
15. Virescens, Muhl. On dry land, May.
16. Varia, Willd. On dry hills in woods, April.
17. Marginata, Willd. In dry woods, May.

18. Tentaculata, Willd. In swamps, May.
19. Lupulina, Willd. In wet meadows, June.
20. Flava L. Borders of Dog pond, Goshen, June.
21. Folliculata, Willd. In swamps, June.
22. Pubescens, Muhl. In wet woods, June.
23. Plantaginea, L. Moist woods, April.
24. Granularis, Muhl. On dry land, May.
25. Laxiflora, Willd. ? Near brooks, May.
26. Hystericina, Willd. Wet meadows, June.
27. Flexuosa, Muhl. Near brooks, June.
28. Miliacea, Schk. Wet meadows, May.
29. Pseudo-cyperus, Willd. Swamps by Ponds, June.
30. Pellita, Willd. In swamps, May.
31. Lacustris, Willd.
    Riparia, Muhl. Gram. Swamps, June.
32. Vesicaria, L. Wet meadows, May.
33. Rostrata, Mx. In swamps, June.

Comptonia.

Asplenifolia, Ait.
Liquidambar asplenifolium, L. Dry hills, May.

Eriocaulon.

Pellucidum, Mx. Borders of Ponds, Aug. White.

Serpicula.

Occidentalis, Ph. In Bantum lake, Aug. White.

Tetrandia.

Urtica.

1. Pumila, Willd. Wet places, July.
2. Dioica, L. Cultivated grounds, July.
3. Canadensis, D. Moist woods, Aug.
   Whitlowi, Muhl. ?

Alnus.

Serrulata, Willd. In swamps, April.

Pentandria.

Ambrosia.

Elatior, L. In cultivated fields, Sept.

Amaranthus.

1. Albus, L. Streets, July.
2. Hybridus, L. In cultivated fields, Aug.

POLYANDRIA.

Myrioiphyllum.

Capillaceum, Torrey, (Mss.) ponds, July.

Sagittaria.

1. Sagittifolia, L. Borders of Ponds and streams, Aug.
2. Hastata, Ph. with the last. Aug. White.
3. Gracilis, Ph. In similar situations, Aug. White.
4. Acutifolia, Ph. Muddy banks of ponds, Aug. White.
5. Simplex, Ph. with the last, Aug. white.

Calla.

Palustris, L. In swamps July. white.

Arum.

1. Triphyllum, L. In moist woods, May. white and purple.
2. Virginiana, L.
   Calla virginica, Mx. In swamps, July. Green.

Quercus.

1. Tinctorium, Willd. Woods, May.
2. Alba, Willd. Woods, May.
3. Montana, Willd. Rocky woods, May.
4. Bannisteri, Mx.
   Ilicifolia, Willd. Mountains, May.

Juglans.

1. Nigra, L. Introduced ? May.
2. Cinerea, L. In woods, May.
3. Squamosa, Mx.
   Compressa, Willd. Woods, May.
4. Alba, L. Willd. In woods, May.
5. Glabra, Muhl. In woods, May.

Fagus.

Ferruginea, Ait, In woods, May,

Castanea.

1. Vesca, Willd. In woods, July.
   Betula-populifolia, Ait. In woods, June.
2. Lenta, L. In woods, June.

Carpinus.

Americana, Willd. In woods, May.

Corylus.

1. Americana, Wang. In woods, April.
2. Rostrata. In woods, April.

Platanus.

Occidentalis, L. Borders of streams, June.

Monadelphia.

Pinus.

1. Canadensis, L. Pine Island, May.
2. Nigra, Ait. Cranberry pond meadows, May.
3. Strobus, L. Pine island, May.
4. Rigida, L. Sandy hills, May, (rare.)
5. Pendula, Ait. Cranberry pond meadows, May.

Acalypha.

Virginica, L. Dry pastures and road sides, Aug.

DIOECIA.

Diandra.

Salix.

1. Conifera, Willd.
   Eriocephala, Mx. Swamps, April.
2. Nigra, Willd.
   Caroliniana, Mx. Near streams, April.
3. Lucida, Willd. Borders of ponds, May.
4. Cordata, Willd. Wet fields, June.
5. Grisea, Willd. Borders of streams, May.
6. Vitellina, L. Road sides, May.
7. Babylonica, L. Introduced, May.

Tetrandia.

Myrica.

Gale, L. Borders of ponds, May.

Hexandria.

Smilax.

1. Rotundifolia, L. Woods in Woodbury, June.
2. Peduncularis, Muhl. Fields, June.

Octandria.

Populus.

1. Tremuloides, Mx. In woods, April.
2. Grandidentata, Mx. with the last, April.
3. Balsamifera. Introduced? May.

Monadelphia.

Taxus.

Canadensis, Willd. Pine island swamps.

CRYPTOGAMIA.

Gonopterides.

Equisetum.

1. Arvense, L. Low grounds, April.
2. Hyemale, L. Boggy grounds, April.

Stachyopterides.

Lycopodium.

1. Clavatum, Willd. In woods, July.
2. Complanatum, L. Willd. Woods, Aug.
3. Dendroideum, Willd.
   Obscurum, L. Wet woods, July.
4. Rupestre, L. On rocky hills, June.
5. Lucidum, Willd. In wet woods, July.

Botrychium.

Gracile, Ph. In woods, July.

Ophioglossum.

Vulgatum, L. Pond meadows, July.

Schismatopterides.

Osmunda.

1. Cinnamomea, Mx. Low grounds, June.
2. Interrupta, Mx. Marshy grounds, July.
3. Spectabilis, Willd. Swamps, June.

Filices.

Polypodium.

1. Vulgare, L. On rocks, July.
2. Hexagonopterum, Willd. Wet woods, Aug.

Aspidium.

1. Acrostichoides, Willd. July. On rocks.
2. Noveboracense, Willd. July. Wet places.
3. Cristatum, Willd. July. Rocky woods.
4. Marginale, Willd. Mount Tom, July.
5. Asplenoides, Willd. In woods, July.
6. Angustum, Willd. In woods, July.
7. Rufidulum, Willd. On rocks, July.
8. Dialatatum, Willd. In rocky hills, July.
9. Intermedium, Muhl. Moist woods, June.

Onoclea.

Sensibilis, L. Wet grounds, June.

Asplenium.
1. Ebeneum, Willd. Rocks, July.
2. Melanocaulon, Wille. On the sides of rocks, July.

Pteris.
Aquilina, L. In woods, July.

Adiantum.
Pedatum, L. Wet places, July.

Dicksonia.
Pilosiuscula, Willd. Wet woods, Aug.

ZOOLOGY.

Art. VIII.—*Fragments relating to the history of Animals.*

Extract of a letter to the Editor, dated

Princeton, Dec. 22d, 1821.

Dear Sir,

The following are the extracts from my notes on Natural History, mentioned in my last to you. You have my consent to dispose of them as you think proper. My engagements would not permit me to copy them before.

Yours truly,
JACOB GREEN.

Curious Instinct of the common Hog, (Sus Scrofa—Lin.)

It is customary with farmers who reside in the thinly settled tracts of the United States to suffer their hogs to run at large. These animals feed upon acrons which are very abundant in our extensive forests, and in this situation they often become wild and ferocious. A gentleman of my acquaintance, while travelling, some years ago, through the wilds of Vermont, perceived at a little distance before him a herd of swine, and his attention was arrested by the agitation they exhibited. He quickly perceived a number of young pigs in the centre of the herd, and that the hogs were arranged about them in a conical figure, having their heads all turned outwards. At the apex of this singular cone, a huge boar had placed himself, who, from his size, seemed to be the master of the herd. The traveller now observed that a famished wolf was attempting by various manœuvres to seize one of the pigs in the middle; but wherever he made an attack, the huge boar at the apex of the cone presented himself—the hogs dexterously arranging themselves on each side of him, so as to preserve the position of defence just mentioned. The attention of the traveller was for a moment withdrawn, and, upon turning to view the combatants, he was surprised to find the herd of swine dispersed, and the wolf no longer to be seen. On riding up to the spot, the wolf was discovered dead on the ground, a rent being made in his side, more than a foot in length—the boar having, no doubt, seized a favourable opportunity, and with a sudden plunge dispatched his adversary with his formidable tusks.

It is a little remarkable that the ancient Romans, among the various methods they devised for drawing up their armies in battle, had one exactly resembling the position assumed by the swine above mentioned. The mode of attack they called the *Cuneus*, or *Caput porcinum.*

Blue-Yellow Bird.—Fringilla tristis.

To those but little acquainted with Natural History, the assertion that a white black bird (oriolus Phœniceus) or a black swan (Anas Atrata) are animals really in existence, appears too paradoxical for belief. Black swans, however, are found in New Holland and some other places, possessing all the graceful atitudes of the European species; and white black birds or albinos, are of no very uncommon occurrence.

I have observed another anomaly among the feathered tribe no less striking. A bird of precisely the same size, habits, and general appearance with our common yellow bird, (*Fringilla tristis*) associating with it, and differing only in colour—this being of a dark indigo in the places where the male (F. tristis) is yellow; the black bands on the wings, and the spot on the head, were the same in both.

The following hints are offered by way of theory to explain these anomalies :—If there be any truth in the opinion entertained by many, that the imagination of the parent, or that certain casualties during gestation, have an influence on the offspring of the class *Mamalia*—why may not the like circumstance affect the embryo in the egg of birds. Again, we know that when the eye becomes fatigued with beholding the glare of one colour, it is relieved by changing the colour—or if a colour be viewed for some time, the opposite will be painted on the retina—thus when we look on the bright light thrown by a burning glass on any object, a black spot is produced in the eye, and if we look steadfastly on a black spot made with ink on a white sheet of paper, or moving the eye a little, a luminous spot will be seen on the paper, much brighter than the surrounding part.* Will not these two particulars taken together, account for the above anomalies?

The causes which have produced the varieties in the human species, are but little understood. Too much is perhaps attributed to the influence of climate. There are many reasons to satisfy an unprejudiced mind, besides the unerring testimony of the bible, that the whole race of man has sprung from one and the same stock. The five principal varieties mentioned by Blumenbach—the Caucasian, Mongalian, Ethiopian, American, and Malay—may all have arisen from some such accidental cause as those noticed above, or such as occasions the albinos of our species. That species can be continued from such accidental varieties, appears from the following account published in Edwards' Gleanings of Natural History, and in the 424th No. of the Philosophical Transactions. Edward Lambert, or the Porcupine man, was at his birth like other children; but in eight or nine weeks his skin turned yellow and then blackish, covered with conical protuberances, which formed a rugged covering all over him, except his head, palms, and soles of his feet. This man had six children, whose skin exactly resembled his own. Edwards then remarks—" It appears to me beyond all doubt, that a race of people may be propagated by this man, having such rugged coats or covering as himself, which if it should ever happen, and the accidental original be forgotten, it is not improbable they may be deemed a different species of mankind; which considera-

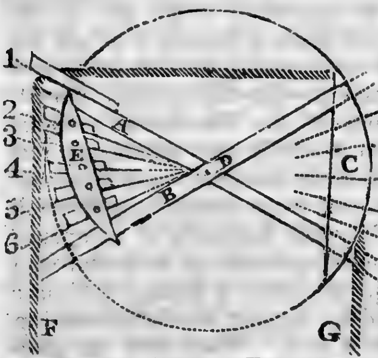
* If we gaze long upon a bright yellow spot, a blue colour will be painted on the retina. Many curious particulars on this subject may be found in the first volume of Darwin's Zoonomia.

tion should almost lead one to imagine, that if mankind were all produced from one and the same stock, the black skins of the Ethiopians, &c. might possibly be owing originally to some such accidental cause."—See Edwards' Plate 212.

MECHANICS AND THE ARTS—PHYSICS AND CHEMISTRY.

Art. IX.—*Account of an improved mode of suspending Gasometers ; by* Dr. Hare.*

It is well known to all who are conversant in gas light apparatus, that no mode has been heretofore devised to render Gasometers accurately equiponderant at all points of their immersion in the water ; a circumstance so indispensable to their action.



The mode usually adopted in the English Establishment, is that of the Gasometer chain. This is costly, and difficult to execute well, or to correct, when erroneously proportioned to the desired effect. The plan of suspension on a beam, like that in the annexed cut, has in practice been found to answer perfectly. Being once executed, it requires no further attention. The rationale of the operation of such a beam, will be evident from the method of constructing one which I shall proceed to explain.

Find (by trial, if possible ; if not, by calculation,) the weight of the Gasometer when sunk so low, as that the top will be as near as possible to the water, without touching it. In the same way find the weight of the Gasometer at the highest point of emersion, to which it is to rise, when in use. Then, as the weight in the last case, is to the weight in the

* Published first in the Analectic Magazine for May, 1817.

first; so let the length of the arm A, be to the length of the arm B. From the centre D, with the radius A, describe a circle; on which set off an arch C, equal to the whole height through which the Gazometer is to move. Divide this into as many parts as there are spaces in it, equal each to one-sixth of the radius or length of the arm A. Through the points thus found draw as many diameters; which will, of course, form a corresponding number of radii and divisions, on the opposite side of the circle. Divide the difference between the length of A and B, by the sum of these divisions: and let the quotient be q. From the centre D towards the side E, on radius 2, set off a distance equal to the length of the arm A, less the quotient or q. On radius 3, set off a distance equal to A, less 2 q, or twice the quotient; and so set off distances on each of the radii; the last being always less than the preceding, by the value of q. A curve line bounding the distances thus found, will be that of the arch head E. The beam being supported on a gudgeon at D, let the Gasometer be appended at G, and let the weight be appended at F, adequate to balance it at any one point of immersion. This same weight will balance it at all other points of its immersion—provided the quantity of water displaced by equal sections of the Gasometer be equal. But as the weights on which A and B were predicated, may not be quite correct, and as, in the construction of large vessels, equability of thickness and shape cannot be sufficiently attained—the consequent irregular buoyancy is compensated by causing the weight to hang nearer to, or farther from the centre, at any of the points taken in making the curve. This object is accomplished by varying the sliders seen opposite to the figures 1, 2, 3, 4, 5, 6. When they are properly adjusted, they are made firm by the screws of which the heads are visible in the diagram.

The drawing is of a beam twelve feet long; and of course the length of the arm A is six feet—that of B four feet—their difference two feet; which divided by six, the number of points taken in making the curve E. gives four inches for the quotient q. Hence the distance on radius 2, was five feet eight inches—on radius 3, five feet four inches—on radius 4, five feet—on radius 5, four feet eight inches—on radius 6, four feet four inches—and lastly four feet.

The iron gudgeon, where it enters the beam, is square:

The projecting parts are turned true, and should be bedded in brass or steel dies; placed, of course, on a competent frame. The sixth part of a revolution of the portions of the gudgeon thus supported, is the only source of friction to which this beam is subject during the whole period of the descent of the Gasometer;—which, in large ones, does not ordinarily take place in less than six hours.

Art. X.—*Pearson's Patent Domestic Telegraph.*

(Communicated for this Journal by the Inventor.)

The Domestic Telegraph has for its recommendations the following advantages, viz.

1. The ease, facility and dispatch with which domestic wants may be supplied.

2. The great saving of labour to domestics, rendering their attendance less irksome to themselves, and more acceptable to principals.

3. The privacy with which domestic communication may be held in the presence of company; and in many other cases that often occur.

4. In cold weather, obviating the necessity of so frequently opening the doors of apartments, which is so incommodious and disagreeable; besides admitting the influx of cold air.

5. By reference to the annexed drawing,* it will be percieved that by the Indexes, *a. a.* moving over two dials, ***B. B.*** an almost instantaneous communication is effected—they operating simultaneously by means of the connecting rods, *c. c.* and wheels, ***D. D.*** The motion, giving the alarm to direct the domestic's attention to the face of the dial, is by means of the small pinion, *e.* and rod, *f*, connected to the Wheels, *d. d.*—on whose centre of motion two small bells, *g. g.* are fixed, with their peripheries facing each other. A small space is left between the bells to give freedom to their vibration—to produce which a cast iron ball is enclosed between them, and revolves on the inner side of their extremities. The dials are divided by zones into three divisions—the *inner* of which contains the letters of the alphabet—the next *exterior*, figures to the number of 30—the *outer* is divided into 30 compartments, each of which contains the

* See the end of the volume.

name of an article in full. These divisions will generally be found to contain as many articles as usually comprehend the wants of a family. Should any article, however, be wanted, not expressed by words on the dial, it may with ease be communicated, by turning the index to the letters requisite to make out the name of the article.

By the power of the alphabet, it will readily be seen that the Domestic Telegraph may be rendered the medium of communication to an indefinite extent.—For the sake of convenience, by an understanding between the parties, words may be so abreviated, that certain letters shall stand as their representatives. Thus the names of domestics may be designated by the initials, and the figure may likewise be applied to similar purposes. By these arrangements it not only appears, how easily domestic wants may be supplied, and private communications held, by the use of the Domestic Telegraph,—but that it may be made to facilitate the conveyance of intelligence through all kinds of buildings—such as stores, ware-houses, counting-rooms, &c. &c. &c.

The simple structure of the Telegraph enables the inventor to furnish the common one at the low price of five dollars ;—while from its form, it is peculiarly adapted to decorate the most elegant rooms—the ornamental ones will be furnished proportionally low.

N. B. No. 2 in the annexed drawing, represents a bell-action applied to the same purpose as bell-action No. 1, and is connected by the pinion, *e.* to the wheel *D.* at 4.

The inventor proposes placing the more costly ones in pedestals, vases, &c. &c. as chimney or table ornaments.—Mr. Pearson's stand is in Water-street, Boston.

Art. XI.—"*Account of the Earthquake at Kutch, on the 16th of June,* 1819. *Drawn up from published and unpublished letters from India.*" From the Edinburgh Philosophical Journal, No. 5, June 1820.

The western coast of India has been visited by an earthquake, which has spread desolation and famine over a great extent of country ; and whose destructive effects will be seen and felt for many years to come. This tremendous convulsion of nature was experienced from Bombay to beyond the tropic of Cancer; but the centre of the convulsion seems to have been in the province of Kutch, which has severely suffered. In describing this alarming occurrence, we shall select from a variety of letters which have heen received on this subject, the most important particulars.

The first and greatest shock took place on the 16th of June, 1819, a few minutes before seven in the evening. The day had been cool and showery; Fahrenheit's thermometer ranging from 80° to 85°. The monsoon had set in mildly without much violent thunder and lightning; and there was nothing unusual in the state of the atmosphere at that season that could afford any ground for apprehension. The wind which had been blowing pleasantly towards evening, at the commencement of the concussion fell into a deep calm, and in a moment all was consternation and horror. The wretched inhabitants of Bhooj were seen flying in all directions to escape from their falling habitations. A heavy appalling noise,—the violent undulatory motion of the ground,—the crash of the buildings,—and the dismay and terror which appeared in every countenance, produced a sensation horrible beyond description. The shock lasted from two to three minutes, and during that short period the city of Bhooj was almost levelled with the ground. The walls, from the sandy nature of the stone, were crumbled into dust; nearly all the towers and gateways were demolished; and the houses which were left standing, were so shattered as to be uninhabitable. The fort, which stands at some distance from the city, is so breached as to be rendered useless as a place of defence. It is calculated that nearly two thousand persons have perished in Bhooj alone. Among the sufferers is the mother of the deposed Rajah, who was buried in the ruins of the palace. The surviving inhabitants were obliged to forsake the city, and encamp outside of the walls on some sand hills. Their situation was truly distressing. Bruised, maimed, and in sorrow, they resorted daily to the city to extricate the mangled remains of wives, children and relations. In this melancholy labour, they were nearly exhausted by the stench arising from the putrid bodies of their friends, and from the carcases of the cattle, which had perished in great numbers. At the date of the last account, between 1000 and 1500 persons had been dug out of the ruins.

The devastation was general throughout Kutch. From Luckput Bunder to Butchao, in every town and village, more or less lives were lost by the falling in of the houses; and in the towns of Mandavie, Moondria, and Anjar, very extensive damage has been sustained. Accounts from Angar state, that the first wall was almost completely destroyed, not one hundred yards of it remaining in one spot, and guns and towers hurled in one common mass of ruin. Scarcely a fourth part of the town is standing, and the houses that do remain are considerably injured. "In one word," says the writer of the account, "a flourishing population has been reduced in one moment to wretchedness and misery; and I fear we shall have to lament the loss of upwards of one hundred people, besides those hurt."

The destruction occasioned by this terrible visitation was not confined to Kutch. From Ahmedabad, the capital of Guzerat, we have the following description: "This city is justly celebrated for its beautiful buildings of stone and other materials, and for the famous shaking minarets, which were admired by every stranger. Alas! the devastation caused by this commotion of the earth is truly lamentable. The proud spires of the great mosque, erected by Sultan Ahmed, which have stood nearly four hundred and fifty years, have tumbled to the ground, within a few yards of the spot where they once reared their heads! Another mosque of elegant structure, which lies to the left of the road leading to the Shahee Bagh, has shared the same fate. The magnificent towers, forming the grand entrance into the citadel, have been much shaken, and cracked in several places, especially the one in which the flag-staff has been placed. Many private houses have been reduced to ruins; but it is most fortunate, amidst all our disasters, that not a single life has been lost, and but few accidents." We learn from Jelilsheer, that "the earthquake was severely felt in that place, and the loss of lives terrible. The fort and town are reduced to ruins. Many of the people killed were already out of doors, which is usually considered a situation of comparative safety. A marriage was about to be celebrated in a rich man's family; and the casts had assembled from various quarters: the shock occurred when they were feasting in the streets, and upwards of five hundred of the party were smothered in the ruins of the falling houses."

