THE

AMERICAN JOURNAL OF SCIENCE, AND ARTS.

CONDUCTED BY

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VOL. III.....1821.

NEW-HAVEN:

PRINTED AND PUBLISHED BY S. CONVERSE, FOR THE EDITOR.

Sold by the Publisher and Howe & Spalding, New-Haven; Huntington & Hopkins, Hartford; Cummings & Hilliard, Boston; Ezekiel Goodale, Hallowel, Maine; A. T. Goodrich & Co. New-York; Littell and Henry, Philadelphia; Caleb Atwater, Circleville, Ohio; Thomas I. Ray, Augusta, Geo.; Henry Whipple, Salem, Mass.; Edward J. Coale, Baltimore; Timothy D. Porter, Columbia, S. C.; John Mill, Charleston, S. C.; Miller & Hutchins, Providence, R. I.; Thomas R. Wililams, Newport, R. I.; William T. Williams, Savannah, Geo.; Luke Loomis, Pittsburgh, Pa.; Daniel Stone, Brunswick, Me.; Professor D. Olmsted, Chapel Hill College, N. C.

CONTENTS OF VOL. III.

GEOLOGY, MINERALOGY, TOPOGRAPHY, &c.

BOTANY.

ENTOMOLOGY.

FOSSIL ZOOLOGY.

Page.

MEDICAL CHEMISTRY AND PHYSIOLOGY.

MECHANICS AND ARTS, CHEMISTRY AND PHYSICS.

AGRICULTURE.

INTELLIGENCE AND MISCELLANIES.

I. Domestic.

II. Foreign Literature and Science.

APPENDIX.

ERRATA.

Page 97—note, for *bones*, read *remains.*
189—line 25, for *I. S.* read *J. L*
184—line 17 from top, for *Medicarninum*, read *Medicaminum.*
do.—line 27 from top, for *Langrist*, read *Langrish.*

ALTERATIONS.

Page 105—Title, dele *new* before theory.
108—line 27 from top, after *troughs* read *made.*
112—line 26 from top, after *Van Marum*, read *with electrical machines.*
114—line 7 from top, for *about*, read *between a quarter and.*
143—line 5 from bottom, dele *when the object is of finite magnitude.*
144—line 9 from top, for *axis*, read *axes.*
do.—line 12, from top, for *pencils*, read *axes.*

PREFACE.

The third volume of this work being now completed, all concerned in its success will naturally wish some account of its situation and prospects. The experiment of an original American Journal of Science, is novel, and it is but reasonable to allow sufficient time to the community to become informed as to the nature of the enterprize before we can expect them to feel interested in its prosperity. The question whether it is to be supported by adequate pecuniary remuneration, is not one which can be hastily decided. It must require several years from the commencement of the work, and the Editor (if God continues his life and health,) will endeavour to prove himself neither impatient nor querulous, during the time that his countrymen hold the question undecided, *whether there shall be an American Journal of Science and Arts.* Another person may conduct it better, and to such an one, the task would be, without hesitation, resigned. But it is due to our numerous and highly respectable band of contributors to say, that no successor, however meritorious, can hope to be better supported. That the Journal is appreciated abroad, in a manner gratifying to its friends, is sufficiently evinced by the numerous extracts from it in the periodical scientific works of Europe, by the readiness to exchange, evinced by the Editors of foreign Journals, and by letters on the subject, addressed to the editor of the American Journal, from scientific and literary men abroad. Among them are the names of the late Dr. John Murray of Edinburgh, of Dr. Thomas Thomson, now Regius-Professor of Chemistry, &c. in the University of Glasgow, of Mr. Tilloch of London, editor of the Philosophical Magazine, of Mr. Julien, editor of the Revue Encyclopedique, and of Mr. Brongniart, both of Paris; of Professor Germar and Sweigger of the University of Halle in Germany, and of Professor Berzelius of Stockholm. From one of these private communications, we shall presume so far on the indulgence of the author, and of the public, as to cite a single paragraph.*

Dr. Thomson, speaking of the first five numbers of the

* One other passage is selected from Mr. Brongniart's letter. [See p. 218 of this Vol.]

American Journal, (which were all that he had then seen) says; "I hail it as the commencement of American scientific periodical works, and have no doubt from the valuable matter which you have already presented us with, that America will rival the most scientific countries in the old world." The citing of this passage would be inconsistent with decorum, were not the commendation of this illustrious author, and teacher, and editor, chiefly the property of our contributors, and but in a small degree our own. The celebrated Professor Ferrara of the University of Palermo in the Island of Sicily, speaking on the subject of American Science, said recently to a friend of the editor, that he "did not doubt that the Sciences and Arts would before long, pass to America in their highest perfection, and that we should ere long, succeed to Asia and Europe, in the literary empire of the world."

But, on the other hand, we are now bound in justice to the interests of American Science, not to withhold from its patrons, the fact that the two first volumes of this Journal have been, thus far, *in a pecuniary view, losing concerns.* The proprietors of the first Volume have not yet received back the money which they have expended—nor is the editor yet repaid, simply for the paper, printing and engraving of the second volume, and that upon the supposition that all the money is collected from the contractors for quantities.

But it is some relief to add, that the patronage, during the past year, has been *gradually*, but on the whole, *regularly* increasing, and as it now stands, will probably, just about cover the expense of the materials and mechanical labour of the third volume. Nothing has ever been paid for contributions to the pages of the work; to the honour of our scientific friends, they have contributed their gratuitous labours with cheerfulness and perseverence, and the scientific public, both at home and abroad, have already decided favourably on their productions.

With this simple statement of facts, we now dismiss the subject, after expressing our determination, notwithstanding all discouragements, to proceed, cheerfully, and with good courage, in our labour, contented also to relinquish it whenever others will more faithfully and successfully perform it, or our country shall have clearly decided that it does not approve, or will not support our undertaking.

May, 1820.

S. S. Jocelyn Sculp.

TOWN'S BRIDGE

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

GEOLOGY, MINERALOGY, TOPOGRAPHY, &c.

Art. I.—*Notices of the Mineralogy and Geology of parts of South and North Carolina, in a letter to the Editor from Mr.* John Dickson, *Instructor of youth at Columbia, S. C.*

Charleston, Dec. 21st, 1819.

Dear Sir,

I take the opportunity given me by a stay of a few days in this place, to send you a few loose remarks on the geology and mineralogy of Carolina, more particularly of South Carolina. That they are not more extended and systematic, you will attribute to my close employment as a teacher. Although my vacations are very short, it is my custom to ride once a year into the regions where minerals are found. I hope this will furnish a few facts for your Journal.

The Carolinas are naturally divided into three parts. From the sea-shore, we pass through the sandy region into the middle, (which I shall distinguish by the name of the Clay region,) and thence into the north-western portion, called the Mountains.

1. The Sandy Region. In this no rocks are found, except near its upper edge, under ground, and in the beds of the Congaree and Wateree. Near the sea it is flat and marshy. As you recede from the coast, the sand rises gradually into hills, some of which, higher up, are immense

piles of white sand, based on rock, and thinly covered with stinted pine or scrub oak. Through all this region swamps of various extent are found. A kind of geodes of sand stone,* filled with ochres of various colours, is frequently met with near its upper edge. A crust of sand stone, with a large proportion of iron in it, only a few inches thick, is spread over the surface in some parts of the range called "The high hills of Santee." Of these hills, the site of Columbia affords a good example. This town stands on an elevated plain, the mass of the hill being a very hard brown clay, deposited upon vast quantities (closely compacted) of the substance enveloped in the paper marked A, and on huge blocks of granite, now completely decomposed, or rather disintegrated. The course of the hill is from N. E. to S. W. The N. W. side is very steep, and quite a heavy clay: the S. E. side slopes off gently in deep sand. In digging wells, rough and hard brown sand stone and pudding stone, with a large proportion of iron, are taken out at great depths. The species of clay† marked A, is used by Col. Blanding in puddling the reservoir from which he will supply the town with water. It is visible in deep gullies, and from a spot of this sort he has it dug out.

2. The Clay country is so called because clay predominates. Here, when land is worn out and left uncultivated, if the slope be considerable, all soil capable of supporting vegetation is washed off, and stiff red clay is left bare. The cultivation of grasses might therefore be useful. Granite is the most common rock, although a large tract of country in this region is formed of argillaceous schistus, (apparently a deposit on the primitive rocks,) in all stages of cohesion, from clay to building stone. The specimens marked B and C‡ are from this tract; and have been used as

* These are abundant near Columbia. I happen not to have any just now, but will endeavour to send specimens by another opportunity. Some of them are globular, and contain emery.

† This clay is pleasingly variegated with red spots interspersed in a ground of white; it contains spangles of mica—is a little harsh at first, between the fingers, but by rubbing becomes somewhat saponaceous to the feel, and adheres strongly to the tongue.—*Editor.*

‡ B, is considerably decomposed, but bears the appearance of being a very fine grained mica slate, or possibly even an arenaceous quartz: it is

whetstones. Fragments of this schistus are often used as "red chalk," and probably by the Indians as paint. They used the various ochres which abound through the clay country for the latter purpose, and the present inhabitants employ them in dying. D* is a specimen from Lincoln County, North Carolina. In that county and York district, South Carolina, are extensive iron works, richly supplied on the spot with productive ore. C, was obtained from a quarry in Anson County, North Carolina, and there is a quarry of the same kind on the estate of Gen. Davie, at Handsford, on Catawba river, in Chester district, South Carolina. Arrowheads of quartz, flint, and schistus, are found every where through the clay region. On Broad river, within its limits, and in the district of ———, South Carolina, limestone has been found, which is thought to be of the best quality for making lime: I have seen no specimens of it.

Thousands of acres in North and South Carolina, consist of small irregular fragments of opaque white or rose coloured quartz, and the poverty of the land is in proportion to the quantity of this quartz mixed with the clay. Poor ridges of this kind produce nothing but a dwarfish deformed oak, called black jack.

The Gold country lies in Cabarras County, North Carolina, where the gold is found in small pieces, from the size of half a pea to mere dust, in the beds of little rills emptying into the waters of Rocky River.

Fine specimens of pyrites (iron) are found in Newberry district, South Carolina. Isinglass in wide plates, and pitch stone, are frequently met with.

3. The Mountains are granite, and, of course, among them are found the minerals usually accompanying the primitive rocks. Rock crystal, antimony, and carburet of iron, I have seen from Pendleton and Greenville, in this

dotted with innumerable exceedingly minute red points of some decomposed substance; possibly garnet.

C, has much the appearance of a true whetstone slate in a state of partial decomposition.—*Editor.*

* D, is a fine specimen of the compact oxid of titanium, and is a true pebble, of an inch and a quarter in diameter.—*Editor.*

state. Silver, it is thought, has been discovered in the former district, near Andersonville.

Of this, I shall endeavour to obtain specimens in the summer, when I expect to visit the upper country.

At the Warm Springs, (Buncombe County, North Carolina,) limestone begins to be found, as we go west. After passing them, we are in the limestone country. A limestone cave is situated very near them. Patent yellow* is found native within a few miles, unless the chemists and painters, who have examined the substance there found, be deceived. Sulphate of barytes is abundant in the neighbourhood.

General remarks. The localities given in Cleaveland from McClure, I find almost always correct, and I presume I should find them always so, had I time for strict examination.

Mineral springs abound. Among the most interesting, is a very strong sulphureous spring, a few miles from Cambridge, South Carolina, near Saluda. This was examined by the late Dr. Smith. It promises fair to be the most useful in the state.

The rough draught below† is intended for a perpendicular section in a W. N. W. direction from the mountains to the sea, passing through the tract of limestone, and that of argillaceous schistus.

I remain with great respect,
Your grateful pupil, and sincere friend,
JOHN DICKSON.

Postscript by the Editor.—Accompanying the specimens transmitted by Mr. Dickson, was a very perfect crystal of corundum; it is a regular prism of six sides—the diagonal diameter measures one inch, and the greatest length of the crystal is nearly three-fourths of an inch; its colour is blue; it scratches carnelian, garnet, and beryl; it presents the cleavage and striæ of the East Indian corundum, and in fact, looks in all respects so like the specimens from those

* Such was, at first, the impression of the late Professor E. D. Smith, of the College of South Carolina, but it was rather weakened by examination of the facts and of the evidence.—*Editor.*

† This sketch being hastily made with the pen, it was not thought necessary to have it engraved.—*Editor.*

countries, that it would easily be mistaken for them. It is not named or alluded to in Mr. Dickson's paper, and it remains for him to inform the American public whether it is a native specimen, and if so, from what locality.

Art. II.—*Notice of vegetable impressions on the Rocks connected with the Coal formation of Zanesville, Ohio, in a letter to the Editor, from* Ebenezer Granger, Esq. *dated August* 18, 1820.

[For the drawings see the plate at the end of this Number.]

Sir,

C. B. Goddard, Esq. will deliver you a small box containing drawings, and specimens of vegetable impressions, collected by Mr. Wm. A. Adams and myself from the rocks of this vicinity.

Ill health, will prevent me from giving a very particular description of the situation in which they are found.

This whole region, you are aware, is composed of secondary rocks. The hills run about two hundred feet above the bed of the Muskingum river, which has evidently cut its channel from their summits; as have all the other rivers and streams in this country—the tops of the hills from Lake Erie to the Ohio, probably being the remains of a once tolerably level plain. The drawings and specimens are marked and numbered agreeably to the order of the strata in which they were found beginning with the lowest. A. No. 1. (drawing,) and No. 2. (drawing, and specimen) from the bed of the river. This stratum is two or three feet in thickness, and contains many shells, it also contains many holes, and resembles in some measure in appearance a large body of cast iron—resting on this is a stratum of bituminous shale, two or three feet in thickness, full of indistinct impressions, over which is found a species of iron stone, from which are taken the specimens marked B.

From this were taken drawing No. 1, of a fan-shaped leaf twenty inches in length, by twelve in width at top—parts of the leaf may be seen on specimen No. 2 and 3—No. 4, 5 and 6, are from the same. The last we suppose to be a fern. We have a very fine and perfect specimen of this with the stalk and leaves—stalk two feet, leaves about eight inches.

No. 7 and 8, impressions are from the same, but the stone contains more sand.

No. 9, specimen of sand stone from the same bed—similar impressions are found in bituminous and argillaceous slate, in the same bed in great abundance.

The next stratum is sand stone varying in thickness from five to fifty feet in different places. The solid parts of the rock contain throughout, pieces of carbonized wood—between the layers, the wood is more frequently bituminized, and changed to stone-coal. Trunks and branches of trees petrified are often found, the bark generally changed to stone-coal. In part the wood seems in these cases to have perished, leaving a mould which has been filled up with sand.

C. No. 1, 2, 3, 4 and 5—the drawings are from specimens in this stratum.

No. 1 must be the same as A. No. 1. They all resemble drawings by the Rev. H. Steinhauer of Fossil Riliquia found in the coal strata of England.

No 4 is a branch about four inches in diameter a little flattened. Above this sand stratum for many feet, lies soft argillaceous slate without impressions.

D. No. 1 and 2—specimens rest upon this and form the floor of a coal stratum.

No 1, was found in length ten feet, and in breadth four feet—impression on the under side. It is doubtless the same as No. 3 in the sand stone. E. Coal.—The stratum from one to five feet thick. In this vicinity but one stratum is found above the river, another much thicker is found by boring from 15 to 20 feet below the bed of the river.

F. No. 1 and 2—(drawing,) three specimens from the roof of a coal bed in one place. In another, small leaves and apparently flowers in the greatest abundance are found.

G. 1, was found a few feet above the coal, a layer of sand stone intervening.

Above this, and sometimes resting on the coal, is a stratum from two to four feet of shell lime stone—from hence to the tops of the hills is either clay, slate, or sand stone.

I can only add that these impressions afford a considerable variety, and are found in great abundance.

I am satisfied they are mostly of a tropical growth. It would be gratifying to us to be informed of the species of plants to which they or any of them belong, or to which they bear the strongest analogy.

I cannot forbear suggesting, that a botanical description of the vegetable remains found in different latitudes and longitudes, and which it is said always occompany the coal strata, may lead to very important results. They may at all events, afford some evidence, whether the poles of the earth have at some remote period been changed.

I had nearly forgotten to mention, that the pebbles in our river are many of them primitive rock. H. No. 1, is a specimen of quartz pebble of considerable size. No rocks of these descriptions are to be found in this region.

Very respectfully
your obedient servant,
EBENEZER GRANGER.

Remarks by the Editor.—Mr. Leconte, of the Engineer department at Washington, on viewing the specimens described above, pronounced the impressions on most of them to be those of ferns; the broad leaved impression he considered a fucus. It may be added, that the specimens are singularly beautiful; and the delineations of several of them given in the present Number, cannot fail of being interesting to Geologists,

We would again call the attention of Geologists to the views of Mr. Brongniart, of Paris, expressed in his note which was printed in the first Number of this work. He is pursuing, on an extensive scale, the plan of comparing the vegetable impressions from different countries, and is particularly anxious to obtain those from the American coal formations. We should be greatly obliged to any persons who will transmit specimens, especially from the anthracite beds near the Susquehannah; from the bituminous coal beds of Richmond, Pittsburgh, and Ohio, and generally from all American localities. Several specimens of a kind are desireable, that at least, one good one may be forwarded to Mr. Brongniart, and others reserved for an American Cabinet. We beg leave to refer to some extracts of a letter from Mr. Brongniart—see the present number. His views are worthy of general encouragement, since they have for their object, the promotion of the science of Geology.

Art. III.—*Description of a variety of Amber, and of a Fossil Substance supposed to be the nest of an Insect discovered at Cape Sable, Magothy River, Ann-Arundel County, Maryland; by* Doctor G. Troost, *of Baltimore.*

The Amber found at Cape Sable is either perfectly Opaque, of the colour exhibiting every shade of a mixture of yellow, grey and brown, sometimes so arranged in nearly concentric zones as to display the most beautiful colours, admired in the Egyptian Jasper, (quartz agathe onyx of Haüy,) or disposed in alternate bands, dots, spots, clouds, each as in the other agates and jaspers. It resembles also, often the mastich or gum sandarac, occurring in that case always as this gum resin does in tears, and is then wax or honey yellow: sometimes with a tinge of brown, and sometimes reddish yellow or hyacinth red. The transparent variety occurs seldom. It is again translucent, resembling nearly, in this case, in its external appearance, the resin or colophony. The lustre of some is very considerable, and of others, particularly of some of the opaque varieties, is dull. It breaks easily, exhibiting a perfectly conchoidal fracture, and is of the same hardness with the amber of the Baltic.

Its specific gravity varies from 1,07 to 1,180. This difference is no doubt owing to small particles of pyrites, with which the cavities are sometimes lined.

Some specimens have only a slight degree of electricity, whilst others possess this property in a high degree.

It is susceptible of a good polish.

2d Variety. Earthy Amber. This usually occurs in fragments or friable porous masses, of the size of a walnut, having a dull earthy aspect intermixed with pyrites. Its solidity does not exceed that of clods of loam or of a stiff soil, with which, externally, it has some resemblance, and like this, crumbles by friction between the fingers. Its colour is gray or yellowish gray like ashes—by exposure to heat it melts, gives out the smell of common amber, and has then all the properties of the common melted amber.

The first variety of amber occurs in grains, and in detached pieces, from the size of a mustard seed to that of pieces from 4 to 5 inches in diameter. Its external surface is rough and of a dirty grey colour, covered, here and there, with pyrites. This surface is an opaque crust, which has in some pieces the thickness of one-eighth of an inch. Of whatever colour and lustre the amber may be, this crust is always of a dirty grey, and dull. It is found in an alluvial formation at Cape Sable, on the north side of Magothy river, western shore, Maryland.

The surface of Cape Sable and of its environs is considerably undulated—some of the hills rising as much as from 80 to 85 feet above the surface of the Chesapeake bay.

The uppermost stratum is sand, the lower part of which is so strongly agglutinated by iron oxide as to form a coarse ferruginous sand stone, usually employed by the inhabitants to wall up their cellars. This stone is sometimes so rich in iron as to constitute the compact brown oxide of iron (dichter braun eisenstein of Werner). This stratum varies from 15 to 60 and 70 feet, below which lies a stratum of lignite of three and an half to four feet in thickness. This bed contains nearly all varieties of lignite, such as Jet, brittle lignite, bituminous wood and brown lignite, penetrated throughout by pyrites. The junction of this stratum with the above is a mixture of lignite and sand, no separation being perceptible. It is in this stratum that the amber is found intermixed with the wood; and sometimes also on the very top of this bed—in one instance, a piece was found one foot and an half above the bed in the sand. This specimen possesses all the properties of the amber of the Baltic, and is of a light yellow colour.* These circumstances would induce the belief, that the amber was formed before it was deposited in the earth. Some of the wood contains also small grains of amber. This lignite seems to be formed of three varieties of wood, or rather the wood has undergone three different changes, some pieces of which are entirely charred, often changed into bituminous wood; and others again having undergone very little change from the brown lignite. All these varieties, particularly the brown lignite and the charred wood, are penetrated by pyrites, and are sometimes entirely changed into it. This stratum offers nearly an horizontal surface, at least no dip more than 5° to

* See Note first, at the end of the Memoir.

the horizon is to be observed, and this seems owing, at the spot examined, to a small undulation.†

Below this, is a stratum of sand intermixed with pyrites, in which are often found large nests of this mineral, 15 to 20 feet in square surface, and from one foot to one foot and an half in thickness. The quantity of pyrites this bed produces is astonishing; having cleared off its superincumbent strata of sand and lignite, (a surface of perhaps 1700 square feet,) it gave me, excluding the pyrites, which were broken up into small pieces, upwards of twenty-five tons. This stratum is here and there entirely wanting, its place being then occupied by shaly clay.

There follows a bed of earthy lignite. from 5 to 12 feet in thickness, embracing a great abundance of pyritous wood, intermixed with large fragments, thirty and more feet long, of bituminous wood. This bed is intersected by streaks and nests of a grey clay and a fine grained earthy lignite, bearing much resemblance to the amber of Cologne. There occur in this, pebbles of greasy quartz, and in one instance. a small crystal of Disthène was found, two substances which occur in abundance in the primitive rocks, fifteen or twenty miles distance from here, principally near Baltimore.

In this stratum of lignite, was found a substance which I at first sight mistook for a fruit, endeavouring to find its analogy among the palm fruits. The error soon, however, became manifest from the observation, that what had been taken for the stem of the fruit, was not implanted in it, but traversed its centre, and sometimes perforated its sides—two circumstances bearing no analogy to the stem of fruits. The substance was therefore subjected to a more attentive investigation, the result of which led to the belief, that it was an animal product of a very curious nature, and that it could be nothing else but a kind of comb or nidus made by some insects around the twigs and extremities of the succulent branches of a tree.

The size of these nests is from one to three inches in length, their diameters varying in proportion—for instance, if the nest have three inches in length, its diameter will have commonly one inch; if one inch in length, its diameter will have half an inch. Their shape is irregular, their

† See Note second, at the end of the Memoir.

surface rough, resembling often in roughness and colour, the unripe fruit of the orange tree known to the druggists by the name of bitter oranges; sometimes its surface resembles the bark of some oak limbs. This surface is overspread with small openings or round holes of two sizes, one size large enough to admit of a large pin, the other, one-fourth of the size. These holes are arranged somewhat in this manner ⁝ : ⁝ , and are the openings of interior cells of an irregular oval shape. There are four of these openings in every cell, one in the centre of the comb being in contact with the branches around which the matter or substance is deposited, and three on the outside, being the openings above mentioned, of which the centre one is the largest. It would appear that these four openings were formed by the female insect on depositing her eggs. The young insects, on being hatched, appear to have fed on the substance, and to have eaten through the investing coat, by which operation one of the openings has become larger, leaving a hollow bag. The substance of which these nests are made is of a resinous nature, possessing the same chemical properties as amber. The cavities and surface are often decked with minute crystals of pyrites. The colour of the internal part varies, probably, according to the change it has undergone from its long stay under ground, or from other unknown agencies—some of them appearing to have undergone a partial fusion, in which case, the internal colour is black, and partly charred. Some others seem to be in a state approaching to their primitive appearance, the colour varying then in every shade of yellow, from whitish yellow to orange.