The effects of this earthquake have indeed been so extensive, that we cannot pretend to enumerate the more minute disasters. We have confined ourselves to the most prominent of them ; and we now proceed to give some account of the sensations felt by the individual sufferers during the continuance of the concussions. In the British camp, which was pitched in a plain between the fort and city of Bhooj, the general feeling was an unpleasant giddiness of the head, and sickness of stomach, from the heaving of the ground ; and during the time the shock lasted, some sat down instinctively, and others threw themselves on the ground. Those who were on horseback were obliged to dismount, the earth shook so violently that the horses could with difficulty keep their feet ; and the riders, when upon the ground, were scarcely able to stand. At Ahmedabad, " all the disagreeable sensations were experienced of being tossed in a ship at sea in a great swell ; and the rocking was so great, that every moment we expected the earth to open under our feet." One gentleman writing from Surat, where the earthquake began at twenty minutes past seven, says, " The vibration of the couch I was lying on was so great, that I was glad to get off it : the house was considerably agitated, and the furniture all in motion ; a small table close to me kept striking the wall, and the lamps swung violently. I ran down stairs and out of my house as fast as possible. On getting on the outside, I found a number of people collected, gazing with astonishment at my house, which stands alone, and was so violently agitated that I expected it to fall down. The earth was convulsed under our feet." Another thus writes from Broach : " Such of the houses as are elevated, and at all loosely built, creaked like the masts and rigging of a ship in a gale, the venetians and window-frames rattling violently, and the buildings threatening immediately to fall ; a considerable lateral motion was impressed on every thing that admitted of it. After this more violent concussion had lasted a minute or upwards, it was succeeded by an oscillatory motion, of a more equable character, which continued for more than a minute and a half, making the whole period of the convulsion nearer three than two and a half minutes." An intelligent native residing in Iseria, gives the following cccount :

"Yesterday in the evening a noise issued from the earth like the beating of the *nobut*, and occasioned the tumbling of all the people : it appeared most wonderful, and deprived us all of our senses, so that we could not see, every thing appearing dark before us ; a dizziness came upon many people, so that they fell down."

Besides the great concussion on the evening of the 16th, frequent slight shocks were experienced during the night, and throughout the following day. One occurred a little before ten in the morning, which shook the houses, and caused the windows and doors to rattle violently. It continued, however, only for a few seconds. Another, rather more severe, took place on the 23d, at midnight. Some houses were thrown down but no lives lost. Indeed daily vibrations were sensibly felt in the camp before Bhooj, for more than a month after. The same unpleasant sensations which were experienced during the first shock, also continued for several days. A giddiness, and slight sickness, accompanied with pains in the knees, and an inclination to lie down rather than sit or stand. This is attributed to the rocking or rolling motion of the earth, which, though not observable, was in constant action. The inhabitants of Kutch, however, were much relieved from the dread of farther convulsions, by the circumstance of a volcano having opened on a hill about thirty miles from Bhooj ; and about ten days after the first shock, a loud noise, like the discharge of cannon, was heard at Porebunda. The sound came from the East and was supposed to indicate the bursting of one or more volcanoes in that direction. Undulations of the earth had formerly been felt in this district, but had never been accompanied with any distressing effects. About two years ago, several of the British officers encamped in the neighbourhood of Bhooj, experienced a slight shock ; but it was so slight that others of them were not sensible of it. It is to be hoped, however, that none will ever be attended with such a horrible catastrophe as the one we have been describing ; for the distress occasioned by it is represented by almost all the writers as almost beyond their abilities to describe.

ART. XII.—*Analysis of a Sulphuret of Molybdenum; by* HENRY SEYBERT, *of Philadelphia.*

(Communicated for this Journal.)

THIS mineral was found near Chester, Delaware county, Pennsylvania, and in its external character so much resembles that of Saxony, as to make a description of it unnecessary. It occurs in a *gangue* of quartz, and is often accompanied by the sulphuret of iron.

The specific gravity of apurcpicca was 4.444.

Analysis.

A. 5 Grammes reduced to minute laminæ were treated by pure concentrated nitric acid; soon after the addition of the acid, the mineral assumed a beautiful blue colour. When heat was applied, effervescence commenced, nitrous acid was abundantly disengaged, and the liquor became turbid, owing to the precipitation of the molybdic acid. The total decomposition was effected with difficulty, and took place twenty-four hours after the acid was added. The liquor was then filtered, and the residue was washed to separate the sulphuric acid, that was formed during the decomposition of the mineral. The filtered liquor was treated by a slight excess of muriate of barytes, a precipitate of sulphate of barytes was formed, which after being washed and calcined, weighed 14.39 grammes, equivalent to 4.945 grammes of sulphuric acid, or to 1.984 grammes of *sulphur* on 5 grammes, or pr 100 = 39.68.

B. The liquor (*A*,) containing a portion of the molybdic acid, was evaporated to dryness, to expel the nitric acid. The dry mass was treated by water; a portion of the molybdic acid remained insoluble, the liquor was then filtered; the molybdic acid, remaining on the filter, after being washed and moderately calcined, weighed 0.44 grammes. The liquor was then treated by ammonia, it became turbid, owing to a precipitation of molybdate of barytes; another portion of muriate of barytes was added to it, and it was then filtered, the molybdate of barytes remaining on the filter, when washed and calcined, weighed 0.90 grammes, which corresponds to 0.415 grammes of molybdic acid.

C. The residue on the filter (*A*,) supposed to be molybdic acid and sulphur, was washed and dried at a moderate temperature insufficient to sublime the sulphur; it was then moderately calcined; during the calcination there was not the slightest odour of sulphur—a proof that the nitric acid had completely acidified it. The molybdic acid, after the calcination, weighed 3.61 grammes, it dissolved entirely in ammonia, and was therefore considered pure. The results in (*B* and *C*.) give a total of molybdic acid, amounting to 4.465 grammes, equivalent to 2.971 grammes of *molydenum* on five grammes, or pr 100=59.42.

The constituents of the mineral according to this analysis, are,

	Per 100 parts,	
A.	Sulphur, - -	39.68
C.	Molybdenum, - -	59.42
		99.10
		100.00
		000.90 Loss.

Art. XIII.—*Analysis of the American Chromat of Iron*; *by* Henry Seybert, *of Philadelphia.*

This mineral was found at the Bare Hills, near Baltimore, in the State of Maryland; the specimen submitted to analysis was amorphous, and incrusted with talc. Its colour was blackish-brown—colour of the powder deep reddish brown. Lustre metallic—opaque—fracture uneven—not very frangible—scratches glass—acts but very slightly on the magnet. The specific gravity, of a pure piece, was 4.0639. Infusible before the blowpipe.

Analysis.

A. 8 grammes of the mineral, after being carefully separated from the talc, were reduced to a very fine powder, and exposed to a red heat in a platina crucible. The calcined mineral was a shade darker, and weighed 7.87 grammes ; the loss of weight in water then amounts to 0.13 grammes on 8 grammes, or 1.625 per 100.

B. The residue of the calcination (*A*) mixed with 16 grammes of nitrate of potash, and 8 grammes of caustic potash, was exposed to fusion at a red heat, in a silver crucible during one hour. The fused mass was treated by water, and the solution, when filtered, was of a bright yellow colour. The matter on the filter was red, it was then treated by diluted muriatic acid, to dissolve the silex which had formed a silicate with the alumine, insoluble in potash. This solution was decanted, and the residue was boiled with concentrated muriatic acid, to dissolve the per-oxide of iron. The last solution was filtered, and the residue on the filter consisted of that portion of the mineral which resisted decomposition ; after being washed and calcined it weighed 3.34 grammes. After deducting the 3.34 grammes of undecomposed mineral, from the 7.87 grammes in (*A*,) there remained 4.53 grammes of the *calcined* mineral for the analysis.

C. The two muriatic solutions (*B*) were mixed and evaporated to dryness ; the dry mass was treated by water acidulated with muriatic acid ; it was then moderately evaporated, again treated by water and filtered. Silex remained on the filter, which, after being washed and calcined, weighed 0.48 grammes, on 4.53 grammes, or 10.596 per 100.

D. The liquor (*C*) was treated by an excess of caustic potash, and boiled during an half hour ; it was then filtered ; muriatic acid was added to the filtered solution, and by means of ammonia, was found to contain a mere trace of alumine. The residue on the filter, washed and calcined, weighed 2.09 grammes ; it was dissolved in muriatic acid, evaporated to expel the excess of acid, and treated by water ; the iron was then precipitated by ferruginous hydrocyanate of potash. The liquor was filtered, the alumine was precipitated from the filtered solution by ammonia, washed and calcined it weighed 0.459 grammes—then by difference we have 1.631 grammes of per oxide of iron on 4.53 grammes of the mineral, or 36.004 per 100.

E. The yellow solution (*B*) was saturated by muriatic acid, a precipitate of alumine was formed, which, washed and calcined, weighed 0.13 grammes, so that, with the alumine obtained in (*D*,) we have 0.589 grammes alumine on 4.53 of the mineral, or 13.002 per 100.

F. To ascertain whether the proper quantity of acid was added to the liquor (*E*,) a portion of it was rendered slightly acid, and treated by ammonia ; no precipitate was formed ; it was therefore certain, that the acid added had precipitated all the alumine. The liquor was then treated by an excess of muriatic acid, it became intensely brown ; chlorine was disengaged, and on heating the liquor, it was changed to a beautiful deep green. The muriatic acid decomposed the chromate of potash, and formed muriate of potash and proto-muriate of chrome. The green colour proved that the chrome was in the state of a protoxide. The liquor, treated by ammonia, yielded a light green precipitate of proto-hydrate of chrome, which, washed and calcined, gave protoxide of chrome 1.79 grammes on 4.53 grammes of the mineral, or 39.514 per 100.

This chromate of iron, after being calcined, is constituted as follows.

	Per 100 parts.	
C. Silex, -	10.596	Containing oxygen, 5.329
D, Per-oxide of iron,	36.004	- - - 11.038
E. Alumine,	13.002	- - - 6.073
F. Protoxide of Chrome	39.514	- - - 11.810
	99.116	
	100.000	
	000.884 Loss.	

During my residence in Paris, I examined, in the Royal School of Mines, a specimen of the chromat of iron, found in Chester county, Pennsylvania. In its external characters, it did not vary materially from that found at the Bare Hills ; the result of the analysis was as follows, viz :

	Per 100 parts.	
Silex, - - -	02.901	Containing oxygen 01.45
Peroxide of Iron, -	35.140	- - - 10.77
Oxide of Manganese,		a Trace.
Alumine, - - -	09.723	- - - 04.54
Protoxide of Chrome,	51.562	- - - 15.41
	99.326	
	100.000	
	000.674 Loss.	

ART. XIV.—*Analysis of the Sulphat of Strontian from Lake Erie, and of some Sulphats of Barytes; by Mr.* GEORGE T. BOWEN, *of Providence, R. I.*

Remarks by the Editor.

In our present No. pa. 279, we have inserted notices of the sulphat of strontian from Lake Erie. The highly respectable authority upon which those localities have been received, scarcely demands any confirmation, especially as the external characters support the opinion of the gentlemen who have given their names to the public. Still the actual analysis is always desirable, and especially in this country, where we have so few original analyses of our own native minerals. Those detailed in the annexed paper were executed by a pupil in the Labratory of Yale College. *The research is exclusively his own;*—we will observe, only, that the reagents were all pure, and that the results of all the stages of the analysis being shewn us, at the moment, were considered entirely satisfactory.

The discovery of sulphat of strontian in our sulphats of barytes, must be deemed interesting: Klaproth made a similar observation on some of the sulphats of barytes which he examined; but in no instance did he find so much as Mr. Bowen found in the Berlin mineral; he generally found from one to two per cent, but the Berlin mineral affords nearly four per cent. The analysis of the Erie strontian was performed upon a fragment of the very large and pure crystal furnished by Major Delafield.

Analysis of the Sulphat of Strontian.

A.

Three pieces whose specific gravities were respectively 3.82, 3.78, and 3.88, were finely pulverized and sifted.

B.

Two hundred grains of this powder were mixed with three times their weight of pure carbonat of potash and six ounces of distilled water, and the mixture boiled for two hours—the loss of water by evaporation being from time to time supplied.

C.

The whole was then thrown upon a filter, and the insoluble powder repeatedly washed with distilled water. This powder when collected and dried, weighed 175 grains.

D.

Upon the insoluble portion (C,) muriatic acid was poured, when it was entirely dissolved with effervescence, excepting a residue of one grain, which was silex.

E.

The muriatic solution (D) was filtered and saturated with caustic ammonia, when a brownish coloured precipitate was produced. This precipitate when collected and dried amounted to two grains in weight. Diluted sulphuric acid when digested upon it, dissolved it in part, and gave with prussiate of potash a blue precipitate. The residue was then heated with caustic potash, and dissolved in water. Sulphuric acid being added, and the solution placed in a moderate heat, crystals of alum were formed. This precipitate then consisted of alumine and oxide of iron.

F.

The muriatic solution was then evaporated, when it crystallized entirely in needle-shaped crystals, which possessed all the properties of muriate of strontian—particularly the alcoholic solution tinged flame of a most beautiful red. Estimating, therefore, the quantity of pure strontian from the carbonate produced by the decomposition of the sulphate, the Lake Erie mineral contains in two hundred parts—

Pure strontian, - -	108.5
Silex, - - - -	1.
Alumine, - - -	1.5
Oxide of iron, - - -	1.
Sulphuric acid and water, -	88.
	200.

Analysis of a Sulphate of Barytes from Berlin, Con.

Having, by the aid of charcoal and a red heat, decomposed a specimen of sulphate of barytes from Berlin, for the purpose of obtaining the muriate, it was observed that the crystals which were deposited after the solution had been much concentrated by evaporation ; did not possess the usual form of the barytic salt. An examination of the mineral was in consequence undertaken, the results of which follow. Its specific gravity is 4.36—colour pure white—structure broad foliated—lustre shining—and in its other external characters it agrees so completely with common specimens of sulphate of barytes, that a further description of it would be unnecessary.

Analysis.

A.

1. Distilled water digested upon the mineral in powder for one hour was rendered slightly turbid by nitrate of silver, and by oxalate of ammonia.

2. Pure muriatic acid was then poured upon the powder, and heated with it for half an hour ; it dissolved nothing, however, excepting a scarcely perceptible portion of iron.

3. Two hundred grains exposed for one hour to a high red heat, lost only two grains in weight.

B.

Two hundred grains of the mineral finely powdered and sifted, were mixed with three times their weight of pure crystallized carbonate of potash, and exposed for two hours to a moderate red heat in a crucible of pure silver.

C.

The mass (B) after having been pulverized and boiled with water, was thrown upon a filter, and the insoluble portion repeatedly washed with distilled water.

D.

To the filtered solution muriatic acid was added in excess, and the fluid evaporated to dryness. Water being then poured upon the mass, there remained undissolved one grain, which was silex.

E.

To the insoluble powder (C) diluted muriatic acid was added, when it was entirely dissolved with effervescence, excepting a residue of four grains of siliceous earth.

F.

The muriatic solution was then filtered and saturated with caustic ammonia, when a brownish coloured floculent precipitate was produced, which when dried, weighed three and a half grains, and consisted of oxide of iron with a trace of alumine.

G.

The muriatic solution freed from iron and alumine, was decomposed by carbonate of ammonia, and the precipitate again redissolved in muriatic acid. This solution being placed on a sand bath, deposited tabular crystals of muriate of barytes until the solution had become highly concentrated, when it shot into needle-form crystals, which tinged the flame of alcohol of a deep red colour, and possessed all the other properties of muriate of strontian. These crystals of muriate of strontian, when collected and dried on paper, weighed twelve grains. The crystallized muriate of barytes, when washed with alcohol and dried, amounted to 182 grains.

The sulphate of barytes from Berlin contains then, in two hundred grains—

Pure Barytes, - - -	114.66
Pure Strontian, - - -	7.84
Sulphuric acid - - -	67.
Silex, - - - - -	5.
Oxide of iron and alumine, -	3.5
Water, - - - - -	2.
	200.00

Remark.

The sulphate of barytes which forms the gangue of the celebrated Missouri galena, having been examined by a similar process, gave, in one hundred parts, about one part of strontian ;—the sulphat of barytes, from the Southampton lead mines, Mass. gave no trace of strontian.

Art. XIV.—*Description of the Aphlogistic Lamp.*

Communicated by Dr. J. L. Comstock, of Hartford, Ct.

In the construction of this lamp, the object is to keep a coil of wire in a state of permanent ignition, without either flame or smoke.

The principle on which it is constructed, I believe was first discovered by Sir H. Davy. He found that on heating the end of a piece of platina wire red hot, and instantly holding it near the surface of some ether placed in a wine glass, the wire was kept at a red heat as long as the experiment was continued.

Whether Sir Humphrey pursued the subject any farther, I am not informed. It is most probable, however, that he did not, as it is stated in a London paper of the last year, that Prof. Ure of Glasgow had determined the circumstances which modify the performance of the lamp, and that one constructed by him was in full action in that city, (London,) and had excited much public curiosity.

This notice contains some directions concerning the size of the wire, and the manner of coiling it. I have, however, seen no description of this lamp, which would enable one readily to construct it. The following may therefore interest such readers as have seen no account of this curious discovery.

The principle on which the aphlogistic lamp is constructed involves two conditions, which are absolutely requisite, viz : that we make use of a combustible substance which evaporates at a low temperature, and a metal which is a bad conductor of caloric. For the combustible *alcohol* seems best suited to the purpose. *Sulphuric ether*, aside from its high price and disagreeable smell, I have found sometimes to fail ; the ignition ceasing without any obvious cause. In regard to the metal, *gold* and *silver* both fail in consequence of the rapidity with which they conduct caloric. Silver too would soon be destroyed by the intense heat.

Iron, although so bad a conductor as to remain ignited for a time, soon fails, being converted into red oxide. *Platina* seems to be the only metal adapted to this purpose, being comparatively a slow conductor of caloric, and not easily oxidated at the highest temperatures.

This is to be drawn into wire of the diameter of $\frac{56}{100}$ or $\frac{60}{100}$ of an inch, being about equal in size to card, or brass wire No. 26. Experience has shewn that this size succeeds better than any other. If larger, the heat is carried off too rapidly, and ignition ceases in a few moments. If much finer, it does not retain sufficient heat at the lower part of the coil to keep up the evaporation of the alcohol from the wick. The coiling of the wire, and the adjustment of the wick, are the most difficult parts of the construction.

The coil A. fig. 1, of the annexed plate,* is made by winding the wire round a piece of wood cut of the proper size and shape. The size is determined by the bore of the glass tube, allowing for the diameter of the wire. The shape in that part which enters the tube is plain cylindrical, but slightly conical where it projects above the tube, as seen in the figure. (I believe this is the best shape, though I have succeeded equally well when the coil was of the same shape throughout.)

In winding the coil, it is best that the turns of the wire should come in contact. Afterwards it is to be gently extended, so as to leave the turns as near as possible to each other without touching.

The diameter of the coil is about one sixth part of an inch where it enters the tube. Its length half an inch or a little less, containing from twenty to thirty turns of the wire. The projection above the tube is rather less than one half the length.

B. fig. 1, is a glass tube containing a cotton wick which by capillary attraction carries the alcohol up to the platina coil. The length of this tube is arbitrary, being from one inch to three or four inches. The bore is about one sixth of an inch, so as barely to admit the coil. The wick consisting of eight or ten threads, is first drawn through the tube, and then introduced about half way into the coil, so as to come nearly even with the top of the tube. This requires very nice adjustment. If the wick is too high, the wire is rapidly cooled by the alcohol, and ignition soon ceases. If too low, the evaporation by the heat of the wire is insufficient. If, however, the other parts are well constructed, a few trials will insure success.

* See the end of the Vol.

Fig. 2, shows the lamp complete. The body of it is a low vial, or glass inkstand capable of holding about two ounces of alcohol. It is stopped accurately with a cork, which is covered, for ornament, with tin foil. The aperture for admitting the tube and wick is made with a hot iron. D is a small tube through which the alcohol is poured. A *dropping* tube is convenient for this purpose ; but a small funnel is easily made by cutting off an inch of the neck of a broken retort, into which is pushed a cork, and through this a small quill. Another orifice still for letting off the air, as the alcohol goes in may be made through the cork. After the lamp is charged ; these orifices, are of course, to be closed to prevent evaporation.

When the lamp is completed, and charged, the alcohol is inflamed by holding the coil in the blaze of a candle. After letting it burn for a minute or two, the flame is blown out, when, if every thing is properly adjusted, the wire will continue red hot until the alcohol is exhausted.

The explanation, why the ignition of the wire is permanent, seems to be sufficiently simple. Alcohol, when in the state of vapour, combines with oxigen with great facility. The temperature of the wire is first raised by the flame of the candle to about 800° Fah. This degree of heat is such as to effect the combination of the alcohol with the oxygen of the atmosphere. When this is once effected, the caloric extricated by the combustion of the alcohol is sufficient to keep the coil at a red heat, which again is the temperature at which the alcohol is combustible, so that one portion of alcohol, by the absorption of oxygen, and the consequent extrication of caloric, lays the foundation for the combustion of another portion ; and as the alcohol rises in a constant stream, so the effect is constant. The stream of vapour is much increased by the heat of the lower part of the coil, where it embraces the wick, and the temperature of the vapour is considerably raised before it reaches that part of the coil where its combustion is effected. Sometimes, the last or upper turn of the wire only, is kept red hot.

This lamp, though one of the most curious inventions of the age, is not merely a curiosity. The facility and certainty with which, by means of a match, a light may be obtained from it, constitutes its utility. The proper matches for this purpose are prepared by dipping the common brimstone matches into a paste made by mixing two parts of white sugar with one part of chlorate, (oxy-muriate) of potash. The red French matches are of this kind, and answer the purpose completely.

In cases where a light might be wanted, but a constant one would be offensive, this lamp would be a great convenience; a light being almost instantaneously obtained by touching a match to the platina coil, and then to the wick of a candle. Physicians, or others, who are liable to be called up in the night would also find it convenient.

The aphlogistic lamp, with the proper matches, may be obtained at Mr. Charles Hosmer's variety store in this city, (Hartford.)

A description of this Lamp is printed in the sixth edition of Conversations on Chemistry, just published by O. D. Cooke of this city, with notes, by the author of this article.

Art. XVI.—*Natural Ice-House near Williamstown, Mass.** *Lat.* 42° 38′ *N. Lon.* 73° 15′ *W. from London.*

Brinley Place, Roxbury, Dec. 17, 1821.

To Prof. Silliman,

Sir—In the last number of your excellent Journal of Science and Arts, there is an account of a natural ice-house, which you examined, situated in the township of Meriden in Connecticut. Near the close of the article, it is observed, that you should be obliged by any information, respecting similar facts existing elsewhere.

In the month of July 1800, in company with several young gentlemen, I visited a natural repository of ice, in Williamstown, in the north-west part of this State. It is near the summit of a mountain, the name of which I do not recollect, nearly west from the colleges, on the top of which is fixed a pile of stones as the bounds between New-York, Vermont, and Massachusetts.

* Country mountainous—more than one hundred miles in a right line from the ocean.—Ed.

There is a large fissure which is open towards the west, I think, or south-west ; above it a projecting cliff excludes the direct rays of the sun, from falling into the cavity, which recedes, under the incumbent mass, at an angle of about forty or fifty degrees.

During the winter, the cavern is filled with snow, by the driving storms, that sweep over the mountain range, with great violence.

We found plenty of ice with which we cooled our liquors, and, I was informed by several of the oldest inhabitants of the town, that there was ice there during the whole year.

You can get a particular and correct account of this curious depot, from Professor Dewey of Williams College, who I presume has been to it, or will go, to gratify that very commendable and zealous passion, which he has evinced, to advance the natural history of our country.

With the highest respect, I have the honour to be
Your most obedient servant,
H. A. Y. DEARBORN.

Additional particulars communicated by Mr. THOMAS IVES, *of Yale College.*

PROF. SILLIMAN,

The account which Mr. Dearborn has given of the natural ice-house, and which you shewed me in MS. accords entirely with my recollections. I visited it in the month of July 1818—the day was one of the warmest in the season. I would suggest in addition to what he has communicated, that the mouth of the "fissure," or cave has the form of an irregular ellipse, (or of a wedge obtruncated at the vertex.) Width at the top, where greatest, about ten feet—length from fifteen to twenty—depth not exceeding twenty. All the dimensions diminish as you descend. The descent is easy by two or three landing places or steps ; also assisted by fragments of stone and old logs.—There is likewise a thick growth of evergreens and other wood about the entrance, which contribute to exclude the sun's rays.—It is designated in the neighbourhood by the name of the *snow-hole,* the contents being rather snow than ice—*a mixture of both.* The distance from the College is between four and five miles.

Art. XVII.—**Abstract of a Meterological Journal kept at Deerfield, (Mass.) beginning March* 1817, *and ending November* 1818. *North latitude* 42° 34′ 32″. *West longitude* 72° 39′ *from London; by* Edward Hitchcock, A. M. *to which is added a Meteorological Table, kept at Albany, by Dr.* T. R. Beck.

This abstract embraces nothing but the range of the thermometer, direction of the winds, and state of the weather. The thermometer used was an ordinary one, with Fahrenheit's scale; and on examining it by a test, it was found to vary one degree from the truth. This allowance was made in forming this abstract. The situation of the thermometer was on the second story of a brick building, twenty feet from the ground, where it was not exposed to the direct or reflected rays of the sun. Several circumstances rendered it necessary for me to fix on 7h. A. M. 1½ P. M. and 10 P. M. for the hours of observation in the winter, and on 6h. A. M. 2 P. M. and 10 P.M. in the summer. I am sensible the observations were not, on these several accounts, of the most delicate kind; but believing them to give a tolerably correct view of the temperature of this climate, and knowing of no journal of this kind kept in this vicinity, I presume to offer this to your consideration. My thermometer has accidentally been broken, or I should continue the journal so as to make out complete years before sending it to you.

			Thermometer.				Wind.				Weather.			
			7h. A.M	1½h. P M	10h. P. M.	Mean of Months.	Northerly.	Southerly.	Westerly.	Fair.	Mostly fair.	Stormy.	Showery.	Cloudy.
1817.	March	Highest	36	52	36									
		Mean	25	40	28	31	1	8	16	12	4	3	1	7
		Lowest	8	19	11									
	April	H.	68	76	65									
		M.	40	52	40	44	6	8	16	16	5	3	2	4
		L.	30	35	31									

Numbers without any sign are above Zero;—with the negative, below.

* This communication was received in the winter of 1818—19; and the Editor regrets the long delay in publishing it, but the facts are still valuable.

			Thermometer.				Wind.			Weather				
			6h. A.M	2 h. P.M.	10 h. P.M.	Mean of Months.	Northerly.	Southerly.	Westerly.	Fair.	Mostly fair.	Stormy.	Showery.	Cloudy.
1817.	May	Highest.	60	78	61									
		Mean.	45	66	50	53.6	10	13	9	17	6	4	3	1
		Lowest.	30	46	33									
	June	H.	67	87	66									
		M.	55	69	56	60	9	12	16	11	3	7	7	2
		L.	41	51	47									
	July	H.	73	94	71									
		M.	61	81	63	68.3	6	16	12	15	5	1	5	2
		L.	52	71	55									
	Aug.	H.	70	86	70									
		M.	60	76	62	66	11	16	16	12	8	5	5	1
		L.	41	61	46									
	Sept.	H.	67	87	71									
		M.	53	70	55	59.3	8	10	9	9	3		8	6
		L.	37	50	31									
	Oct.	H.	59	69	57									
		M.	38	46	40	41.3	7	11	8	15	4	4	3	2
		L.	19	35	24									
			7 h. A.M	1½ h. P.M.	10 h. P. M.									
	Nov.	H.	61	67	62									
		M.	34	45	37	38.6	6	8	16	16	2	6	1	5
		L.	19	25	17									
	Dec.	H.	40	47	43									
		M.	24	33	26	27.6	6	9	14	8	5	7	3	6
		L.	3	11	– 1									
1818.	Jan.	H.	38	40	35									
		M.	16	27	19	20.6	5	10	15	15	2	5	3	5
		L.	–12	– 1	–12									
	Feb.	H.	33	48	32									
		M.	6	24	11	13.6	3	7	20	17	[illegible]	3	2	6
		L.	–25	5	–11									
	March	H.	46	57	46									
		M.	25	40	29	31.3	10	6	15	18	1	3	6	3
		L.	– 1	17	3									
	April	H.	46	65	51									
		M.	36	46	36	39.3	11	6	13	7	4	11	6	2
		L.	31	32	28									

		Thermometer.				Wind.			Weather.				
		6 h. A.M	2 h. P.M.	10 h. P. M.	Mean of Months.	Northerly.	Southerly.	Westerly.	Fair.	Mostly fair.	Stormy.	Showery.	Cloudy.
1818. May.	Highest	65	85	65									
	Mean.	48	63	50	53.6	15	8	11	6	5	6	9	5
	Lowest.	40	43	38									
June	H.	79	95	79									
	M.	62	80	62	68	9	14	12	15	1	4	9	1
	L.	52	58	49									
July	H.	76	96	79									
	M.	65	82	66	71	7	13	16	16	4	2	6	3
	L.	55	70	55									
Aug.	H.	69	90	72									
	M.	56	74	62	64	2	9	24	21	2	2	6	
	L.	45	67	51									
Sept.	H.	64	84	65									
	M.	49	66	53	56	12	3	19	15	3	5	5	2
	L.	32	53	39									
Oct.	H.	53	69	57									
	M.	38	56	40	44.6	4	2	22	20	5	1	2	
	L.	27	41	30									
		7 h. A.M	1½ h. P.M.	10 h. P. M.									
Nov.	H.	47	61	51									
	M.	35	47	37	39.6	4	11	16	14	4	2	2	8
	L.	23	35	23									

Mean Temperature of the Season, &c.

		Thermometer.				Wind.			Weather.				
		Mean.	Highest.	Lowest.	Range.	North.	South.	West.	Fair.	Mostly fair.	Stormy.	Showery.	Cloudy.
1817.	Spring.	42.9	78	8	70	17	29	41	45	15	10	6	12
	Summer.	64.8	94	41	53	26	44	44	38	16	13	17	5
	Autumn.	46.4	87	17	70	21	29	33	40	9	10	12	13
1818.	Winter.	20.6	48	-25	73	14	26	49	40	7	15	8	17
	Spring.	41.4	85	- 1	86	36	20	39	31	10	20	21	10
	Summer.	67.6	96	45	51	18	36	52	52	7	8	21	4
	Autumn.	46.7	84	23	61	20	16	57	49	12	8	9	10

The greatest range in the table, is between February and July, 1818; viz. 121°. The winter of 1818 was more severe than is usual in this place.

The winds in the above tables are divided into Northwardly, Southwardly and Westerly. The first includes N. E. and N. winds, and those between N. and N. W. The second includes S. E. and S. winds and those between S. and S. W. The third takes in S. W., W. and N. W. winds. No column is given for easterly winds; for, during the time the above journal was kept, only four from that quarter were noticed; viz. June 29th 1817; and May 18th, June 13th, and August 28th, 1818. These winds are generally not more frequent in this place; and S. E. winds are also rare—usually bringing a storm. Our other winds that produce long storms, are South, North-East, and North: those from the south generally shortest. It has been remarked, that for several years past, our N. E, winds do not so commonly bring storms as formerly; whereas those from the N. and N. by N. W. are more frequently attended with storms.

It will be perceived that the above abstract shows the number of winds on the points of compass, without regard to the days. This list of the winds is not in every case complete; since for a few days in some of the months, neither the wind nor weather were observed. In the columns of the weather those days are put down as *mostly fair*, in which were light broken clouds but no rain or snow. Those are called *showery*, in which there was any storm whose duration did not exceed half the day.

Other occurrences.

1817. March 6th, lightning in the evening: 10th, violent thunder and lightning with hail. During this storm the same electrical phenomenon occurred on the hills a few miles west of this place, that was noticed throughout the lower part of Vermont in a thunder storm of January preceding, viz a light radiating from the extremities of objects, attended with a hissing or crackling sound. On the 10th however, I do not know that this was observed in more than one place. A light was perceived on the elevated extremity of a pole used for drawing water from a well. In lowering the pole, this luminous appearance gradually diminished and disappeared. On raising it again, the light reappeared. May 13th, 14, 16th, 20th, 21st, and 31st, frosts: do. June 12th and 17th: do. August 25th and 26th, October 5th, 11th. 35 m. A. M. shock of an earthquake: continuance four or five seconds. Three swells or undulations, were distinctly felt. Objects suspended, vibrated several degrees.

1818. From March 21st to May 17th, (58 days) only thirteen days are recorded as clear: on almost every other day there was rain or snow. May 8th and June 6th, *aurora borealis.* July 29th a parhelion was visible on each hand of the sun. July 11th, 13th, 14th, 15th and 16th, smoky. Sept. 3d and 26th, *aurora borealis.* This appearance is becoming more frequent than formerly. October 25th, 26th, 27th, 29h, 30th, 31st, Nov. 1st, 2d, 4th, 11th, 12th, and 23d, smoky. A succession of smoky days generally occur at this season of the year, and is here called *the Indian summer.*

Register of the Weather for the year 1820. *Kept at the Albany Academy, by* T. Romeyn Beck, M. D.

	Thermometer.								*Barometer.*					*Weather.*					*Winds.*								
	Mean temperature at 7 A. M.	Mean temperature at 2 P. M.	Mean temperature at 9 P. M.	Mean of all the observations.	Highest at 2 P. M.	Lowest at 7 A. M.	Greatest monthly range.	Greatest daily range.	Mean of all the observations.	Highest.	Lowest.	Greatest monthly range.	Greatest daily range.	Clear days.	Cloudy days.	Variable.	No. of days rain fell.	No. of days snow fell.	North (No. of days.)	Northwest.	West.	South.	Southwest.	Southeast.	East.	Northeast.	Prevailing wind.
Jan.	17.19	27.51	20.48	21.73	37	–3	40	24°	29.6373	30.02	28.90	1.12	,60	9	17	5	—	6	5	3	6	7	3	6	1	–	S.
Feb.	24.69	36.72	28.48	29.96	56	–5	61	31°	29.6488	30.30	29.20	1.10	,42	12	15	2	6	5	4	6	7	6	2	4	–	–	W.
March	27.71	39.96	30.51	32.73	69	9	60	29°	29.7486	30.32	28.80	1.52	,46	8	15	8	5	7	7	4	10	8	–	–	1	1	W.
April	42.36	62.50	47.70	50.85	85	21	64	36	29.7514	30.22	29.34	,88	,25	11	12	7	9	2	4	2	5	6	3	7	2	1	S. E.
May	52.78	69.87	56.32	59.65	85	44	41	36	29.6708	29.97	29.23	,74	,18	7	22	2	14	–	3	6	7	5	1	6	2	1	W.
June	63.86	80.80	69.96	71.54	98	48	50	32	29.7296	29.90	29.50	,40	,22	15	8	7	4	–	2	5	8	11	1	3	–	–	S.
July	71.32	85.42	76.00	77.58	100	63	37	25	29.8040	30.10	29.47	,63	,18	11	10	10	13	–	–	7	3	5	–	13	–	3	S. E.
Aug.	65.42	79.06	70.45	71.64	89	54	35	31	29.7766	30.05	29.60	,45	,15	11	9	11	12	–	3	8	5	8	–	7	–	–	S.
Sept.	58.40	72.83	64.03	65.08	90	38	52	24	21.9136	30.26	29.30	,96	,31	15	8	7	5	–	–	4	6	8	2	9	1	–	S. E.
Oct.	43.32	54.43	47.54	48.43	71	27	44	23	29.8086	30.20	29.15	1.05	,30	8	17	6	11	3	4	5	10	5	1	4	2	–	W.
Nov.	31.23	40.03	34.30	35.18	56	11	45	18	29.6961	30.11	28.97	1.14	,39	9	17	4	5	2	1	4	8	14	1	2	–	–	S.
D ec.	20.61	26.67	23.03	23.44	39	2	37	11	29.6892	30.22	29.20	1.02	,30	6	18	7	3	5	8	9	6	6	–	2	–	–	N.W.
MeanT	43.24	56.31	47.40	48.98	100	–5	105	36	29.73955	3.032	28.80	1.52	,60	122	168	76	87	30	41	63	81	89	14	63	9	6	S.

Coldest day, February 2—5° at 7 A. M. 7° at 2 P. M. and 8° at 9 P. M.——Warmest day, July 9th, 100° at 2 P. M.

ART. XVIII.—*On the cause of Goitre.—Felix qui potuit rerum cognoscere causas.*

PITTSBURGH, DEC. 21, 1821.

TO PROFESSOR SILLIMAN,

SIR—You know that the inhabitants of this place have been from its earliest settlement, subject to the *Goitre* :—The greater part of philosophers have very properly, sought to trace this complaint to the influence of local and natural causes; but prevailing as it does in countries so widely different in their geological and mineral features, there is always some circumstance irreconcilable with all their theories on the subject.

That indefatigable naturalist, the late Dr. Barton, attributed Goitre to a miasm of the same species as that which produces intermittent fevers, and assumes the fact that the scite of Pittsburgh is low and confined, somewhat in the form of a basin, the atmosphere of which in summer becomes heated and stagnant. This description is true to that extent; the scite of the town is low in comparison with the adjacent hills but high enough from the water, which is pure and salubrious, for every object of health, and it is freely ventilated by the constant breeze through the river valleys. There is no doubt however, that there are many situations in the south west regions of this country where this miasm exists under every possible condition, where Goitre is unknown.

Dr. Barton refers also to this place in confirmation of the doctrine of Mr. De Saussure, that "the cause of the complaint is to be sought for in some modification and condition which is exclusively confined to valleys but little elevated above the level of the sea; this modification is a heated and stagnated air, owing to the confined situation of the valley." It so happens unluckily for this opinion of Mr. De Saussure, that Goitre prevails on the prairies of Michigan, on the German flats in New York, and upon the spacious and open plains of Mexico, in the latter case at an elevation of six or seven thousand feet above the ocean; and is unknown in the little coves among the mountains of this state, which in some instances resemble amphi-theatres, and are exceedingly hot in summer.

According to Coxe, *Tuf* abounds in all those districts where Goitre is common, and that gentleman agrees with Mr. De Luc in considering Tuf as the cause: In those parts of the state of New York where the disease prevails, the springs are said to deposit calcareous matter: so does the well water of Pittsburgh, but much less than the water in the Limestone valley of Cumberland in this state where no cases of Goitre occur.

The water of the *Rivers* Alleghany and Monongehela, on the contrary contains little or no calcareous matter: This fact is worth mentioning in connexion with the opinion of De Luc, and the statement of Dr. Stevenson of this place, that "formerly the inhabitants of Pittsburgh drank the water of the neighbouring rivers, of late well water only is used, still the increase of inhabitants considered, the disease is not more frequent than formerly."

With respect to the idea the doctor probably meant to suggest, that the river water might have been concerned in the matter; it is opposed by the fact, that our boatmen, who amount to some thousands, and who drink no other water than that of these rivers, are as free from the disease as any other class of people.

Fodere remarked that the Goitrous tumours commonly increased in summer and decreased in winter: in this place they decrease in summer, and increase in winter.

Some have thought it owing to the use of water impregnated with Fossil coal: Coal being a characteristic of this place, a conjecture of that sort would naturally present itself. The probability is that coal exists in this country wherever Goitre prevails. Indeed Bituminous coal may be found in all the great secondary region from the Alleghanies to the Rocky mountains: but we do know that elsewhere the same coal does not produce it, and why should it?—The springs that come out from our strata of coal, are strongly impregnated with the oxid of iron, mixed with aluminous matter, slightly vitriolated by the pyrites: This water has a good deal of astringency: its qualities are tonic: and tonics or astringents are the remedies in Goitre if there is any virtue in *Burnt sponge.**

* Perhaps the author may not have met with the fact now stated on good authority, that sponges contain the new and powerful body Iodine which is said to be almost a specific in Goitre, and to which the efficacy of sponge in this complaint, is now, in Europe distinctly attributed.—*Editor.*

Our coal yields 64. 5 carbon, 33, bitumen, 2. 5 earth and oxid of iron. These proportions vary a little—the best coal for domestic use is considered to be that which has the most bitumen with the least earth.

Whether the immense increase in the consumption of coal, and the vast volume of smoke that envelopes the town, together with the floating particles of soot that are constantly inhaled, may not have expelled the disease on the principle of burnt sponge; is a question I leave for those who are professionally qualified to answer.

My object is not to offer any speculations on this matter, but merely to correct the case stated for argument, from the few facts within my own observation: I prefer your Journal for that purpose; as the subject comes fairly within the department of general science; if the phenomenon of Goitre is attributable to causes existing in the geological features of particular districts.—Very respectfully Sir,

Your humble serv't.

W. H. DENNY.

Art. XIX.—*On Luminous appearances in the Atmosphere; by* J. A. Allen, A. M. *Lecturer on Chemistry in Middlebury College.*

(Communicated for the American Journal of Science.)

On the evening of the 18th of January 1817, during a rapid fall of moist snow, attended with repeated claps of thunder; lights or luminous appearances were seen in the atmosphere in many places on the Green Mountains.—The lights were observed by different persons in the towns of Andover, Jamaica, Wardsborough, Dover, Somerset, Stratton and New Fane.

In all these places the lights were described as having the same appearance. They were observed on the tops of bushes, fences, houses &c. Some persons represented them as appearing like the blaze of candles, but all agreed that they were luminous spaces which appeared to rest on pointed or elevated substances—In some instances, persons who were travelling, suddenly observed a light surrounding their heads; in others they were completely enveloped in a light but little less than the ordinary light of the sun—Several persons found when they elevated their hands, that the light appeared to stream from their fingers. This fact was particularly noticed by J. Deming, Esq. of Andover.

Such phenomena as these it is believed, have seldom been observed in this vicinity, probably this is the first instance since the settlement of the country.* But in other parts of the world they have long been witnessed—though not very frequently.

When Gyllippus went to Syracuse, he perceived a flame upon his spear, and during the night before the victory which Posthumius gained over the Sabines, the Roman javelins emitted light like torches—Cæsar informs us, that in the month of February, about the second watch of the night, there suddenly arose a great cloud, followed by a dreadful storm of hail, and on the same night the points of the darts of the 5th legion appeared to be on fire.

In 1713, Marquis de Maffei observed in time of a storm on a mountain a brilliant flame issuing from the ground, attended with a loud noise.

In October 1805, on an evening after a considerable fall of rain, several gentlemen at the house of the Rev. Mr. Gross, Hartford Vt. noticed a bright light, resembling the Aurora Borealis, apparently perpendicular to White River, elevated a few degrees above the horizon, and from which, luminous streams shot toward the zenith.

From these facts the inquiry naturally arises, how can an explanation be given of their production? Were analogical reasoning to be admitted, the most plausible inference would be that they were caused by electricity. It is a fact well known, that when electricity becomes accumulated, as on the prime conductor of an electric machine, its tendency to restore an equilibrium, will cause it to escape in diverging rays from every conducting point. If the experiment be made in the dark, beautiful electric light will be produced. The same unquestionably takes place whenever electricity becomes accumulated either on the earth or in the air.—When electricity becomes accumulated in the upper regions during a shower or a storm, it is launched to the earth or other places which are negatively electrified. On the con-

* We presume that Dr. Allen has not seen an interesting collection of similar facts that occurred on the same occasion, and an account of which was presented to the American Academy at Boston, by Professor Farrar of Cambridge University.—See the Transactions of the Academy.—*Ed.*

trary, if the earth becomes positively electrified, and there happens a storm, it will escape or be conducted in to the upper regions. In this case if it escapes in a large quantity at one point, the brilliant flame and noise mentioned by the Marquis de M. would be produced; but if it escapes in not very large quantity and at many points, it would produce those curious appearances recorded in history, and the lights seen in Vermont.

The opinion that the earth at times becomes positively electrified appears to have, in amount, been entertained by the ancients. The Tuscans divided thunder into two kinds, celestial and terrestrial; or that which falls from the clouds, and that which rises from the earth. The identity of lightning or thunder and electricity, since the investigations of Franklin and Buffon is probably unquestionable.

BRATTLEBOROUGH, OCT. 5th, 1821.

P. S. That species of Epidote called Zoisite I have found in beautiful large crystals at Wardsborough Vt.: Some of which I shall put into the box which I am preparing for the American Geological Society.

N. B. This box has been received.—*Editor.*

MATHEMATICS.

ART. XX.—*On the Curves of Trisection; by the Rev.* WILLIAM ALLEN, D. D. *President of Bowdoin College, Maine.—Communicated for this Journal.*

Two new curves may be called *Curves of Trisection*, since by means of either of them any angle may be trisected, and thus the problem be solved, which has engaged the attention of mathematicians for above two thousand years. These curves, if I mistake not, may justly claim to be considered as *geometrical* curves, for they are distinctly defined, and also accurately described by points, and by a continued motion, instruments for which description I have invented. In this respect they are very different from the *Quadratrix* of Dinostratus, and that of Tschirnhausen, the *Spiral* of

Archimedes, and the *Logistic Curve* and *Spiral*, which are described only by points ; and stand on the same footing with the *Conchoid* of Nicomedes, the *Ellipse* and the *Hyperbola*, while they are superior to the *Cycloid*, described by the motion of a wheel, and to the *Parabola*, which can be described only, I believe, by points, and in a continued line by means of a thread.