This bed contains also, a fruit bearing some resemblance to a bean, but so much disfigured, that I cannot ascertain to what species it belongs.

The stratum of lignite containing these fossil remains rests on an argillaceous sandstone, from two to five feet in thickness, embracing small masses of pyrites. The surface of this stratum is very hilly, and is neither intermixed with lignite at its line of junction, nor is the least fragment of lignite perceptible through the whole bed: hence, it may be conjectured that the lignite has been deposited after the argillaceous sandstone was formed, and is, therefore, a separate formation.

This is followed by a stratum of whitish grey clay, four feet in thickness, exempt from pyrites. This clay rests on a bed of white sand, in which the water is so abundant as to render it difficult to penetrate lower.

Note First, p. 9.—The difference existing between this amber and that of the Baltic, is, perhaps, ascribable more to the local circumstances than to the difference in the trees which produced it. The amber found, one and an half foot above the stratum of lignite is, in every respect, equal to the Prussian amber, is exempt from pyrites, had no crust except some ferruginous sand cemented around it: in other lumps which are found in the bed of lignite, in contact with and sometimes wholly penetrated by pyrites, the amber has usually a thick opaque crust; and the more it is in contact with this mineral, the more the colour deviates from that of the Baltic. According to Hotsman, who has examined these mines, the amber seems not to be in contact with the pyrites, but the mines are worked in a bed of coarse sand below. As for the rest, the geognostic situation of Cape Sable seems to have much resemblance with the Baltic mines. It would be very interesting to determine what sort of trees produce this amber—at least there seems to be no doubt that amber owes its origin to the vegetable kingdom: this has been the opinion of the oldest nations, whose histories have been transmitted to us by the fables of the ancients, as we learn from the beautiful fiction of the hazardous enterprize of Phaëton, where his sisters, bewailing the loss of their brother, find their feet fastened to the shore, their arms stretching out in flexible twigs, upon which Zephyr moves the silvery leaves of the poplar, and their falling tears becoming yellow pearls, give birth to the precious amber, which is gathered by the Graces for the toilet of Venus.

Judging from the position in which we find the amber here, we have to conclude that it was already formed before it was deposited in the earth, and only by some, at present, unknown agent, has acquired the nature of amber. It must have been a vegetable resin, perhaps of the nature of copal, before it was buried with its parent trees; it cannot be, as professor Stermstadt supposes, a mineral ore, thickened by the absorption of oxigen; nor, as is the opinion of Mr. Parkinson, an inspissated mineral oil; nor again, as Patrin maintains, honey modified by time and mineral acids, which has converted it into bitumen: in all these cases, it would have been in a liquid state in the earth; it would have been produced by the vegetable substances after they were buried: and we should find it in the form of stalactites, below the substances from which it was generated—this is not the case at Cape Sable; we find it in the stratum of lignite on its top, and one foot and a half above it.—And in the former case I would ask, whence the insects which are sometimes found in the Baltic amber? Certainly, these insects did not dwell in a living state one hundred and more feet under the surface of the ground, a depth at which the amber mines are usually worked. It is more reasonable to suppose, that they existed in the resin before it was deposited in the earth—besides, the form in which the pieces occur, bears more resemblance to that of the copal, than to a substance which was liquid, and in this state filled up some interstices found below it. There is a still more striking circumstance which induces me to believe, that amber is nothing but an altered resin, which is, that the nests of insects found in the stratum of earthy lignite have, when burnt, the smell of amber; are like this substance, only sparingly soluble in alcohol, and have, as far as I have been able to ascertain, all its other properties. Now, these nests were not in a liquid state before they were deposited in the ground, but were formed of a resinous substance, in the same way as those of the coccus lacca,* and have acquired the nature of amber during their stay in the earth, from the same agent as other resinous substances. These fossil remains can, perhaps, throw a clear light on the formation of amber—at least, by their assistance we shall be able to determine to what species of trees it owes its origin. Amongst the varieties of wood of which the stratum of lignite at Cape Sable is formed, of which I believe there have been different kinds, there is only one which appears to have produced the amber; at least, I have found it only in one of these varieties: and this wood, in its mineralized state, is of a very compact and close grain, which according to the smallness of its concentric layers, must have been of a slow growth; (nevertheless, these layers may have been altered by the pressure the wood has undergone, having now all a flat appearance.) But I have not been able to ascertain the species to which it belongs.

In elucidation of the foregoing, I would propose the following questions:

1st. What kind of insects are found in the Baltic amber?†

* *Coccus lacca* of Kerr, inhabits India, on the figs of the Pagodas, the *pipiba* and some varieties of the *croton;* it transforms into a particular species of red resin, the juices produced by these trees.

† According to Jussieu, they are not natives of the continent of Europe. The amber of Cape Sable does not contain any insects. I have seen large collections of amber, but found only one variety of insects in the true. The greatest part of specimens in the Cabinets, labelled amber, with insects, is not amber but copal—I myself have assisted, in Holland, one of my friends in selecting from copal, found at different Druggists, a large collection with insects, which was cut and polished. This collection, after the death of the owner, was sold as one of true amber with insects, which the most practised eye was not able to distinguish.

2d. Does this insect make its nidus of resinous matter, as the coccus lacca?

3d. What species of trees do these insects inhabit?

Note Second, p. 10.—Nature seems to have adopted this bed of lignite as its laboratory for the formation of sulphur, of which the pyrites are composed—at least, it is true, that above this bed not the least vestige of this mineral is to be found, whereas, it appears as soon as the lignite is discovered. In the superior part, the pyrites is found in the wood partly charred; lower down is found, here and there, the sand which exists in the interstices of the wood, agglutinated by pyrites, and at other times, uniform pieces, or twigs of trees entirely changed into this mineral, the cavities lined with small crystals. Beneath this bed, in the stratum of sand, of which we have made mention in this memoir, are large masses of pyrites, found principally in the inferior part of the stratum, at a spot where the water has been prevented from infiltering itself to a lower depth, by the bed of earthy lignite through which (as in the case of common clay) water does not penetrate but with great difficulty, if at all. In the stratum of earthy lignite, the greatest part of these branches have been changed into pyrites, and have preserved the primitive structure of wood; in the stratum of sandstone which serves as a support to the lignite, we find small masses of sand cemented together by pyrites. This stratum is generally ten or twelve feet below the surface of Magothy river, and of course, that which filtered through the superior strata, descends no lower than in a proportion to its greater density compared with common water, which density it has acquired, in its passage, by the solution of foreign matter. Below this bed, of which the mean thickness is three feet, no pyrites are formed.

What shall we conclude from all this? Here I would hazard my opinion. Let us at first suppose that the constituent parts of the sulphur are lodged in the vegetable matter—that only an active agent is wanting to disengage them from the matter with which they are combined, and to recombine them to produce sulphur—let us suppose, at the same time, this agent to be water, or water charged with iron, then the water, by filtering through the superior stratum, which, as has been said, is sand agglutinated by oxide of iron, is charged with the iron, and meeting in the stratum of lignite the constituent parts of the sulphur, has put the same into action. The sulphur being now made,* has entered into combination with the iron, producing for result, the pyritous matter, partly filling, in the first place, the cavities occasioned by a decomposition in the wood, by which operation the pyrites has acquired the form and the very texture of the wood. The liquid thus generated, filtering

* Does Dr. Troost consider sulphur as a compound? *Ed.*

lower and lower through this stratum, becoming more and more charged, and being for the most part stopped by the bed of earthy lignite, has there given birth to the large masses above mentioned. The stratum of earthy lignite being but a bad filter, the pyrites become very scarce beneath, and soon (at two to two and an half feet below it) disappears altogether.

Art. IV.—*Notices of the Geology, Mineralogy, Topography, Productions, and Aboriginal inhabitants of the regions around the Mississippi and its confluent waters—in a letter from* L. Bringier, *Esq. of Louisiana, to Rev. Elias Cornelius—communicated for this Journal.*

Introductory Remarks.

Through the medium of this Journal, vol. I. pp. 214 and 317, the public have been already favoured with the observations of the Rev. Mr. Cornelius, on some portions of the southern and south western States. At the request of the Editor, facts and statements, derived from other sources, were obtained by Mr. Cornelius; and relating principally to parts of the country on the Mississippi, which that gentleman had not the opportunity of seeing. This was the origin of Mr. Bringier's memoir, which peculiar circumstances have prevented our publishing till now.

Although somewhat immethodical, it abounds so much with interesting statements, that we have thought it better to publish it, with some alterations and omissions, (agreeably to the author's permission communicated with the paper,) rather than to attempt a new digest of the subjects: for Mr. Bringier appears to have contemplated little more than the communication of *materials*, to be wrought into a different form.—Editor.

County of Accadia, 20th March, 1818.

MR. ELIAS CORNELIUS.

Sir,

I regret sincerely, that yours of the 28th ultimo, on account of my being absent when it arrived, has reached me only this day: this delay has nearly absorbed (if not altogether) the latitude you had prescribed for an answer, and which would have required several days, in order to give you any satisfaction.

Notwithstanding, I will endeavour to send you, for the present, such information as the narrow bounds I have left will admit. I will hereafter take more time for a detailed description, which I will forward to you, or to Professor Silliman.

I am extremely mortified, that the specimens* remaining in my possession, and which will accompany this, are of so little account. I should have been happy to be able to give you a better testimony of my good will, towards all attempts useful to society.

Before I proceed, I must claim your indulgence for attempting to write in a language with which I am so little familiar.

The state of Louisiana,† covering mostly a country of alluvion, just making its appearance above water, affords but little variety of Mineral productions; whilst it presents a vast field for those who wish to trace many grand operations of nature.

I will pass over the numerous phenomena which the sediment of the Mississippi is preparing, for future ages, in the Gulph of Mexico. The effect resulting from the infinite quantity and variety of matter carried daily by the torrents into the bosom of the sea, and precipitated therein, according to their respective gravities; the depth of the water: its currents and counter-currents, and all the various marine productions, constitute a subject sufficiently interesting, but which can be examined in many other places.

Banks of the Mississippi.

I will, however, stop a moment, on the margin of the Mississippi, to consider how, as the stream is ascended, the banks of this river gradually rise, and again descend towards the swamps; so that the Mississippi, in all its allu-

* The specimens alluded to by the author, are in our possession, and in general we agree with him as to their nature. *Editor.*

† In this Essay, I uniformly use the names on Mellish's map of the United States.

vial region, may be considered as a river running on the top of a hill of 24 feet in its highest position—whose base of three miles, in its average diameter, reposes on the swamps, which are about nine feet above the marshes of the sea shore, which swamps descend gradually towards the marshes until they are confounded together. It must be remarked, that I am alluding to a distance up the Mississippi equal to 215 miles from its mouth, (Baton Rouge,) where, as we ascend, the first high land begins on the right hand; on the left, the first high lands are at the mouth of the St. Francis, or 7 miles below, although the grand valley is intersected several times below the St. Francis, by the high lands of Sicily Island, between the Wachitta and the Mississippi, which are not visible from the banks of this river.

Drift Wood.

Before I speak of that immense valley, which covers an area of upwards of thirty-five thousand miles,* of which one-third belongs to the territory of Missouri, I must remark that, by what has been exposed of the Mississippi river, it is evident that whatever once escaped from its banks, never returns to them again; hence, we could form an idea of the enormous beds of timber, leaves, and other substances, which are assembled below the surface of the valley mentioned above, provided we could know how long the Mississippi has been floating them into the lower country. This inference we might found upon the quantity that we see going, without interruption, into the Achafalaya, where several hundred miles are converted into solid rafts

* The bed of the Mississippi occupied formerly, the actual bed of St. Francis, and the hills at the mouth of this river, then were at the mouth of the Ohio. The old bed of the Mississippi is at Cape la Cruz, six miles below Cape Girardeau; and now, since the Ohio and Mississippi have united; in time of high water, the Mississippi, following the high lands of Black river, and those of Arkansas, covers all that bottom, and, after crossing White river, overflows a great part of Wachitta, then all the low lands between itself and Apelousas, and Atacapas and all its swamps, and that of Achafalaya. It thus covers an area of thirty-five thousand miles, offering a great surface to the action of the atmosphere, which evaporates nearly as much water, as what empties itself out of the mouth of the river. This causes the mouth of this river to be so narrow in proportion to the extent of its dimensions.

of wood. These rafts of wood, in the course of every two or three years, disappear under the sand and leaves. This operation alternately removes the bed of the Achafalaya sometimes four or five miles to the east, or two or three to the west, but more commonly towards the east. On this side, it has gained more than 10 miles already, since it has become an outlet of the Mississippi; indeed, in its length, it will soon fall into this river, and bring its mouth lower down; for it is evident that the Achafalaya was formerly the outlet of Red river, whose actual confluence with the Mississippi is two and three quarters of a mile from the mouth of the Achafalaya. When this was joined to the Red river, it formed a separate stream, running parallel to the Mississippi, without any communication. This communication has however taken place in consequence of the encroachment of the Mississippi, whose bed constantly gains on one bank or the other, substituting, on the opposite side, glarle and sand, (what is called sand beach,) and thus forming bars, some of which are one mile broad, and from three to five miles long.

I will now return to the drift wood accumulated in the Achafalaya. Lest any one should hear with incredulity of the enormous quantity of wood spread over the country which that river every year inundates, I will give an abstract of my observations, made in 1812. Having landed at the mouth of this river, when it was at its fullest, I was surprised at the quantity of wood leaping perpetually into the shoot. I then counted the large trees entering the river, in a given time, which I found to produce more than eight thousand cubic feet per minute. The estimation, I am satisfied, was rather below than above the fact; but if we even reduce this estimate to less than one half, we shall be astonished to find what a surface of country such an accumulation of timber will cover in twenty-four hours, particularly, when we consider how much space large trees will occupy with their limbs and roots. The reader will observe, that I have omitted to estimate the leaves, bark, reeds, &c. whose united quantity is, probably, equal to that of the wood; neither have I included the sediment of the muddy water, as discharged from the mouth of the Mississippi river, which proved, according to several elaborate experiments which I formerly made, to be equal to thirty-six cubic miles annually.

I will give a few more examples of this kind, before I change the subject; for I consider it to be of great importance. I will leave, for the observation of the Mississippi navigators, the beds of drift wood collected on the heads of the Islands, which they pass in coming down the Ohio, and more particularly the Mississippi. I will, therefore, advert to the large raft of the Red river, which is sixty miles in length, and, in many places, fifteen in breadth. On this, in some places, cedars are heaped by themselves, and in others, pines. At the foot of a hill, where nothing else grows, the flood sweeps them into a pile, where they are matted together, with their leaves, and with the pods or capsules of their seeds, forming the most compact kind of rafts. If these leaves ever enter into fermentation, or any other decomposition, this must certainly produce bituminous substances in great quantity; whilst the other kinds of wood mixed likewise, by the same cause, with a very large proportion of minute vegetables, may produce other bituminous bodies in smaller quantity; but I conceive that mineral coal would be formed in greatest abundance, as the rafts of mixed wood are inexhaustible.

In this raft of the Red river, numerous small streams are seen to disappear under the raft, and show themselves again, after having passed several miles under the surface, and under the sand banks, which are, probably, part of the raft buried under the sand.*

* This account being communicated in MS. to N. A. Ware, Esq. an intelligent and scientific gentleman, from Alabama, he gave me the following opinion of the statement of facts.—*Editor.*

TO PROFESSOR SILLIMAN.

Sir,

Mr. Bringier's estimate of the drift, and his account of the extent of the raft in the Achafalaya, is much too large. Darby, in his Emigrant's Guide, gives the best account of it: to which I refer you, pp. 15, 52, 53, and 54.

Darby's account, as far as regards the state of Louisiana, is very minute, and very correct, in the aforesaid work; and is the best account extant.†

† The passages referred to by Mr. Ware, are as follows: "This river (the Achafalaya) exhibits the singular spectacle of being choked with timber, brought by the floods from the Mississippi. Some extraordinary facts have been published respecting this mass of timber, such as being sufficiently compact to admit of horses and men passing, as on a bridge; of having large trees growing upon it, and finally, of having been passed unperceived. The falsity of this the author can aver from his own personal observa-

The following circumstance will show what influence rafts have on the alluvial soils of such rivers as this.

Earthquakes and Eruptions.

On the sixth day of January, 1812, during the earthquakes* which destroyed New-Madrid, and which were felt two hundred miles around, I happened to be passing in its neighbourhood, where the principal shock took place. The violence of the earthquake having disturbed the earthy strata impending over the subterraneous cavities, existing probably in an extensive bed of wood, highly carbonized, occasioned the whole superior mass to settle. This, press-

I have seen the oil stone for hones and tools, mentioned by Mr. B. as found on the Ouichita—it is no doubt better than those brought from Turkey. I have always heard the same account of the Ouichita, that he gives in regard to its minerals. I never heard of the cinnabar or quicksilver ore, of which he speaks; but there is no doubt at all, of the salt rock abounding on the Arkansas; and of the salt sterilizing the soil, and mixing its crystals through large plains. The large piece of pure iron, weight near three thousand, which he speaks of, was displayed in New-Orleans, and is now, as you know, in New-York; it was found as he describes. I have often heard of the abundance of marble, which he mentions as being on the White river; and I have heard that the same river ran over a bed of green marble for fifty miles. I have no doubt of the granite or primitive mountains, on the Arkansas, and neighborhood.

tion, having surveyed the right bank of the river, on all the parts where the rafts are lodged. Men may pass in many places, but in none without difficulty and danger. The timber rises and falls with the water; is continually shifting; lies in all directions, having large interstices open, and frequently moves in a body, from the weight of the incumbent mass. It is about twenty miles from the upper to the lower extremity of the raft, ten miles only of this is actually closed with timber," pp. 52.

There are other rafts mentioned by Mr. Darby, but none so large. Mr. Darby's book was published in 1818; and Mr. Bringier's visit to the Achafalaya was in 1812. Whether the rafts had actually diminished since this period, or in what way we are to reconcile the accounts, we cannot at present discern; even Mr. Darby's account is however sufficiently wonderful.—*Editor.*

* Several authors have asserted that earthquakes proceed from volcanic causes, but although this may be often true, the earthquake alluded to here, must have had another cause. Time, perhaps, will give us some better ideas as to the origin of these extraordinary phenomena. It is probable, that they are produced, in different instances, by different causes, and that electricity is one of them; the shocks of the earthquake of Louisiana, in 1812, produced emotions and sensations much resembling those of a strong galvanic battery. It will, perhaps, be pertinent to observe, that this earthquake took place after a long succession of very heavy rains, such as had never been seen before in that country.

ing with all its weight upon the water that had filled the lower cavities, occasioned a displacement of this fluid, which forced its passage through, blowing up the earth with loud explosions. It rushed out in all quarters, bringing with it an enormous quantity of carbonized wood, reduced mostly into dust, which was ejected to the height of from ten to fifteen feet, and fell in a black shower, mixed with the sand which its rapid motion had forced along; at the same time, the roaring and whistling produced by the impetuosity of the air escaping from its confinement, seemed to increase the horrible disorder of the trees which every where encountered each other, being blown up, cracking and splitting, and falling by thousands at a time. In the mean time, the surface was sinking, and a black liquid was rising up to the belly of my horse, who stood motionless, struck with a panic of terror.

These occurrences occupied nearly two minutes; the trees, shaken in their foundation, kept falling here and there, and the whole surface of the country remained covered with holes, which, to compare small things with great, resembled so many craters of volcanoes, surrounded with a ring of carbonized wood and sand, which rose to the height of about seven feet.

I had occasion, a few months after, to sound the depth of several of these holes, and found them not to exceed twenty feet; but I must remark the quicksand had washed into them. The country here was formerly perfectly level, and covered with numerous small prairies of various sizes, dispersed through the woods. Now it is covered with slaches (ponds) and sand hills or mounticules, which are found principally where the earth was formerly the lowest; probably because, in such places, the water broke through with more facility.

A circumstance worth noticing, was a tendency to carbonization, that I perceived in all the vegetable substances soaking in the ponds produced by these eruptions. It was about seven months after the event had taken place, that I had occasion to make these remarks, on the spot before mentioned. The same earthquake produced a lake between St. Francis and Little Prairie, distant twenty-seven miles from the Mississippi river. This lake much resembles the Big lake on Red river, inasmuch as the trees are standing upright in all of them, and sunk about thirty feet when the water is high. They are all evidently modern lakes, whose beds were, not long since, part of the forest.

Fossil Remains of the Mastodon.

On the same voyage, I saw, in New-Madrid, a Mammoth grinder, which had just been found by one Francais Lesieur. Along with it were several other teeth belonging to the same jaw—it was found about three miles below the village, on the banks of the Mississippi, but it was very damp and very soft.* This kind of fossil is frequently met with on the porphyry ridges bordering, in many places, a portion of the grand valley which is included in the state of Missouri.

Between White river and Strawberry river are three parallel porphyry ranges, running circularly from the west to the north east; the three mountains are twenty-eight miles across, and seem to have been above water, when the whole country around was covered by the ocean. The south-west side presents a large undulating valley of basalts, amongst which are some calcareous stones that may be denominated marbles.

At the foot of the before mentioned mountain, was an elephant or mammoth's tooth (or grinder) of an enormous size; it was fully twice as large as the largest I had seen before at Big-Bonelick. A great quantity of these fossils are there gathered in a small compass, and this collection was doubtless occasioned by the appetite which these animals had for the salt. Attracted by the water that oozes in these marshy places, they were evidently mired when they ventured too far in, and of course, the struggles of the last one would sink the bones of his predecessor still deeper. Thus these collections are easily accounted for, although at first, it seems very strange to see these bones accumulated, like those of some of the extinct Indian tribes in the west. The grinder which I discovered, was perfectly preserved in its shape, and converted into a siliceous petrification, representing milk white jasper, variegated with beautiful colours. It was incrusted by a solid block of porphyry, which the destructive hand of time had worn away to such a degree,

* Its weight is mentioned in the text as being, if we could read it correctly, eleven to seven ounces—but this could hardly be the correct meaning.

that it projected like a tooth in its own alveolage. By breaking a piece from one corner, the enamel and the layers of the tooth soon became visible, so that there could be no doubt as to what it was.

I examined the block of porphyry attentively, and think I could discern some osseous forms; the bones appeared to be in their full size, and, like the grinder, converted into jasper; but it was of a more dull colour, and not so hard, and resembled indurated clay. The other component parts were clay, feldspar, and quartz, and some other things not ascertained.

Marbles.

I will next describe the marbles found in those hills already mentioned, which are situated in a portion of the territory of Missouri, known by the name of Laurence county.

The kind that is most abundant is a brick coloured marble, with brown stripes, (resembling the Italian *Roso di Monte Catini.)* The next is a plain flesh coloured marble, (*Rosso di Caldona.*) A white and black marble, is the first that occurs at the foot of the ridges; it is a most beautiful variety, *(Nero, y Bianco Antico.)* I have found many other varieties in the branches of the creeks, but have not discovered the quarries. The kinds first mentioned, are found in great plenty. The first covers more than 50 miles of surface. The land is extremely fertile in the places where the Marble lies, buried in two or three feet of loam. This is particularly true on the bottoms of a great number of streams which abound in this country, and are produced by large springs flowing every where. The growth is black-walnut, hickory, mulberry, sassafras very large, white oak, cherry, &c. Where the rocks are above the vegetable earth, nothing is seen for miles, except now and then a few wild gooseberry bushes. These quarries generally exhibit level surfaces of a tolerable height.

Other Mineral Productions.