Newton has said,—" We ought either to exclude all lines, beisde the circle and right line, out of geometry, or admit them according to the simplicity of their descriptions, in which case the Conchoid yields to none except the circle." " That is *arithmetically* more simple, which is determined by the more simple equations, but that is *geometrically* more simple, which is determined by the more simple drawing of lines ; and in geometry that ought to be reckoned best, which is geometrically most simple ; wherefore I ought not to be blamed, if with that prince of mathematicians, Archimedes, I make use of the Conchoid for the construction of problems." With these remarks in view, the claim of the *Curves*, which I have discovered, to be regarded as *geometrical* curves will probably not be controverted ; and possibly the description of one of them by the instrument invented will be thought little inferior in simplicity to that of the Conchoid of Nicomedes by means of the instrument which he invented, and for the invention of which he felt an extreme elevation of mind.

It seems, that the Greek geometricians, although they could not trisect an angle by a right line and a circle, yet were able to solve the problem by means of the Conic sections and the Conchoid. " The moderns," as is stated in the History of the Royal Academy of Sciences in France, " have demonstrated, that this problem depends on the resolution of an equation of the third degree ; that this equation has three real roots ;—and that the problem cannot be constructed, except by the intersection of a right line with a curve of the third degree, or by the intersection of two curves of the second degree ; the analysis, which they have given of this problem is complete, and has for a long time left nothing to desire." With these impressions the Academy resolved in 1775, that they would not examine any new solution of the problem of the trisection of an angle. Geometricians must decide, whether this determination is to be commended, and whether the Curves of Trisection do not offer a more simple and excellent method of trisecting an angle, than any method previously known, inasmuch as by means of a single curve every angle is trisected, and thus it is no longer necessary to describe a new curve for every different angle.

By means of the Quadratrix an angle may be trisected; but the Quadratrix cannot be described by a continued motion; and as, in order to describe it, the quadrant must be divided into equal parts; it can be of no use in trisecting an angle, unless the angle in fact be previously trisected in forming the curve. The thing must be done before the Quadratrix can furnish any aid in doing it.

By the Trochoid or Cycloid, a curve which was not known by the ancients, angles may also be trisected; but this curve, described by the motion of a wheel on a plane, is not easy and simple of description, and is of little practical use for the trisection of an angle.

The Curves of Trisection may be distinguished by calling the first the *Curve of Secants*, and the second the *Curve of Sines*, since the first gives the *Secant* of the arc measuring the third of the angle to be trisected, and the second gives the point in the radius, from which point the *Sine* of the third of the proposed angle is to be drawn by a perpendicular to the radius.

1. *The Trisecting Curve of Secants.*

In figure 1, the line F*mo*D is the Trisecting Curve of Secants, passing from F at the extremity of the radius CF to D at the extremity of the radius CD, which is double the radius CF or CE; and so passing, as that the intersection, at any point of this curve, of a straight line from the centre to the circumference (as CA) and of a straight line from the extremity of the radius D to the circumference, (as DG) shall give the distance from the curve to the centre, (as *o*C) equal to the distance from the curve to the circumference, (as *o*G.)

1. This curve may be conceived to be generated, somewhat like the quadratrix and spiral, in the following manner. If on the centre D the radius DB be supposed to revolve from B to G and *g*, and at the same time a point in this ra-

dius be supposed to move from F at an equal distance from the centre C and B in the circumference of the outer semi-circle, and as it moves towards D in the moving radius, always to keep at an equal distance from the centre C and from the arc BHAD, this last distance being measured on the moving radius;—the point thus carried around from F to D, continually receding from the inner semi-circle and approaching D until it touches the outer semi-circle at D, will describe the trisecting curve of secants.

Or the generation of this curve may be expressed as follows: Let the radius DB revolve on D, and the radius CB on C, in such a manner as that the distance from F to B on DB shall be always equal to the distance from F to C on CB. The point of intersection of these radii describes the curve. When DB is in the position DG, and CB in the position CA, FB will be enlarged to *o*G and FC to *o*C. When DB is in the position D*g*, and CB in the position CD, FB becomes D*g*, and FC becomes DC.

2. This curve may be described *by points*, thus. Take two thirds of the exterior semi-circle, which is found by extending the radius twice along the arc from B. In figure 1, two thirds of the exterior semi-circle will be the arc BG*g*. Divide this arc into any number of equal parts, and to each point of division draw a straight line from D. Divide the *whole* interior semi-circle into the same number of equal parts, and from the centre through each point of division draw a straight line to the exterior semi-circle: or, which is the same thing, divide the whole exterior semi-circle into the same number of equal parts, and draw the lines from the centre. The intersection of these lines from D and from the centre, will give points of the Curve of Secants, through which points with a steady hand the curve may be drawn.

3. This curve may be described *mechanically*, by a continued motion, as follows. In figure 2, let CG be a straight rule, moveable about the centre C, where it is fastened by a pin. Let this rule have a fixed part, or perpendicular rule, HK, attached to it at H, and let there be a slit through this perpendicular rule, which slit meets CG at H at an equal distance from C and G.

Let CA be another rule, moveable about C, fastened by the pin, which fastens CG, and having a slit through a little more than half of it from A towards C.

Let DG be a third rule, moveable about D, where it is fastened by a pin, having a slit through it of the length of DB; and the distance CD being equal to CG. Let the pin G in CG pass through this slit of DG, so as to move in it.

The instrument being thus constructed, let a single pencil pass through each of the slits of the three rules at the common point of intersection, *o*. By pushing the pencil either way the rules will move one upon another, and a portion of the curve of trisection will be described. If CG be brought to the position CB; then the pencil will begin the curve at F, and will have described it and reached D, when CG shall have reached the position C*g*, cutting off two thirds of the arc BAD.

When CG is in the position CB, *o*G will coincide with FB, and *o*C with FC, that is, will each be equal to the radius of the interior circle; but as the curve is described, they continually increase, until at the completion of the curve they each are double to the radius of the exterior circle, or equal to the radius of the exterior circle, that is, *o*C coincides with DC, and *o*G with D*g*.

From the construction of the instrument, HK being perpendicular to CG, and H equidistant from C and G, it is evident, that C*o*, and *o*G are always equal. Supposing the curve to be described;—then whatever line is drawn from the centre to the circumference between B and D, as CA, in fig. 1, a straight line from D passing through the point of intersection of the line CA and the curve, and proceeding to the circumference, as at G, will give that part of the line DG, which is *without* the curve of trisection, as *o*G, equal to that part of the line from the centre, as CA, which is *within* the curve, as *o*C. That is, *o*G and C*o* are always equal.

Suppose then, the curve has been described, as in figure 1, and the semi-circles drawn. Let ACB be the angle to be trisected. Through the point *o*, where CA intersects the curve, draw, from D, a straight line DG to the exterior circumference. Then *o*G is equal to *o*C. From the centre draw CG. And because *o*G is equal to *o*C, the angle *o*GC is equal to the angle *o*CG; and A*o*G being an exterior angle to the triangle *o*CG, is equal to the two angles *o*CG and *o*GC, that is, is equal to ACG and DGC, and these are equal to each other. Because GCB is an angle at the centre, it is double GDB, an angle at the circumference. But GDB is equal to DGC, they being angles formed by the radii CD and CG, and the chord DG; and therefore, as ACG has been proved to be equal to DGC, ACG is equal to GDB. Consequently ACG is equal to one half of GCB. Bisect, then, the arc GB in H, and draw CH, and the angles ACG, GCH, and HCB are equal. The angle ACB is therefore trisected.

In like manner may any other angle, of which CB is one side, and the other side extending from C to any point of the circumference between B and D, be trisected by drawing from D a straight line through the intersection of the curve and of the side of the angle. By drawing this straight line through the point of intersection, it gives the point on the circumference, which is distant from A one third of the given arc. So that with this curve, all that is wanting in order to trisection, is to draw a straight line through a given point, and to set off a given distance.

From the description of this curve it is evident, that an angle may be trisected by the rule and compasses, in the following manner. ACB being the proposed angle, and the semi-circles being drawn with the radius of one semi-circle double that of the other; apply a straight line to D and extend it across AC till by the compasses the distance from a point in AC to the circumference, as measured on the rule, be equal to the distance from the same point to the centre C. When the distance *o*G is thus found equal to *o*C, G is the point marking one third of the arc AGB, and a straight line from the centre C to G will therefore cut off one third of the proposed angle.

If the points *o* and K be connected by a straight line, *o*K, this line is a tangent to the arc IK, of which C*o* is the *Secant*; that is, C*o* is a secant of the arc measuring one third of the given angle, and *o*K is a tangent of the same arc. All this is very obvious from an inspection of the instrument for describing the curve, as in figure 2. Or CK being, by the construction, in figure 1, equal to KG, and C*o* equal to *o*G, and CK being the radius of the interior semi-circle, it is evident, that *o*K is the tangent and C*o* the secant of the arc KI.

The curve of secants being drawn, the angle ICF, and any other angle, may be trisected without the aid of the exterior semi-circle. All that is necessary is to find the point

K, where the tangent *o*K touches the circle. And this is easily found by taking the secant C*o* in the compasses, on C as a centre, and drawing the arc *o*S, and then erecting on I the perpendicular I*n*. The intersection of this perpendicular and the arc *o*S gives the point *n*, to which is to be drawn from the centre the line C*n*. This line cuts the arc IF in the point K, where the tangent touches the circle, giving the arc IK one third of the arc IF, and measuring one third of the angle to be trisected. Bisect then KF, or set off IK from K towards F and you obtain the point L, to which draw CL, and the angle ICF is trisected without the aid of the exterior semi-circle.

It is obvious that a similar curve may be formed on the other side of the diameter DB, and the two curves together would complete the curve of secants, forming a kind of oval, with a point at D, as in figure 7.

II. *The Trisecting Curve of Sines.*

Two semi-circles being drawn, with radii as one to two, B*mo* in figure 3, is a part of the *Trisecting Curve of Sines*, the property of which is, that HC is equal to H*m*.

1. This curve may be conceived to be generated by the motion of a point, as follows. Let EB be a radius moving on E as a centre to I, and G, and further, and let a point move with this radius, setting out at B, distant CF or the radius from the interior semi-circle, which point keeps always at the same distance, as measured on the moving radius, from the circumference of the interior circle until it arrives at O.

2. This curve may be described *by points*, as follows. Take three quarters of the exterior semi-circle from B, and divide this arc into any number of equal parts, and to each point of division draw a straight line from the centre. Then divide the *whole* interior semi-circle into the same number of equal parts, and from E draw a straight line through each point of the division, and raise a perpendicular to DC at E. The intersection of these lines, and of the lines from the centre will give points of the curve of sines, through which with a steady hand the curve may be drawn.

This curve may also be described, as follows. Extend a straight rule from E towards the arc BIAG, and with a pair of compasses, opened to the distance of CE, or radius of the interior circle, set off this same distance from the point of intersection of the rule, and interior circle towards the exterior circle. If, for instance, the rule intersect the circle in H, then set off the radius EC or HC, from H to *m* Then will *m* be one point of the curve. In this way may a sufficient number of points be found to enable one with a steady hand to draw the curve.

3. This curve may also be described *mechanically*, by a continued motion, as follows. Let a straight rule CH in figure 4, be fastened by a pin at C so as to be moveable about C. Let H*m* be another rule of the same length, with a hole at *m* for a pencil to pass through. Let this rule be pinned to the rule CH at H so as to move about H, as CH moves about the centre C. Let EG be another straight rule, a little longer than three times CH, with a slit through the length of it, and moveable about E, where it is fastened with a pin, the distance EC being equal to CH. In the slit of this rule let H*m* be placed, so as to slide in it with ease and yet with accuracy.

The instrument being thus constructed, put a pencil through the perforation at *m*, and by pushing the rule with it to B on one side and to *o* on the other, the curve will be described. But when the point *m* is at *o*, the rule CH will be in the position CE, and the rules EG and H*m* in the position E*o*.

As the largest angle, which can be trisected by means of this curve, is an angle of 135°, if the given angle is larger than 135°, it must be bisected, and the parts trisected separately.

Let ACB, in figure 3, be the given angle to be trisected. Describe the curve of sines, which intersects the side CA in *m*. From the point *m* raise *m*I perpendicular to AC. The perpendicular *m*I is the *sine* of one third of the angle ACB. From the centre C draw CI. Of course the arc AI is one third of the arc AIB, and the angle ACI is one third of the angle ACB. Wherefore, by bisecting IB, or setting off the arc AI towards B, and joining the point thus found with the centre C, the angle ACB will be trisected.

The *demonstration* of which is as follows.

Through H, the point where Em intersects the interior semi-circle, draw CG. Because EHC is an exterior angle to the triangle HmC, it is equal to the two angles HmC and HCm. And these two angles are equal to each other because by the construction Hm is equal to HC. Therefore the angle HCA or GCA, is one half of the angle EHC.

Because HCF is an angle at the centre, it is double the angle HEC at the circumference. But the angle HEC is equal to the angle EHC, because by the construction HC is equal to EC. Therefore the angle EHC is one half of the angle HCF. And as the angle GCA has been proved to be one half of the angle EHC, it consequently is one quarter of the angle HCF, of which the angle EHC is one half; or the angle GCA is one quarter of the angle GCB, which is the same with the angle HCF. The angle GCA is therefore one third of the angle ACB, for it being one quarter of the whole angle GCB, if it be abstracted from this whole, there will be left three parts, each equal to this part abstracted. Make AI then equal to AG, and draw CI, and the angle ACI is one third of the given angle ACB.

This demonstration applies to every angle less than angle of 135°. The angle of 135° is known by the construction; and that the supplement is 45°, or a third of 135° and a quarter of 180° needs no proof.

The curve being described and ACB being the angle to be trisected; take the radius of the interior circle in the compasses, and from m, the point of intersection of the side CA and the curve, intersect the arc EF. The point of intersection of radius CH and radius mH, each equal to the other, being H, through this point draw CG. The demonstration just given will show the angle GCA to be one third of the angle ACB.

From the point H let fall Hn perpendicular to Cm. CH and Hm being equal, this perpendicular will bisect Cm in n, making Cn equal to nm. As CH is equal to HG and in the same straight line, and as Cn is equal to nm, and Hn is perpendicular to CA, it follows that Gm is parallel with Hn and therefore perpendicular also to CA. Or make H the centre of a circle with HC radius. It is evident that GmC will be an angle in a semi-circle, which is a right angle. Gm is therefore perpendicular to mC or CA.

But Gm is the sine of the angle GCA; therefore mI, which is perpendicular also to AC from the same point m, is the sine of the angle ACI, equal to the angle GCA. That is, mI is the *Sine* of one third of the given angle ACB.

By letting fall therefore a perpendicular from the point of intersection of the curve of sines and of the side of the given angle, the intersection of this perpendicular and of the arc measuring the given angle cuts off one third of that arc, or gives the point of that arc, to which point a line drawn from the centre will cut off one third of the given angle.

The consideration of the nature of this curve suggests a method of trisecting an angle by the rule and compasses alone. Let the angle to be trisected be ACB. Produce BC and draw the two semi-circles. Extend a rule from E to the side AC, and taking the radius of the interior circle in the compasses move the rule, cutting the circumference HF and the side AC, until the distance between them by the edge of the rule be found, by means of the compasses, to be equal to the radius; that is, until Hm be equal to HC. Having thus found the point H, through it draw CG, and the angle GCA is found, and may be demonstrated as before to equal to one third of the given angle ACB.

By a slight change in this instrument the third part of any angle, not larger than 135°, may be obtained by it mechanically. In figure 5 the instrument has the addition of two rules, namely, the rule CL, (parallel with EG) revolving on C, where it is fastened by a pin to the rule DB, and the rule KN, moveable about a pin at K, where it is connected with the rule CL, and moveable also about a pin at m, where it is connected with the rule Hm; and the distances CH, Hm, mK, and CK being each equal to the other, and one face of the rule CL towards L being in the straight line joining C and K continued.

Let ACB be the given angle to be trisected. Apply the face of the rule DB to the side of the angle CB, and the centre C at the angular point. Then move the sliding rule Hm, and of course the other moveable rules, till the point m is on the side AC, which can be easily determined, (if the rules EG and KN are of the same width) by the side AC passing through the angle formed by the rules EG and KN. Then the rule CL gives the line for one third of ACB, or cuts off one third of the angle to be trisected. For as it has been proved under figure 3, the angle HC*m*, or HCA, is one quarter of HCB. But ACL is obviously equal to HCA; it is therefore one third of ACB. The rule CKL therefore cuts off one third of the given angle.

If this curve, which terminates at *o*, was continued to E, any angle could be trisected by it though larger than 135° without the necessity of bisection.

By the following methods the curve may be continued to E.

In figure 6 let B*o* be the part of the curve of sines already described. By the construction E*o* is equal to the radius EC. The semi-circles on the opposite side of the diameter being formed, let E*o* be supposed to move upon the fixed point E at the extremity of the radius CE, the extremity E of E*o* moving in the arc EGI, until IE be equal to E*o*. The point *o* will describe the curve *o*AE, which continues the curve B*o* from *o* to E.

Or with the radius in the compasses, if it be set off from various points of the arc EGI towards *o*, so that a straight line from each point shall pass through E, the points between *o* and E, thus found, will be points of the curve; and through these points with a steady hand the curve *o*AE may be drawn.

Or this curve may be drawn *mechanically*, by a continued motion, as follows. Let CE, in figure 7, be a straight rule, fastened by a pin so as to be moveable about the centre C. Let E*o* be another rule of the same length, fastened by a pin at E, the extremity of the rule CE, so as to be moveable about E.

Through this rule let there be a slit, so as to allow the rule to move upon a fixed pin at E. Let a pencil pass through a hole of this rule at *o*. By pushing the pencil towards E the rule will move on the pin E and being fastened to the radius CE will always, at its extremity E, be on the circumference EI. The pencil will describe the curve *o*E.

The curve being thus formed, let HCB, (in figure 6,) an angle greater than 135°, be the angle to be trisected. From A, the point of intersection of the side CH and the curve, draw through E the straight line AG, terminating at G on the circumference of the inner circle. By the construction AG is equal to E*o*, or to the radius. Through G draw CF.

The angle ACG, or HCF, is one third of the angle ACP, or HCB.

Produce GC to L, and the opposite angles GCE and LCP are equal. Draw GN parallel with DB, and produce AG to M; and the angle ECG is equal to CGN, and MGN equal to GEC.

The angle FGA being an exterior angle of the triangle AGC is equal to the angles ACG and GAC, and these are equal to each other, because GA is equal to GC. But the angle MGC is equal to FGA; the angle ACG is therefore one half of the angle MGC.

Again, the angle GEC at the circumference is one half of the angle GCP, or ECL, at the centre; the angle MGN therefore, which is equal to GEC, is one half of the angle ECL.

The angle CGN being equal to LCP and also equal to ECG, it is one half of these two angles together.

Therefore the whole MGC, (composed of the angles MGN and NGC) is one half of the whole composed of ECL, LCP, and ECG. But this whole is the same as the two angles ACP and ACG; wherefore the angle MGC is equal to one half of the whole composed of ACP and ACG.

But ACG has been proved to be equal to one half of the angle MGC. It is therefore one quarter of the whole composed of ACP and ACG. Abstract this quarter, ACG, and three parts are left each equal to ACG; that is ACG is one third of the given angle ACP, or HCB. Set off then the arc HF twice from H towards B, and through the points thus found draw straight lines from the centre, and the angle HCB is trisected.

The same demonstration will apply to any other angle.

But it yet remains to prove, that in this part of the curve a perpendicular to AC will be the *Sine* of one third of the given angle. The proof is as follows.

Join AF. The exterior angle AGF is equal to the two angles ACG and GAC, and these are equal to each other. The exterior angle AGC is also equal to GAF and GFA, and these are equal to each other. But AGC and AGF are together equal to two right angles; therefore GAC and GAF are together equal to one right angle. FAC, composed of these, is therefore a right angle, and FA is perpendicular to AC or HC.

Or the same thing may be demonstrated thus. By the construction GC, GA, and GF are equal to each other. Let G then be the centre of a circle drawn through the points CAF. It is evident that FAC is an angle in a semicircle, which is a right angle, FA is therefore perpendicular to HC.

A perpendicular on the opposite side of AC, drawn from the same point A, will necessarily be equal to AF, and cut off an arc equal to the arc HF; that is, will cut off an arc, HR, measuring one third of the given angle HCB.

The whole curve therefore, B*o*AE, though formed by a complex operation, may well be called the *Trisecting Curve of Sines.*

By making in the same manner a corresponding curve on the other side of the diameter, the curve of sines will be completed, and the whole figure will resemble in form, though not in properties, the Cardioide of Carrè.

In figure 8 the two trisecting curves, completed on each side of the diameter, are placed together. D*o*F*np* is the Trisecting Curve of Secants, and E*m*B*sp* is the Trisecting Curve of Sines. Any angle may be trisected with the greatest ease by either of them; as the angle ACB on the one side of the diameter, merely by drawing through the point *o*, (where the side AC intersects the curve of *secants*,) the straight line DG, which gives the arc AG, one third of the arc AGB measuring the proposed angle,—or merely by erecting at the point *m* (where the side AC intersects the curve of *sines*) the perpendicular *m*G, which also gives the arc AG, one third of the arc AGB.—In like manner may the angle HCB, on the opposite side of the diameter, be trisected by drawing through the point *n* of the curve of *secants* the straight line DI, or by erecting at the point S of the curve of *sines* the perpendicular *s*I, for by both methods the arc HI is obtained, one third of the given arc HIB.

And by the same methods may any angle whatever, (on either side of the diameter), formed with CB by AH revolving on C, be trisected.

By inverting the position of one of these curves, (as the curve of sines, so that its point B shall be at D), it is obvious, that while the angles ACB, HCB may be trisected by means of the one curve, (as the curve of secants) the contiguous angles ACD, HCD may be trisected by means of the other; and thus by means of these curves, as AH revolves, all the angles, which it makes with DB at C, may be trisected.