Marls of several varieties cover a great portion of this extensive country. In the south, swine stone, impregnated with bitumen, is very plenty; and in the north, another variety (which is a non-descript) covers extensive vallies, upon which the pieces are scattered in piles, that are from three to four feet in diameter, and two in height. The colour presents different shades of gray: the texture is earthy, although in some places exhibiting a chatoyant knob of various colours, having some resemblance to the cat's eye. These colours are produced by the reflection of small prismatic crystals, filling up the places which had been left empty by some other substances, that must have expanded themselves, and occasioned the protuberances on the stone, and the alteration of its composition, which is in these places siliceous, resembling transparent white flint. This peculiar appearance, however, confounds itself with the great mass within an inch from the central point, which is very hard, giving fire with steel. It is composed of calcareous, siliceous, and a little portion of argillaceous earth, besides metallic substances, for some are striped with black veins like marbles, with which it might well compare.

While I speak of non-descript objects, or at least of what I have seen described no where, I will mention a stone resembling granite, although it is no granite, which is found ten miles south of Batisses ford, St. Francis river, on the road from Laurence court house to St. Michal. The beauty of this stone exceeds any thing that I had seen before. The quarry is inexhaustible, and blocks of any size, from one to a thousand feet, may be got, precisely alike in every part. This is composed of pure transparent prismatic crystals, of the size of grains of wheat, cemented with very black crystals of the same size and shape, without the appearance of any other mixture or colour.

Not far from that place, has been found sulphuret of antimony, and is said to be in great quantity; but I receive this fact on the report of others.

Lead Mines.

A few miles north of St. Michal, is the mine Lamotte, a celebrated place where an immense quantity of lead ore was formerly dug. This ore is the common galena, having, as usual, the colour of lead; it crystalizes in small cubes. Its fracture is foliated, and it soils the paper when rubbed on, leaving a metallic lustre. It affords from seventy to eighty-six per cent. of lead; and this lead is said to have afforded one per cent. of silver. But the other lead mines, now working near Herculaneum and St. Genevieve, produce only one-fourth per cent. which is not separated, as it would not defray the expences.

The galena or lead ore is found disseminated in blocks of different sizes, at a depth of about nine feet, covered with a stratum of seven feet, composed of rubbish, very much decomposed, and strongly impregnated with oxid of iron, under which, large blocks and small pieces of what Wallerius calls *Corneus Trapezius*, are found intermixed in about equal proportion with white selenitic spar, (sulphat of Barytes, *Ed.*) in pieces of about the same size, buried in the rubbish before mentioned with the ore, which generally adheres to some of the spar.

The workmen dig only at random. Some are fortunate, and will dig, on an extraordinary occasion, two thousand pounds a day; when another will not dig fifty pounds. At mine *Chobohôllay*,* the workmen who lease, each of them, so many square yards per week or per day, all work on their own account, and sell their ore at two dollars per hundred, to the founderers, who are proprietors of the mineral land. The ore is simply piled on a few logs of wood, which reduces all the metal it can, and the cinders (since a few years only) are put afterwards into an air furnace, where they are reduced into slags, after yielding another little portion of the lead remaining in the scorias. The ore of this mine yields generally eighty per cent. of lead.

To the north of mine Chobohôllay, the whole face of the country exhibits indications of metals. In 1812 I had gathered numerous specimens while merely crossing the country. Unfortunately they all went under a raft, with my boat, below Cape Girardeau, as I was descending the Mississippi. I would advise adventurers to explore the mountains between the waters of St. Francis, high up near its sources, and near and even above the head waters of Big and Little Black river, Between these waters and White river are very extensive salt petre caves, where great quantities of nitrate of potash could be extracted. Lead mines are very

* A Choctaw name for St. Francis river, upon the head of which this mine is situated: it means (smoke) taken from *oca chobohôllay*, smokey water.

abundant; their ores exhibit much variety, and the hunters relate that there are a variety of other minerals.

Iron Ores.

Iron ores of several varieties are found in great quantity, between the currents and White river. The Wachitta, eighteen miles below the hot spring, affords, in a place called the cove, five points of hills, where the very richest iron ore is gathered in enormous heaps; it yields the best of Iron.

Some cellular brownish red ore, which occurs in very large bodies, and mineralized by about thirty per cent. of oxigen, is likewise found in this cove, and in many other places, particularly on the north side of the mouth of Little Missouri, (a fork of Wachitta.)

About one hundred and fifty miles up this Little Missouri river, there are inexhaustible quarries of sulphate of lime, of several varieties; it is likewise found in the cove, within two hundred yards of the magnetic iron ore. Above the ore, and not one hundred yards off, is an extensive bed of common talc, (mica? *Ed.*) the leaves are of an extraordinary size, not less than five inches by seven.

Cove of Wachitta.

The Cove of Wachitta is formed by a circular mountain, shaped like a horse shoe. This mountain consists of sparry iron stone and heavy spar; it encloses an area of nine miles of surface of very fertile soil, traversed with two very fine streams fed by numerous springs. In this valley there are trees of an enormous size, and of a very great variety. This cove faces on the Wachitta river, and offers a charming perspective. It is surrounded with pitch pines of the extraordinary height of one hundred and sixty feet.

Clays, Hones, &c.

This valley affords all kinds of earths of the very best quality for every kind of furnaces and crucibles, for glass manufactories and iron founderies. There is petunzé or kaolin of a very superior quality, for porcelain. Materials for glass are equally good and plenty. A quarry of razor hones (Lapis Coticularis of Wallerius) has been opened for several years past within a few miles from this place;

and the hones have been found so good in the States, to which four hundred pounds were taken last year, that the same man who discovered the quarry is now loading a flat boat with them. He sold the first at one and two dollars per pound. Those taken out of the lower strata are of a coarser grain, and are found by the carpenters who use them much superior to those imported from Turkey. Some are red, some of a flesh colour, others transparent with a greyish blue cast. They have a sparry texture; they seem to be an aggregate of siliceous argillaceous and magnesian earths, with a little oxid of iron.

Salt, Sand Hills, &c.

On the opposite side, I mean six miles below the cove, (the hone quarry is above the cove) there is a salt work; it makes a great quantity of salt, which is sold at one dollar per bushel. They could make any quantity, the water is so far saturated that it yields one fifteenth of salt; but there are salt springs on the Arkansas that yield one sixth of salt; and higher still there are streams of a sufficient size for a boat to navigate in, coming out of a lake called lake Jefferson, which is a saturated solution of salt. This water is of a bright red, taking its colour from cinnabar or quicksilver mines, which are very plenty on the Canadian. Large blocks of rock salt of the same colour are found in the crevices of the mountains eastward of these lakes. There are three in a range; their beds are a solid mass of muriate of soda, and beyond them are immense plains where the eye beholds nothing but naked hills of light flat sand, mixed with the fragments of snails, and perhaps marine shells pulverised like wheat bran. These hills move about according as the wind directs them, sometimes eight or ten miles or more at a time. They are impassable; one would sink in them as in ashes.

The north side of the Arkansas exhibits a prairie country having all the characters of a mineral region.*

* It is inhabited by innumerable herds of Buffaloes, wild horses, wild goats, (*Berindos*) prairie wolves and common ones. There are also, it is said, prairie dogs, called by some republican dogs, on account of their living in large families, and having, according to popular impression, watches placed round their encampment. They burrow under ground, and when they come out of their holes, which they always evacuate in a body when the sentries

Other facts respecting the Cove of Wachitta.

Since I was at the Cove of Wachitta, I understand that an Indian has found a piece of native copper of the size and shape of an ear of Indian corn. He melted and doubtless used the copper, for some of the Cherokees on the Arkansas are tolerable silver-smiths. Pyrites is found here in abundance, so is native copperas, or vitriol; this forms a component part of some veins running through a large bed of a milk white and apparently talcose earth, which the blow pipe, even when aided by borax, does not affect.

Burr Mill Stones.

On the hills surrounding the Cove there are among the Spathose iron stone, and the fibrous and compact heavy spar, some of the siliceous stones with which the French Burr mill stones are made. They are pronounced by a good judge to be of a superior quality; this person caused to be cut, from a solid block, a pair of stones twenty-two inches in diameter.

Alum Slate.

Twenty four miles from the Cove between that and the Arkansas, one hundred yards to the left of the road, after crossing the third fork of the Saline river, and immediately on its banks, there is an acclivity leading to a perpendicular wall of about one hundred feet in height; this is composed of a black slate, (aluminous shistus) rather inclining in its position. The observer, on removing a few of the loose slates under his feet, will discover the upper surface of many thousand tons of Alum. It is the kind called Feather Alum (plumose alum.–*Ed.*) it is in large light cakes, matted in with some pieces of slates and composed of long needle shaped crystals of a bright whitish hue, between that of silver and silk

perceive any thing, they bark or make a kind of clapping noise, on which account they have been referred to the canine tribe, although they appear to resemble them in no respect: but, what I know of them is only by hearsay. I have however seen their stamping ground, and their holes, which appeared to be very deep. For this reason travellers can never catch them, and rarely even get sight of them, except a few beaver trappers who venture thus far with their traps, which they set at the entrance of the holes. By what I understood from the information which I have received, they appeared to resemble the weasel more than any other animal, although they are larger and have a long snout.*

* *See Pike's Journal.*

Hot Springs.

The hot springs of Wachitta have proved to be the most efficacious thermal waters in the United States. Their reputation, particularly in one disease, has undoubtedly reached the most remote corner of our country; it is much to be regretted that visitors find no accommodations When I was at these springs, there were two hundred and eighty persons. A number had come more than one thousand miles from home; but they all appeared to suffer for want of accommodation, provisions, &c. for, in fact, they had none of the comforts which they ought to have had. Still, notwithstanding, every year about the same number of persons come hither, and they generally return well. The heat of the water is 192° of Fahrenheit; there are about thirty springs; two are about forty feet above the level of the other springs; the water in those is only 186°. They issue out of a bed of fibrous heavy spar* which some travellers have taken for a volcanic production, but I could see no trace of any such agency. Some sulphur which is seen in the pores of the spar, in some places mixed with a metallic substance which I took to be iron, has been deposited by the water, but it is not volcanic sulphur. Indeed, the country is well known for more than five hundred miles around, and no signs of burning volcanoes have been seen. There seems to be little or no foreign matter dissolved in this water, for it has no peculiarity of taste whatever, and is generally made use of for tea, and indeed for all culinary uses; besides being drunk when it is cold enough. Still there are good springs of water flowing down the hill, after issuing from the earth not two hundred yards from the hot springs. All the springs together will, with ten feet head, yield a supply of water equal to eight inches square, and perhaps more. They are seated between two hills, running parallel, joining together in the shape of the letter U, and forming a valley which is very level. The stream of the springs flows towards the eastern wall, where it extends for one quarter of a mile, in all that extent receiving the springs, besides the very high ones mentioned before; there are a few, four or five feet above the branch; the others are quite low.

* Probably fibrous sulphate of barytes—possibly fibrous sulphate of Lime. —*Ed.*

Soil, Productions, &c.

At first sight, the country about the hot springs appears poor, being composed principally of pine lands; but experience has proved, that the pine flats, which are very extensive, produce the best of wheat, and cotton of a superior quality. The soil produces, moreover, the majority of the other productions cultivated in that climate; a great quantity and variety of grapes, of an exquisite quality, and as large as musket balls, are found in the woods.

The extensive surrounding country is populating rapidly, in spite of the repeated orders which have been given to the settlers to move out of that region. Emigrants daily pass over the Arkansas, and they count already, upward of 3000 individuals spread, since three years, about the springs Fourche Cadeau, Little Missouri prairie *aux Anes*, Mount prairie, (a thick settlement,) and Pacane point, joining Red river, above the rafts.

Indian Nations—their Manners, &c.

A small party of Cherokee Indians, amounting to about forty, likewise went over the Arkansas last year, to form a settlement on the Red river; they are increasing every day by the accession of dissatisfied persons living on the Arkansas; they will probably, all pass over there before long; and claim both the country they will have in possession, and that which has been given to them by treaty, in exchange for some of their lands in Tennessee.

Nearly all the country, lying between the Canadian river to the west, the Red river to the south, the Wachitta to the east, and Arkansas to the north, is claimed by a small remnant of a once formidable nation of Indians, called the Arkansas or Quawpaws, (from Ogâghspâgh floating with the current or down stream.) They pretend to have come down the Ohio about five generations ago, and at the confluence of that river, as some wanted to go up the Mississippi, and others to descend the river, they divided into two parties: these came down stream as far as the mouth of Arkansas, which they ascended about thirty miles to the first prairies; the others ascended the Mississippi and the Missouri. They are the Mawpaws settled below the river Kansas. They understand each other perfectly well. The Osages are said to have sprung from these, and their language differs very little from that of the other two. All three tribes abound with tall, well-proportioned, and large men. Both in their physical and moral faculties, they are much superior to all the other tribes of Indians inhabiting North America.

Amongst the Osages, there are some unsubordinated stragglers, who now and then commit depredations abroad, but in their villages, as in those of the other two tribes, a stranger is in more security than he would be in any civilized city. Their hospitality exceeds all bounds; they act as if nothing was their own, and the best way to please them, is to refuse nothing from them. When a trader stops his boat on the Arkansas, at the landing place, forty-six miles from their village, they immediately send people to transport his goods to the village; they unload the boat themselves; station a guard to take care of the empty boat, sometimes for four months; and they pack the goods themselves, disputing the privilege of lodging the people of the boat, whom they divide among them. The merchant is reserved for the principal chief, who gives him a warrior to guard his person and his goods, besides many other attentions, which, with delicate although unpolished courtesy, he pays to his guest, who receives every day, a large wooden bowl full of provisions, from every one of the principal cabins of the village. The bowls contain smoked pumpkins, cut in slices and plated together; sweet corn which they boil when green, and dry in the sun; buffaloe's dry meat, and bear's meat, or fresh venison and turkeys. All the other Indian tribes, except these Osages, eat beaver; the latter have a tradition, by which they pretend to have sprung from a female beaver and a snake. They, like most of the other tribes, believe in the metempsychosis; they revere a Supreme Being, whom they call Kaykay, (great Chief,) to whom they always present the best piece in the dish, which they bury in the fire before they eat. They have a great veneration for old people, for the use of whom the first choice of their provision is put aside. When the whole village united, surrounds a herd of buffaloes, by making a double fence, with their own bodies, so as to encircle sometimes forty or fifty of these animals, two or three men on horseback pursue the animals within the circle with their bows and arrows, (for they never kill a buffaloe with a gun,) and when all are killed they first select the fattest for the old people, and the remainder is divided among all the others.

They have prophets, whom they call thinkers; they prophesy many absurdities, which they pretend are communicated to them by messengers of the Great Spirit, with whom they can converse when they are in a profound sleep, occasioned by a certain somniferous beverage, which they know how to prepare. They are very adroit in playing a number of tricks which, to the Indians, appear to be of a very serious nature, and some of them would surprise our own show masters. The most extraordinary is a secret they pretend to have, of a composition which preserves them altogether from the action of fire. After anointing their hands with this composition, which leaves no mark on the hand, they take hold of large stones red hot,* which, even at arm's length, would burn any other person. The acid of a kind of prickly ash *(zautoxilum)* enters into the composition; that is all I could find out. They likewise expose threads on a round siliceous stone, in the fire; they do not burn—but this was known before: all silex has that property. The rounder the stones are, the better they preserve the threads, and if they are perfectly round they preserve them entirely. I have seen also, several in the possession of some of the French hunters on the Arkansas, which have manifested that property.

The Osage prophets are likewise their physicians.

The Osage village on the Verdigris river, contains about two hundred and fifty lodges or cabins, of about forty feet by eighteen or twenty, placed with little regularity: some are built with barks, and others with upright poles; they are all nicely covered with plated flags. The village stands in a handsome and fertile prairie, where weeds grow twelve or fourteen feet high.

Near this village there are three beautiful mounts, which may be eighty or one hundred feet high; the surface of one is perfectly level, and is more than 150 yards in diameter. The rest of the country, for a great distance round, is almost level. The mounts afford three fine springs, which yield good pure water, although the country is a calcareous one.

* Mr. Bringier does not inform us, whether he received this from *hearsay;* he relates it *with the air* of belief, but possibly he meant it only as an example of *legerdemain*, where one thing *appears* to be done, and quite a different one *is* done.—*Editor.*

Salt Springs.

Fifteen miles from the village, is the saline which yields the water that gives one-sixth of salt. One Herhart had put up about thirty kettles on that spring.

Historical Anecdote.

But last year the Cherokees persuaded a number of other tribes to join them, and destroy the Osages, in order to take their rich possessions, (for these prairies afford the most fertile lands in the United States;) but they were deceived in their expectations. Six hundred and fifty of them, after committing the most atrocious act towards a flag of truce, sent to them by the Osages, were defeated by three hundred and fifty Osages, whom they had even surprised in the night; but returned home shamefully beaten, after butchering ninety-six women and children whom they traced into a cave, where they had hid themselves. As the Herhart mentioned before, had committed a murder in the Indiana territory, the Cherokees threatened to deliver him to the governor, if he did not draw the Osages into their ambuscade. To effect this object, he did his best; but the Osages mistrusting the propositions of the Cherokees, which Herhart was charged to interpret, refused to come and treat for peace without arms, as they were requested to do. One warrior said he would go, and followed Herhart; as he arrived, the Cherokees fell on him, and while they were disputing who should have the honour of killing a defenceless wretch, having already several spears through his body, "Finish your deed," (said he:) "my death, justifying the opinion we had of your '*canardiere*',* will manifest the wisdom of our old men."†

The Osages.

The Osages on the Verdegris, may amount to about fourteen hundred altogether: and they had, in this last engagement, all the men they could or can muster. It is said that the White Hare village, on the Osage river, the Missouri two villages, and the band *de la Chenierre*, amount to a

* Decoy—ambush.

† Herhart, since that time, has abandoned his salt works.

population of two thousand souls, including two small new villages on the head of the Verdegris. They all cultivate Indian corn and pumpkins, in one field common to all and not fenced in; none but the women work in these fields, which are about half an acre for each woman. All their tools consist in one hoe, and a large tomahawk.

The Osage women are generally very homely, which must be attributed to their hard labour.

A man may have as many wives as he can obtain; these mayleave their husband when they please, and the man, on his part, can repudiate his wife, but if she belongs to a family of consideration, he is liable to have an explanation with the men belonging to it. The Osages have no other law but the law of nature; the law of the strongest. If they commit a murder, they must submit to the law of retaliation, or redeem themselves with one hundred fathoms of wampum beads,* presented to the nearest friends of the murdered, who are the only ones who pursue them. The Osages are very faithful. There is no instance of any trader having lost, in consequence of the credit given to them. When necessity or bad fortune obliges them to postpone their payment to another succeeding hunt, they are always found to be punctual. They are sober, and never take spirituous liquors. Their wealth consists in horses which they possess in great numbers.

Cherokees.

But what a dreadful contrast is presented by the Cherokees, who possess all the vices which the Osages have not, and not one of their good qualities. I have witnessed so many infamous acts of these half civilized savages, that I revolted at the idea of tracing them. Did they not rob three out of four boats with force and arms last year? Did they not, about the same time, in several instances, murder their own friends while drinking with them, and when showing no spite a minute before? Did they not dismount a number of travellers, and send them on foot when they did not murder them? Can their neighbours keep any horses or cattle? Have they ever paid a cent entrusted to them,

* Beads made in Canada of clam shells

except what the United States paid out of their annuity? Was there ever one seen sober, where spirituous liquors could be got? Is there any hospitality amongst the Cherokees? No! I will dispense with answering the first questions; but I will warn the travellers, who should happen to cross their settlement on the Arkansas, to be on their guard wherever they incamp; otherwise they are sure to be left on foot next morning, unless their horses should be of very little consequence. In that case, an officious fellow will offer himself to go and hunt the horses, sometimes for as much as they are worth,* and he will always be sure to find them where the thieves had left them under the care of another Cherokee, often fifteen and twenty miles out of the way. They are haughty and deceitful to the last degree, and, in one word, completely perverted. It is true that these Cherokees on the Arkansas, are those who have been driven away, and have fled from the old nation on the Tennessee river, (with whom I am not acquainted.) However, it is notorious that all the Indian tribes in a state of civilization, within the limits of the United States, are extremely corrupted, whilst those under the Spanish iron rod, are mild, and possess no other vices, except those inseparable from ignorance.

Indian Languages.

Some may object that they can be of a different temper; but I will mention a circumstance, which evinces that there is no great difference between these very Cherokees, and the Othomite Indians in the province of Michioican, (in Mexico,) who, notwithstanding their great distance apart, speak nearly the same language, (at least I found much resemblance with some words, and a perfect one with others, which I noted in a journal, whilst I was viewing the province of Michioican, which is mostly inhabited by the Othomite Indians, who are seldom found to speak Spanish.) As water is very scarce in those parts, I often had to enquire where I could find some at hand for my horses; and very often I was presented with salt, instead of water. By making further inquiry, I found out that *ama* was water, and

* They never agree to go out until they think you have given up all hopes of finding them.

aman was salt. These two words I was particular in setting down with their true pronunciation; and I found them, after I learned the Cherokee language, to correspond precisely to the same thing amongst them. The other words, which I was rather careless about, have some similar sounds; but every one knows how difficult it is to seize the pronunciation of a dialect we do not understand.

Cherokee,	Naytaw,	Sellaw,	Chennoyhay,	Catouch,
Othomite,	Noatsaw,	Deghton,	Chonoyay,	Cahatogh,
English,	Sun,	Corn,	Night,	Mountain,

These are the common names which I find in my journal, and if corn differs thus much, it is not improbable that they did not know that grain, before they left the source from which they both took their origin. Cahato, in Cherokee, means bread, and cato means the earth, catouch means mountain; and in Othomite, cahatogh means mountain, where we find resemblance in the sound, and with the word cato, the earth, and cahato, a loaf of bread; but I doubt whether they knew how to make bread before they knew corn.

Digression *on the province of Michiwacan.*

Whilst I am adverting to the province of Michiwacan, (although it is far out of my present sphere,) I will add something on that topic.

In the province of Michiwacan, or from Tobuca to Salamanca, and more particularly about Acambaro, to the west of lake Gasquaro, there is a number of thick veins of vitreous lava, running in all directions. In some places they occur in large bodies, all shivered confusedly. This kind resembles perfectly, the glass of the English porter bottles; it is very compact; the Spaniards call it pedernal. I have seen it no where else, except some few small pieces used for arrow points, found in the numerous Indian mounds which cover the greatest part of these western countries.

Indian Mounds.

They have a great resemblance to the old Mexican villages, built with raw bricks of fourteen inches square, and covered with limbs, and turf on top, which, when mouldered down leaves a mound, such as a traveller is never out of sight of, from Red river to St. Louis, Missouri Territory. In this distance of about five hundred miles, in a breadth of, in some places, eighty, and in others, two hundred miles, and seldom more than three-quarters of an acre from each other, these mounds constantly occur; and, generally, they are symmetrically arranged. In all this extent, there are hardly two-thirds of the surface vacant. What an immense population must have inhabited these innumerable huts! They all contain the ruins of human works; and many of them the bones of the inhabitants, and some of their productions.

On the banks of White river, where the earth had caved in, I found part of an earthen coffin, in which the neck bones and the scull were yet remaining; and on top of the neck bone, as I dug to see what bone could be inserted thus in part of an earthen box, I found a parcel of pieces of bones cut round, and remaining on the neck in the exact position in which they had been used as a necklace. They were pierced, but the string had entirely disappeared; they were the one-eighth of an inch thick, and three-fifths in diameter; and the bones of which they were made, were much better preserved than those of the skeleton. This, I was confident, did not belong to the modern tribes of Indians which inhabit some parts of that country. I found among the clay, which rolled down from the same mound, several pieces of lead ore, (common galena,) which had been carried there. It is not uncommon to find this ore amongst human bones, throughout the whole country; probably they used trinkets made of lead, and this was a provision for them to dress in the other world.

Ancient Fortifications.

There are several curious fortifications in these western countries; but they are described by Clark, and Lewis, Capt. Pike, and others—except one within two miles from the banks of the Arkansas, and two miles and a half to the north of a base line, commencing at the mouth of St. Francis river, latitude 35°, and running due west till it strikes the Arkansas, at a distance, across, of eighty-two miles and a half, three hundred and twenty miles from its mouth, or twenty-four miles below the crystal rock. This fortification is tolerably regular, covering an area of about twenty-five acres; the trenches remain about eight feet high, and the ditches which are nearly filled up, seem to have been very deep, and about twenty-five feet wide. There are two gateways, in the inside of which there is a large well, which probably was a covered way; and in the centre there are two mounds about eighty feet in height, whose bases are about three hundred feet in diameter, with a truncated summit offering a surface of about ninety feet across. Both are artificial, and perhaps were formed from the dirt out of the ditches. The country around is perfectly level.

The Cherokees.

From this digression we return to the Cherokees, who are divided into seven clans or tribes; there were twelve tribes, but five of them having been too much reduced, joined the others, and there now remain but seven, viz.

The Neewahaya—means the Wolves; they are the most populous.
The Neekeelawhay—the Floating hair; next do.
The Neekawtaylaway—the Blind in the field; third.
The Neewawtay—the Pyed or Painted: fourth.
The Neecaway—the Deer in the field; fifth.
The Neeshawnee—(*I do not know the meaning of this;*) sixth.
The Neekoola—feeds upon Acorns; seventh.

No Cherokee can take a wife in his own tribe; it would be considered as an incest. Each tribe forms a family, and the individuals call one another brother and sister, making no difference between their relations of the same blood and those who have not the least affinity with them. They are therefore obliged to marry with other tribes, and the children belong to the tribe of the mother, who protects them as brothers and sisters. The father has no control over his own children; but the mother, and her own tribe, have power of life and death; and no member or members of any other tribe, not even the father, has a right to interfere.

If a member of one tribe assassinates a member of another clan, it is the duty of his nearest blood relation, ("*consanguine*,") belonging to the tribe of the deceased, (for a Cherokee who has two or three wives of different tribes, may have children by all three wives, and these children are not, by their laws, related to each other,) to waylay the murderer, and kill him; unless this last can escape, and return with seven scalps, which he must present to the tribe whom he has deprived of a member. This must be performed before the expiration of a certain period or epoch, which, I believe, is during their assembly of the green corn dance, which takes place every year before they ever dare to taste of a grain of new corn. These assemblies last sometimes several weeks, and they often come one hundred and fifty and two hundred miles to attend them.

On these occasions, they discuss all their matters of consequence, and their prophets display their eloquence. In 1812 I happened to assist at one of these assemblies; and I will copy the following speech from my journal, for the sake of giving an idea of their eloquence.

Cherokee Prophecy.

Speech of the Cherokee Skaquaw, (the Swan,) on the 3d day of June, 1812, *at Crowtown, on St. Francis river.*

"Ye red men, who have prepared to fill yourselves with the words which will mark what will come to pass. (Atea,) (a word which they repeat at the end of every sentence, as we should say, *Amen.)* If thou hast been continent nine nights and days, and viewed the sun these two last days with a hungry stomach, open your ears, and feed with the sacred words which the ever great Spirit (*Skayaaguste*) has sent in my mouth, for me to transmit over to his red children. (Atea.) It was about one moon before the earth first shook, or about seven moons ago, one night, when every thing was silent, and the sky as clear as spring water, that I was standing leaning on a stump, contemplating the blazing star, (comet,) those everlasting lights which sparkle from one horizon to the other, when suddenly four lightnings departing from the four opposite points, came and alighted together at my feet, and there I perceived the blazing star; I first raised it on a chip, but perceiving it did not burn the chip, I tried with my finger, and found it was a *tame* fire. The moment it was in my hand. I saw two children come towards me, one from sun set and the other from sun rise. They were as bright as the sun of noon, and exhaled a perfume which laid my senses asleep for a few seconds; when I awoke I was in the hands of one of the children; my spirit had passed into the blaze of the star, and I perceived my body leaning on the stump where I had left it. (Atea.) *Skaquaw*, said the child which held my spirit, we are the messengers of the Ever Great Spirit; we have come to bring the word of truth, for the red children of our beloved father, who lives beyond the blue world above, as nothing from there can have any communication with the impure matter here below, we have parted your spirit from its mortal body, which we have purified in this celestial fire, its present body. Now you are ready to hear the word of the Great Spirit, open your ears *Skaquaw*. The Ever-Great spirit, with your mouth, speaks to his beloved red children, that he has determined to put an end to mankind,* their mortal enemy, and save his children alone; the fire of war is burning already in all four corners of the earth. Watch for a sign, and the earth will soon shake, like a horse who shakes the dust from his back; but be sure to move away from St. Francis before the next sign manifests itself: go towards the sun set, and travel until you are stopped by a big river which runs towards sun rise; there stop, plant corn, and hunt in peace, until the last sign prepares you to hope for days of happiness, (it says days without clouds)— a spark brighter than the moon, will give light to the earth, drive away the winter, and drain the swamps; corn will grow in all seasons; and there will be but two families on the globe, (it repeats earth,) one to the sun rise, and his beloved red children to the sun set.' (Atea.) As soon as he had thus spoken, the other child blowed out the blaze; my spirit resumed its mortal body, and I perceived them no more. (Atea.)"

The singularity of the ideas of this prophet, induced me to set down his prophecies, which I did nearly in his own metaphors.

I must observe, that the Cherokees, like most of the Indians, speak aphoristically. The result of these prophecies was the total evacuation of St. Francis river. Two or

* It says, "mankind, the mortal enemy of mankind."

three months after, all the Cherokees abandoned their farms, (and some were very good ones,) their cattle, and other property and removed, some to White river, and the greatest part to the Arkansas. Those that fixed on the White river have since removed to the Arkansas, where they occupy the river on both sides, from point Renou, (four hundred miles up the river,) to the Big Mulberry, where the Osage line crosses: departing from the fine prairie on the Missouri river, the land they occuppy is far the best on the Arkansas.

Anthracite.

On the north bank, a little above the pine bayou, (five hundred miles from the mouth,) there is a large body of blind coal immediately on the bank of the Arkansas. It is equal in quality to the Kilkenny coal; it is by far the best I have seen in the United States.

About one hundred and twenty miles above this place, there are some United States troops, who stopped there a few months since, and probably they will take a station at the mouth of the frog bayou, which affords a fine place for a garrison, between the Osages and Cherokees.

The Cherokees on the Arkansas, are about twelve hundred and fifty. They have cleared about six thousand acres of land with the fire which they have set in the thick canes; but they do not cultivate more than two thousand five hundred acres, and that very badly. They raise no other staple except a few sweet potatoes and pumpkins, although they might cultivate a great quantity of cotton, which grows exceedingly well on the Arkansas, and whose quality is much superior to all that is raised in Louisiana. The Indians spin some cotton, but this hardly amounts to five or six yards per annum, for each of those who spin, and these are but few individuals. Indeed, the whole amount is not two hundred yards. The women are very licentious, and the men extremely lazy. The men dress with what we call a morning gown, or a long hunting shirt, a pair of leggings, a calico or a white shirt, and a shawl tied around their heads in the manner of a turban. The women dress with gowns like white women. They are homely, but less so than the Osage squaws; but they do not look so well as the Quawpaws, who have a custom peculiar to them alone, to distinguish the women from the girls, by the different manner in which they put up their hair. These Quawpaws have four small villages, two hundred and sixty miles below the Cherokees, on the south bank of the Arkansas, extending along the bank as low as the post. Although they have been better than one hundred years with the French hunters, they are precisely in their primitive savage state; and what is strange, most of the French hunters who have lived with them, are nearly savages like them. These Indians are very mild; and, in every respect, the best savages in the world, though very miserable, and in all other respects they resemble the Osages.

Anecdote.

A trait of magnanimity worth figuring in the annals of the aboriginal American heroes, is evinced in the following act of Kaÿkay Watonica, one of the ancient chiefs of the Quawpaw Indians. The fact occurred about the time when the French first came on the Arkansas river, which French gave a common name to all the tribes on that river.

This chief leading a party of one hundred and twenty Quawpaws,* in pursuit of the Chekessas, overtook them at the mouth of St. Francis river. This party consisted of two hundred and sixty men, who were making all speed to cross the river in order to avoid an engagement. Kaÿkay Watonica taxed the Chekessas with cowardice; they replied that they could not make defence, as their powder had got wet. Well, said Kaÿkay Watonica, send yours here; we have some which is dry, it is not enough to share with you, but we will mix the whole together, and then we will share. This was done accordingly—all the horns were emptied on

* When Mr. Lasalle, and after him, Mr. Delatharpe, first came on the Arkansas river in 1617, they found it inhabited by the Quawpaws, the Nasonites, the Sacks, the Cherokees, and the Kansas, who were the first tribes they met with. They called the river *des Kansas*, which meant the river of the Kansas, and all the other tribes were named after the river. As these Indians made very fine bows with the bow wood mentioned before, which grows on this river, their bows were in great demand amongst the other tribes, who generally gave a good horse for one of them. So a Kansas bow was something of importance, which makes *Arckansas* in French. The river took the full name, and all the Indians of course: hence the Quawpaws and Arkansas are synonimous.

a blanket, and equally divided; and then addressing the Chekessas, now, says he, when this tree falls it will give the signal of the engagement: therefore be ready. He then ordered a small tree to be cut by one of his warriors. The issue of the action was, the total destruction of the Chekessas, and only five killed on his side. They spared one of the Chekessas, whom Kaÿkay Watonica sent home free, to give the news to the Chekessas, who soon after made peace,* giving up altogether, their pretensions on the west of the Mississippi.

The Cherokees.

I now return to the Cherokees, and their green corn dance. I said that a murderer must return within a certain period, otherwise the life of his nearest friend must pay for that of the murderer; for that reason it is very common to see a brother kill his full brother who has become an assassin, not with a spirit of justice, but for self-preservation. This is savage philosophy: they say one must die in any event; and if the murderer is a coward, it is soon over with him, but a famed warrior can kill as many as he pleases with impunity.

Indian Cruelty.

One Catecantiskey (the dirt-seller or merchant of earth) was boasting one day, in my presence, that he had killed nine or ten Cherokees, and had redeemed himself with

* The last engagement which took place between the Quawpaws and the Chekessas, offers another singularity. The Chekessas, seeing that they could gain nothing against the Quawpaws, sent a *calumet*, (this is a parlimentary with tobacco and pipe,) to make peace with the enemy; during this time a party of discontented Indians, about thirty in number, started to make a last *coup de main*, but unfortunately they fell in with Kaÿkay Watonica, with one hundred men and more. As they took to their heels, Kaÿkay Watonica hailed them to stop, and not to show themselves such cowards; the Chekessas replied, he was too strong for them; you are right said Kaykav Watonica; but come and I will give you a fair chance: here pick out two of my worst men, and oppose them with two of your best, in single combat; if your's are victorious, you may hunt on this side of the Mississippi; but if mine are victorious, you must come no more and disturb my game. The challenge was accepted. The contest was warm, but Kaÿkay Watonica was still more fortunate than the Romans, for he lost none of the modern Horatii, and was presented with both of the now Curiatii's scalps.

American scalps, which many times he delivered without counting; for he had never penetrated into any houses, without finding children more than he needed for the present.

This was during the Indian war it is true, but who would not revolt at hearing a monster in human shape, boast of having slaughtered seventy or eighty harmless women and children, to redeem himself from punishment for the murder of his companions. I could not restrain myself from telling him, that his boasting of such atrocious deeds had torn off the mask which hid the blackness of his soul. (They make use of wooden masks in their dances.)

Yellow Wood, resembling Fustic.

I have omitted to mention, that on the Arkansas and on Red river, we have a great quantity of a yellow wood answering perfectly well the same purpose as the fustic. It is called *bois d'arc* by the French hunters, (bow-wood,) but it is absolutely a non-descript. It is like the fustic of the *morus genus*, with some modifications.* The wood is as tough as whale bone. The Indians made, and still make, all their bows of the wood of that tree.

We have likewise the tree which gives the vegetable caoutchouc or elastic gum. This tree is the same that they have in Peru, which they call Higera del oule; the bark of this tree being pounded and washed, gives one-third of its weight of oule, or caoutchouc. The tree does not grow of the largest size; it has a tolerably smooth bark; when this is cut, milk exudes, which coagulates and forms elastic gum. It has the strong smell of the common caoutchouc; the leaves of the tree resemble those of the pin oak; it bears a black olive, a little smaller than the common olive; it is sweet and good to eat, the birds and the bears being fond of it. The French hunters on the Arkansas, call it *arbre a gomme*; it is easily known by chewing a piece of the bark—the gum remains in the mouth; or if a piece of the decayed bark is washed until the rotten *ligneous* substance is gone, the remainder is pure. Some Americans, to whom I have made it known, on the Arkan-

* I cannot find the description I had taken of the tree.

sas, told me it was very common on the Ohio, and all over Kentucky, but none could tell me the name. The bark of the tree is rather whiter, and the leaves very deep green, resembling the live-oak and the pin-oak, as I have before remarked. Some trees will yield from one hundred and fifty to two hundred pounds of caoutchouc. I have observed, that this wood, when dry, is very electric; like the caoutchouc if rubbed on a body which is electric, particularly in a cold day, the body rubbed will adhere to the wall; a quill for example, will be attracted six inches from the wall, and stick fast to it, until all the fluid is dissipated. But the electric excitement of this substance differs ftom the common; it has not only the property which the idio-electric bodies possess, but it communicates the same properties to the anelectric bodies. The gum elastic drawn several times on a quill, produces the same phenomena: these experiments made in a cold winter's day, afford some amusement.

SUPPLEMENT.

Although this communication might be much farther extended, I will close it with a few miscellaneous facts and observations.

On the head of the river Trinity, longitude from London, 95° 10′, and latitude 32° 7′,* are, or were, several blocks of native iron, from one thousand to seven or eight thousand pounds weight—one of which was taken to New-York, weighing twenty-five hundred;† it is now in that city.‡ It is very malleable, and equally good as the Swedish red short iron. How did these masses come into that prairie? (for they are in a prairie,) is a question worth resolving: for what process in nature can reduce iron ore to a state of ductility, except the hammer.

It is observable, that there is a kind of varnish, which covers them all over, and prevents their oxidation. I must rest on the suspicion, that they proceed from meteoric bodies; and this is countenanced by the manner in which they are scattered about over an extent of about seven or ten

* See Melish's Map of the United States.

† Over three thousand—*Editor.*

‡ It was afterwards bought by Col. Gibbs, and deposited in the Museum of the Literary and Philosophical Society of New-York.—*Editor.*

miles, without any sign of iron ore or other minerals in that region. The varnish can proceed only from a sudden cooling, after changing the atmosphere. Whether dampness in ours, or whatever cause might have occasioned the explosion, that event will explain the scattering of the pieces.

A few miles to the east of these blocks of native iron, a belt of trees is seen extending itself towards the SS. E. The hunters know this by the name of the cross timber; they mean that it crosses the prairie; for there is no other wood in sight. This wood grows in a low ridge of lime stone, which extends to the north-west shore of the lake Sabine, bordering on the river Natchez; but here it is only one mile in breadth, whereas, ten miles above, the timber spreads from fifteen to twenty miles in breadth. It gives rise to the waters of the Trinity, whose west fork runs entirely through it. These hills afford a great number of enchanting seats, whose description would occupy a great deal of time, without affording me any hopes of success; for they are beyond description. The trees, which are naturally low, but spread very wide, become smaller and smaller towards the north-east, till they grow quite scrubby. The country is siliceous, and a soil of gravel and loam produces a great variety of distinct qualities of grapes, in patches of twenty miles surface; one acre of surface will here afford more grapes than three acres will in the best cultivated vineyards. These grapes are certainly suitable for wine, if one may judge by their fragrance and flavour, and their good appearance. Some are white and transparent, so that we can count the seeds through them; some are blue and very sweet, but hard, in a thick skin of a yellow or straw colour; and are very large, nearly or quite as much so as an English cherry. The former are a little smaller. The black are not sweet, but very fragrant, and the pulp is as thin as if they were cultivated grapes, something like those of Sovignon. In fact, the view of these extraordinary grape patches would astonish even the person who should have perused this description before. To the north-east are immense prairies which the eye cannot measure.

ART. V.—*Notice of "Geological Essays, or an inquiry into some of the Geological Phenomena, to be found in various parts of America and elsewhere—by* HORACE H. HAYDEN, *Esq. member of the American Geological Society," &c. &c.*

THE author of this volume has long been known, to the cultivators of mineralogy and geology, in the United States, as an active, acute and successful observer in this department of Natural History. Although we believe he has never before appeared, *in form*, as the author of a distinct work, he has aided others, by the communication of valuable facts, and we observe his name frequently cited, as an authority, in Professor Cleaveland's valuable Elementary work, on Mineralogy and Geology. Those who have been accustomed to contemplate Mr. Hayden with respect, as a devotee to science, in the midst of the distractions of business;—while they will not find their respect diminished, will be gratified at observing the persevering and discriminating industry—the patience of research, both in the great volume of nature, and in the volumes of men, and the signal zeal, with which he has prosecuted an investigation, that must have cost a great amount of labour.

We are free to say, that we have perused his work, with much pleasure and advantage, and that we consider it as a valuable acquisition to the science, to which it appertains.

At the same time we cannot help expressing a little regret, that the respectable author had not pruned off from his style some redundancies and inaccuracies, of expression. These are however in a considerable degree, veiled by a glow and energy of thought and language that evince a mind at once ardent and vigorous.

As verbal criticism is not our object, we leave these minor things, to the author's own correcting hand, and proceed to the far more grateful task, of stating the object and scope of Mr. Hayden's Essay.

This work may be regarded as a history, to a very considerable extent, of the most important alluvial formations of our globe.

In the systematic arrangement of Mr. Werner, it is well known that the three leading formations, the primitive, the transition, and the secondary, occupy a rank far more extensive and distinguished, than the volcanic and the alluvial. The latter has been, for years, growing in importance in the view of geologists, and has, in consequence of much contemplation and research, assumed, in Mr. Hayden's eyes, a rank not inferior—to say no more—to that which he allows to the other formations. Indeed his book, (provided that no very commanding importance were attached to the peculiar theory which the author so zealously espouses and defends,) might, we imagine, be very properly, entitled, *materials towards a history of the alluvial formations of our globe.* In this view, the collection is rich and various, and we are disposed to think with an intelligent scientific friend, must "become *a text book*, for geologists, in the subjects of which it treats."

Indeed we are not aware that there can be found, in any single author, so complete a view of alluvial districts, as Mr. Hayden has presented, and it is probable that the elaborate defence of his peculiar theory, has thus, incidentally secured to his work, a perpetuity which even that theory, however beautiful, might not have enjoyed.

We do not however mean to prejudge this theory, but perhaps it would have been as well to have made it a deduction from the facts, rather than to have prefixed it to them; the latter method is the most grateful to the majority of minds, while the former is perhaps safer, and more apt to lead us to truth.

The quotation from Patrin, which Mr. Hayden has introduced upon his title page, gives, it is true, a very just view of the uses and consequently vindicability of hypotheses, and certainly the course pursued by our author, is entirely justifiable.

In his preface he states that "the principal and only motive by which he has been actuated, is the wish to interest and invite the attention of geologists, naturalists, and scientific men of every denomination, to the great and important physical changes, that appear to have taken place upon and near the surface of the earth, in various parts of the world, and more particularly in our own country; and also to the numerous and interesting facts, that seem to have, not only a direct relation to, but an intimate connexion with those changes; and this with the view of enabling us to form, something like correct ideas of the causes and operations, by which they were produced; and possibly too of the *times at which* they took place.

Among the most prominent of these changes (and which may be considered, as being one of the most interesting features in the geology of this country) is the alluvial region, skirting the Atlantic ocean.

It is this which constitutes the principal subject of the present work, and in the examination of which, he has endeavoured to adduce facts sufficiently numerous and strong, to prove that the whole region, with the attendant phenomena, is the result of the operation of currents, that flowed from the north-east to the south-west; or from the north to the south over the whole continent of America."

The existence of the vast alluvial district of the southern American states, has ever appeared to us, as it does to Mr. Hayden, as a very interesting geological fact, and by no means, to be accounted for by the commonly received opinions respecting alluvion. In Mr. Hayden's view, there is no circumstance that affords so strong an evidence of the cause of its formation, as that of its having been deposited by a *general current*, which, at some unknown period, flowed impetuously across the whole continent of America; and that from north east to south west."

Those who may regard this opinion with the smallest degree of favour, will be struck with the numerous proofs which the author has adduced in its support.

The almost universal existence of rolled pebbles, and boulders of rock, not only on the margin of the oceans, seas, lakes, and rivers; but their existence, often in enormous quantities, in situations quite removed from large waters; inland,—in high banks, imbedded in strata, or scattered, occasionally, in profusion, on the face of almost every region, and sometimes on the tops and declivities of mountains, as well as in the vallies between them; their entire difference, in many cases, from the rocks in the country where they lie—rounded masses and pebbles of primitive rocks being deposited in secondary and alluvial regions, and vice versa; these and a multitude of similar facts have ever struck us as being among the most interesting of geological occurrences, and as being very inadequately accounted for by existing theories. Pebbles may, in given instances, be formed, (possibly,) by decomposition of the angular portions of a stone, by various chemical agencies, aiding those of a mechanical nature, but an immense number, and in our view, the immensely *greater* number of pebbles, present unquestionable evidence of having been brought to their rounded form by attrition.

The attrition of the common waters of the earth, and even that exerted during the comparatively short period of the prevalence of the deluge of Noah, would do very little towards producing so mighty a result, and we must assign this operation to the more recent periods of the prevalence of the great chaotic deluge, whose existence is distinctly recorded in the first chapter of Genesis, and equally admitted by all geologists. However strongly inclined, we have neither time nor room to pursue this fruitful topic any further, but must leave it to return to Mr. Hayden's book.

In support of the opinion, that our alluvial formations have been produced by currents, the author mentions "the wave-like or undulating appearance of almost every section of alluvial formation, whether perpendicular to the surface, or inclined, shewing the operation of a current from the north-east."

This appearance we have often observed in the alluvial plain of New-Haven, and in other alluvial regions of Connecticut—exhibiting frequently, a delicacy of flexion, in the layers of gravel and sand, which makes them appear as if they had, but a moment before, received their impulse and position from undulating water, and as if they had copied the very eddies, and gyrations of the wave.

To support the position, that the currents flowed from the north-east to the south-west, Mr. Hayden mentions the rivers in the vicinity of Baltimore, which generally run in a direction from north to south. "In almost every instance," he remarks, "where the rolled pebbles abound, they are in much the greatest quantities on the west or south-west side of the river or creek." He states also, that there are great accumulations of sand and gravel in such places as correspond with the southern mouths or outlets of valleys and streams, or with their southern sides, and but small portions or none of these things are found in the opposite directions.

Mr. Hayden mentions similar facts as existing in a very striking manner, and degree, on the Connecticut river, and on several of its branches; the accumulations of pebbles being on those banks, and in those places, which correspond with the idea of a current from the north and east, and with a consequent deposit of alluvial spoils, in a position, which is south or west in relation to the current.

Other instances are described, by the author, which, in connexion with those already mentioned, go far towards making out his case; but, in order to its full establishment, would it not be necessary, to enter into a very extensive induction of particulars, regarding, especially, the great alluvial formations of this country, and to derive those facts from as many portions as possible, of the flat country of the southern states?