[The following additions to the above Memoir have been lately received in a letter from the author.]

In re-examining the instruments for describing the curves of trisection, it has occurred to me, that they might be improved.

In the instrument for describing the *curve of secants*, (figure 2,) the part AC is wholly unnecessary for the purpose of describing the curve; and it is obvious, that it renders the instrument more complex. Removing this part, the pencil will pass through the slits of only the two rules HK and DG.

Another change may be made in this rule. Let the pin at G, instead of moving in the slit of the rule DG, be made fast to the rule DG, only allowing the two rules to move upon G as the centre. Let the rule, with its slit, be lengthened beyond D. At D let there be a fixed pin, on which the rule GD shall move by its slit. By this change the motion of the rule is on a fixed pin at D, instead of being on a moving pin at G.

The instrument for describing the *curve of sines* also admits of improvement, and may be rendered more simple. Let the rule EG, (figure 4,) be entire from H to G, without the rule H*m*. Let it be extended beyond E, with slit from H, so as to allow its motion on a fixed pin at E. The rule CH is retained with pins at C and H. The distance H*m* is made equal to CH. The point *m* describes the curve. By this change the rule EG slides upon a fixed pin at E, instead of having the rule H*m* slide within it.

Even without the central rule CH, if a perpendicular rule be attached to the rule EG at H, extending through the point F, with a slit in it so as to move upon a fixed pin at F, while the part EG moves or slides in the same manner on a pin at E, it is obvious, that the result will be the same, as if there was a central rule. As this square rule is moved by its legs on the fixed pins at E and F, the point of the right angle at H will necessarily describe the semi-circle, and the point *m* will describe the curve of signs. In this way a circle is described by a square.

Hence by means of a *Square Rule*, without slits or pins, may an angle be trisected. Suppose EG (figure 4,) with a perpendicular part at H to be such a rule, the legs HE and HF being made of sufficient length. On the outward face of the rule EG mark the angular point formed by the outward face of the perpendicular part; and on the same face mark any distance from the angular point, (as H*m*,) which is to be the radius of the semi-circle. With this instrument in the hand, supposing the angle ACB (figure 3) to be the angle to be trisected and the semi-circle drawn, of which H*m* is equal to the radius,—bring the point *m* to the side AC, and move it up or down on the said side of the angle until the faces of the square touch, at the same time, the extremities of the diameter, E and F. Then mark on the plane the angular point H, which will necessarily be in the circumference, and knowing which the angle may be trisected. The proof is the same, as has been given in reference to figure 3.

The rule may be formed of an entire piece of wood or metal, as figure 9. Let H*m* in this rule be the radius of the semi-circle in figure 3. In any given angle, as ACB, there is but one position of the square rule, in which its point *m* shall touch the side AC, and the faces of the square, HP and HR, shall at the same time touch the extremities of the diameter, E and F; and this position gives the point H in the semi-circle. And thus of any other angle.

MISCELLANEOUS.

Art. XXI.—*Original Letters of Dr.* Franklin *and others, addressed to the late Rev. Jared Eliot of Killingworth, Con.*

Remarks by the Editor.

The late Rev. Mr. Eliot was highly distinguished (for the period in which he lived) by a knowledge of natural science, and by the successful application which he made of its principles to rural economy and other useful arts. He was the son of the Rev. Joseph Eliot of Guilford, Connecticut, and was born Nov. 7, 1685. He received the degree of Master of Arts at Yale College in 1706, and spent his life at Killingworth. He died in 1763. He was a man of such uncommon vigor and industry, that he was at once a minister of religion—a practising physician—a naturalist and philosopher—an agriculturalist, and a cultivator of some other of the useful arts. He became so distinguished, that he was made an honorary member of the Royal Society of London, and his correspondence and acquaintance were sought by many eminent men, who were drawn towards him by his social and amiable qualities, as well as by his talents and learning.

The Essays of Mr. Eliot on field husbandry, the earliest of which appeared in 1747, and which were continued annually for several years, attracted so much attention that they were extensively read and published, both in the other colonies, and in England. We have recently perused them with much satisfaction. Although written in the *quaint* and *unformed* style, which, with few exceptions, prevailed in this country at the period when they were composed, they are so replete with good sense—with proofs of original and acute discrimination, and with important facts, that they are, even at the present time, valuable, and with due revision, and the addition of some notes relative to modern improvements, these essays might be worthy of republication. They appear to have been the principal means of bringing the author acquainted with his distant correspondents.

We have recently been put into possession of a considerable number of original letters, addressed to Mr. Eliot, by several eminent men both at home and abroad; they were obtained from one of his descendants, and we propose occasionally to publish some of them in this Journal. Among them were several from Dr. Franklin, and few things which fell from his pen can be uninteresting to his countrymen. We shall give several of his letters on the present occasion.

1. *From Dr. Franklin to Mr. Eliot—a fragment without date, but appears to have been written before* 1747.—Ed.

Sir—I have perused your two Essays on Field Husbandry, and think the public may be much benefitted by them

But if the farmers in your neighbourhood are as unwilling to leave the beaten road of their ancestors as they are near me, it will be difficult to persuade them to attempt any improvement, where the cash is to be laid out on a probability of a return, they are very averse to the running any risque at all, or even expending freely, where a gentleman of a more public spirit has given them ocular demonstration of the success. About eighteen months ago, I made a purchase of about three hundred acres of land, near Burlington, and resolved to improve it in the best and speediest manner, that I might be enabled to indulge myself in that kind of life which was most agreeable. My fortune (thank God) is such, that I can enjoy all the necessaries and many of the indulgencies of life, but I think that in duty to my children, I ought so to manage, that the profits of my farm may balance the loss my income will suffer by my retreat to it. In order to this I began with a meadow, on which there had never been much timber, but it was always overflowed, the soil of it is very fine, and black about three feet, then it comes to a black clay; of this deep meadow I have about eighty acres, forty of which had been ditched and mowed; the grass which comes in first, after ditching, is spear grass and white clover, but the weeds are to be mowed four or five years before they will be subdued, as the vegetation is very luxuriant. This meadow had been ditched and planted with Indian corn, of which it produced above sixty bushels per acre. I first scoured up my ditches and drains, and took off all the weeds, and then plowed it and sowed it with oats in the last of May; In July I mowed them down, together with the weeds, which grew plentifully among them, and they made good fodder. I immediately plowed it again, and kept harrowing till there was an appearance of rain, and on the twenty-third of August, I sowed near thirty acres with red clover and herd grass, allowing six quarts of herd grass and four pounds of red clover to an acre in most parts of it, in other parts four quarts herd grass and three pounds red clover; the red clover came up in four days and the herd grass in six days, and I now find that where I allowed the most seed, it protects itself the better against the frost. I also sowed an acre with twelve pounds of red clover; it does well. I sowed an acre more with two bushels of rye-grass seed, and five pounds of red clover; the rye-grass seed fail-ed, and the red clover heaves out much for want of being thicker; however, in March next I intend to throw in six pounds more of red clover, as the ground is open and loose. As these grasses are represented not durable, I have sown two bushels of the sweeping of hay lofts, (where the best hay was used)well riddled, pure, supposing that the spear grass and white clover seed would be more equally scattered when the other shall fail. What surprised me was to find that the herd grass, whose roots are small, and spread near the surface, should be less affected by the frost than the red clover, whose roots I measured in the last of October, and found that many of their tap roots penetrated five inches, and from its sides threw out near thirty horizontal roots, some of which were six inches long and branched. From the figure of this root I flattered myself that it would endure the heaving of the frost, but now see that wherever it is thin sown, it is generally hove so far out, as that but a few of the horizontal and a small part of the tap root remains covered, and I fear will not recover. Take the whole together, it is well matted, and looks like a green corn field. I have about ten acres more of this ground ready for seed in the spring, but expect to combat with the weeds a year or two. That sown in August I believe will rise so soon in the spring as to suppress them in a great measure. My next undertaking was a round pond of twelve acres; ditching round it with a large drain through the middle, and other smaller drains laid it perfectly dry; this, having first taken up all the rubbish, I plowed up, and harrowed it many times over till it was smooth; its soil is blackish, but in about a foot or ten inches you come to a sand of the same colour with the upland. From the birch that grows upon it, I took it to be of a cold nature, and therefore I procured a grass which would best suit that kind of ground, intermixt with many others, that I might thereby see which suited it best. On the eighth Sept. I laid it down with rye, which being harrowed in, I threw in the following grass seed; a bushel of Salem grass or feather grass, half a bushel of timothy or herd grass, half a bushel of rye-grass, a peck of burden grass or blue cent, and two pints of red clover pavea, all the seed in the chaff except the clover, and bushed them in, I could wish they had been clean, as they would have come up sooner, and been better grown before the frost; and I have found by experiment that a bushel of clean chaff of timothy or Salem grass will yield five quarts of seed. The rye looks well, and there is abundance of timothy or Salem grass come up amongst it, but it is yet small, and in that state there is scarce any knowing those grasses apart. I expect from the sand's lying so near the surface, that it will produce good —— —— —— —— —— —— ——

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2. PHILADELPHIA, JULY 16, 1747.

Dear Sir,

I received your favor of the 4th instant. I ought before this time to have acknowledged the receipt of the book, which came very safe and in good order, to hand. We have many oil mills in this Province, it being a great country for Flax. Linseed oil may now be bought for 3*s*. per gallon; sometimes for 2*s*. 6*d*.: But at New York I have been told it generally holds up at about 8*s*. of this you can easily be satisfied, it being your neighbour government. In your last, you enquired about the kind of land from which our hemp is raised. I am told it must be very rich land; sometimes they use drained swamps and banked meadows: but the greatest part of our hemp is brought from Canistego, which is a large and very rich tract of land 70 miles north from this city, on the banks of the Susquehanah a large fresh water river. It is brought down in waggons. If you should send any of your steel saws here for sale, I should not be wanting where my recommendation might be of service. We have had as wet a summer as has been known here these thirty years, so that it was with difficulty our people got in their harvest. In some parts of the country a great deal of hay has been lost, and some corn mildewed: but in general the harvest has been very great. The two preceeding summers, (particularly the last,) were excessively dry. I think with you, it might be of advantage to know what the seasons are in the several parts of the country. One's curiosity in some philosophical points might also be gratified by it. We have frequently along this North American coast, storms from the North East, which blow violently sometimes three or four days. Of these I have had a very singular opinion some years, viz. that though the course of the wind is from N. E. to S. W. yet the course of the storm is from the S. W. to N. E. i. e. the air is in violent motion in Virginia before it moves in Connecticut, and at Connecticut before it moves at Cape Sable, &c. My reasons for this opinion, (if the like has not occurred to you,) I will give in my next. I thank you for the curious facts you have communicated to me relating to springs. I think with you, that most springs arise from rains, dews, or ponds, &c. on higher grounds: Yet possibly some that break out near the tops of high hollow mountains, may proceed from the abyss, or from water in the caverns of the earth, rarified by its internal heat, and raised in vapour, till the cold region near the top of such mountains condense the vapour into water again, which comes forth in springs and runs down on the outside of the mountain, as it ascended from the inside. There is said to be a large spring near the top of Teneriffe; and that mountain was formerly a Volcano, consequently hollow within. Such springs, if such there be, may properly be called springs of *distilled* water. Now I mention mountains, it occurs to tell you, that the great Apalachian mountains, which run from York River back of these Colonies to the Bay of Mexico, show in many places near the highest parts of them, strata of sea shells, in some places the marks of them are in the solid rocks. 'Tis certainly a *Wreck* of a world we live on! We have specimens of these sea shell rocks broken off near the tops of those mountains, brought and deposited in our library as curiosities. If you have not seen the like, I'll send you a piece. Farther about mountains (for ideas will string themselves like ropes of onions) when I was once riding in your country, Mr. Walker showed me at a distance the bluff, side or end of a mountain, which appeared striped from top to bottom, and told me the stone or rock of that mountain was divided by nature into pillars;* of this I should be glad to have a particular account from you. I think I was somewhere near New Haven when I saw it. You made some mistake when you intended to favour me with some of the new valuable grass-seed, (I think you called it hurd-seed) for what you gave me is grown up, and proves mere timothy; so I suppose you took it out of a wrong paper or parcel.

* Without doubt the now well known mural precipices of columnar green-stone trap, constituting the East and West Rocks, &c.—*Ed.*

I wish your new law may have the good effect expected from it, in extricating your government from the heavy debt this war has obliged them to contract. I am too little acquainted with your particular circumstances to judge of the prudence of such a law for your colony with any degree of exactness. But to a friend one may hazard one's notions right or wrong. And as you are pleased to desire my thoughts, you shall have them in welcome. I wish they were better. First, I imagine that the five per cent duty on goods imported from your neighbouring governments, though paid at first hand by the importer, will not upon the whole come out of his pocket, but be paid in fact by the consumer: For the importer will be sure to sell his goods as much dearer as to reimburse himself: So that it is only another mode of taxing your own people, though perhaps meant to raise money on your neighbours. Yet if you can make some of the goods, heretofore imported, among yourselves, the advanced price of five per cent may encourage your own manufacture and in time make the importation of such articles unnecessary, which will be an advantage. Secondly, I imagine the law will be difficult to execute, require many officers to prevent smuggling in so extended a coast as yours; and the charge considerable: And if smuggling is not prevented, the fair trader will be undersold and ruined. If the officers are many and busy, there will arise numbers of vexatious law suits, and dissensions among your people. Quere, whether the advantages will overbalance. Thirdly, if there is any part of your produce that you can well spare and would desire to have taken off by your neighbours in exchange for something you more want, perhaps they, taking offence at your selfish law, may in return lay such heavy duties or discouragements on that article, as to leave it a drug on your hands. As to the duty on transporting lumber, (unless in Connecticut bottoms, to the West Indies,) I suppose the design is to raise the price of such lumber on your neighbours and throw that advanced price into your treasury: But may not your neighbours supply themselves elsewhere; or if numbers of your people have lumber to dispose of, and want goods from, or have debts to pay, to your neighbours, will they not, (unless you employ numbers of officers, to watch all your creeks, and landings) run their lumber, and so defeat the law; or if the law is strictly executed, and the duty discourage the transportation to your neighbours, will not all of your people that want to dispose of lumber, be laid at the mercy of those few merchants that send it to the West Indies, who will buy it at their own price, and make such pay for it as they think proper. If I had seen the law, and heard the reasons that are given for making it, I might have judged and talked of it more to the purpose. At present I shoot my bolt pretty much in the dark: But you can excuse and make proper allowances. My best respects to good Mrs. Eliot and your sons; and if it falls in your way, my service to the kind hospitable people near the river, whose names I am sorry I've forgot. I am, Dr. Sir, with the utmost regard,

Your obliged humb'l serv't.

B. FRANKLIN.

3. PHILADELPHIA, Feb. 13, 1749.

Dear Sir,

You desire to know my thoughts about the N. E. storms beginning to leeward. Some years since there was an eclipse of the moon at 9 in the evening, which I intended to observe; but before 8 a storm blew up at N. E. and continued violent all night and all next day; the sky thick clouded, dark and rainy, so that neither moon nor stars could be seen. The storm did a great deal of damage all along the coast, for we had accounts of it in the newspapers from Boston, Newport, New-York, Maryland and Virginia. But what surprised me was to find in the Boston newspapers an account of an obervation of that eclipse made there: for I thought as the storm came from the N. E. it must have begun sooner at Boston than with us, and consequently have prevented such observation. I wrote to my brother about it, and he informed me that the eclipse was over there an hour before the storm began. Since which I have made enquiries from time to time of travellers and of my correspondents, north-eastward and south-westward, and observed the accounts in the newspapers from N. England, N. York, Maryland, Virginia, and South-Carolina, and I find it to be a constant fact, that N. East storms begin to leeward, and are often more violent there than farther to windward. Thus the last

October storm, which with you was on the 8th, began on the 7th in Virginia and N. Carolina, and was most violent there. As to the reason of this, I can only give you my conjectures. Suppose a great tract of country, land and sea, to wit, Florida and the bay of Mexico, to have clear weather for several days, and to be heated by the sun, and its air thereby exceedingly rarefied : Suppose the country north-eastward, as Pennsylvania, New-England, Nova-Scotia, Newfoundland, &c. to be at the same time covered with clouds, and its air chilled and condensed The rarefied air being lighter must rise, and the dense air next to it will press into its place ; that will be followed by the next denser air, that by the next, and so on. Thus when I have a fire in my chimney, there is a current of air constantly flowing from the door to the chimney : but the beginning of the motion was at the chimney, where the air, being rarefied by the fire, rising, its place was supplied by the cooler air that was next to it, and the place of that by the next, and so on to the door. So the water in a long sluice or mill-race, being stopped by a gate, is at rest, like the air in a calm ; but as soon as you open the gate at one end to let it out, the water next the gate begins first to move, that which is next to it follows; and so though the water proceeds forward to the gate ; the motion which begun there runs backwards, if one may so speak, to the upper end of the race, where the water is last in motion. We have on this continent a long ridge of mountains, running from N. East to S. West ; and the coast runs the same course. These may, perhaps, contribute towards the direction of the winds or at least influence them in somedegree. If these conjectures do not satisfy you, I wish to have yours on the subject.

I doubt not but those mountains which you mention contain valuable mines, which time will discover. I know of but one valuable copper mine in this country, which is that of Schuyler in the Jersies. This yields good copper, and has turned out vast wealth to the owners. I was at it last fall ; but they were not then at work : the water is grown too hard for them, and they waited for a fire engine from England to drain their pits. I suppose they will have that at work next summer ; it costs them 1000*l*. sterling.

Col. John Schuyler, one of the owners, has a deer park five miles round, fenced with cedar logs, five logs high, with chocks of wood between; it contains variety of land high and low, wood land and clear. There are a great many deer in it; and he expects in a few years to be able to kill 200 head a year, which will be a profitable thing. He has likewise 600 acres of meadow all within bank. The mine is not far from Passaic Falls, which I went also to see. They are very curious; the water falls 70 feet perpendicular, as we were told; but we had nothing to measure with. It will be agreeable to you to hear that our subscription goes on with great success, and we suppose will exceed 5000*l.* of our currency. We have bought for the Academy the house that was built for itinerant preaching, which stands on a large lot of ground, capable of receiving more buildings to lodge the scholars, if it should come to be a regular college. The house is one hundred feet long and seventy wide, built of brick, very strong, and sufficiently high for three lofty stories. I suppose the building did not cost less than 2000*l.*; but we bought it for 775*l.* 18*s.* 11¾*d.* though it will cost us three, perhaps four hundred more to make the partitions and floors, and fit up the rooms. I send you enclosed a copy of our present constitution; but we expect a charter from our proprietaries this summer, when they may probably receive considerable attentions. The paper admonishes me that 'tis time to conclude.

I am, Sir, your obliged humble servant,

B. FRANKLIN.

4. PHILADELPHIA, Oct. 25, 1750.

Dear Sir,

I ought to have informed you sooner that we got well home, and should have enquired after your health, as we left you in the hands of a fever. I beg you'd excuse the delay, and desire you would remember in my favour the old saying, *they who have much business must have much pardon.* Whenever Mr. Francis and I meet of an evening, we drink your health, among our other New-England friends, and he desires to be always respectfully remembered to you.—I am glad to hear you are got well again, but cannot have the pleasure of seeing you again this year. I will write to Col.

Schuyler, and obtain for you a particular account of his manner of improving his banked grounds; and will also procure you a specimen of our alum earth, with Mr. Syng's observations on it. In return (for you know there is no trade without returns,) I request you to procure for me a particular account of the manner of making a new kind of fence we saw at Southhold on Long-Island, which consists of a bank and hedge: I would know every particular relating to this matter, as, the best thickness, height, and slope of the bank; the manner of erecting it; the best time for the work; the best way of planting the hedge; the price of the work to labourers per rod or perch; and whatever may be of use for our information here, who begin in many places to be at a loss for wood to make fence with. We were told at Southhold that this kind of fencing had been long practiced with success at Southhampton and other places on the south side of the Island, but was new among them. I heard the minister of Southhold is esteemed an ingenious man; perhaps you may know him, and he will at your request, favour me with an explicit account of these fences.

The fore part of the summer here was extremely dry, and the grass in many places was burnt up. But we had a good crop of wheat; and rains coming on about the end of July, we had in August a new spring, the grass sprouting again wonderfully thick and fast in fields where we thought the very roots had been destroyed. Our grave-diggers said they found the earth hot sensibly at three feet depth, even after these rains. Perhaps the great heat below and the moisture above, occasioned this sudden and profuse vegetation, the whole country being as it were one great hot-bed.

I am, with esteem and affection, dear Sir,

Your obliged humble servant,

B. FRANKLIN.

5. PHILADELPHIA, SEPT. 12, 1751.

Dear Sir,

I received your favour of last March, with the twelve essays. Some time since, I mentioned to you a method of increasing dung by leaves; did you receive that letter?

The Collinson you mention is the same gentleman I correspond with; he is a most benevolent worthy man, very curious in botany and other branches of natural history, and fond of improvement in agriculture, &c. He will be pleased with your acquaintance. In the late Philosophical Transactions, you may see frequently papers of his, or letters that were directed to him, on various subjects. He is a member of the Royal Society.

An ingenious acquaintance of mine here, Mr. Hugh Roberts, one of our most curious farmers, tells me that it appears by your writings your people are yet far behind us in the improvement of swamps and meadows; I am persuading him to send you such hints as he thinks may give you farther insight into that matter. But in other respects, he greatly esteems your pieces: He says they are preferable to any thing of late years published on that subject in England. The late writers there, chiefly copy from one another, and afford very little new or useful; but you have collected experiences, and facts, and make propositions, that are reasonable and serviceable. You have taught him (he says) to clear his meadows of elder, (a thing very pernicious to banks,) which was before beyond the art of all our farmers; and given him several other useful informations.

I am exceedingly obliged to you for the plan and directions concerning ditching. It is very satisfactory and I hope will be useful here.

Our Academy flourishes beyond expectation. We have now above one hundred scholars, and the number daily increasing. We have excellent masters at present; and as we give pretty good salaries, I hope we shall always be able to procure such. We pay the Rector, who teaches Latin and Greek, &c. per Ann. - - - - £200

The English Master - - - -	150
The Mathematical Professor - - -	125
Three Assistant Tutors, each 60£ -	180.
Total per Ann.	£655.

Our currency is something better than that of New York. The scholars pay each 4£ per Ann.

The changes of the barometer are most sensible in high latitudes. In the West India Islands, the mercury continues at the same height with very little variation the year round. In these latitudes, the alterations are not frequently so great as in England. Thermometers are often badly made: I had three that differed widely from each other, though being in the same place. As to hygrometers, there is no good one yet invented. The cord is as good as any, but like the rest it grows continually less sensible by time, so that the observations of one year cannot be compared with those of another by the same instrument. I will think of what you hint concerning the Hydrostatic balance.

What you mention concerning the love of praise is indeed very true, a love of praise, although corrected by art *reigns more or less in every heart;* though we are generally hypocrites, in that respect, and pretend to disregard praise; and that our nice modest ears are offended, forsooth, with what one of the ancients calls the *sweetest kind of musick.* This hypocrisy, is only a sacrifice to the pride of others, or to their envy; both which I think, ought rather to be mortified. The same sacrifice we make, when we forbear to *praise ourselves,* which naturally we are all inclined to; and I suppose it was formerly the fashion, or Virgil, that courtly writer, would not have put a speech into the mouth of his hero, which now-a-days we should esteem so great an indecency, *Sum pius Æneas,—fama super æthera notus.* One of the Romans, I forget who, justified speaking in his own praise, by saying, every freeman had a right to *speak* what he *thought* of himself as well as of others. That this is a natural inclination, appears, in that all children show it, and say freely, *I am a good boy; am I not a good girl?* and the like; 'till they have been frequently chid, and told their trumpeter is dead; and that 'tis unbecoming to sound their own praise, &c. But *naturam expellas furca licet, usque recurret;* being forbid to praise themselves, they learn instead of it to censure others; which is only a round about way of praising themselves; for, condemning the conduct of another in any particular, amounts to as much as saying, *I am so honest or wise, or good or prudent, that I could not do or approve of such an action.* This fondness for ourselves, rather than malevolence to others, I take to be the general source of censure and backbiting; and I wish men had not been taught to dam up natural currents, to the overflowing and damage of their neighbor's grounds. Another advantage, methinks, would arise from freely speaking our good thoughts of ourselves, viz. if we were wrong in them, somebody or other would readily set us right; but now, while we conceal so carefully our vain erroneous self-opinions, we may carry them to our graves, for who would offer physic to a man that seems to be in health? And the privilege of recounting freely our own good actions, might be an inducement to the doing of them, that we might be enabled to speak of them without being subject to be justly contradicted or charged with falsehood: whereas now, as we are not allowed to mention them, and it is an uncertainty whether others will take due notice of them or not, we are perhaps the more indifferent about them: so that upon the whole I wish the out-of-fashion practice of praising ourselves, would, like other old fashions, come round in fashion again. But this I fear will not be in our time, so we must e'en be contented with what little praise we can get from one another. And I will endeavour to make you some amends for the trouble of reading this long scrawl, by telling you, that I have the sincerest esteem for you, as an ingenious man, and a good one, which together make the valuable member of society; as such, I am with great respect and affection, Dr. Sir,

Your obliged humble serv't.

B. FRANKLIN.

INTELLIGENCE, &c.

1. *Foreign Literature and Science.*

Communicated by Prof. Griscom.

Iceland.—Professor Menge de Hanau, in a tour which he made in Iceland, writes from his tent in July 1819, at the very foot of the Geyser, a description of the phenomena which the boiling spring presented. A funnel of 700 feet circumference but of unequal depth, is alternately filled with boiling water and then emptied. In one of the intervals M. Menge had the courage to penetrate the interior and to collect from the bottom some stones, which were only siliceous tufa, of which the silex is in actual solution in the waters of the spring. If a stone be thrown into the funnel it produces an explosion.

In the middle of one of the nights which he passed near the Geyser, the traveller was awakened by a noise similar to that of thunder. He rushed from his tent, and saw the waters of the Stroch projected to such a height, that the smoke of the boiling water seemed to reach the skies; whilst in the midst of terrible explosions, the grand Geyser displayed most magnificently its colossal mountain of vapour. The brightness of the moon and the first rays of Aurora enlightened on each side, the waving clouds formed by this watery volcano. In his enthusiam Professor Menge congratulated himself in having been a witness to the first spectacle which in his opinion nature can offer to the view of mortals.

2. M. Gaus, of Gottingen, an eminent Geometrician has been elected a foreign associate of the French Academy, in the room of Sir Joseph Banks.

3. *Lava.*—Dr. Gmelin, of Tubingen, has found in clinkstone lava, (which includes the narolite or mesotype,) a certain quantity of ammonia, which is disengaged by distillation. He has also met with it in columnar basalt. It would be extremely interesting to be able to prove that lava contains an animal substance.

4. *Sculpture.*—The celebrated Canova has proved, by his sculpture of the two lions which ornament the mausoleum of Pope Clement XIII. in the church of St. Peter, that his talent is equally adapted to all sorts of composition. A few years since he made the model of a horse of a colossal size. This work, which presented a crowd of difficulties, was much admired by connoisseurs. It was cast in bronze at Naples, with much success. Canova then engaged in another model of the same animal in a different attitude. This model, in which the sculptor has surpassed himself, will be connected with the former. Both of them will ornament the grand place of the magnificent temple of St.

Francis de Paul, which is building at Naples, from the design of the architect Bianchi.

5. *Capacity of Gas for Caloric.*—J. H. Mallet, secretary of the Academy of Lyons, has published experiments, very judiciously contrived, upon one of the most important problems of philosophy, the constitution of mixed gasses, and their capacity for Caloric. He thinks he has shown that at the same temperature the particles of different gasses are at equal distances, that their molecules have different volumes, and that the quantity of caloric which a gas can admit depends upon the extent of the space which separates the molecules.

6. *Natural History.*—M. Adolphus Brogniart has discovered in the ponds of the forest of Fontainbleau, a new *crustacea* which he has named *limnadia*, and which is remarkable by its size. It appears to form a very distinct species. All the individuals which Mr. B. has remarked, to the number of a thousand, had eggs upon their backs. He has not yet been able to account for this striking peculiarity.

7. *Dolcoath Mine.*—The magnificent copper mine of Dolcoath in Cornwall, employs under ground 750 persons, consumes monthly 3000 lbs. of gunpowder and 5000 lbs. of candles. It is 1400 feet deep, and contains within it 7,000,000 of cubic feet of excavated space. The pumps bring up daily from this mine 120,000 cubic feet of water.

8. *Heat of the Earth.*—It appears from the statements of Dr. Forbes and R. W. Fox, of Cornwall, that the temperature of the mines in that country increases progressively about one degree for every 60 or 70 feet of descent. The maximum temperature of the deepest mines (1300 to 1400 feet,) is about 80 degrees of Fahrenheit, or 28 degrees above the mean climate of the country.

9. *Test for Barytes and Strontian.*—These earths may be readily distinguished from each other by the following process :—Make a solution of the earth, which ever it may be, either by nitric, muriatic, or some other acid, which will form a soluble salt with it ; add solution of sulphate of soda

in excess, filter, and then test the clear fluid by sub carbonate of potash. If any precipitate falls down, the earth was strontian; if the fluid remains clear, it was barytes.—*Brande's Jour.*

10. *The Niger.*—It is at length ascertained that this river empties itself into the Atlantic Ocean a few degrees to the westward of the Equator. This important fact is confirmed by the arrival in England of Mr. Dupuis from Africa. This gentleman was consul at Ashantee. He is acquainted with the Arabic and Moorish languages, and got his intelligence by conversing with different traders with whom he fell in at Ashantee. He thought it so important as to warrant his voyage home to communicate to government what he had learnt.—*Tilloch Mag.*

11. *Natural History.*—M. Balande has returned to France, after an absence of two years in the interior of Africa. The whole collection which he has brought home for the Museum of Paris, comprises 15,000 articles. Among which are the skeletons and skins of an enormous Hippopotamus, a Rhinoceros, and three Whales, one of which is 75 feet in length.

12. *Gas Illumination.*—At a meeting of the citizens of Hull, in England, on the 15th of January, after a discussion on the respective advantages of gas from coal and gas from oil, it was unanimously agreed to adopt the latter for the purpose of lighting the town. It was stated that oil gas is free from the offensive smell of gas from coal; that it does not corrode the pipes, nor tarnish nor discolour polished metals, silks, &c.; that it is used in Covent-Garden theatre, in the Argyle Rooms, in Whitbread's brewery, and some other places, and that 1000 feet of oil gas will produce light equal to 3333 feet of coal gas. It appears that the Emperor Alexander is lighting up his palace at St. Petersburgh with oil gas.

13. *Extract from a French work on Lime, Mortar, and artificial Puzzolana.*—Lime stones vary greatly in quality. Those which approach to marble in purity or consist almost entirely of carbonate of lime are called *rich*; those on the

contrary are called *meagre*, which contain notable portions of sand or silex, alumine and iron. The former when burned, slacked, and made into paste, will retain their softness for ages under water, or excluded from the air, but exposed to the air, they contract a remarkable hardness by the double effect of dessication and union with the carbonic acid of the atmosphere. They even become susceptible of a beautiful polish.

But the meagre lime stones, in general, treated in the same manner, if kept under water, harden in a few days and at length form a kind of free stone which could be acted upon or broken only by the pick axe. Exposed to the air it acquires a crumbly consistence and will never admit of polish. From this circumstance the lime which possesses the quality last mentioned, is called *hydraulic lime*. But some of the meagre lime stones are unfit for hydraulic purposes, especially those which contain large particles of silex.

Puzzólanas are either natural or artificial. The natural is found in situations which have been acted upon by subterraneous heat. They all consist of silex, alumine, oxide of iron, and a little lime, the properties of which vary greatly. Silex is always the predominating ingredient, the lime and iron are sometimes, though rarely, wanting. The scoria of forges and furnaces, broken pottery, and pulverized brick or tile are artificial substances, analagous to puzzolanas.

There is one class of puzzolanas which dissolve readily in sulphuric acid, and abandon the silex which immediately subsides. Others resist the action of this acid.

If we mix in various proportions, very rich lime, slacked in the usual way with sand alone, or with puzzolana which resists the action of sulphuric acid, we obtain a mortar, which, placed under pure water, remains always soft, or acquires, after a long time, only a feeble consistence. The same mortar exposed to the air, soon hardens by drying, but is always easily broken or pulverized. But if the same experiment is made with a puzzolana readily affected and decomposed by sulphuric acid, a mortar is obtained, which soon *sets* under water, and becomes gradually harder, but in air it does not acquire any great resistance in consequence of its drying too rapidly.

Hydraulic lime presents phenomena nearly the reverse. That is to say, it furnishes good mortar when combined with sand alone, or with puzzolana, unaffected by acids, whilst very unsatisfactory results are obtained by employing it with substances which unite well with rich or pure lime.

Since the quality of natural hydraulic lime depends only on the presence of a certain quantity of clay or argile combined by heat with calcareous matter, it is natural to suppose that in mixing clay in suitable proportions with a rich slacked lime, and submitting the mixture to heat, the same result might be obtained. Experiments made upon a large scale and in various places, have confirmed this opinion so fully, that it is now possible to fabricate almost every where and at a very moderate price, artificial lime, superior to the natural.

14. *Tropical Rains.*—(Extract of a letter from M. Roussin, captain of a vessel, dated Cayenne, 28th February, 1820.) You will perhaps learn with no inconsiderable interest the following meterological fact, the authority of which I am able to certify. From the 1st to the 24th of February, there fell upon the isle of Cayenne twelve feet seven inches of water. This observation was made in the country by a person of the highest veracity; and I assured myself, by exposing a vessel in the middle of my yard, that there fell in the city ten and a quarter inches of water, between 8 in the evening and 6 in the morning on the night of the 14th and 15th of this month. From these enormous rains, which have covered with a very high tide, there has resulted an inundation from which every plantation has suffered. The oldest people assure us that within the memory of man, nothing equal to this has been seen.

15. *Eruption of the Volcano of Goonong-Api.*—M. Gaumbaner, Dutch resident at Banda, has transmitted details of the volcanic eruption of Goonong-Api, which took place on the eleventh of June, 1820. This phenomenon announced itself at half past eleven in the morning, in a frightful manner. At half past two o'clock a mass of red hot stones flew from the volcano with extraordinary force, and set on fire in their flight whatever they happened to reach. The shocks occasioned by the eruption were so great, and succeeded each other so rapidly, that the houses and even the ships felt the effects. The smoke and ashes

vomited from the crater soon obscured the region of the mountain, and even more distant places. The shocks encreased toward evening, and the stones were carried to twice the height of the mountain, which appeared covered with torrents of fire. This spectacle became still more frightful by an earthquake, which happened in the evening, and by a violent hurricane, so that the whole population of Banda and of other islands, passed the night in agony, and at day break all the ships in the harbour removed from the crash. The eruption continued during the whole of the 12th. The smoke and ashes covered Neira and Louthois, as far as the middle of the park of Baganev. The trees were almost buried in the sand, and the wells that were not covered were filled up. The verdure was burned up, and the earth covered with ashes, which in its fall smothered many birds and quadrupeds. On the north-west of the mountain, a new opening was formed, from which stones issued as large as the habitations of Banda. According to Valentine the mountain burned during five years from the eruption of 1690; and an old man worthy of faith, asserts that the same thing took place from 1765 to 1775.—*An. de Chimie.*

16. There were consumed in the city of Paris, during the year 1819—of wine 805,499 hectolitres, (each about $26\frac{1}{2}$ gallons)—of brandy, 43,849—of cider and perry, 15,919—of beer, 71,896, and of vinegar, 20,756 hectolitres. Of beef, 77,298 head—calves, 67,719, and sheep, 329,070. The whole number of births in the city were 24,344, of whom 8,641 were *hors de marriage.* Of the whole births 12,407 were boys, and 11,937 girls. The deaths amounted to 22,671. The number of marriages were 6,236, of which 5,025 were between young men and young women—315 between bachelors and widows—671 between widowers and girls, and 225 between widowers and widows.—*An. de Chimie.*

17. *Steel.*—There appears reason to believe, from the experiments of J. B. Boussingault, of the French School of Mines, that silicium or the base of silex, is as essential an ingredient as carbon, in the constitution of steel. It is found

in all the varieties ; whereas there was one variety in which only a trace of carbon could be procured.—*Idem.*

18. *Tea.*—A colony of Chinese established itself in Brasil, soon after the king of Portugal fixed his residence there, and applied to the cultivation of tea with so much success, that they have now three million of trees in full bearing.—*Rev. Ency.*

19. *A skull found in a tree.*—The English Journals state that a labourer in the county of Warwick, in cutting an old ash tree which he had felled, found in the heart of the log, the cranium of an unknown animal. The wood that surrounded it was perfectly sound, as well as the bark, and nothing apparent could lead to the conjecture how the skull could have been introduced. The cavity occupied by the skull was about four inches in diameter.

20. *New diplomatic Cypher.*—Richard Chenevix, F.R.S. has invented a new cypher, which satisfies the rules prescribed by Bacon, and which he is confident it will be impossible to unravel. He has engaged to pay 100*l.* to any person, who, before the end of the present year, will find out his character ; 50*l.* if they succeed in reading a phrase of two lines.

21. *A new mineral substance* has been discovered by Garolin, in the blue quartz of Finland. It is composed of 45.5 silex, 23 alumine, 10 of a rose red matter, unlike any known substance, 8.5 of magnesia, 5.6 oxide of iron, and 7.4 of water. It is called Steinheilite, from count Steinheil, the governor of Finland, a distinguished mineralogist, who first separated this substance from the genus quartz.

22. *New Mathematical Instrument.*—M. Maestens, of Halberstadt, has invented an instrument, by which can be traced the ellipses, the parabola, and the hyperbola, in any given relation of the parameter to the axis.

23. *Steam-Boats.*—By the well directed enterprize of the American Consul at Trieste, a steam-boat called the *Carolina*, performs every Monday the passage between that port

and Venice. Another called the *Eridano*, goes from Venice to Pavia on the Po, and so rapidly as to make the passage in 37 hours.

The steam-boat at Trieste lately saved a merchant vessel, richly loaded, from shipwreck, when the weather was such as to prevent our vessels from leaving the port.

24. *Royal Medical Society in France.*—An ordinance of the king, of the 20th December, 1820, establishes at Paris, for the whole of France, a *Royal Academy of Medicine.* This Academy is specially instituted to answer the demands of Government in all that relates to the public health, and principally with respect to epidemics, diseases incident to certain countries, the diseases of domestic animals, the various cases of legal medicine, propagation of vaccination, examination of new remedies internal as well as external, mineral waters natural and artificial, and, in short, to occupy itself with all the objects of study and research which can contribute to the progress of the different branches of the art of healing. The Academy is divided into three sections, one of medicine, one of surgery, and one of pharmacy. It is composed of honorary titulary, associate and adjunct members. There will be thirty honorary members in the section of medicine, twenty in the section of surgery, and ten in the section of pharmacy. Of titulary members there will be forty-five in medicine, twenty-five in surgery, and fifteen in pharmacy. There will be thirty free associates, who must reside in Paris, forty-five ordinary associates, of whom twenty will reside in Paris, and thirty foreign associates. The associates will be attached to no particular section. The number of resident adjuncts may equal that of the titulars in the section to which they are attached. The number of correspondent adjuncts is indeterminate. Each of the three sections will elect its honorary titular and adjunct members. The associates will be elected by the entire Academy. The general board of the Academy will be composed of a perpetual honorary president, a temporary president, a secretary and a treasurer. The first physician to the king will, ex-officio, be the president *d'honneur perpetuel;* the other members of the board will be elected by the entire Academy. The particular board of each section will be composed of a president, vice-president, and secretary.

25. *Manufactory of Apprentices.*—A benevolent institution has been formed in Paris, for the purpose of rescuing from idleness, misfortune and vice, the crowd of little unfortunate beings that swarm in the capital, and of giving them the means of gaining useful instruction, morals and industry. For this purpose a capital has been raised by subscription, consisting of 800 shares of 1000 francs each. Every share is divisible into ten parts. The administration is composed of a director, three administrators, and seven counsellors, all chosen among the stockholders. To give the institution greater weight and celebrity, an honorary council has been added, chosen from the most distinguished men, united in the national representation, the magistracy or public administration.

The stockholders who only wish to place their funds temporarily in the institution, may withdraw them at certain periods with ordinary commercial interests, or if they remain they will be entitled to whatever dividend shall arise from the profits of the manufacturing and commercial operations of the company. Those who subscribe from motives of benevolence, will be at liberty to bestow their profits on the apprentices of the establishment—or if they choose, on some one whom they may wish to promote at the time of his exit from the institution. The most exact account is kept of all those appropriations. Each stockholder has a right to present an apprentice for each of his shares for gratuitous admission into the institution. Nothing is undertaken in the work-shops but by the advice of the council, the more experienced members of which watch over the progress of each branch of industry. The benefit of the instruction professed in this general manufactory will not be confined to the indigent. The children of parents above want will be received as day pupils in the work-shops for a moderate contribution.

The operations which have constituted the daily work of the apprentices of this useful establishment, are book binding and ruling, cabinet making, joinery, tanning, various objects in the art of painting, gilding and varnishing, preparation of mastic, varnish, &c. &c.

26. *Philology.*—M. D'Arndt of Frankford, has just published a treatise on the " origin of the languages of Europe,

and the different points of resemblance which exist between them." This work will serve as a supplement to the Dictionary of all languages, which was undertaken under the auspices of the Empress Catherine, and to which M. D' Arndt was one of the most zealous contributors. The explanations of this scavant prove that many nations, now entirely separated, have been formerly united. It throws great light upon many obscure parts of Ancient history. The first volume comprehends all the languages of Europe, Asia, and some of Africa; the second contains notices relative to the origin of languages and people, extracts from the best historians who have treated the same subject, and a very curious comparison of fifteen words in two hundred different languages. The style is remarkable for its simplicity and clearness.

27. *The Museum of the Vatican at Rome*, which posseses already so many riches, has just been augmented by a piece of antiquity unique in the world. It is a bathing tub formed of a single piece of Rouge Antique. Its length is six feet, its width rather more than three feet, and its depth about the same. It has no vein of calcedony nor any other mixture, and is in good preservation. Its form is very elegant, and it is ornamented on the sides with four lion's heads which are of the most perfect age of sculpture, and according to custom hold each a ring in its mouth. It was found in a private house in Florence, which has in all probability belonged to the family of De Medici. Some Roman workman who knew the value of this piece, bought it at a trifling price and sold it to the government for 9000 Roman piasters, (nearly 10,000 dollars.)

28. *The Literary Society of Antwerp*, on its session of the 21st of August 1821, will decide the prize of a gold medal for the best poetical essay in the national language on *Paul Rubens*, and a similar medal for the best essay on the question, "whether the maternal language ought to serve as a basis for the study of foreign languages and science, and to what extent it ought to be carried." Lastly, a silver medal to the author of the best piece of one hundred and fifty to four hundred verses on the re-union in 1814 of the seventeen provinces of the Low Countries under the form of a kingdom.

29. *Natural history in France.*—The splendid collection of natural objects in the several museums of the garden of plants in Paris is almost daily enriched by fresh accessions from Naturalists attached to the Institution, and who, supported by the government, perform voyages of research and collection in all parts of the world. The following substance of a report presented the 10th of January 1821, to the minister of the Interior, by the administration of the Museum of Natural History, on the collection just brought from the Cape of Good Hope, by M. Delalande, is worthy of notice. Notwithstanding the previous researches of Kolbe, Sparrman, Le Vaillant, &c. it was believed that the Natural history of Southern Africa had not been sufficiently explored.