The general cause of these currents Mr. Hayden concludes to be the deluge of Noah. While no one will object to the propriety of ascribing very many, probably most of our alluvial features, to that catastrophe, we conceive that neither Mr. Hayden, nor any other man, is bound to prove the immediate physical cause of that vindictive infliction.

Neither the fusion of the polar ice, as imagined by St. Pierre, nor the subsidence of continents, as conjectured by Dr. Clarke, are necessary to account for an event of this nature, when it is attributed, in the history which records it, to the immediate power of the Creator, who (although in this instance, rains are named, and subterraneous waters alluded to, as the immediate agents) never hesitates for means, to accomplish an end.

If however, in our turn, we might be indulged in stating an hypothesis, we would beg leave to suggest the following as a cause which *may* have aided in deluging the earth, and which, were there occasion, *might* do it again.

The existence of enormous caverns in the bowels of the earth, (so often imagined by authors,) appears to be no very extravagant assumption. It is true it cannot be proved, but in a sphere of eight thousand miles in diameter, it would appear in no way extraordinary, that many cavities might exist, which collectively, or even singly, might well contain much more than all our oceans, seas, and other superficial waters, none of which are probably more than a few miles in depth. If these cavities communicate in any manner with the oceans, and are (as if they exist at all, they probably are,) filled with water, there exist, we conceive, agents very competent to expel the water of these cavities, and thus to deluge, at any time, the dry land. These agents are *the aerial fluids —the gases*—whose competency to any and every degree of energy, which a given mechanical movement may require, is abundantly exhibited, in the rending force of gun powder, and of the other still more potent explosive compositions, and in the phenomena of earthquakes and volcanoes, whose mechanical effects, we conceive, depend principally upon the sudden and abundant evolution of aerial bodies. These bodies, suddenly evolved, and subjected to pressure and resistance, are competent not merely to propel cannon balls and bombs, to burst rocks and to explode mines—they can rend mountains—they can rock them from their bases—they can shake continents, and cause the globe itself to vibrate and tremble.

If then, there were occasion to elevate a column of water even six miles in height, so that it should transcend the highest mountains; aerial fluids would be equal to the effort. Should they be disengaged, abundantly, in the vast subterraneous and subaqueous cavities, they would of course occupy the roof or vaults of the cavity, and would therefore expel the water, which we suppose they may contain, and this water rising and spreading itself over the dry land, might, by its abundance, more or less complete, submerge the continents more or less completely. In short, it would be merely a case of compressed air acting to raise a column of water, as in a fire-engine. If it be objected, that the pressure would split the incumbent earth, we answer that it would do so did not its counteracting pressure, arising from a specific gravity at least two or three times greater than of water,* resist, with even superfluous energy.

It is not necessary to shew, that any such agencies have been actually exerted, and have certainly produced these effects. It is sufficient to evince that they are possible, and that if exerted, they are competent to the supposed effect.

* Possibly even much greater, according to the deductions of Maskelyne and Hutton on the specific gravity of the earth.

If it be required what aerial fluid could be furnished in the earth in sufficient abundance, it may be answered, that hydrogen gas, proceeding from the decomposition of water, by the action of metallic and inflammable bodies, aided by subterranean heat, would be abundantly equal to the effect, and even the evolution of oxigen and hydrogen from the decomposition of water, by the natural galvanic arrangements in the bowels of the earth, is probably a sufficient source for the gas. We have not mentioned carbonic acid gas, which might be evolved by many agencies, because it is absorbable by water, especially when aided by pressure. Although it is true, that water once saturated by it might then be elevated by its pressure. If by any cause, the gas that has forced the water from its internal cavities, should be absorbed, or make its escape, the waters would again retire into the caverns, and the lands that had been inundated, would be left dry.

It is very possible, that anterior to the deluge of Noah, and to the peopling of the globe by rational beings,* and during the gradual draining of the earth from the grand chaotic deluge, several floods more or less partial or extensive, may have taken place,—thus accounting for partial formations, as the parasitical trap rocks, &c.

To return from this digression. It is not within the scope of this desultory notice, to follow Mr. Hayden through all the varied and deeply interesting proofs, by which, in our opinion, he completely establishes the fact, that our great alluvial formations have proceeded from the sudden and violent prevalence of a deluge, attended by sweeping currents, which buried great quantities of animal and vegetable bodies.

Among these things are trees,† sometimes of large size, found, frequently, at the depth of forty or fifty feet: sometimes their fruit is found with them. Bones and skeletons of whales, porpoises, and sharks of enormous size—bones and teeth of the Asiatic elephant, and of the Mastodon or

* We consider the accurate chronology of the Genesis as commencing only with the creation of man, and the *first* formation and chaotic state of the globe, as not included in any of the periods called *days*.

† The trees are in many instances below low water mark, and in a bed of bluish clay or mud resembling sea bottom.

or Mammoth—horns of deer, and other animal as well as vegetable remains, are found in many parts of our alluvial districts, both near and remote from the sea; and evincing, completely, that they could never have been deposited and covered by any of the ordinary processes of alluvion.

These facts, it is well known, are common to the alluvial regions of other continents; and Mr. Hayden has adduced many examples in relation to this part of the subject.

The author has suggested some ingenious thoughts as to the processes of petrification. We feel and acknowledge, that there is a difficulty in accounting for the preservation of animal and vegetable substances, by petrifaction or other similar changes; but as we see the process, actually going on, at the present day, and some very perishable substances preserved either by petrifaction or incrustation;—as at Knaresborough in Yorkshire; at the baths of St. Philip in Italy, and in many other places, we perceive that the thing is *actually possible*, and whatever may be the difficulties of the subject, they appear to us less than those that attend the bold assumption that petrified bodies have been invested by earthy substances in the gaseous state, or that even our planet may have been formed by gaseous emanations from the sun.

Mr. Hayden believes that, from the opposite polar regions, there were currents which combined to produce the deluge, and he conceives, that their ravages are distinctly recorded in the naked and rocky state of the land in the higher latitudes, of both hemispheres, the loose earth having been, as he imagines, swept away and transported to other regions.

Mr. Hayden objects to the received ideas, as to the formation of soils and loose earth, by the decomposition of rocks, which he believes to be much less extensive and rapid, than has been generally imagined. This is probably true in a degree, but still we cannot but think that he has underrated these agencies. The decompositions, arising from the unintermitted activity of galvanic electricity, evolved by the juxta position of strata and fluids of different kinds, is probably a potent cause, and is not, we believe, adverted to by Mr. Hayden.*

* This cause would, however, it is true, operate principally in the interior of the earth.

We think, that he has not conceded enough to the ravages, committed by time, upon a part at least, of the stony monuments of the globe, whether erected by the Creator or by man. Stonehenge which he cites, (and which is not granite, but sand stone,) is very deeply furrowed by time: the angles are rounded, and the stones are evidently reduced in size. The same thing is true of many of the ancient cathedrals, castles, palaces, and other buildings in England and Scotland. Where they have not been kept in repair by assiduous attention, they are all in ridges, hollows, and prominences, decisive marks of the tooth of time, and many prominent parts of considerable size, are almost or quite destroyed.

Most of the public buildings in England, both ancient and modern, are constructed of a calcareous sand stone, or of lime stone of the secondary or transition class.

In Cornwall, one of the granite regions of England, extensive ledges of granite, as we have seen, are crumbling down in a state of decomposition, and the granite of Limoges, in France, from which their excellent porcelain clay is derived, is decomposed in some instances almost to a clay.

The degradation of hills and mountains is, we suspect, much more considerable than he admits it to be. We could take him to a place* where enormous broken columns of greenstone trap, even twenty-five feet in diameter, are lying upon a declivity in just that confusion in which they evidently fell, from some colonade of naked pillars, forming a greenstone ridge, and yet the nearest ridge, which is materially higher, is a mile distant. The particular ridge from which they originally fell, must have been, *at hand*,† and although its ruins are still there, the ridge itself has been degraded by time.

Mr. Hayden has assembled a very instructive and entertaining collection of facts respecting the Deltas of rivers, and generally concerning their alluvion, whether relating to their banks or their embouchures. We conceive that he has proved, that even these examples of alluvion are less attributable to the agency of the rivers themselves, than is

* The western declivity of Talcot mountain, ten miles from Hartford, on the Albany turnpike.

† Unless, indeed, Mr. Hayden would suppose, that currents had moved these enormous masses from some other place

generally supposed, and of course much more to other causes: among the most conspicuous of which, in his view, are the operations of man himself in creating artificial ground, and the action of winds, in transporting sand and loose earth. But, it is impossible to convey any adequate idea of the value of this part of Mr. Hayden's work, without entering more into detail than is consistent with the nature and limits of this article.

In concluding our remarks, we will observe, that Mr. Hayden's book will prove an interesting and useful volume to the general reader, as well as to the Geologist.

It is not so much involved in technics as to assume a repulsive aspect to the view of the general scholar, or of the reader of common intelligence. It will prove an agreeable, and we think, an attractive volume, *at the family fire side*, and we therefore hope that the meritorious author may be adequately remunerated for his labour and expense, by an extensive sale of the work, and be enabled, in a future edition, to add those useful illustrations from maps which he had designed.

He will allow us to suggest, that some sort of table of contents or index (or better both) would greatly increase the ease of reference, and consequently, the utility of the volume, in the divisions of wh'ch, there is at present little to guide the eye, or to aid the recollection, in retracing our steps, for the purpose of adverting to particular parts.

Among the original productions of this country, the present volume has a right to hold a very respectable rank. We must be allowed however to observe, that its principal value consists, in its presenting so extensive a view of the numerous and very astonishing facts, connected with the important, but perhaps undervalued subject of alluvion.

We are not averse to the author's particular theory, but, still, we could wish to see the present volume grow into a regular systematic work upon alluvion, excluding extraneous matter, and including a digested arrangement of all the important facts connected with that subject, with as much theory as those facts will warrant, and the theory would then flow naturally *as an induction*, according to the strict Baconian mode of philosophising.

The author would, in that case, obtain also the important additional advantage, that while the volume would not be less attractive to general readers, of intelligence, it would be in a form adapted to the uses of the geological student, and could hardly fail of coming into general use as a text book on the doctrine of alluvion.

Art. VI.—*Notice of Ores of Iron and Manganese, and of Yellow Ochre, in Vermont; by Professor* Frederick Hall, *in a letter to the Editor, dated,*

Middlebury College, Dec. 1, 1820.

TO PROFESSOR SILLIMAN.

I visited a few months since, the iron ore bed, and the iron works, in Bennington, Vermont. The ore bed is situated on the south side of an arm of the green mountain. It is covered by a stratum of sand, about two feet thick, containing innumerable round, quartzose stones of various sizes, called by the inhabitants of the town, *hard heads.* The ore is obtained with great facility from the bed. It is mostly brown hematite. I collected a few specimens of the common argillaceous oxide of iron. It does not make good bar iron. It is manufactured into kettles, stoves, carriage-boxes, &c. The ore is not rich. Mr. Traner, the owner and superintendant of the works, informed me, that it yields, on an average, about 33 1-3 per cent. He added, that not far from two hundred and twelve tons of cast iron are made annually, at his works.

The iron ore rests on a bed of unknown thickness, of the oxide of manganese, which appears to belong chiefly to the variety called *earthy oxide of manganese.* Its colour is brown, often very deep brown, inclining to black. Its texture is earthy; its lustre dull. To borax it imparts a violet colour, verging to red. The surfaces of some specimens, which I procured from this bed, are slightly mammillary. It gives oxigen in abundance when heated with sulphuric acid.

The iron ore is sometimes mixed with manganese, which renders it totally useless. " For," said Mr. T. " if we melt it with the iron, the gas causes such an explosion, that it scatters the metal in small pieces over the whole furnace."

The iron ore bed is very extensive, and will probably not be exhausted for several ages.

I proposed to Mr. T. a number of questions, in writing. The following is one of them. I give you the answer in his own language. Have you found ochre? "Yes, in vast plenty." After showing me the substance, as it was dug from the earth, he proceeded to describe how he prepared it for the market. "We first break it in small pieces, then put it into a large cistern, filled with water, and keep stirring it, until all is dissolved; then after allowing the sand to subside for some moments, let it off into a second cistern; in this it stands till the paint settles to the bottom, and the top is clear water; by a two inch hole, just where the water and paint meet, let off the water; then, by a large door in the bottom, let off the paint into a large square cistern. After lying in this a day or two, we carry it off into small flat boats to dry. In order to make the paint separate completely from the water, there must be a shovel full or two of good lime, thrown into the cistern, in the first washing. It is now *yellow ochre*. In order to make it brown, or red, we expose it to the fire in an oven or kettle."

I lately examined the iron works and iron ore of Pittsford, twenty-four miles south from this place. The ore is dug within a few feet of the spot, where it is manufactured. It is chiefly an *ochrey brown oxide of iron*, and quite friable. Its fracture and texture are earthy. It soils the fingers strongly. When taken from the earth, its colour resembles that of yellow ochre. Exposed to the action even of a small degree of heat, it loses its yellow hue, and assumes a reddish brown colour. Mixed with borax, it fuses before the blowpipe, and yields a globule of transparent glass of a beautiful green colour. It occurs both in beds, and in veins in limestone. The ore is less productive than the Bennington ore. It yields, as I was told by the proprietor, Mr. Nathan Gibbs, about 25 per cent. "or four tons of the ore make one ton of iron." He informed me, that the quantity manufactured, yearly at his works, was about twenty tons of bar iron, and eighty tons of cast iron, consisting of stoves, potash kettles, &c. &c. I may give you, in a future letter, some account of the iron ore, manufactured at other places in this state.

ART. VII.—*Notice of "A view of the Lead Mines of Missouri including some observations on the Mineralogy, Geology, Geography, Antiquities, Soil, Climate, Population, and Productions of Missouri and Arkansaw, and other sections of the Western country, accompanied by three engravings; by* HENRY R. SCHOOLCRAFT, *corresponding member of the Lyceum of Natural History of New-York."*

As this work has been more than a year before the American public and is already well known, it may seem superfluous to make any remarks upon it at so late a period. It was our purpose to have given it an early notice but circumstances which could not be controlled, prevented. Still, as it is devoted to subjects, which form a prominent object in this Journal, and is, as far as we are informed, the only elaborate and detailed account of a mining district in the United States, we are not disposed to remain silent, especially as the discharge of the duty is not likely to be painful, either to ourselves or to the author. Reviews in form, although within the plan of this Journal, do not constitute one of its most leading objects, and we do not hold ourselves responsible for analyses or even for notices of new American books, unless they appear particularly interesting or important, or hold a very intimate connexion with the great design of our work.

We have already intimated that we regard Mr. Schoolcraft's work in this light. We take it for granted, that the statements of facts made by this author, are both faithful and accurate; the information which we have incidentally derived from other sources, certainly countenances this impression, but the whole amount of it is small, compared with the details contained in the present volume.

Mr. Schoolcraft's opportunities for observation were extensive, particularly in relation to the mines of lead in the Missouri region. Among those mines he spent a year. "I have made, (says he) a personal examination of every mine of consequence, with a view to ascertain its general character and value and its peculiarities. I have travelled on foot over the whole mine country, exploring its minerals, its geological structure, its geographical position, soil, climate, productions, towns, streams, settlements, and whatever else appeared to me to be necessary to describe, explain and illustrate the subject before me."

Mr. Schoolcraft appears to have made good use of the advantages which he enjoyed, and his countrymen are indebted to him for a great amount of valuable information. He appears also to have studied the observations of preceding writers, and, with their works before him, it was in his power to correct errors and to supply deficiencies.

He has prefixed an historical sketch which we presume will be acceptable to every reader. The French as is well known were the original discoverers and settlers of the Missouri, and Illinois regions, which were embraced in their vast scheme of forming a chain of posts and settlements from the mouth of the St. Lawrence, to that of the Mississippi.—They did not occupy the country of the Missouri and Illinois, till more than a century after the settlement of Quebec, and about a century before the present period. At that time, (1720) the lead mines were discovered by Philip Francis Renault, and M. La Motte, and by them they were wrought, although they and the adventurers under them were disappointed in their expectations of finding gold and silver.

At the end of about half a century, the country passed into the hands of the Spaniards, and under their dominion, probably about forty years since, the principal mine was discovered by a man of the name of Burton, and from him it has derived the name of *Mine a Burton*.*

It appears that the processes of mining under the Spaniards were very imperfect as they obtained only fifty per cent. of lead from the ore, threw away the lead ashes, and did not attempt any manufactures of shot or any other articles. They employed only the open log furnace.

In 1797, Moses Austin, Esq. a native of Connecticut, who had been occupied with lead mines, in Weythe County in Virginia, obtained from the Spanish government, a grant of a league square in the mining district in consideration of his introducing a reverberatory furnace. He sunk

* It seems he was hunting and found the lead ore lying upon the surface of the ground. This remarkable man was living last year, near St. Genevieve, at the great age of one hundred and nine. He had been employed under the first adventurer, Renault, and has passed an eventful life, having served both in Europe and America, as a soldier under distinguished commanders, and on various memorable occasions, as at Fontenoy and Bergen op zoom, under Marshall Saxe, and at Braddock's defeat, near Pittsburgh.

the first regular shaft—the mining having, till that time, been prosecuted solely by open digging, in the manner of quarries. Mr. Austin also introduced the manufacture of shot, and that of sheet lead soon followed. About the same time several other American families collected at the mines, and infused new spirit and enterprize into the mining operations, so that they were carried on with considerable vigour at the time when (in 1803) the country was transferred to the United States. Mr. Schoolcraft, from whom these facts are taken, remarks, that since 1804 the number of mines has been astonishingly multiplied—population has flowed rapidly in—the processes on the ore have been much improved—better furnaces have been constructed; and "every season is adding to the number of the mines." "Every day is developing to us, the vast resources of this country, particularly in lead," and the author expresses his opinion that "the mines of Missouri are paralleled by no other mineral district in the world."

From the specimens which we possess of this ore, and from the documents produced by the author respecting the produce of the mines, we believe his opinion is correct, especially if we consider the fact that "the earth has not yet been penetrated over eighty feet;" "we know not what may be found in the lower strata." "There is reason to believe that the main bodies of ore have not been hit upon, that they lie *deeper*, and that we have thus far been only engaged upon the spurs and detached masses."

Mr. Schoolcraft informs us, that although the mining business is much improved, there is still a great deficiency both of capital and of skill—there is in the whole district but one regular hearth furnace for smelting, and that not the best;—among forty mines, there are only four or five regular shafts—there is among all the mines, no engine of any description, for raising water, and some of the richest mines with the best prospects in view, have been in consequence abandoned. Yet, under all these disadvantages, the annual produce of the mines is estimated at three millions of pounds of lead.

The author suggests the expediency of establishing a school of mines and minerals in the midst of the mines themselves; this would, without doubt, be a very proper measure, but in the mean time, skilful practical miners, and captains of mines, such as are found in every mining district in Europe, would supply the immediate demands of the country.

The mining district, formerly called the *lead mines of Louisiana*, is situated between the 37th and the 38th degree of north latitude, and between the 89th and 92nd degree of west longitude, covers three thousand one hundred and fifty square miles—it is from seventy to one hundred miles long by forty or forty-five wide, extending in width from the Mississippi south-west to the Fourche à Courtois, and in length from the head waters of St. Francis northerly to the Merrimack.

Lead ore is found in almost every part of this district. Mr. Schoolcraft says, "the general aspect of the country is sterile, though not mountainous: the lands lie *rolling*, like a body of water in gentle agitation. In some places the hills rise into abrupt cliffs, where the great rock formations of the country may be seen; in others, they run into level plains; a kind of highland *prairie*."

"The soil is a reddish coloured clay, stiff and hard, and full of fragments of flinty stone, quartz and gravel: this extends to the depth of from ten to twenty feet, and is bottomed on limestone rock. It is so compact in some places, as almost to resist the pick-axe; in others it seems to partake of marl, is less gravelly, and readily penetrated. The country is particularly characterized by quartz, which is strewed in detached pieces over the surface of the ground, and is also found imbedded in the soil at all depths. This is here called *blossom of lead*. Iron ores and pyrites are also scattered over the surface of the ground, and occasionally lead ore. Such is the general character of the mineral hills, which are invariably covered by a stinted growth of oaks."

Walnut is also found on the hills, and there is a ridge of yellow pine, not more than six or eight miles wide, running nearly south-east and north-west, but it is nearly or quite destitute of lead—the mines lie generally east of it. In summer the flinty aspect of the country is veiled by a luxuriant growth of grass, which gives it a very pleasing and picturesque appearance.

The vallies have a rich alluvial soil, well fitted for cultivation; but our limits will not allow us to mention the vegetable productions of the country. This region is well irrigated, and very healthy, being possessed of a fine climate. Mr. Schoolcraft remarks, that during a residence of ten months he never heard of a death; the country is free from the fevers which infest some of the neighbouring regions. It seems, however, that the animals are visited by what is called the *mine sickness.* "Cows and horses are frequently seen to die without any apparent cause. Cats and dogs are taken with violent fits, which never fail, in a short time, to kill them." It is said that the inhabitants impute these affections to the sulphur exhaled in smelting the lead, as the cattle are often seen licking about the old furnaces. But sulphur is not poisonous either to men or animals. The author imputes it to the sulphat of barytes, with which the district abounds, which he states is a "*poison to animals.*"

The *carbonat of barytes* is eminently poisonous, but we have never heard that the sulphat is so. May not the licking around the furnaces expose the cattle to receive lead in some of its forms, minutely divided—or if it be not active in the metallic state, both the oxids and the carbonat, which must of course exist around the furnaces, would be highly active and poisonous. Is it not possible also that *some* of the natural waters of the country may, in consequence of saline or acid impregnations, dissolve some of the lead, and thus obtain saturnine qualities? We must allow, however, that we are not acquainted with the existence of any natural water thus impregnated.

Among the mineral productions of this region, certainly not the least remarkable mentioned by Mr. Schoolcraft, is the *Iron mountain*, where the ore is piled in such enormous masses as to constitute the entire southern extremity of a lofty ridge, which is elevated five or six hundred feet above the plain: the ore is the micaceous oxid, and is said to yield good malleable iron.

There is another body of iron ore five miles west of the iron mountain, scarcely inferior to that mentioned above, and it appears that several other beds exist in the same vicinity.

Zinc is abundant, but as the ore is the sulphuret, it is not very valuable. It is not mentioned that the calamine, which is *the useful* ore of zinc, has been found.

As to the Geological nature of the country, in which the lead mines are situated, we must confess, that we are not quite so well satisfied, as we have found reason to be with almost all the other important facts and opinions, which Mr. Schoolcraft has communicated.

He informs us that "Bellevue abounds in granite;" that the only vein of granite rock in the mine country (as far as he had opportunity to observe) passes across the south-western end of Madison county—runs into Bellevue—is four or five miles wide, and twenty or thirty miles in a direction from S. E. to N. W.

We are again informed that the country affords *granite*, *gneiss* and *mica slate*, and that the whole country is bottomed on *primitive lime stone*, that secondary lime stone is met with, and that when it occurs, it lies over transition and primitive rocks. The granite is spoken of in another place, (p. 170) as being a geological phenomenon, as containing imbedded in it or lying upon its surface, gneiss, green stone, porphyry, iron ores, &c.; it is spoken of as a red granite, containing very little mica, and as being used for mill stones. It is mentioned as the "only mass of granite known to exist between the primitive ranges of the Alleghany and Rocky mountains," and as being surrounded on all sides, and to an almost immeasurable extent, with secondary lime stone.

Again, (p. 193) the granite is cited as the "old red granite in mountain masses, with some veins of green stone, green stone porphyry, and gneiss;" it is said to terminate in very rough and broken high lands. At page 213, it is mentioned, still again, as giving origin to the river St. Francis, whose "springs gush out among these stupendous piles of red granite." Besides the ores of iron, lead and zinc, "quartz, feldspar, shorl, mica, and graphite are among the minerals furnished by that region, and "green stone, gneiss, and green stone porphyry, are among the larger masses of rock." The green stone, it seems, "is found in large isolated fragments, lying promiscuously among the fragments of granite which have tumbled down from the lofty cliffs above, and is rendered porphyritic by crystals of green and flesh-coloured feldspar."

We have no right to doubt that the rock described is granite, as the principal features delineated, correspond with that supposition. As it is described as being solitary, the only granite between the Alleghanies and the Rocky mountains, we are lead to ask—is it a portion of the nucleus of our globe, covered on every side, for many hundred miles, with secondary rocks, and here heaving its head through the superincumbent strata, and standing alone ?

But, what are we to conclude of the lime stone ? Although Mr. Schoolcraft states that the granite is every where surrounded by secondary lime stone, he remarks in several places that the country is based on *primitive* lime stone : as at page 92, " the whole mineral country is bottomed on primitive lime stone"—at the same time he adds, that " secondary lime stone is met with, but that it is far less common than in Ohio, Indiana," &c. At page 108, speaking of the lime stone, which, he says, is the rock invariably met with in digging, and generally at the depth of fifteen or twenty feet, he remarks, that there are many varieties of it, the texture varying from very hard and compact, to soft and friable—the latter crumbling between the fingers, and being called rotten lime stone : lime stone, he says, is invariably the basis on which the mineral soil at Mine a Burton, and the numerous mines in its vicinity reposes. He speaks of it as " passing into transition and secondary lime stone, in various places on the banks of the Mississippi, between Cape Girardeau and St. Louis, and as becoming a variety of *marble* near Herculaneum." He does not inform us whether this primitive lime stone is crystalline in its structure, or translucent, if not crystalline. He generally speaks of it as compact, and if he uses the word compact, in the sense to which Mr. Werner's descriptive language limits it, we must remark that compact lime stone is rarely if ever primitive—the structure of this latter being almost always crystalline, and if ever compact it will generally be translucent also, at least on the edges, but if compact and a secondary lime stone, it will in most instances be perfectly opake. The compact translucent lime stone is generally of the transition, and not of the primitive class.

The term *marble*, sometimes introduced by Mr. Schoolcraft, is not distinctive—perhaps it was not intended to be so ; for the marbles, it is well known, are derived from all the divisions of lime stone, primitive, transition and secondary. Nor is the absence of " shells, (p. 108) animalcula, or other traces of animal life" conclusive ; their presence would of course decide the lime stone not to be primitive, and therefore to be transition or secondary; but both these latter kinds of lime stone are often found without shells, vegetable impressions, or any other trace of organized beings.

The minerals mentioned by Mr. Schoolcraft as accompanying the lead ore, in and above the supposed primitive lime stone, are not such as are decisive of a primitive country—for crystalized quartz, sulphate of barytes, calcareous spar, blende, hornstone, flint and pyrites, &c. are found along with lead ore in the Peak of Derbyshire, a transition country; and they are found also in secondary countries. Primitive lime stone also, we believe, (at least this is the fact in the magnificent formations of it in Connecticut, Massachusetts, and other northern States) usually occurs, forming *beds* in the primitive rocks, especially in gneiss, mica slate, and clay slate; and we are not aware that it often forms the basis of a country; whereas transition and secondary lime stone form immense masses, and pervade extensive regions, without necessarily forming beds in other rocks.

It would then have been more satisfactory to have had the mineralogical character of this lime stone described with more precision, and especially to have had the order of succession, (if any exist) with respect to contiguous rocks delineated.

We should have liked especially to have had the relations of this lime stone with that remarkable granite region, pointed out. As that granite ridge is said to be surrounded by secondary lime stone, does this secondary lime stone repose on this other, called primitive, and does this latter repose on the granite, where it dips obliquely under, as it probably does, in order to find its way beneath the other rocks, and to vindicate its claim to a fundamental position? But, perhaps we are asking more than is reasonable, for, it may be that there are no such sections in the strata as would expose all these facts to view, and enable the observer to decide.

These hints we have dropped, not, we trust, from a captious disposition, (which we abhor) but because we have found a real difficulty in conceiving clearly of the geological nature of *this lime stone*, which, it seems, is the basis of the lead mine country, and therefore it is very important that its characters should be indubitably fixed. We have not been so fortunate as to see Mr. Schoolcraft's specimens: possibly a view of them would have rendered the preceding remarks, in part at least, unnecessary.

The difficulty of conceiving that this lime stone is really primitive, is increased by the very remarkable position of most of the lead ore hitherto obtained in the Missouri mines, and which, it appears, is still obtained in the same situations, although some of the mines have been wrought for a century.

We allude to the vast deposit of alluvion with which this lime stone is covered, and in which, to the depth of many feet, the lead ore lies, often in loose pieces of several pounds weight.

Leaving the Geological features of the lead mine district, we proceed to cite some interesting and important facts from Mr. Schoolcraft's work:—"The soil, he remarks, is a reddish coloured clay, stiff and hard, and full of fragments of flinty stone, quartz and gravel; this extends to the depth of from ten to twenty feet, and is bottomed on lime stone rock. It is so compact in some places, as almost to resist the pick-axe; in others it seems to partake of marl, is less gravelly, and readily penetrated. The country is particularly characterized by quartz, which is strewed in detached pieces over the surface of the ground, and is also found imbedded in the soil at all depths. This is here called *blossom of lead.* Iron ores and pyrites are also scattered over the surface of the ground, and occasionally lead ore." The mineral productions of the country, in addition to lead, are, zinc, iron, ochre, red chalk, salt-petre, sulphur, alum and salt."

The number of lead mines is forty-five; and there are certain points in which they resemble each other. "The ore is found in detached pieces, and solid masses, in veins and beds, in red clay, and accompanied by *sulphuret of barytes*, *calcareous spar*, *blende*, iron *pyrites*, and *quartz*."

The ore (the author remarks) is the lead glanee, galena, or sulphuret of lead. It is very rich and beautiful, and specimens in our possession fully confirm Mr. Schoolcraft's account; they have a very broad, and perfectly foliated fracture, and a high degree of metallic lustre; they break in cubical fragments, and the minutest portions still retain this form.

We have already observed that large fragments are formed loose in the earth; they sometimes weigh four or five pounds; we have such specimens from these mines; they are of a cubical form, and are surrounded, except where they have been broken, by an earthy incrustation.

It is observed, that the marly earth thrown out from the pits, enriches the ground, so that in a few years it is covered with a very rank growth of trees, vines, &c, and this is a regular characteristic of old diggings. Innumerable portions of radiated quartz, and sharp fragments of flinty stones are mixed with the clay, and form the first stratum of about fourteen inches. The next is of a red clay, and is four or five feet thick, and less mixed with similar siliceous substances. Then comes a layer of gravel and rounded siliceous pebbles, about one foot thick, containing small portions of lead ore. The thickness of the bed of ore is generally a foot; and the lumps of ore appear to have been rounded by attrition, like common gravel. "This is the character of what is called the *gravel ore*, and no spars are found accompanying it. The greatest proportion of lead ore is, however, found imbedded in, and accompanied by the sulphate of barytes, resting in a thick stratum of marly clay, bottomed on limestone rock." They invariably arrive at the rock at the depth of from fifteen to twenty, or sometimes thirty feet—a new process by boring and blasting is now necessary, and most diggers abandon their pits rather than prosecute them at this expense. If, however, (as there can be little doubt,) the limestone is the real matrix of the lead ore, the time will come when the present diggings will be considered as merely superficial beginnings, and the work will be resumed where hitherto it has been abandoned. It seems that the almost invariable practice of the miners now is, to persevere till they strike the rock, and then to go and dig elsewhere; they cannot, if disposed, prosecute the business by levels or galleries, for they are not permitted to carry on their mining, except immediately under the surface that is covered by their respective leases, or by twelve feet square which, if unoccupied, an adventurer may cover by occupancy. Among the substances accompanying the lead, blende and the sulphate of barytes, are said to be very abundant; the latter in specimens which we have, is particularly brilliant and white ;* the quartz is often prettily crystalized, and is so invariable a concomitant of the ore, that the miners, as we have before remarked, give it the meaning appellation of *mineral blossom.*

A curious fact is mentioned by Mr. Schoolcraft, respecting the Elliott's mines. " During the remarkable earthquakes of 1812, a fine spring of water at the mouth of the mines suddenly became warm, and foul, and in a few days dried up entirely, and no water has run there since." " Illuminations in the atmosphere are frequently observed in this vicinity on the approach of night."†

It seems there is a considerable quantity of a greyish white sublimate collected at the log hearth furnaces, and rejected by the workmen upon the supposition that it is sulphur and arsenic ; but Mr. Schoolcraft, by unquestionable experiments, ascertained that it was lead, (as would appear) in the form of a carbonated oxid. A considerable loss is in this manner sustained, and in a more advanced state of the metallurgic operations of these mines, the author's valuable suggestions will not be neglected. There is one mine (M'Kain's,) where the ore is of the *steel grained* variety —it is said to yield less lead, and is inferred to contain more silver than the common ores : we are aware that this is the common impression, but our own experiments on different varieties of lead ore, would induce us to think that it cannot be relied upon. We have examined fine steel grained ore which contained very little silver ; in one specimen only one five thousandth part, and in another, and that a foliated specimen, we found three and a half per cent. of silver.

The methods of digging for the ore are sufficiently simple. " A pick-axe and shovel are the only tools used for removing the earth, and the drill, hammer and priming rod are added when it is necessary to blast." The process is carried on as in digging a common well.

* It is mentioned by the author (p. 70) as a chemical test or reagent : it may, by decomposing it by ignition with charcoal, or with an alkaline carbonat, be made to afford its earth for the preparation of barytic tests, but we are not aware that it is *itself ever* used as a test.

† They are attributed by the author to phosphorus. Is it supposed to be in the form of phosphuretted hidrogen ? may not these be electrical phenomena ?

We must refer our readers to the book itself for a clear account of the furnaces and furnace operations, employed for smelting the lead: it will be the more intelligible, as it is accompanied by two good plates containing views and sections of the furnaces. A circumstance which appears very extraordinary is, that the furnaces are most commonly built of limestone, which is of course calcined, and brought to the condition of quick lime by a few blasts, and then it crumbles and the furnaces must be rebuilt.

The ore yields at first fifty per cent. and then the ashes give fifteen per cent. more—sixty-five* in the whole.†

Custom, says the author, has established a number of laws among the miners, with regard to digging, which have a tendency to prevent disputes. Whenever a discovery is made, the person claiming it is entitled to claim the ground for twenty-five feet, in every direction from his pit, giving him fifty feet square. Other diggers are each entitled to twelve feet square, which is just enough to sink a pit, and afford room for throwing out the earth. Each one measures and stakes off his ground; and though he should not begin his work for several days afterwards, no person will intrude upon it. On this spot he digs *down*, but is not allowed to run drifts *horizontally*, so as to break into or undermine the pits of others. If appearances are unpromising, or he strikes the rock and chooses to abandon his pit, he can go on any unoccupied ground, and, observing the same precautions, begin anew. In such a case, the abandoned pit may be occupied by any other person; and sometimes large bodies of ore are found by the second occupant, by a little work, which would have richly rewarded the labours of the first had he persevered.

Mr. Schoolcraft, from various particulars, infers, that the average annual produce of the Missouri lead mines, as mentioned before, is three million pounds per annum, and the lead was worth in 1819, at the mines, four cents per pound.‡

* According to Dr. Meade, the Missouri ore affords only a trace of silver. (See Bruce's Minl. Journal, Vol. I. p. 10.

† Mr. Schoolcraft thinks it may yield seventy per cent.—it gave him by analysis eighty-two per cent.

‡ "The price paid to the miners for raising the ore, and delivering it ready dressed to the smelters, is two dollars per cwt. payable in pig lead."

For the last three years, up to 1819 inclusive, the produce of the mines was estimated at three million seven hundred twenty-six thousand six hundred and sixty-six pounds per annum of pig lead, which the author supposes to be not more than one half what the mines are capable of yielding.

The number of miners is between eleven and twelve hundred, and the number of hands employed in labour at different mines, is from twenty to two hundred and forty, including in both cases persons of all descriptions.

Many miscellaneous topics connected with the general subject of his work, are introduced by Mr. Schoolcraft, such as the sections relating to the manufactures, and uses of lead, &c. but it is not our object to advert to those topics.

Among the miscellaneous mineral productions of the western regions, there are some that are interesting, and it will be seen from the author's table of minerals (p. 177) that the list is various. There are several caverns which produce nitrate of potash by the usual treatment, and *Ashley's* Cove, about eighty miles from Potosi, is said to be one of stupendous size, and to "afford native nitrate of potash in beautiful white crystals."

Beds of chalk are mentioned as occurring on the west bank of the Mississippi, about thirty-five miles above the mouth of the Ohio. It is described as being of an excellent quality, and as containing flint in strata,* and sometimes in nodules.

The novaculite is mentioned as occurring on Wachitta, as described by Mr. Bringier in the present Number.

Steatite exists in abundance at the Falls of St. Anthony, on the Mississippi, and is used by the Indians for pipes.

The fluate of lime near Shawneetown, was described in the first volume of this journal.

Among other minerals, Mr. Schoolcraft mentions chalcedony in several varieties, earthy oxid of lead, native copper, alum, manganese, opalized and agatized wood, opal, jasper, coal, gypsum, native epsom salts, pumice stone, agate, onyx, burr mill stone, native iron, &c. for the localities and descriptions of which we must refer to the book itself.

Those facts of Mr. Schoolcraft's volume which relate to statistical and political topics do not come within the plan of these remarks.

* May not this be *hornstone* in veins?

During our cursory notice of this work, we have cited a number of the most prominent facts which it contains, both because they are in themselves important, and because we were willing to call the attention of our readers both to them, and to the volume in which they are contained. Both are, in our view, entitled to great respect, and we confess ourselves very much indebted to Mr. Schoolcraft for a great mass of valuable information, which, in a connected form, is, we believe, no where else to be found. His statements (as regards the most valuable part) are drawn from his own researches and observations, and have, evidently been the result of much effort, and of no small share of fatigue and personal privation. We trust that so valuable a work will not stop with a single edition, and perhaps we might venture to suggest to the author, that in a second, he might advantageously condense into one view, some facts which are several times repeated in different parts of the volume ; such as those respecting the granite and its connected rocks —the lead ore and its associated minerals, &c.

We consider the present work as an acquisition to our means of information respecting our mineral resources, and believe that it must be a regular volume of reference for all those who are interested in the investigation of these subjects.

Art. VIII.—*Geological Notice of Troy.—Extract of a letter to the Editor.*

The city of Troy is situated on the east bank of the Hudson river, on an elevated plain, from eighteen to twenty-four feet above the bed of the river. It is about one mile and a half in length, and about sixty rods wide. When digging for wells, &c. we pass through a series of almost uninterrupted gravel, of the coarsest and most sterile kind, mixed with a vast number of pieces of quartz of various colours, and all worn smooth, and rounded so as to be fit for paving streets, &c. : among these are many of the same size and figure as before mentioned of horn stone, lydian stone, sinople jasper, chlorite, (connected with quartz,) siliceous slate, rubble stones, &c. Sometimes we meet with a stratum of coarse blue clay or sand, but we uniformly find, at from eighteen to twenty-four feet deep, logs of wood and other vegetable substances, in a tolerable state of preservation. At the lower end of this plain, and where the river was probably once bounded, a quarry of siliceous slate appears, which is worked for use in building, &c.; and all interspersed through this, we find bituminous shale and blind coal or anthracite, as you will observe by the specimens, with frequent pieces of iron pyrites, lenticular spar, crystalized quartz, &c. in connexion. Over this, the alluvial deposits appear, in regular order, consisting of gravel, sand, clay, and loam. No rocks, except slate, are found in the neighborhood for several miles around, although all the incrustations or natural cements, as in pudding stone, appear to be carbonate of lime. The water is generally sweet and good.

Should you wish any other information as respects localities in this neighbourhood, I will furnish them with pleasure.

Yours respectfully,

MOSES HALE.

Troy, October 6, 1818.

Art. IX.—*On the Question, whether there are any traces of a Volcano in the West River Mountain—in a letter to the Editor from Dr.* Jonathan A. Allen.

Brattleborough, Vermont, July 31, 1820.

West-River Mountain having been announced, in the annals of the American Academy, as volcanic, and in Bruce's Mineralogical Journal, as "presenting no traces of an eruption," I was induced to examine the evidence.

I have not only several times visited the mountain, but I have availed myself of the accounts of those who resided in this vicinity, at or near the time when the eruption was said to have happened. There is now living in this town, an old man of acknowledged veracity, who, at the time of the reported explosion, resided at Fort Dummer, about two miles distant from the spot. He says, that he frequently heard " noises like thunder on the mountain"—that " the hole made by the eruption, was about thirty feet deep"—and that " he repeatedly visited the place, but never saw any flame."

The mountain is situated on the east side of Connecticut river, opposite to Brattleborough, East-Village. Its greatest length is north and south, and does not exceed four miles. Its height, above the water in the river, as ascertained by my friend Erastus Root, M. D. is nine hundred and forty feet. Passing from the river to the mountain, the rocks change from argillite to mica slate which constitutes most, if not all the mountain.

Towards the top, the mountain separates into an eastern and western section. At a distance of about thirty rods, ascending from where vegetation flourishes, on the south extremity of the eastern cliff, you come to the shaft which has been sunk into the rock about one hundred feet. Here the volcanic eruption is supposed to have occurred. This place is extremely craggy. A spectator, here instinctively falls on his hands and knees, and cautiously peeps into the shaft,—for about thirty feet he sees a wide expanse, like an irregular excavation in the rocks; it then diminishes like a funnel, and at a distance of forty or fifty feet below, the water, when a stone is thrown in, is seen undulating, and appears to aid in reverberating a hollow sound. Above, masses of rocks impend over your head, and seem ready to crush the observer. From this place, I have known people retreat with precipitation, lest that should be their fate.

The shaft has been sunk at different times, by individuals in search of the precious metals. The vein which has been followed into the rock, is about a foot in diameter, and contains hæmatite iron ore. From this shaft, at some former period, it is said, capillary filaments of silver were obtained, but this is probably a mistake.*

* Mr. Gibbs, recently a tutor in Yale College, shewed me some of this ore, which, many years ago, was sent from the garrison at Fort Dummer, to his father, who then owned the *mine*. Afterwards, this gentleman said, he carried some of it to Professor Silliman, who pronounced it to be silver. Some of the ore which Mr. Gibbs gave me, is inclosed—is it not a soldier's epaulet? Did not the locality of native silver, mentioned in Cleaveland's Mineralogy, originate from this?

Answer.—It did—we know nothing, however, of the *soldier's epaulet*—we can say only that the original specimen, like that sent by Dr. Allen, was

The rock, through which the workmen have passed in making the shaft, is mica slate, passing into granular quartz. In some instances, however, the quartz is found crystalized, but it is neither frequent nor elegant.

Leaving the shaft, and ascending to the top of this cliff, on the west side, you observe a descent of one hundred feet perpendicular, and from the bottom of this the rocks are scattered in huge broken masses, in such a manner, that an inclined plane over the whole would form an angle of about 45°, for the distance of ten or twelve rods where it intersects the western section of the mountain.

No appearances of lava could, by repeated examination, be discovered. How then, it may be asked, are we to account for the repeated reports heard at Fort Dummer? Could they be imaginary?

We have no right to conclude they were, for the facts were related by persons whose testimony would not have been doubted on other occasions, and why should they be called in question in this? It is asserted in Bruce's Journal, that the reports were caused "by the wind's rushing through the clift of the mountain near the shaft." If so, why are not the same noises heard at the present time?

Then to what cause shall we attribute these *noises like thunder on the mountain?* The most probable conclusion is, that they were produced by the falling of the immense masses of rocks from the western side of the eastern cliff. By this conclusion every difficulty is removed. Go to the spot, and there you will find evidences in favour of this opinion, stronger than language can describe,—but search for volcanoes, and you will find nothing deserving your notice.

In determining the geological character of the West-river mountain, I am happy to acknowledge the assistance of the Rev. Edward Hitchcock, A. M. of Deerfield, Ms.

silver in filaments—that it exhaled arsenic, by the blow-pipe, and would not dissolve in nitric acid till the arsenic had been expelled; it then dissolved readily and was precipitated white by muriate of soda. Manufactured silver, we believe, does not exhale arsenic, but native silver often contains arsenic—such is that at Mr. Lane's mine in Huntington.—*Ed.*

Localities of Minerals in the vicinity of Brattleborough, communicated by Dr. Allen.

Tremolite—beautiful specimens crystalized in quartz, are found at Wardsboro, Vt.; also at Brattleborough, but not good.

Schorl———elegant crystals, in quartz, Dummerston; and, also, Baattleborough, less perfect.

Indicolite—-in large crystals contained in feld spar and quartz, Hinsdale, N. H.

Granular Quartz—appearing like loaf sugar, Vernon, Vt.

Actynolite—Windham and New-Fane. At New-Fane I found it in large masses, separate from any other substance.

Micaceous Oxide of Iron—Jamaica: in veins in white lime stone, near Turkey mountain.

Garnets———Crystalized in chlorite, beautiful specimens, Marlborough, Vt.

Scaly Talc—beautiful specimens, discovered by Professor Hall, Windham, and by myself, New-Fane.

Serpentine—-An immense mass, Grafton, discovered by Professor Hall.

Magnetic Iron Ore—in large quantities, containing about sixty per cent. iron, Sumerset, Vt. This ore is frequently carried to the forge near Bennington, to be wrought. Pyrites is also found here in abundance, and what the people call bog ore.

At Sumerset, an iron forge might be established, with much profit, but those in this vicinity who have the disposition, have not the necessary capital.

BOTANY AND ZOOLOGY.

Art. X.—*Experiments on a valuable variety of fruit, produced between the Spanish Chesnut, and the Maryland Cinquapin—in a letter from* William Prince, *Esq. to the Hon.* Samuel L. Mitchill.

(Read before the Lyceum of Natural History, at New-York, Oct. 15, and communicated for insertion in this Journal.)

Flushing, Oct. 14, 1820.

Dear Sir,

Knowing the interest you take in the various phenomena of nature, I wish to call your attention to one of its most curious operations, the production of new varieties in the vegetable kingdom. I herewith send you a specimen of a new and valuable Chesnut, accidentally produced in the following manner:—about the year 1788, the large Spanish chesnut was first imported into this country. I planted some of the nuts, and obtained bearing trees—beneath one of which, I had planted the fagus pumila or chinquapin of the southern states, which produce fruit when not more than two feet in height. The farina of the blossoms of the large Spanish chesnut, fell on the stiles of the flowers of the little chinquapin, whose fruit, when ripe, I planted, and in the spring when they came up, I observed several of the plants had leaves resembling the Spanish chesnuts—those plants far outgrew the others, and have produced a new fruit, partaking of the chinquapin in its abundant prolificacy, and of the Spanish chesnut in the improved size of its fruit, which is larger than the common American Chesnut. The quality of the fruit you will be able to judge of by those I send you.

This is a satisfactory evidence of the improvement that may be made by mixing the different kinds of European and American fruits; and I have no doubt great improvement might be made in the American grape, if the seeds were sown from vines whose blossoms had been previously impregnated by the farina of the best foreign sorts. Vines might be thus produced, that would stand the cold of our climate, and combine the prolificacy of the indigenous with the flavour of the finest exotic kinds.

I am, with respect,
Your obedient servant,
WILLIAM PRINCE.

(ANSWER.)

NEW-YORK, Oct. 16, 1820.

My Dear Sir,

I beg you to accept my thanks for your valuable communication of yesterday. The articles susceptible of preparation in a herbarium, have been placed there for the inspection of my friends and visitors at home, and of my class at the college. The capsules and fruits have already been exhibited to such agriculturists and cultivators as have called upon me. They, who have tasted them, admire the new product, as an excellent variety for the table.