M. Delalande had given proof of his capacity in three voyages to Lisbon, to the sea of Provence, and to Brazil under the direction of the government. He again left Paris on the 2nd of April 1818, accompanied by his nephew twelve years of age, who has shared in his fatigues, his labours and his dangers. Two of the largest animals of Africa were much desired by the directors of the museum, viz. the double horned Rhinoceros, and the Hippopotamus. In search of them he wandered among the Hottentots and the Caffres, the latter of whom were at that time much incensed against Europeans, and carried on a ferocious war when opportunities for it offered. M. Delalande remained a long time in this research, and wandered 800 miles west of the Cape. But his intelligence and perseverance were at length crowned with success. He obtained a Rhinoceros twelve feet in length, and on the Berg River he surprised a family of the Hippopotamus, and killed the largest and most formidable of the company. In this enterprise he was generously assisted by Lord Charles Somerset Governor of the Cape, and Col. Bird his Secretary, who in his favour dispensed with a law which forbids the hunting and killing of the Hippopotamus under a penalty of 1000 Rix dollars. Thanks, (says the Report) to the enlightened protection of those two chiefs of the colony, who procured for him the greatest facilities, gave him flattering encouragements, and furnished him with instructions to commit, by an authorized exception, an infraction of the law. In the interval of these distant expeditions, M. Delalande employed his time at the

Cape upon animals of very different dimensions from the Giraff, the Rhinoceros and the Hippopotamus. There were enormous whales thrown upon the shore by the violent storm of the Cape. With almost incredible pain and labour, this Naturalist and his nephew, though exposed to the heat of the sun, and the excessive putrefaction of those huge masses of flesh, cut to pieces a number of them and obtained three complete skeletons. All the pieces, even to the small bone of the ear were faithfully preserved. But these results in themselves so satisfactory, were not the limits of his labours. During his stay of two years at the Cape, he collected the following objects.

	Individuals.	Species.
Of Insects, - -	10,000 - -	982
Birds, - -	2,305 - -	280
Mammifferes, -	228 - -	59
Reptiles, - -	322 - -	136
Fish, - -	263 - -	70
Molluscas, - - -	387 - -	102

And 122 Skeletons of his *own preparation.*

In all 13,627 Individuals, 1629 species. In the number of Molluscas, are several individuals of a new species of *Tethys composita.* Animals living in a family and all adhering to a fleshy nucleus, and fed by a common life—this is a wonderful organization, very recently known and never before seen in animals so large as these. The interesting department of *Anthropology* was not neglected by M. Delalande. He procured skeletons and heads of the people of this country, the races of which are as remarkable for their number in this little corner of the earth, as for their extraordinary conformation.

Three hundred specimens of minerals, and about 6,000 of plants belonging to 235 different genera, with some living plants, and a quantity of seeds also enrich his collection.

Such extensive labours, secured for M. Delalande the highest consideration of the first inhabitants of the colony, whose kindness was also conciliated by his modest and obliging demeanor.

The administration of the museum solicit for M. Delalande the decoration of *the Legion of honour.—Rev. Ency.*

30. *Scientific Journey.*—M. Seiber, a Bohemian Naturalist who travelled over Egypt and Syria in 1817, and 1818, is preparing to make a journey in Abyssinia.

Professor Rask of Copenhagen, known by his Icelandic and Anglo Saxon Grammar, has set out for St. Petersburg where he has employed much time in studying the Sanscrit. He is to proceed to the Birman Empire to study the *Pali* language, and the sacred books of the Buddhists. He will remain sometime in the mountains of Caucasus to seek the origin of the languages of the North. The probable duration of his journey will be three years. Professor Nevi has been sent by the Emperor of Russia to make researches in the Steppes of Independant Tartary and to examine the course of the Oxus and the towns of Balk and Samarcand. The expedition will extend perhaps as far as the lake Saisan. Embassadors have been previously sent to prepare the way in those countries so little known, and we may hope that success will crown this enterprise, which viewed merely under its Geographical relations, must lead to important results.

Count Romanzow has sent travellers who are to cross the ice from the Eastern coast of Asia to the Western coast of America.

The *Academy* of *Sciences* of *Munich* in Bavaria gave a brilliant reception at its first general session to two learned travellers, M. M. Martins and Spix, who were presented to the Academy on their return from Brazil. After the address of felicitation made them by M. Schichtegroll, the perpetual Secretary, one of the members of the Academy proposed to strike a medal in commemoration of this happy voyage, and of the generous assistance granted by the King, to this important enterprise. The proposition was unanimously agreed, and steps were immediately taken to obtain the Royal authority.—*Rev. Ency.*

31. *Pisa.*—M. Andrea Vacea Berlinghieri, a physician of that town, has found a new method of performing the operation of *Esophagotomy.* By means of an instrument of his invention and which he calls *ettopesofago ;* the operation may be made without danger, and all foreign substances taken from the esophagus. He published in 1820 a memoir containing all the necessary developments.

32. *Means of detaching Painting in Fresco.*—Many attempts have been made to detach pictures in fresco from the walls, but without success. M. Stefano Barezzi of Milan, has lately found a very simple method of doing it, whatever may be the size of the picture, and of transferring it to another wall without the least risk of injury. For this purpose he covers the picture with a cloth so prepared as to detach the picture completely, and leave the wall white. The same cloth is afterwards applied to another wall, to which the picture attaches itself, without losing the least trait. By this means many paintings have been detached from their primitive position. The trial has been made on rough or uneven as well as on smooth walls; and always with the same success. The artist has received all possible encouragement from the Roman government. He is now engaged in separating the great picture of Marco D'Oggivne in the church della Pace, and it is hoped that by this process he will be able to preserve from the ravages of time the beautiful remains of the *supper* of Leonardi de Vinci.—*Rev. Encyc. Mais* 1821.

33. *Pompeia.*—The labours at this place have been carried on with such activity that people may now pass through most of the streets. M. Williams, an English traveller, has lately visited these ruins. He entered by the Appian way through a narrow range of tombs very well sculptured, on which he could read very distinctly the names of the dead. They have found near one of the gates of the city a sentry box, with the skeleton of a soldier holding a lamp in his hand. The greatest part of the houses, and public edifices preserve their ornaments of architecture and painting fresh and entire. The pavement of the streets is worn in many places with the wheels of carriages, and every where the life and activity of the inhabitants seem to have been all at once interrupted. At each step are discovered traces of the industry of a people overwhelmed in the midst of their labour. Here the shop of a blacksmith, with the hammer resting on the anvil; there the shop of a sculptor filled with the statues just sketched out, and blocks of marble; the shop of a baker or a wine merchant, whose drawer contains money; a school, in the midst of which is an elevation intended for the master; a large theatre; a court house; an

amphitheatre 220 feet in length; temples; barracks whose columns are covered with humorous inscriptions and the names of soldiers who occupied it; wells, cisterns; public seats; beautiful altars in mosaic; fragments of statues; earthen tubes for carrying water through the streets; prisons and fetters; such are the principal remains of the arts of ancient Italy. The houses of Pompeia are in general very low, many of them are only ten feet high. The streets are about sixteen feet wide, and the foot walks three feet, considerably elevated. The narrower streets are only sixteen feet wide with side walks in proportion.

34. *Remedy for Drunkenness.*—The use of dilute liquid Ammonia as an antispasmodic has been long known. Dr. Girard, of Lyons, has applied it to the cure of fits of intoxication, which he considers as a nervous affection. Seven or eight drops of this alkali in half a glass of water, is enough to rouse a person from this morbid condition. It operates not by a decomposition of the wine or alcohol, but by modifying the sensibility of the mucous membrane of the stomach, and acting upon the innumerable nerves which are distributed over it, and transmit to the brain the impression they have received.

35. *Hydrophobia.*—In a report made to the Faculty of Medicine of Paris, on the virtues of *scutellaria laterifolia*, M. Merat observes that the New-York physician who eulogises this plant so highly, and who speaks of more than a thousand cures it has effected, does not distinguish in any case hydrophobia from madness, and seems to be ignorant that the first is only a symptom of the second, and may exist in other maladies. Hydrophobia is only a nervous malady, susceptible sometimes of cure, whilst confirmed madness is always incurable. Dr. Merat fears that the *scutellaria laterifolia* has had no more success against madness than *anasellis* so much boasted of formerly, and *alisma plantago* recently presented as a true remedy, and which in reality is like the others, destitute of properties in this frightful malady. To form a safe conclusion, we must wait until the American physician shall have pronounced decisively on this subject.—*Rev. Encyc.*

36. *Comparative table of condemnations to afflictive and disgraceful punishments, pronounced by the Court of Assize in Paris during the years* 1817, 1818, *and* 1819.—The friends of humanity will observe with satisfaction that notwithstanding the alledged corruption of the age, the number of crimes is obviously diminished.

	1817.	1818.	1819.
Condemned to hard labour for life, and disgrace,	511	393	398
For a limited time,	2,645	1,992	1,421
Ditto, with disgrace for the crime of falsehood or vagabondage,	173	184	196
Total,	3,329	2,569	2,015

We would remark, however, that this summary does not include condemnations to solitary confinement, exportation and banishment.

37. *Organic remains.*—Baron Cuvier is engaged in the publication of a new edition of his work on the fossil bones of quadrupeds. It will be greatly enlarged and perfected. The price of subscription in Paris is 40 francs per volume. The first volume was to have appeared in May last, and the last volume is to be published in June, next year. The subscription was to close immediately after the publication of the first volume, after which the price would be doubled, and will extend to five volumes and include 200 plates.

38. A correspondent in the *Calcutta* journal for May, 1820, asserts that he had obtained the happiest effects from the Voltaic pile in cases of inveterate cholera morbus.

39. *Astronomy.*—The Emperor Alexander has ordered a magnificent observatory to be constructed at Abo in Finland.

40. *Generous Legacy.*—The princess Anna Narischkin, who died lately in St. Petersburgh, at an advanced age, left by her will the sum of 150,000 rubles to various public schools, among which was the institution for the deaf and dumb.

41. *New Machine.*—M. Kuhaiewski, a gentleman of Warsaw, in Poland, has invented a portable machine for cleaning grain, which in separating the grain from the ear, breaks neither the grain nor the straw. A single man by this machine can do the work of some dozens of common labourers. The same able mechanic has contrived a sawing mill, to work by hand, and an astronomical watch, which indicates the difference of time in various parts of the globe. The Emperor Alexander has sent to the inventor a magnificent snuff-box, and has furnished him with funds to carry on his useful labours.

42. *Monument to Copernicus.*—The collossal statue in bronze, which is to be erected to the great father of modern astronomy, will be placed before the magnificent edifice of the "*Society of the Friends of Science*" in Warsaw. This illustrious man will be represented sitting upon an antique seat, covered with an Academic gown of rich drapery. In one hand he will hold a celestial globe, divided by its astronomic circles. The expense of this monument is defrayed by voluntary subscription in Poland.

Twelve periodical journals are published at Warsaw, the population of which, including the military, does not exceed 210,000.

43. *Academy of Sciences at Stockholm.*—The king having sanctioned the new regulations and statutes of the Academy, was waited upon by a deputation of its members to express to him its gratitude. The following was his reply : "Gentlemen, I have approved with the greatest pleasure of the regulations which the Academy has submitted to me, because they have issued from the pens of men known by their sagacity as well as by their profound knowledge, and whose labours will form an era in the history of science. In all enlightened, but especially in all free States, the monarch is the protector of the sciences ; and when he protects them as he ought, the nation as well as himself, may hope to witness the gradual confirmation of those rights which nature has engraven upon every human heart. Continue, gentlemen, to labour to render more and more general the development of the intellectual faculties. The light of knowledge will, by degrees, dim those baleful stars whose fatal

influence has desolated by turns not only our own but other countries of Europe, the most fertile as well as the poorest. General peace, internal repose, the security of States,—these are blessings toward which the wishes of all nations now aspire."

44. *Benevolent exertion.*—After the battles of Jena, Lutzen, and Leipzic, some friends of humanity at Weimar in Prussia, formed the generous design of assisting a great number of children who had lost their parents, or who separated from the troops they were following, wandered without shelter in the environs of that city, situated in the centre of the carnage. One of those respectable philanthropists M. J. Falk, set a noble example to his fellow-citizens, in this good work. He went from house to house, accepting the smallest sum which might be offered in this and the neighbouring towns. In the course of seven years he has been thus enabled to place out above 500 of those poor children, belonging to the various nations engaged in the war, among respectable citizens, and to provide for their religious instruction. These young people whose lives have been almost miraculously preserved, desirous of leaving a feeling proof of their gratitude, have resolved to construct a chapel all the materials of which from the brick and tile to the cloth of the altar, and from the smallest nail to the lock of the door should be the work of their own hands. To aid them in this interesting project, a publication has been proposed of religious songs or hymns, with an exposé of the use to which the money is to be applied. Subscriptions for it are received in Paris.

45. *Zeal for Science.*—M. De Candolle, professor of botany in Geneva, had in his possession a flora of Mexico, collected and drawn in New Spain, by the Spanish botanists, and contained in thirteen volumes large folio. This collection being called for by the owner, De Candolle regretting to loose so much treasure, desired his friend to join in taking copies of the most curious of the plants. All the inhabitants of Geneva, capable of handling the pencil, were soon engaged in copying the Flora of Mexico. The ladies in a particular manner, evinced an unbounded zeal in this undertak-

ing, and in a week's time not a drawing in the collection remained to be copied.

46. *Sculpture.*—Canova has just finished a work which is said to be superior to every other production of his chisel. It is a group of collossal statues, one of which represents Theseus killing a Centaur. The hero grasps in his left hand the neck of his enemy, whose human part is still making useless struggles against his formidable opponent, who lifts in his right hand the massy club of Periphates. This group is destined for the imperial court of Vienna.

47. *Lancasterian Schools in France.*—At the Society in Paris for the amelioration of elementary instruction, M. Jomard read on the 24th of March last a detailed report of the actual state of those schools in France. From this it appears there were then 1550 schools of mutual instruction in activity in France, which is more than 200 above the number of last year. 170,000 pupils received instruction in those schools.

48. *Russia.*—The whole number of births in the Russian Empire during the year 1817, is stated to have been 786,810 boys, and 711,796 girls. The number of deaths was 423,092 males, and 405,469 females, of whom 208,954 died under 5 years of age. Increase of population, 670,045. The number of individuals who had attained the age of

60 years was -	68,723
70 - - - -	38,764
80 - - - - -	16,175
90 - - - -	2,108
100 - - - -	783
115 - - - -	83
120 - - - -	51
125 - - - -	21
130 - - - -	7
135 - - - -	1
140 - - - -	1

Total, 126,717, about the seventh of the deaths.

49. *The head of Descartes*, the celebrated philosopher, was presented to the French Institute at Paris, on the 30th of April last, by Cuvier, one of the perpetual secretaries. It was sent from Sweden by Professor Berzelius.

50. *Currents of the Atlantic.*—A bottle was thrown into the sea from the Ospray, a British vessel, on the 28th of March, 1820, in lat. 5° 12′ S. lon. 28° W. (that is, on the N. W. of the Island of Ascension,) and found ten months after on the shore of Martinique, in lat. 14° 23′ N. lon. 65° 13′ W. Making all reasonable allowances for the sinuosities of its track, it must have moved at the probable rate of 150 toises per hour, or about 54 feet per minute. It results from this that beyond the equator, at least as far as 5° 12′ S. and at the turn of the equinox, the great current of the Atlantic sets north, and that the great bay of Mexico receives the waters of the ocean not only from westerly currents on its own parallel, but from the south of the equator. This shows how and by what means the plants of Congo in Africa, are found reproductive in the flora of the American Archipelago, and how they are still transported into these Islands.

51. *Medical Quackery.*—The police of Paris, from a conviction of the mischief and damages resulting from the secret remedies of Charletans, have revived and enforced the law which prohibits the editors of journals and papers, from publishing the advertisements of quacks and pretenders.

52. *Pepper.*—The analysis of black pepper, (piper nigrum,) has been recently made by Pelletier of Paris, apparently with much care and judgment. The results are,

1st, That the common pepper is composed of a peculiar crystalline matter, which he calls *piperin*—of a conerete and very acid oil—of a volatile balsamic oil—of a coloured gummy substance—of an extractive principle analagous to that of leguminous plants—of malic and tartaric acids—of starch—of *Bassorine*—of ligneous matter—and of earthy and alcaline salts, in small quantity.

2d, That there is no vegetable alcali in pepper, notwithstanding the assertion of M. Olrstaidt.

3d, That the crystaline substance of pepper is of a peculiar nature.

4th, That pepper owes its *savour* to an oil slightly volatile.

53. *American Skunk.*—A chemical examination has been made by J. L. Lassaigne, of the fluid which produces the intolerable odour of the American skunk, (viverra putorius.) It is contained in a sack of the form and size of a walnut, situated between the tail and the anus, having two exterior orifices. The fluid is emitted only as a defence when the animal is provoked. It consists of

1st, a volatile oil, extremely powerful.
2d, Of a fat oil.
3d, Of a colouring matter.
4th, Of sulphur combined with fatty matter in the proportion of $\frac{8}{100}$.
5th, Of a small quantity of hydro sulphuret of ammonia.

54. *French voyage of discovery.*—The No. for April last of the Annales de Chimie et de Physique, contains a very interesting report of a committee of the Institute, consisting of *Humbold, Cuvier, Desfontaines, de Rossel, Biot, Thenard, Gay Lussac, and Arrago,* relative to the voyage of Captain Freycenet in the Corvette Uranie. This expedition was fitted out by the government, and sent under the direction of the Royal Academy (Institute,) for the purpose of making researches in the two hemispheres, respecting the figure of the earth and the elements of terrestrial magnetism, and at the same time to embrace every occasion of extending their observations to Meteorology, Geography, Hydrography, and the various departments of Natural History. The corvette sailed from Toulon on the 17th of September, 1817, and after touching at Gibraltar and Teneriffe, proceeded to Rio Janeiro, thence to the Cape of Good Hope, Isle of France, Bourbon, Timor, New Guinea, Mariannes, and Owhyhee; thence to Port Jackson in New South Wales and to Terra del Fuego, whence the vessel was driven by a violent storm, and in six days after, namely the 13th of February of 1820 they were shipwrecked on one of the Falkland Islands. From this perilous situation in this desert Island they were happily relieved by an American ship; and without much loss of the products of the voyage; they sailed again the 27th; stopped at Montevideo and Rio Janeiro and arrived at Havre on the 13th of November 1820; having been absent three years and nearly two months. The experiments made with the pendulum and magnetical apparatus are very numerous, and the collections brought home are rich in

Zoology, Entomology, Botany and Mineralogy, and the collection of drawings is said to be one of the most remarkable which has ever been seen as to the number and variety of its subjects, and will furnish materials for the most interesting and complete work which navigation has ever yet produced. The national museum will be greatly enriched by these discoveries and collections. The report concludes thus. "It remains for the Academy to desire only two things,—first, that a publication, sufficiently in detail should speedily be made in order that science may reap the benefit deducible from this voyage.—Secondly, that labours so arduous and important may claim for those who have performed them the just rewards of Government. These rewards will become fresh motives of encouragement, to the officers and all other persons attached to the service of our marine, to circulate every kind of knowledge which may place them in a condition to render those important services to science which the interesting and curious event of these voyages may enable them to furnish."

55. *Leipsic fair.*—This is the most famous place in the world for the sale of books. At the Easter fair of last year, there were exhibited 12,700 new works in German, Greek and Latin, and 262 in foreign languages, such as French, Italian Danish, Polish, &c.

56. The fair of *Nishegorod* in Russia, which is attended by large caravans from Buchava, was last year so abundant that the merchandise brought to market, was estimated at 139 millions of Rubles, about 33,360,000 dollars.—*An. de l'industrie Nationale No.* 7.

57. *Consumption of Coffee.*—At a time when commerce is languishing, it is not useless to note as one of the causes of this evil the prodigious diminution in the consumption of coffee. It has been calculated that anterior to 1819, the common consumption in Europe rose to 69 millions of pounds, whilst in 1819 it was only 37 millions.—*Idem.*

58. *Caterpillars.*—A gardiner at Glasgow, having observed that a piece of woollen cloth which, blown by the wind, had accidently lodged upon a goose-berry bush, was soon covered with caterpillars, took the hint of putting pieces of

stuff upon other plants infested with these insects. The caterpillars took refuge upon them during the night and in this easy way the bushes were clear of them.

59. *Suspended Animation.*—There were submerged, in Paris during the last year, (1820) two hundred and sixty persons, only seventy one of which instances were accidental. Of them sixty two were taken out and restored to life. But of the whole two hundred and sixty, there were but eighty six who had remained less than twelve hours under water. Hence the number of persons restored of those of whom there was the least probability of success was as sixty two to eighty six, or as five to seven nearly. A set of Newfoundland dogs is now trained for the purpose of diving for persons submerged in the Seine, and for rescuing such as may be in danger of drowning.

60. *Death of an Elephant.*—A beautiful Bengal Elephant about nine feet high was purchased in London about six years ago, and conducted through different parts of Europe by a female with whose presence the animal always appeared to be pleased. He had been exhibited at Geneva in Switzerland about a fortnight, and gratified every one by his docility and sagacity. In departing for Lausanne as usual in the middle of the night, and conducted by his two male keepers, he had scarcely cleared the gate of the town, when without any apparent cause he fell into a paroxysm of anger and pursued his keepers into the town whither they thought it proper to flee. His mistress who intended to follow him in the morning, was greatly alarmed at the information, but on gently approaching him, and offering him dainties, she enticed him into an inclosure, but finding him still untractable, she desired that he might be killed as speedily as possible, greatly fearing the same consequences which had been experienced at Venice a few years since by a similar animal of which she had been also the proprietor. Poison was first resorted to. They first administered three ounces of prussic acid mixed with ten ounces of brandy (a favourite liquor of the animal.) He seized the bottle and swallowed it at one draught, drew back into the court, lay down a few moments, then rose up, recommenced his sport with the things around him, and remained entirely unaffected by this most terrific of all poisons, a single drop of which placed on

the tongue of a dog produces instant death. Three ounces of the oxid of arsenic were afterwards given him, and the same dose again repeated but without any effect. About an hour afterwards he was shot through the head with a cannon ball and expired without a struggle. Notwithstanding the poison he had taken, three or four hundred individuals ate of his flesh without inconvenience. His skeleton was carefully preserved for the Museum of Natural History, and his skin will be used, after due preparation, for covering an artificial animal to be placed in the same inclosure. The occurrence at Venice, and that just described, very properly suggest doubts of the propriety of suffering these animals to be taken about the country without greater precaution. In India, where they are domesticated, when one of them is seized with a paroxysm he is immediately placed between two others, and sometimes a third is put behind him, which soon reduce him to order.