It is a curious and memorable fact, that the *farina fœcundans* of the *European chesnut*, does, in the manner you describe, impregnate the *American chinquapin.*

I believe, with you, the principle is capable of extensive application. Hybrid plants, possessing qualities worthy of being known and perpetuated, have often appeared. I am inclined to think, they are more frequent than is generally supposed. I hope vines may be found susceptible of improvement by such an intermarriage; and that all interested may experience the benefit, in the better quality of grapes, and of the precious liquid they afford.

The world stands very much in need of faithful observers, to ascertain facts. Another class of persons is quite as necessary, I mean those who write and register their remarks, for public instruction. Unless the things we know, are thus put upon record, to travel far and wide among our contemporaries, and forward a long line to our successors, they will perish with our failing memories—die with us, or at farthest, be imperfectly remembered a generation or two by tradition.

I rejoice that you have set so good an example; and recommend it to diligent imitation.

Health and respect,
SAMUEL L. MITCHILL.

ART. XI.—*A memoir* on the honey-bees of America, addressed to the Hon. Samuel L. Mitchill, President of the Lyceum of Natural History*—*by* J. C. VANDEN HEUVEL, Esq.

(Communicated for insertion in this Journal.)

SIR,

CONSIDERING the institution over which you preside as the proper depository of such articles of interest or value in any of the branches of natural history, as may be brought from foreign countries by private means, I take the liberty of addressing you for the purpose of contributing to their cabinet, a collection of bees obtained by me, during a recent residence in Guiana; indulging a belief that the region whence it proceeds will rather increase than diminish the interest which it may excite. While most of the provinces of South-America have been examined by scientific observers both of the old and new hemisphere, the portion lying between the rivers Oronoke and Amazon has attracted but little of their attention. To this neglect various causes of a moral and political nature have contributed; but impediments, arising from the physical aspect of the country, have been alone sufficient to occasion it. Its immense forests, almost impervious by their exuberant luxuriance of vegetation, excited by a tropical sun and humid atmosphere, are rendered inaccessible during a great part of the year by the torrents of rain that periodically fall, and descending from the higher grounds, form vast reservoirs on the intermediate Savannas; while a still farther difficulty is presented in the dreadful aspect of hordes of savages roaming there in primitive rudeness, and in many cases with existing traits of the wildest ferocity.

In the course of my residence in the province of Demerara, I became acquainted with a German naturalist, Dr. George Schmidt, who has lived for a number of years in various parts of Guiana, and is now an inhabitant on the banks

* Dated at New-York, Sept. 21st, 1820, and read before the Lyceum, 25th Sept. 1820.

of the river Essequibo. His assiduous and persevering exertions have brought to light sufficient data to convey an idea of the extensive and most interesting treasures of Natural History, which are contained in that unexplored region. The department to which he has chiefly devoted himself, is that of Entomology, and the abundance and diversity of the various tribes of insects, as disclosed by him, among which is a vast number heretofore unknown, cannot be viewed but with mingled delight and astonishment.—Among the varieties collected by him, I was particulary struck with the number and beautiful diversity of the order of bees; and presuming that of a country so little known, any information would be gratifying to Naturalists of the United States, I obtained from him a preparation of the species in his possession, and which I have now the pleasure to present to your highly respectable institution. The number of bees contained in the collection is twenty, but half of the whole number (as Dr. Schmidt informed me) which he had indicated. I regret that no nomenclature attends them, as in consequence of his discoveries not being completed, he had not yet bestowed his attention to that subject. It may be gratifying, Sir, however to you and others, to learn the names given to these various species by the Aborigines of the country, not only as furnishing means for a systematic discrimination, but also as corroborating the statement of Dr. Schmidt, of the *honey-producing* property of all these varieties. This information I have derived from an individual who was for many years a constant resident among the savage tribes, and qualified both by education and an inquisitive turn, to notice and preserve by written memorials, whatever important facts came to his knowledge. He took up his abode chiefly among the celebrated nation of Arrowauks, who, distinguished above all the tribes for their mildness and benevolence of disposition, are also pre-eminent among them as minute observers of all the productions of nature. Being the original proprietors of the whole coast of Guiana, though subsequently dispossessed of a portion of it by the ferocious Charibs; all the rivers and creeks, the intervening territories and prominent positions; all the varieties of animal and vegetable life bear to this day their own appellations. Like other savages, they are little used to abstraction and generalization, but led by their habits, accustomed to an attentive observance of external objects, they evince in the discovery of specific differences, an inquisitiveness of remark, and nicety of discrimination, which cannot be surpassed by naturalists whose minds have been disciplined by systematic studies. Not a tree nor a shrub, no creature of the air, of the flood or of the forest, however diminutive, or however rare, throughout the endless distinction of nature, exists without an *Arrowauk* denomination. According to the authority referred to, their name for *Bee* is *Ambani;* and every variety is designated by prefixing to this word another, indicative of some analogy which its shape or colour, the acuteness of the sting, or the scent of the honey bears to some other object. *Maba* is their name for honey, to which, in like manner, to distinguish its several kinds, they prefix the term appertaining to that species of Bee from which it is obtained. Thus they say *Kurewáka-Ambáni.* Kurewáka is the name of a small Parrot, whose colour that of the Bee bearing this name resembles; and *Kurewáka-Mába*, is the honey of that Bee. *Hyáo-Ambáni* is a Bee whose honey smells like the milky juice exuding from a tree, called Hyáo: and *Yawáhu-Ambáni* is one whose sting causes fever, *Yawáhu* being their name for Devil, whom they, like most other rude nations, believe to be the cause of all diseases, as well as other calamities with which they are afflicted. The number of Bees noticed by my informant is twenty-nine, all of whom he asserts are honey Bees; the quality of the honey, he moreover adds, is remarkable for its clearness, thickness and sweetness; the wax of a yellowish brown, imparting a fragrant smell. The following are the *Arrowauk* names, as furnished by him for these species:

1. Hilími-Ambáne,	Carrion-Bee, (from the smell of the honey)
2. Siwiriri,	Small.
3. Mabúria,	Very small.
4. Honno-Honuri,	Large.
5. Honno-Honno,	Very large.
6. Tuturúlu,	Large black.
7. Híkki,	Fire, (stings like.)
8. Wakára,	White Golding.
9. Wirukutúri,	Yellow-Bird.
10. Kuyára,	Large Deer.

11. Puteréra,	Very painful.
12. Kuriwiri,	Blood-letting.
13. Kana,	Wild Cow.
14. Haw,	The Sloth.
15. Hituri,	Black Ape.
16. Kuriwáka,	A species of Parrot.
17. Sarámma,	Largest sort of Parrot.
18. Warumúri,	Long black Ant.
19. Pariéddi,	Large White.
20. Léndi Gúbi,	Calabash.
21. Baráddi,	Bill Bird.
22. Waráddi,	Very rare.
23. Kuribíru,	Snake Fish.
24. Warakábba,	White back.
25. Yawáhu,	Devil.
26. Sibéru,	Frog.
27. Súli-Sáli,	Small black Parrot.
28. Aláso,	Small land Turtle.
29. Hyáo,	A Tree that exudes a milky juice.

In presenting this collection to the Lyceum, I have, Sir, another pleasure, independent of that of enlarging its cabinet. It is derived from the opportunity I have of affording by ocular evidence, incontestable refutation of a theory which has been maintained by European writers, of the origin of the Bees of the western hemisphere. In consequence of their supposed fewness in North-America, an opinion was advanced by the Abbe Raynal that they were brought there by the first settlers, and is recently put forth in a work of credit and general reference, (Rees' Cyclopœdia: Art. Bees,) in these words: "The Apis-mellifica, or common honey Bee, is an European insect. It is supposed by Mr. Hunter to be an inhabitant of Asia and Africa; its appearance in America may be accounted for in the *presumption* that it was originally introduced there from Europe, and in the course of time has been completely habituated to the climate." Thus, by an inversion of the rules of just reasoning, an hypothesis is formed before acquiring a knowledge of facts, and these, when disclosed, though entirely at variance with it, must, to support it, be explained away by arbitrary assumptions. Of the native origin of the Bee of North-America, no doubt can be entertained by any one, possessed of the least experience in the country. Even the fewness of its numbers may fairly be questioned; at least if applied in any other than a comparative sense. In all parts of this portion of the continent, to the remotest settlements, honey Bees are found in a wild and unappropriated state in every wood. Of these there are several varieties which have never been domesticated, and therefore could never have been brought from foreign regions. If neither the climate, nor the fruits of the soil are entirely uncongenial with the habits of these species, no reason exists for the *presumption* that those which are domesticated, are not also indigenous. To facts of which we have daily evidence, it is superfluous to produce written authorities; but allow me Sir, to observe, that Carver, in his Travels in North-West-America, describes the Bee, in connection with the Beaver, &c. "as one of those productions *almost peculiar* to America," an opinion very extraordinary, when contrasted with the hypothesis of Raynal, and which could have arisen only from his observation of such numbers of this insect, as surpassed in his belief the swarms of the old world. Their mode of depositing their honey is indeed peculiar, and occasioned solely by local causes. Instead of concealing it in the hollow of a tree, or suspending their hives from the branches, they place it in a hole made in the ground, their object being to preserve it from the attacks of tigers. With reference to the southern portion of North-America, I take the liberty also, of presenting an anecdote I accidentally met with, illustrative of the existence of Bees in that quarter. In Roberts' History of Florida, it is mentioned that in the Expedition of Ferdinand De Soto, for the conquest of that territory in 1539, his army, after a fatiguing march of some days, besides receiving provisions from the Indians, were agreeably surprized with the discovery of wild honey in the woods, which, considering the date of the expedition, must have proceeded from Bees indigenous to the country.

Their paucity in North-America, admitting it to exist, might have been accounted for by Raynal, without hazarding the idea of their transmigration from the other continent, by reflecting that the nature of the climate was less favourable to them, than that of more southern regions; as in Europe, though they are cultivated to some extent in the northern parts, they are more the objects of the attention of man, and thrive more under his fostering care, beneath those warm and indulgent skies, where nature affords nutriment for them in gay profusion, and lengthened summers prolonging their labours render their products of greater importance. In like manner on the Western Continent, it is in southern climes that they are found in greatest abundance, and that the results of their iudustry are most valuable.

The ardent sun of the tropics, which generates in all vegetable bodies an increased portion of saccharine matter, which decks the woods and groves with an endless display of blossoms and flowers, of aromatic and nectareous fragrance, and distils from the trees of the forest in luscious streams those balmy juices with which it surcharges them, furnishes a region where Bees may luxuriate in "a wilderness of sweets." Accordingly in all parts of South America, and in the West Indies, their different products form not only material articles of diet and domestic utility, but also very considerable items of foreign exportation.

Along the banks of the Amazon, says Southey, (1st Vol. History of Brazil) honey is one of the principal articles of sustenance of the natives.

In Chili, according to Molini, it is an article of commerce between several of the provinces.

In Paraguay, wax is one of the two staples of trade by the river La Plate, across the country, (Ulloa.)

In Peru, Bees are so numerous, that when one of the Spanish Generals, on the conquest of it, entered a certain province, scarce a tree could be cleft but honey flowed from the aperture. (Southey.)

The province of Yucatan, in New-Spain, says Humboldt, is so well stored with this insect, that *wax* is its principal export; and in the island of Cuba, adds the same authority, it is so abundant, that in 1803, 45,000 Arobbas, or one million pounds weight of that article was exported.

In regard to the remaining part of South America, the collection I lay before the institution, affords a sufficient testimony to the point.

Such being the abundance and variety of this insect in the southern portion of the continent, far superior to all similar productions of the old world, the idea of its transportation to those parts from Europe, is manifestly absurd; and even if the *North* American Bee should be admitted not to be indigenous to its own climate, an admission, contrary to fact, and unsupported by the shadow of authority, we should of course attribute its appearance there to emigration from the contiguous and well supplied regions of the south, rather than to transportation by human agency, from the far less extensive swarms of another continent.

On the whole, Sir, from these facts, it appears to me, and I trust will also appear to your better judgment, that the presumptuous hypothesis of Raynal and his successors, is to be considered merely as the genuine offspring of the spirit once so fashionable among a certain class of European writers, and even now not extinguished, of decrying and disparaging all the productions, animal and vegetable, moral and intellectual, of the Western Hemisphere.

I have the honor to be, Sir, with best wishes for the continued prosperity of your Institution,

Your very respectful,
and obedient humble servant,
J. A. VANDEN HEUVEL.

Art. XII.—*Some curious facts respecting the Bones of the Rattle Snake; communicated for this Journal by* Professor Jacob Green, *in a letter to the Editor, dated Princeton, Dec.* 9, 1820.

About the year 1748, some labourers in working a quarry in this neighbourhood for the stone with which our College is built, discovered a small cavern, which contained the entire skeletons of an immense number of the *rattle snake*, (Crotalus.) The bones were in such quantities as to require two or three carts for their removal. There can, I think, be but little doubt, that this cavern had once a small opening which was afterwards closed by the accidental fall of a stone, or some other impediment. This cavehas probably been the winter abode of the rattle snake for years, where many have died through age, and others in consequence of the circumstance just mentioned. Mr. Humboldt, in the third volume of his Personal Narrative, hints at an occurrence somewhat similar to the above. "I had visited the caverns of the Hartz, those of Franconia, and the beautiful grotto of Treshemienshiz, in the Carpathian mountains, which are vast cemeteries of bones of tygers, hyenas and bears, as large as our horses." Bakewell, in his Geology, has an account of the entire skeleton of an elephant of immense size, discovered in Derbyshire, in a cavernous rock composed of *marine* animals. He supposes the cavern to have been open, and afterwards closed by the deposition of calcareous earth, forming stalactites; instances of which are common in Derbyshire. "Into this cavern I conceive, (says he) the animal had retired to die, at a period long after the existence of the marine animals which are imbedded in the surrounding rock."

The discovery of the organic remains of the rattle snake in our neighbourhood, may serve as an additional caution to geologists, not to form theories from isolated facts; and that if the bones of animals similar to those which now inhabit our earth are discovered, with reliques peculiar to what we now suppose to be ancient strata, a careful examination of all the circumstances will sometimes illustrate the anomaly.

The stones of which our College is built are argillite and hornblende, taken from various quarries in the neighbourhood. In which of these the above remains were discovered I am unable to state, but most probably they were in the argillite.

Within the memory of some of the old inhabitants of our town, rattle snakes were common in this vicinity; but as in other places, they have retired as the population has increased to more uncultivated regions. There is a popular story among them, that this reptile always retired to his winter quarters before the leaves of the white ash (*Fraxinus discolor*) began to fall—the leaf of this tree being peculiarly obnoxious to him. I am aware that stories of this kind are not entitled to much credit, and therefore do not intend to add the leaves of the white ash to the list of antidotes to the bite of the rattle snake, but merely state the circumstance to excite further observation.

CHEMISTRY, PHYSICS, MECHANICS, AND THE ARTS.

Art. XIII.—*Upon the fusion of various refractory bodies by* Hare's *Blowpipe.*

(Translated from the Annales de Chimie et de Physique of Paris, for July, 1820—Editors Gay Lussac and Arago.)

The blowpipe of Hare was described in the Annals of Chemistry, (Vol. 45, p. 113.) It is supplied by two streams, one of hydrogen and the other of oxigen, which do not mix till the moment of their combustion, and consequently are attended by no kind of danger. This blowpipe is in this respect far preferable to that of Newman, or rather of Brook, who appears to have been the first inventor, and it is not inferior to it, or only in a very slight* degree, in intensity of heat. We can besides supply it with hydrogen gas and oxigen gas, compressed each in its own reservoir; but, if we were to judge of it by the effects produced by this instrument, and by that of Brook, there is but little advantage in having recourse to this means.

The simplest mode of constructing Hare's blowpipe in a laboratory, would be, by taking two cylindrical bell glasses, furnished with stop cocks, the horizontal sections of which (the glasses) should be such, that the one should present a surface double to that of the other: they are to be fixed in the pneumatic cistern, the largest to contain oxigen and the smallest hydrogen. From each of the bell glasses should proceed a tube, which should terminate in a somewhat massive cone of platina, perforated with two small ducts, very near to each other, and corresponding to the two tubes. The cistern being supposed to be filled with water, and the bell glasses immersed in it, the gas will escape from them by opening the stop cocks, always in the proportion to form water, which is the best adapted to produce the *maximum* of heat.

* Whether it is inferior even in *the slightest degree*, may be seen from the detailed comparison of results, made by Professor Hare, in our last Number. —*Editor.*

Lavoisier, as is well known, by directing oxigen gas upon burning charcoal, succeeded in melting and volatilizing some substances, which, till that time, had been considered as infusible and fixed. (Mém. de l'Acad. 1782 et 1783). He melted alumine, and many of its mixtures; but he did not succeed in melting silex, barytes, lime and magnesia.

Mr. Hare, by means of his blowpipe, perfectly melted alumine, silex and barytes, but with great difficulty, lime and magnesia. He brought silver and gold to a state of ebullition, and succeeded, almost instantly, in volatilizing completely, globules of platina of more than a line in diameter. (An. de Chim. XLV. 134. et LX. 82.)

Some years afterwards, Mr. Silliman, Professor of Chemistry and Mineralogy, who had co-operated in the early experiments of Mr. Hare, performed new ones, which were published in 1813, in the first volume of the Memoirs of the Connecticut Academy of Arts and Sciences; we proceed to give the principal results.

Alumine was perfectly melted into a milk white enamel.

Silex, into a colourless glass.

Barytes and strontian into a greyish white enamel.

Glucine and Zircon were perfectly melted into a white enamel.

Lime, prepared by the calcination of Carrara marble, was melted into a perfectly white and brilliant enamel.

The splendor of the light was such that the eye, when naked, and even when protected by deeply coloured glasses, could not sustain it. The lime was seen to become rounded at the angles, and gradually to sink down; and in a few seconds, there remained only a small globular mass.

Magnesia was affected almost exactly as lime; the light reflected was equally vivid; the surface was melted into small vitreous globules.

Platina was not only melted, but volatilized with strong ebullition.

A great number of minerals, such as rock crystal, chalcedony, beryl, Peruvian emerald, peridot, (chrysoberyl) amphigene, (leucite) disthène, (sappar) corundum, zircon, spinel-ruby, &c. melted with the greatest facility.

In subsequent experiments, which Mr. Silliman has communicated to us, platina, gold, silver, and many other metals were not only rapidly vaporized, but entered, at the same time, into beautiful and vivid combustion.

Although the experiments of Mr. Silliman date in 1812, we have thought that they ought to be known upon our continent. They demonstrate, on the one hand, that Mr. Clark has been anticipated in America, with respect to the fusion of bodies in the flame of hydrogen and oxigen;—and on the other, that the blow-pipe of Hare gives results almost perfectly identical with those of Brook.

Remarks by the Editor.

Having, in company with Professor Griscom, used the blowpipe of Brook, and repeated with it many of the experiments cited above, we are constrained to agree with Messrs. Gay Lussac and Arago, (an authority which both on this point, and on that of *priority*, will probably be admitted as of the first import,) and to say that we can perceive very little, if any superiority which Brook's instrument has over the *prior* and *original* invention of Mr. Hare. The *exact* apportionment of the gases is, at first view, a consideration of importance—but in practice, (and we speak from a long course of experience with Mr. Hare's instrument,) it is really found of very small moment. A little habit in using the instrument, soon enables the operator to decide by the eye, from the size and intensity of the flame—especially when directed upon any object, whether the proportions are right, and nothing is easier than to alter them, by simply turning the key of one stop cock, or of the other, as may appear necessary. We can say with the utmost confidence, that there is no difficulty on that head, and the results with the two instruments sufficiently establish this fact.

Theory would probably lead us to expect much from the effect of pressure—but here again we were, when using Brook's instrument, greatly disappointed. We raised the pressure, by forcing in the mixed gases till the flat sides of the thick and strong copper parallelopiped, which is employed as a recipient, were swollen out till they were all distinctly convex, and yet the intensity of the flame did not appear to surpass that produced by Mr. Hare's instrument, used with the aid of a pressure of a few inches of water.

Ought we, however, even from theory, to expect any advantage from pressure, beyond that which may cause the gases to flow decidedly to the focus, and with such rapidity as to keep up a constant supply. As there is nothing to confine the stream of gas—no reacting force, particularly on the sides of the stream, except simply the pressure of the atmosphere, will not the effect of great pressure be, to dissipate laterally, a portion of the gases, so that they will not arrive at the focus, either burning out of it, or possibly, even to some extent, escaping combustion.

In Brook's instrument also, were a high pressure deemed of advantage, it is evidently very transient, as, the moment the gases begin to flow, it is diminished, probably, in a geometrical ratio, and it is very soon reduced to a pressure not superior to that exerted in Mr. Hare's. From the small capacity of the reservoir, the entire duration of one charge of gas is also very short, and it is burnt out in a minute or two. It is true, it is possible in some measure to compensate for this defect, by employing an assistant to inject gas constantly while the flame is burning, but this, besides the inconvenience of the thing, would probably occasion vibrations in the flame.

The reservoir for Brook's blowpipe may, indeed, be made stronger and larger to any extent—but who (considering the evident liability to explosion which, after all the ingenious contrivances to prevent it, does *occasionally* happen) would wish to be in the vicinity of even a cubic foot of these gases which, when kindled, would, of course, exert, in their explosion, a force proportioned to the resistance of the walls of the reservoir, and might therefore propel fragments, with even fatal velocity.*

* That this inference is not unfounded, will perhaps appear from the following fact. We had been accustomed (borrowing the experiment from the late Dr. Woodhouse, of Philadelphia) to mix fulminating mercury and oxy muriate (chlorate) of potash by agitating them on an open paper by a feather; they were then gently poured into the bowl of a common tobacco pipe, and exploded by pouring sulphuric acid from a long pole; the explosion was always very violent, but no harm happened from the fine fragments, into which the pipe bowl was always broken.

On one occasion, we substituted for the pipe bowl, a common tinplate candle extinguisher, placing it with the vertex, of course, downwards, in an iron candlestick, which was intended to act as a support. We were aware, that by the explosion, the tin recipient would be torn, but we imagined that the fragments would hardly be projected, or, if they were, it was concluded that, on account of their thinness, they would not be propelled to any distance, nor with sufficient momentum, to do any harm. But when the explosion occurred, the iron candlestick was split, although no part of it

Especially, would this danger be serious, were such volumes of the gases employed as to keep up a train of experiments for hours, without recruiting the gases. This is the case in the large pneumatic cistern in the Laboratory of Yale College. The recipients for gas, in this, amount collectively to the capacity of fifty gallons; they are all connected at pleasure; the gas in them, when they are full, has a pressure of fifteen inches of water, and the consumption of half a cubic foot of gas reduces the pressure only one inch, and so in proportion.

This instrument, or one on similar principles, has been in use, in our hands, for the purposes of the compound blowpipe, seventeen or eighteen years; and no explosion ever occurred, or can occur, because the well of the cistern is between the two hostile gases.

The scale of the instrument has enabled us to indulge, even to luxury, in the numerous and splendid experiments of fusions and combustions, which were performed on most substances that possess any particular interest, in the successive public courses of chemistry before the various classes, as well as in private researches, *for years before the Cambridge experiments were ever heard of.*

Application of Hare's Blowpipe to the synthetical formation of Water.

The synthetical formation of water, from the combustion of the oxigen and hydrogen gases, is of course an interesting experiment, to all who attend on a course of chemical demonstrations.

The apparatus of Lavoisier, or rather an enlarged and improved one which we had made under our direction, in London, exhibits the fact extremely well; but the apparatus is expensive,—rather complicated, and not without some practical difficulties in the use.

was missing; and the fragments of the tin extinguisher were shot out among the audience, to the distance of twenty feet all around; several persons were scratched, and one young man had the right temporal artery divided, so as to produce a copious hæmorrhage; perhaps this little incident will justify the remarks in the text.