61. *Spirits in glass Jars closed with Bladder, mode of improving wines.*—Dr. Summering, in a curious set of experiments detailed in the Memoirs of the Munich Academy of Sciences, has proved, that if mixtures of spirit of wine and water in glass jars, are covered, some with bladder and others with paper, that the aqueous ingredient escapes through the bladder, and leaves a concentrated spirit; while on the contrary, it is the spiritous ingredient which passes through the paper, and leaves little else than water. It is proposed to fine and improve wines by exposing them in vessels covered with bladder or some similar substance. In some experiments made with Cyprus wine, a sixth part escaped, and the wine was very much improved in quality. This mode of improving wines is practised in some parts of Suabia.—*Edin. Philos. Jour.*

Commmunications in letters to the Editor, &c.

62. *Memoir on the Vincentin.*—M. Brongniart is about publishing a memoir on the Vincentin in Italy, the result of his late travels in that country. This memoir will be illustrated by figures of the fossil shells and reliquia of that region.

63. *Mineral geography of the environs of Paris, by* Mess. *Cuvier and Brongniart.*—As this forms a part of M.

Cuvier's great work, (the new edition of which we have already mentioned,) M. Brongniart is engaged in revising it for that work. We are informed by him that it will be greatly enlarged, and that he will refer to it the analogous formations which he has had occasion to observe, or to become acquainted with in other countries. The department relating to chalk is already executed, and the author has described and figured all the fossil shells characteristic of that formation—four plates at least are requisite for this subject. From the chalk he will pass to the lime stone of the Jura and of transition.

In executing the memoir on the Vincentin, and the work just mentioned, the author was obliged to have many figures delineated, and to digest many descriptions. This has afforded him materials for another work which is a very great desideratum in the geological science : we mean—

64. *A new elementary work on fossil shells with a particular reference to Geology.*—Every person conversant with geological investigations, must have found extreme inconvenience from the want of a good elementary work with plates exhibiting the various fossil reliquia in a manner so distinct, that they may be recognized by a learner. The splendid work of Parkinson, embracing a part of this subject, is too expensive to be in many hands, and that of La Marck is little known in this country.

We are therefore peculiarly happy in learning from M. Brongniart, that he is himself engaged in the preparation of such a work, which is already far advanced.

The fossil shells characteristic of the geological formations to which they belong, are enumerated, described, and figured, with the greatest attainable exactness. The subjects are arranged in zoological order, and will thus constitute an elementary work in that department. It may be expected to appear about the end of the year 1822. We have seen some of the prints executed for the above work : they are beautifully done in the Lithographic method, and when accompanied by their appropriate descriptions, we cannot doubt that they will prove perfectly satisfactory.

We shall wait with much impatience for the appearance of this work, which will probably be even more useful in this country than in Europe.

65. *M. Brongniart's Researches on Organized Remains.*—We have already had occasion to call the attention of American Geologists to the researches of M. Brongniart on fossil remains. We regard it as the cause of the scientific world, and therefore renew our request that specimens may be forwarded to M. Brongniart from all our secondary regions. Those that have been already transmitted have been respectfully acknowledged, by him and we shall, by and by, reap an ample recompense, when we obtain the result of the grand survey of the organized remains of all ages and countries. In this work M. Brongniart is constantly engaged.

He is aided in the Botanical department by his son, who is about publishing a memoir on fossil vegetables : we have before us some of the plates illustrating this memoir, and recognize in them fossil vegetables, similar (if we do not mistake) to those which accompany the coal formation on the Muskingum. They are elegantly executed in the Lithographic mode.

II. *Domestic.*

1. *Dr. Hosack's donation of Minerals.*

PRINCETON, Dec. 6th, 1821.

Dear Sir,

Knowing as I do that your love of natural science disposes you to take a deep interest in every exertion which is made to increase the facilities in our country for acquiring mineralogical knowledge, it is with great pleasure I inform you that Dr. David Hosack of New-York, with his characteristic liberality, has presented to the college of New-Jersey a very handsome collection of minerals. It consists of about one thousand specimens, several of which are rare and splendid. They are arranged according to the order observed in Professor Cleaveland's admirable treatise, and are exhibited agreeably to the French method, in very convenient cases, erected by the Doctor at his own expense, in one of the public rooms of our college. To render this donation immediately useful, it was accompanied by a collection of the most important works on Mineralogy.

The brilliant cabinet of minerals, which Col. Gibbs, with a spirit which does him unspeakable honour, has deposited in Yale College, will probably long remain unrivalled in this country. But smaller collections, if judiciously made and consisting of the most important articles, may be of extensive utility. Many of the students of our college, by having the specimens of Dr. Hosack's collection exhibited in illustration of the lectures they receive on mineralogy, have been led to enter into the subject with a zeal, which I hope will be productive of public benefit.

Having requested of Dr. Hosack to give me an account of the manner in which he obtained this collection, he has obligingly returned an answer, from which I send you for publication the subjoined extract, in connexion with the statements here made. This I do not only as a merited acknowledgment of the Doctor's liberality, but in hope that what he has done may serve as an example to others. It would be of incalculable benefit to the interests of science among us, if American gentlemen, while they visit foreign countries for their personal improvement, would remember the colleges—perhaps the places of their own education in the United States; and make them such donations as their means and inclination should dictate. A principal reason why a liberal education with us is less valuable than in the Universities of Europe is, that we want the literary apparatus which they possess. If, by the aid of a liberal patronage, the libraries, philosophical apparatus and cabinets of natural history in our colleges, could be suitably extended, we should, I trust, be able before long to do full justice to our national reputation.

Yours sincerely,

JACOB GREEN.

2. *Extract of a letter from Dr. Hosack to Prof. Green.*

During my residence at the University of Edinburgh in 1792—3, my first attention was given to this department of natural knowledge—in my tour through the north of Scotland, I afterwards became more enamoured with this science by an opportunity which was afforded me of examining at Lawrence Kirk, the small but beautiful collection made by Lord Gardenston. In the summer of 1793, in London, my acquaintance with Mr. Schmeisser,* the pupil of Werner,—with Dr. Babington, and Dr. now Sir Alexander Creighton, afforded me access to most of the collections then forming in this metropolis; I availed myself of those opportunities of beginning the small collection now deposited in your college. I also added to it many valuable articles purchased at the celebrated cabinet of the late Earl of Bute. The beautiful specimens of dendritical marbles were derived from the latter source. Shortly after my return to New-York, with the assistance of the late Dr. Bruce, who was then my † private pupil in medicine, I arranged and marked the several specimens in that collection. This exercise first awakened Dr. Bruce to this subject, and laid the foundation for his knowledge in that interesting branch of natural history, in which he afterwards became so distinguished.

From time to time I hope still to make such additions to the above cabinet, as to render it more deserving of notice. As the first collection that crossed the Atlantic, and as the parent of many others of much greater value and extent, it perhaps merits regard as such. I shall endeavour to improve it and increase its usefulness as a source of instruction to the pupils of Nassau Hall. With my best wishes for the prosperity of the institution, I am, dear Sir,

Respectfully yours,

DAVID HOSACK.

JACOB GREEN, *Professor of Natural History in Princeton.*

3. *New Graduating Instrument.*—The Editor has been lately favoured with a drawing and description of an instrument invented by Mr. Thomas Kendall, Jr. of New Lebanon, N. Y. and called by him the *Universal Graduator.* It furnishes a mode, inferior we presume to none hitherto known, in point of expedition and accuracy, of dividing a line of given length into any desired number of equal parts. The principal use to which the inventor proposes to apply it, is to the graduating of thermometer scales. We do not

* This gentleman gave in the winter of 1783—4, the first course of lectures on Mineralogy ever delivered in the city of London. I had the pleasure of being one of his hearers.

† In the Biography of Dr. Bruce, contained in Silliman's Journal, this fact is not mentioned and appears not to have been known to the writer.

know whether any contrivance is now in the hands of artists for adapting the graduation of the thermometer to the irregularities of the bore. If there is not, the instrument of Mr. Kendall has the important peculiarity of supplying the defect,—supposing a number of points in the scale to have been previously ascertained by comparison with a standard thermometer. We are not authorised by the inventor fully to develope the principles of his instrument at the present time; but we can state in general, that for every point in the scale which has been experimentally determined, the instrument furnishes the ordinate of a curve. When the bore is uniform, the curve becomes a straight line; but when variable, a continued curve is to be drawn through the extremities of the ordinates, and to be employed instead of the straight line in the process of graduation. An irregular scale is thus furnished, which is exact at the points experimentally determined, and through the intermediate space varies according to the law of continuity. The nature of the operation is such, that if a considerable number of points be ascertained, including those at which the ordinates are nearly or accurately a maximum, the small errors to which the mechanical process of constructing the curve is liable, will have no sensible effect on the graduation. With such improvements in the construction of Mr. Kendall's instrument as experience will probably suggest, we think it promises to be of very essential service to the artist, in constructing thermometers for those experimental researches which require very accurate measures of temperature, and in which, of course, no dependence ought to be placed on the uniformity of the bore.

We have seen an instrument on a principle similar to that of Mr. Kendall, and with some valuable additions, although without any provision for an irregular graduation, in the possession of Professor Noyes, of Hamilton College. It is due to these ingenious gentlemen to state, that each has proceeded without the knowledge of the other, and that both are entitled to the full credit of their respective inventions.

4. *Singular Explosion.*

Extract of a letter from Mr. *Samuel Howard* to the Editor, dated

Savannah, Dec. 13*th*, 1821.

Sir, I have lately been induced to suppose that I had met with a detonating mixture with which I was not acquainted; about equal parts of wood ashes sifted; of common Liverpool salt, and of clay, apparently of the argillaceous kind, were mixed together with water, forming a kind of mortar; and a layer of this was put between two copper plates, exposed to a strong heat, with a view to stopping a leak in the copper; but an explosion of considerable violence took place.

Please oblige me with your opinion, whether this was owing to the mixture, or arose from other unknown causes.

Answer.

It is well known that the fixed alkalies at a red heat have a strong affinity for the silex and alumine of clay. Upon this principle common salt is decomposed for the purpose of procuring muriatic acid, by mixing clay with it and exposing the mixture to a red heat. By similar treatment, nitric acid is obtained by the agency of clay from nitrate of potash. It appears probable that in this experiment, the clay united rather suddenly with the potash of the wood ashes, and with the soda of the salt, disengaging from the first carbonic acid gas and from the second muriatic acid gas. These aerial agents, thus suddenly liberated, aided also by the steam arising from the water in the composition, would afford a mechanical power of sufficient energy to produce the effect above related.

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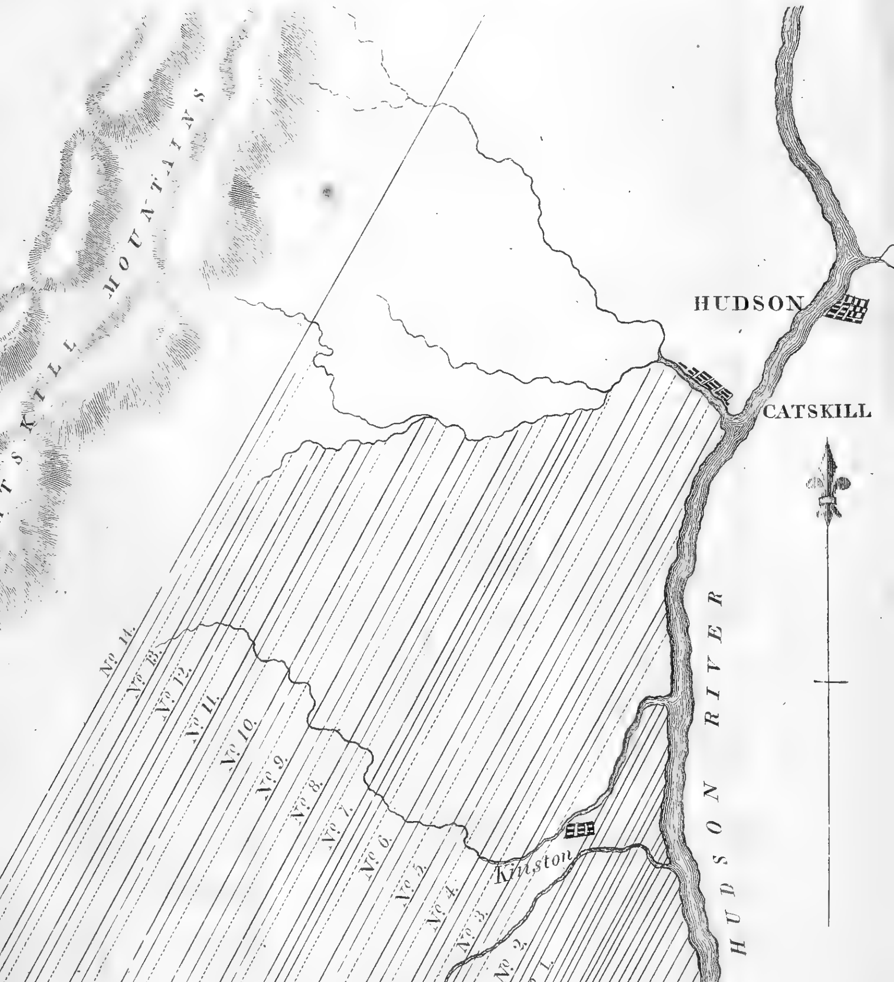
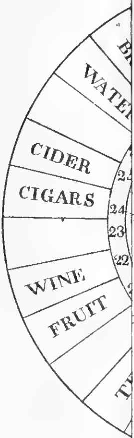
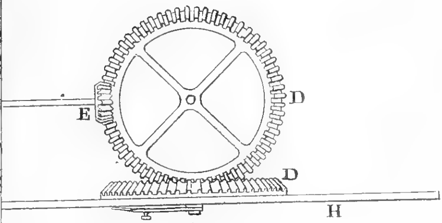
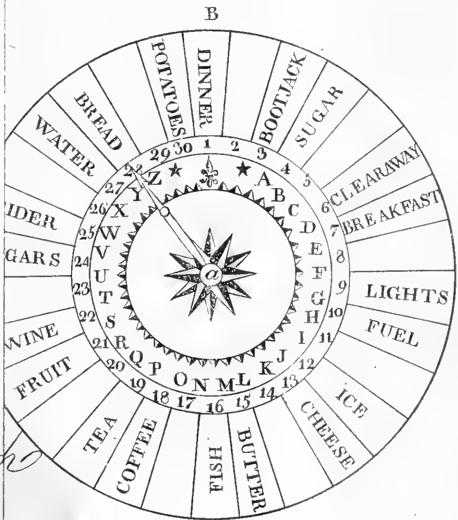
I.

Barton on the Catskills.









Pearson

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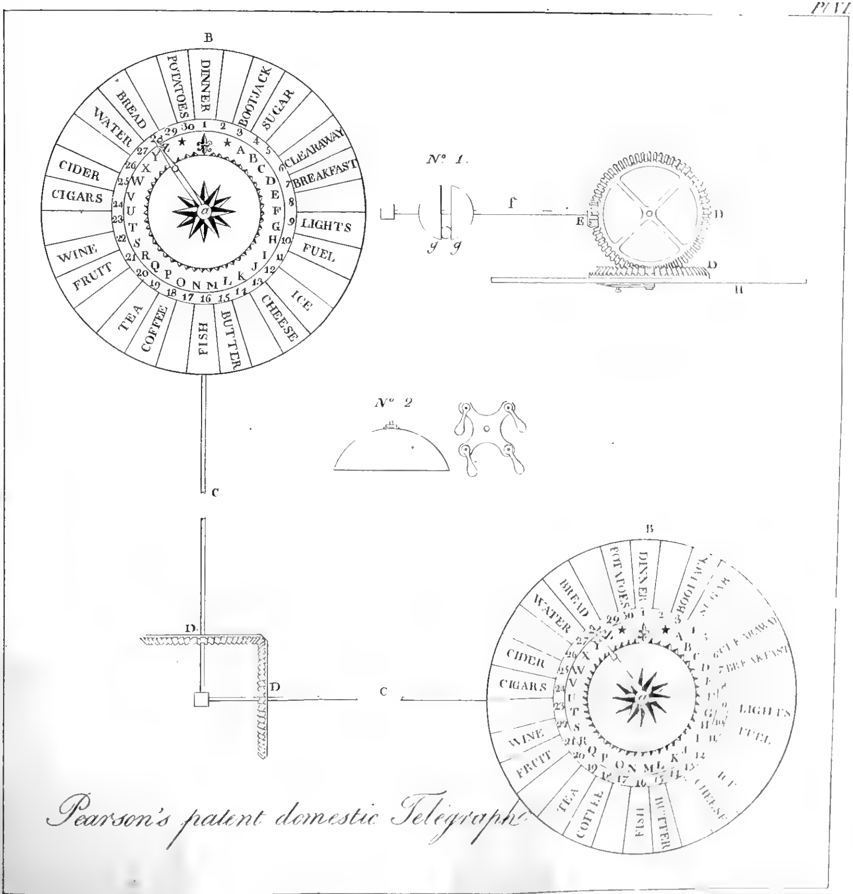

Pearson's patent domestic Telegraph

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Fig. 1.

Fig. 2.

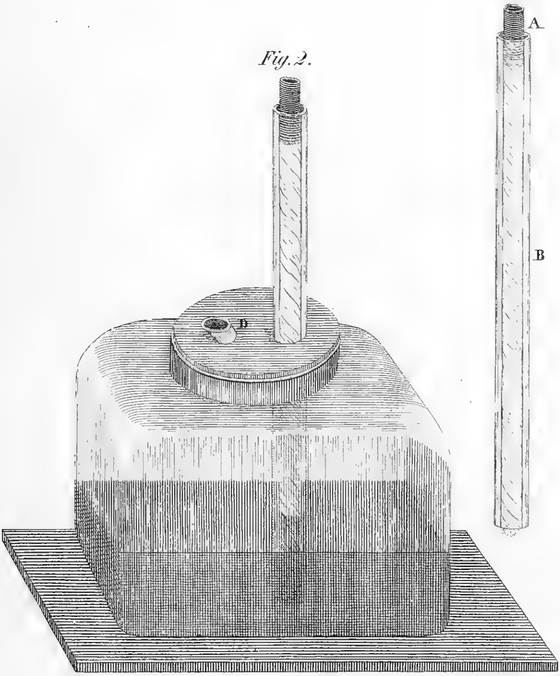

Fig. 1. A *The Coil of Platina wire.* ... B *The glass tube containing the wick.*
Fig. 2. The Lamp complete. ... D *The tube for charging.*

APHLOGISTIC OR
Flameless Lamp.

Designed by Dr. J. L. Comstock

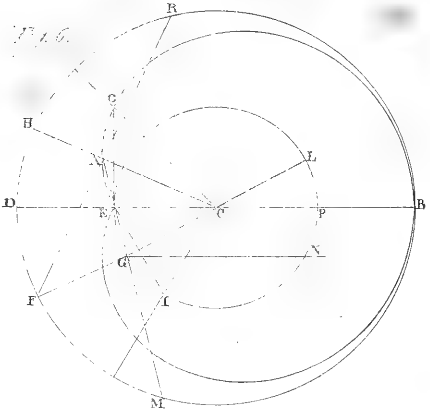

Fig. 6.

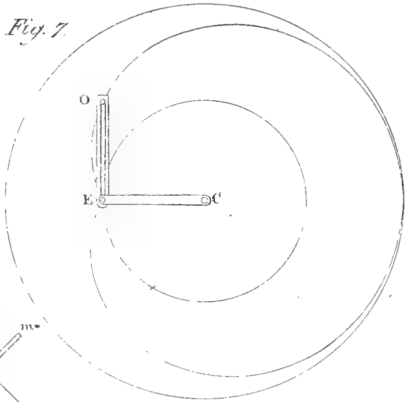

Fig. 7.

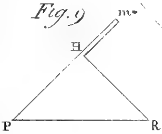

Fig. 9.

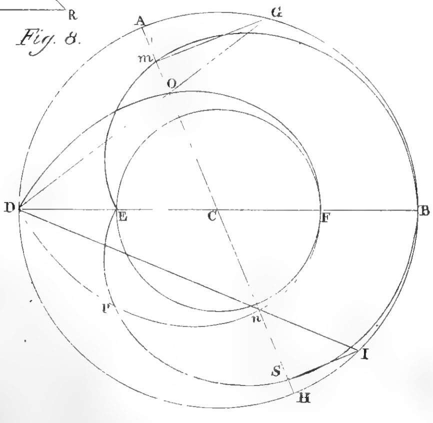

Fig. 8.

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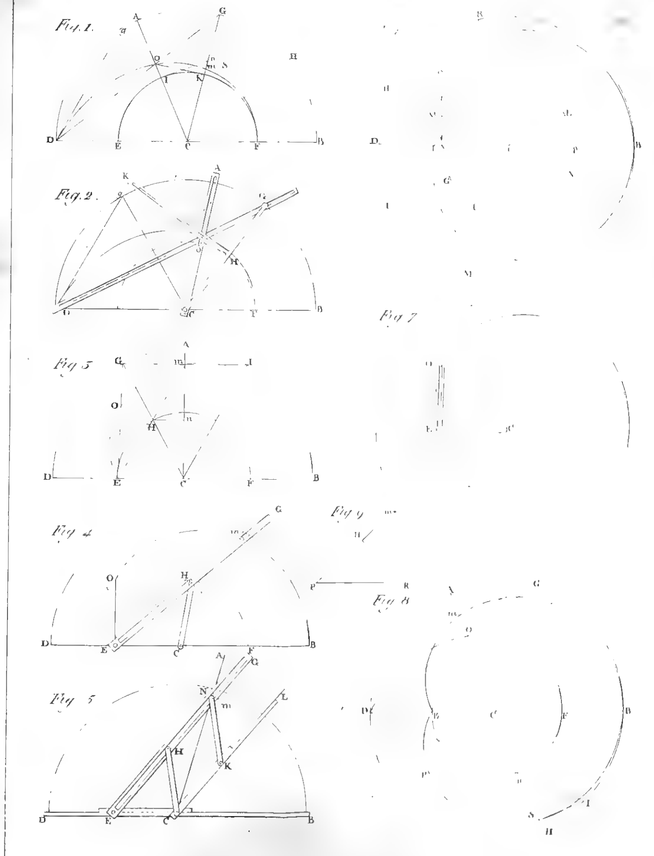

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