We have, this season, availed ourselves of Mr. Hare's blowpipe, and have applied it with good success, to exhibit the formation of water. For this purpose, the two tubes which end in the frustrum of platina, are screwed out and inserted through a cork: they are then again screwed into the platina, and are lastly connected with the tubes which lead to the reservoirs of gas, exactly as when we are to use the compound blowpipe.

An apothecary's bottle, which should be from fifteen to eighteen inches high, and of the capacity of about three or four gallons, is then filled with oxigen gas. This is easily done, without the air pump, by using a tube bent twice at right angles, and long enough to reach with one leg to the bottom of the bottle; the other leg is screwed to the stop cock of a large bell glass; this last is filled with oxigen gas, and by being pressed into the well of the pneumatic cistern, while the long leg of the bent tube is passed to the bottom of the large bottle, on turning the key of the stop cock of the bell glass, the oxigen gas flows in, and lifts the common air out, and takes its place, thus filling the bottle with an atmosphere of oxigen gas, without resorting to the air pump, and without wetting the inside of the bottle, which would, of course, render the experiment nearly nugatory, and the result ambiguous. It is known when the bottle is filled with oxigen gas, by bringing a taper, that instant blown out, to the mouth of the bottle, when if full, the taper will be relighted.

Things being thus arranged, the flame of the compound blow pipe is lighted, and is introduced into the bottle, taking care not to bring it within nine or ten inches of the bottom: the cork which is on the tubes, closes the mouth of the bottle,* which is, from the first moment, kept cold by copious streams of water poured incessantly over the shoulders of the bottle, which, if neglected for a minute or two, will grow hot—the vapour of the water formed will no longer condense—it remains in the condition of steam, and if the bottle be tight, will produce an explosion; or, if after the glass is once hot, we attempt to pour on water, the bottle cracks. But, by reasonable attention, there is no diffi-

* Not, however, *absolutely* tight, for fear of explosion, from the great rarefaction arising from the heat.

culty, and we let in both gases at once, or the hydrogen only, and the oxigen as it is wanted, and thus produce as much water as we choose, or as our gases will afford.

The experiment may be performed without first filling the bottle with oxigen gas, and by operating with it full of common air, but the nitrogen, in a degree, obstructs the combustion, and the result is less satisfactory.

This little application of Mr. Hare's blowpipe may, perhaps, be of some use to chemical demonstrations, and serves to evince the additional value of this fine instrument.

For an illustration of the above description, see the drawing on a plate, at the end of this Number, where a section of the pneumatic cistern, with the air cells—the recurved tubes coming from them and terminating in the blowpipe, and the connexion of the latter with the bottle, are exhibited.

Art. XIV.—*On an instance of instantaneous Crystalization—by Professor* Green, *of Princeton.*

The instantaneous crystalization of a saturated solution of the sulphate of soda or common Glauber's salt, is familiar to every one who makes chemical experiments, and perhaps the crystaline process I shall now mention, has been often noticed before—I send you, however, the following account, as I have not seen it any of the books on Chemistry.

In preparing the nitric acid from nitrate of potash and sulphuric acid, I had occasion to stop the process just as the red fumes of the nitrous gas made their appearance, and of course, when the nitrate of potash was completely dissolved in the sulphuric acid—the next day I found the solution perfectly transparent, and upon admitting the atmospheric air no change took place, but upon dropping into it a small piece of the nitrate of potash, crystalization immediately ensued, and the whole was quickly solidified. There was, I think, a larger quantity of caloric extricated during the above process, than in the instantaneous crystalization of the sulphate of Soda—another difference was, that the solidification did not, as far as I observed, commence on the upper surface and proceed gradually downwards, as in the sulphate of soda, but began to form round the small pieces of nitre which were thrown in.

Other particulars might be stated, but as the phenomena are probably familiar to you, I omit them.

The above experiment is another proof that atmospheric pressure is not essential to the crystalization of salts, neither could the phenomena be ascribed to the sudden obstruction of a portion of heat from the liquid on the admission of air, as the crystals were not first formed on the surface; besides, I found in one or two instances, the fluid crystalized throughout, when there was no exposure to the air.

From the numerous experiments on saline crystalization, made by Dr. Coxe of Philadelphia,* and Professor Ure of the Glasgow Institution, no correct inferences, it appears, can as yet be deduced from the facts. The last gentleman supposes that negative electricity may be the agent employed by nature.†

Should not the crystals formed in the experiment I have described, be called the Nitro-Sulphate of Potash?

Art. XV.—*On Artificial Mineral Waters, with some remarks on Artificial Light; by* Samuel Morey, *of Orford, New-Hampshire.*

TO PROFESSOR SILLIMAN.

Dear Sir,

Possibly something for the American Journal may be selected from the following thoughts and experiments, the object of which is to furnish, at a cheap rate, an abundant supply of light for many purposes, and also to multiply fountains, such as those of Seltzer, Saratoga, &c. at such an expense, and in such quantities and situations, that the calls and necessities of every one may be conveniently satisfied.

* See Annals of Philosophy, Vol. VI. page 101.

† See Journal of Science and Arts, by Broude, Vol. V. page 106

It is well known, that the vapour of water, in passing through ignited charcoal, is decomposed. If the product is made to pass through water, the carbonic acid gas is absorbed, and the hydrogen is so far separated, as to be at command for furnishing light, filling balloons, or other purposes. If water be composed of 85 parts of oxygen and 15 of hydrogen,* and carbonic acid gas of about 28 of carbon, in the 100; one pound of charcoal and not far from four of water, ought to give something like two hundred and fifty gallons of carbonic acid gas, or enough to supply that quantity of as nearly strongly impregnated mineral water as is to be found in nature ;† and near five hundred gallons, or about seventy-five cubic feet of hidrogen gas, something like equal to twenty-five pounds, or six wax candles burning twenty-five hours, for affording light. Some very trifling addition of spirit of turpentine or other substance will be required to make the flame white. These gases, as formed, may be forced into the aqueduct of a limited quantity of water, to be conveyed along with it to some desirable situation to be let out for use. The quantity of water let in will depend on the quantity of mineral water wanted. If a flame be applied to the surface of these fountains, the hydrogen gas takes fire and burns on the surface of the water : thereby, perhaps, exposing some of nature's hidden operations.

In this way, Towns, Cities, and Manufactories, may be, for aught that yet appears, supplied with a pleasant, healthy drink, and at the same time, and from the same materials, abundantly lighted. There must be an addition of some kinds of fuel, to preserve the red heat of the charcoal, and to evaporate the water. But that will be trifling, especially if it be a fact, as I fully believe, that carbonic acid gas, in forming, always gives out, instead of absorbing, heat. If so, it is at least one source of animal heat. As yet, my attention, so far as my health would permit, has been directed chiefly with a view to come at an easy mode of fur-

* The most recent authorities give the composition of water at 88.24 of oxigen, and 11.76 of hidrogen.—*Editor.*

† Carbonic acid gas derived *directly* from almost any species of *burning* fuel, would be very prone to impart an empyreumatic taste and smell to the water in which it is condensed.—*Editor.*

nishing mineral springs, by the disengagement of the carbonic acid from marble, by the stronger acids. For that purpose and others, I had a small cool spring of water brought in a wooden aqueduct about one hundred and fifty yards, having a descent of fifty feet, all the way on an inclined plane, so that the water should, in no instance, fill the bore of the logs, and obstruct the passage of the gas or gases, if turned into the aqueduct with the water, or forced in at the bottom. I found no difficulty in filling the aqueduct with water, so as to give a pressure or head equal to thirty or forty feet perpendicular. Very fine streams of water, issuing under any thing like this head, and coming in contact at nearly a right angle, with a plane surface, were converted into a spray, as fine, much of it, as mist. When this mist or spray was forced into an atmosphere of pretty strongly compressed carbonic acid gas, it became suitably impregnated with the gas, so as to form a very pleasant drink. To facilitate the impregnation, and to prevent a possibility of any of the sulphuric acid being retained by the water, and for other purposes, I filled the vessel, (a common three gallon stone jug answers well,) about two-thirds or three-fourths, with grains of the marble, about the size of large peas: the spray falling on these, passing slowly from one piece to another, gives more time and presents an immense surface to the gas. In this way, water under a pressure of twenty or thirty feet head, or much less, issuing at the rate of about two half-pint tumblers per minute, flows in, pure spring water at the top, and flows out nearly or perfectly saturated at the bottom: as much so nearly as any known natural mineral spring. By adding one vessel to the top of another, or increasing the length, and increasing the pressure, any desired quantity of the gas may be added to the water. Indeed, any part or the whole length of the aqueduct may be filled with these fragments and with those of iron. The gas and water evidently dissolve more or less of the lime and iron. Carbonate of soda, or any other substance which renders the water more healthy or useful, may be added in any desired quantity. The quantity of water that flows in, may be regulated or stopped so as to meet very exactly the call or demand there shall be for the mineral water. The overplus of the spring water is applied to keep the vessels and mineral water cool. This mineral water, with a portion of the gas, may be continued into an aqueduct, and discharged into the bottom of a box, in which they will rise up for use, with the same bubbling appearance as those of the natural mineral waters. Some of the marble which I use appears to contain much sulphuretted hidrogen,* and some iron pyrites. If the mineralized water stands a day or two on these fragments of lime, it gives the water as strong a smell and taste of this gas probably as any natural spring in the world: and there is an appearance of iron being deposited from this water by standing in a glass vessel. How easy then to produce at one establishment, from a single spring of pure water, our choice of any number of mineral waters, and those as good as any to be found in nature or possibly better.

If the vinous fermentation should be adopted for procuring the carbonic gas, a flood of it may be procured from many sources, not only without expense, but even at a profit.

But in those situations, where these waters will be most wanted, and where they are much the most useful, I know of no reason why an abundant supply of the gas, ready formed, may not always be had, and that without expense—I allude to breweries. At as many of these as is necessary (where there is steam or other power) it will be but to avail ourselves of a forcing pump to drive the gas, as formed and purified or from reservoirs, into suitable pipes with a sufficient quantity of water, to be conducted to some pleasant, suitable situation, far enough to have the water properly impregnated, and then to be let out for use. If a greater pressure than what the ground naturally affords, be wanted, it is only to add at the outlet, a valve sufficiently loaded. A small fountain may receive the water and overplus gas above the valve, or they may be drawn below.

It appears necessary, that where the gas is disengaged from limestone, the vessel containing that and the diluted acid should in some way be agitated, so as to shift the posi-

* It is doubtless *one of those fetid although crystaline and decidedly primitive lime stones*, which have been found repeatedly of late in this country; their existence must give rise to interesting geological speculations. Is the sulphuretted hidrogen, from which fetor is probably derived, owing to the decomposition of pyrites by moisture? Pyrites often exists in primitive rocks, but animal bones never.—*Editor.*

tion of the pulverized marble. The best mode I have tried as yet, is to cause the vessel to revolve, say a stone jug, on an axis and end over end: and to have a portion of the marble coarse. As the sulphate of lime forms on the surface of these lumps, by their friction in rolling over each other, it appears to be worn off, presenting continually fresh surface for the acid to act upon, and thereby continuing very regularly, its operation ever so long. These vessels may be made to revolve (very slowly if necessary) by weights, springs, or a part of the water—or may occasionally be moved by hand. The gas presses out at one end of this axis. A very cheap, quick, and agreeable mode of preparing the water, where we have (or have not) an aqueduct or head to resort to, is to take four or five, or more decanters, say of the capacity of a quart; fill them with fragments of marble—set them in a row or other form, each with a good cork; let a tin tube screw upon the axis to receive the gas, and press pieces of cork or other stuffing to the vessel, to make it tight around the axis. This tube, near the other end, is of a conical form, and turned down at a right angle far enough to be inserted through the cork of the first bottle: another tube, turned down at each end, so that one leg shall pass through the cork also, to the bottom of the first decanter, and the other through the cork of the second decanter; and so on with as many as are to be used. A small reservoir is to be placed as many feet above as convenient, and the first vessel, with a small pipe leading down and through the first cork, with an opening at the lower end about one-thirtieth of an inch in diameter. A quantity of pulverized lime and water may be put into the revolving vessel; then more water, containing a small quantity of clay or sulphate of lime. This will be deposited on the lime, so as to prevent the action of the acid when poured in, which may now be added, and this vessel corked. It is now ready for use. Put cool water into the reservoir, turn the vessel moderately a very little, if the gas is not already forming fast enough. The water strikes on the first fragments of stone, is thrown over them, and passes over the surface, from one to another, to the bottom, where it is continually taken up by the tube with a portion of the gas, and discharged just below the cork of the second vessel; or thrown out in a spray by and with the gas; or else discharged at the lower end of the tube in bubbles; thereby furnishing a carbonic gas within and without, with an almost infinitely thin film of water between, to absorb it on each side. By continuing the same process, it passes the whole, let the number be ever so many. At the last one it is thrown out, through a stop cock, as at common soda water establishments, or flows out in a continued stream with the gas. It may be well to fill the first decanter, or even all of them, with water, and discharge it into the last one, by the gas, before the water is let in from the reservoir above. These glass vessels may be placed in a trough to keep them cold: this can stand on a table or side board, where the domestics or other members of the family, may at any time furnish a bottle or bottles of the mineral water when wanted.

If tin plate tubes will answer, it is but a short day's work to prepare this apparatus, which may afford sixty or one hundred and twenty tumblers per hour, with half a dozen decanters. By increasing their number or size, any given quantity in this way can be constantly or occasionally supplied. One pound of sulphuric acid, if I mistake not, ought to furnish gas enough to saturate sixty or seventy gallons, or not far from one thousand tumblers of water. Experiments, I think, justify me in saying, we may expect not far from half this quantity, *practically*. I can but hope, and do believe, if owned and properly managed by corporations and companies, it may and will do much, very much towards annihilating the use of ardent spirits, as well as be the means of saving many annually from an untimely death, by drinking cold water, to say nothing of its usefulness in other respects.

When currents of this gas, conveniently situated, are found issuing naturally from the earth, they may be turned to account. As for instance, at the Grotto del Cane, two miles from Naples: if the gas from this grotto were received into an aqueduct, and carried in the direction of Naples, or in any others, until a supply of water could be added, the current might be continued until the gas and water were perfectly united, and then they might be let out for use in any situation most agreeable, or most conducive to the comfort and convenience of that city and country.

Orford, Sept. 27, 1820.

Postcript.

From an ounce of sulphuric acid, I practically obtain (I may say without trouble) about twenty tumblers of as pleasant drink as I could ask or wish for.

It is a great luxury, and I have no doubt that it has been of much service to my health. The sulphate of lime here, is worth six or eight times what the ground marble costs.

Art. XVI.—*Case of a Paralytic Affection, cured by a stroke of lightning. Communicated for this Journal, by* D. Olmsted, *Professor of Chemistry in the College of North Carolina.*

The following case of recovery from a paralytic affection by a violent stroke of lightning, was first mentioned to me by a very respectable gentleman in whose hearing I had recited the well known galvanic experiments, performed by Dr. Ure, of Glasgow, on the body of a culprit. My informant not having had opportunity to investigate the facts, was so obliging as to direct me to such sources of information as could be relied on; and I have since been favoured with letters from the individual himself, and from respectable gentlemen in his neighbourhood. Common report, as usual, had represented the case in the most marvellous colours, from which it would appear, that tottering and wrinkled age being restored, in an instant, to vigorous and blooming youth, was no longer a matter of fable. According to this authority, "the patient (Mr. Samuel Leffers of Carteret County, N. C.) having reached a very advanced age, and suffering so severely under a paralytic affection that his feet were unable to support him, and his face was greatly distorted, acquired at once the full activity of his early years, and a remarkable smoothness and beauty of complexion. This complete exemption from decay and infirmity, and the entire possession of his intellectual faculties, he had retained ever since, during a period of fourteen years, which had brought him upon the verge of fourscore years and ten."

Desirous to ascertain how much of this story was matter of fact, I commenced a correspondence which finally introduced me to Mr. Leffers himself, who is still living on the eastern coast of this state, and has attained the age of eighty-four years. As was anticipated, the marvellous circumstances reported of the case have dwindled away to a small compass; but enough, perhaps, remains to render the case somewhat interesting to those who cultivate the study of medical electricity.

I beg leave to give the facts in the language of Mr. Leffers himself, only premising, that I have received the most ample and satisfactory testimonials of his perfect integrity, particularly from the Rev. Mr. Arendell of Beaufort, who characterizes his life "as affording a model of every virtue." The presumption, also, that the facts, as related by himself, may be relied on, is strengthened by the simplicity of his narrative, divested as it is of all those marvellous appendages, with which common report had amplified and embellished the story. The account is as follows.

"In the summer of 1806, waking after a night of quiet rest, I felt an unusual numbness in the left side of my face. I was not alarmed, thinking it might be occasioned by lying too long on that side; but on rising, I felt the effects more painfully—I could not throw the spittle from my mouth; and found great difficulty in speaking; my eyelid was permanently fixed, while the eye remained open, and I was unable to close it. These symptoms made me apprehensive of having received a stroke of the palsy. After some time, the disorder abated in other parts, and centered in the eye, which, remaining uncovered both by day and night, was exposed to constant injury.

"Such was my situation until the 10th of August following, when, as I was walking my floor during a thunder-storm, I was struck down by lightning. After lying senseless fifteen or twenty minutes, (as it appeared,) I revived so far as to be sensible of my situation, and to perceive the objects around me. I recovered the use of my senses and of my limbs, by degrees, during the remainder of the day and night, and felt so well the next day, that I was inclined to give to a distant friend, an account of what had happened. I expected my letter would be short and imperfect through want of eye-sight; but was most agreeably surprised to find myself able to write a long letter without the use of glasses. Since that time, I have not felt a symptom of the paralytic disorder, but have reason to conclude that it was effectually cured by the shock. But I have reason to think, that the same cause which restored my sight, impaired my hearing, since a deafness commenced at the same time, which has continued to the present hour.

I am, Sir, with respect,

Your obedient servant,

SAMUEL LEFFERS."

Art. XVII.—*On the Divining Rod, with reference to the use made of it in exploring for Springs of water; in a letter to the Editor, dated*

Norfolk, (Con.) Oct. 23, 1820.

Remark.—Every person, in the least conversant with the objects of a scientific Journal, must be aware that an Editor is, *in no case*, answerable for the *opinions* of his correspondents. We are willing to preserve all well authenticated facts respecting the divining rod, although we have the misfortune to be *sceptical* on that subject: perhaps, however, we ought in candor to add, that we have never *seen* any experiments. Those so often related by the ignorant, the credulous, the cunning, and the avaricious, are, in general, unworthy of notice; but when attested by such authority as that of the Reverend gentleman, whose name is attached to this letter, they will ever command our ready attention.

Dear Sir,

I am highly pleased with your Journal of Science; and doubt not of its being at once a source of instruction and an honor to our country.

Permit me to suggest the propriety of inserting an article, embodying a sufficient number of well authenticated facts on the use of "*mining rods*" in discovering fountains of water under ground, to put their utility beyond a doubt. I presume that yourself or some of your correspondents are already in possession of such facts and could easily furnish the article.

For myself, I was totally sceptical of their efficacy, till convinced by my own senses.

My class-mate, the Rev. Mr. Steele, of Bloomfield, N. Y. called on me, a few weeks ago, and, in conversation on the subject, informed me that the rods would "work" in his hands. We made the experiment. A twig of the peach was employed for the purpose. It was at once manifest that it bent, and often withed down from an elevation of 45° to a perpendicular, over particular spots; and when we had passed them, it assumed its former elevation. At one spot in particular, the effect was very striking, and he at once said there must be a very large current of water passing under that place, or it must be very near the surface. I informed him that a large perennial spring issued at the distance of perhaps fifty rods, and requested him to trace the current, without informing him of the direction of the spring. He did so, and it led him, in nearly a direct line, to the spring, which was so situated as to prevent his discovering it till within one or two rods of its mouth. The mode of his tracing it, resembled that of a dog on his master's track, crossing back and forth, and he proceeded with as little hesitation. The result, however inexplicable, removed all my doubts. It was in vain for me to reply against the evidence of my senses, by saying, How can this be? and why should not these rods operate in the hands of one as well as another?

On a journey I have since taken to the south-east part of New-Hampshire, I was pleased to learn the practical use which has been made of these rods in that region, for a year or two past, in fixing on the best places for wells. I was informed, by good authority, of a man, in that vicinity, who could not only designate the best spot, but could tell how many feet it would be needful to dig to find water; and that he had frequently been employed for this purpose without having failed in a single instance. I will recite one case out of a number which were told me. A man who had dug in vain for a good well near his house, requested his advice. On experiment of the rods, the best place was found to be directly under a favorite shade tree in front of the house; and there the proprietor was assured he would find abundance of water at a moderate depth. But on reflection, he was loth to sacrifice the tree, and concluded it would answer as well to dig pretty near it. He dug; and after sinking the shaft much deeper than had been directed.

abandoned it in despair. He soon complained of his disappointment. "Did you then dig in the precise spot I told you?" "I dug as near it as I could without injuring the tree." "Go home and dig up that tree, and if you do not find water at the specified depth, I will defray the expence." He did so; and obtained an excellent well at the given depth.

As to the depth, it occurred to me at once, when seeing the operation of the rods in the hands of Mr. Steele, that it might be easily ascertained, by taking the angle they made at a few feet from the spot where they became directly vertical; and this, I conclude, is the mode of ascertaining it, though I was not informed.

Let me also mention a fact in optics, which I have not before witnessed, and which occurred to me when travelling recently in company with a friend. As we were descending the hill perhaps two miles this side of Tolland, we were admiring the fine view of the highlands, which are seen stretching from north to south on the west of the Connecticut. All at once, the northern half of the range appeared to change from the brown hue of an autumnal forest, to a bright and beautiful green, resembling the verdure of a rich pasture in the spring, or a distant wood of deep evergreens. But after descending a few rods further, it assumed its native aspect. The sun, about three hours before setting, was then shining very brightly on the range, and the sky clear, though damp. I conclude the effect was produced by the particular angle of reflection, and the state of the atmosphere.

Yours with respect,

RALPH EMERSON.

P. S.—One morning, we witnessed a beautiful exhibition in nature, of the "sun's drawing water," (as it is commonly termed,) produced by the shadow of a copse on a hill, projected across a valley filled with a dense fog. It led me to conclude, that that appearance is never produced except in clouds of so thin a texture that the sun can shine *through* them—contrary to what I had before supposed. But you are too familiar with so common a phenomenon, to need any remarks upon it from me. R. E.

Art. XVIII.—*A Memoir on some new Modifications of Galvanic Apparatus, with Observations in support of his New Theory of Galvanism. By* R. Hare, *M. D. Professor of Chemistry in the University of Pennsylvania.*

(From a printed paper, communicated to the Editor, by the author, and copied from the Philadelphia Medical Journal.)

I had observed that the ignition produced by one or two galvanic pairs attained its highest intensity, almost as soon as they were covered by the acid used to excite them, and ceased soon afterwards; although the action of the acid should have increased during the interim. I had also remarked in using an apparatus of three hundred pairs of small plates, that a platina wire, No. 16, placed in the circuit, was fused in consequence of a construction which enabled me to plunge them all nearly at the same time. It was therefore conceived, that the maximum of effect in voltaic apparatus of extensive series had never been attained. The plates are generally arranged in distinct troughs rarely containing more than twenty pairs. Those of the great apparatus of the Royal Institution, employed by Sir H. Davy, had only ten pairs in each. There were one hundred such to be successively placed in the acid, and the whole connected ere the poles could act. Consequently the effect which arises immediately after immersion, would be lost in the troughs first arranged, before it could be produced in the last; and no effort appears to have been made to take advantage of this transient accumulation of power, either in using that magnificent combination, or in any other of which I have read. In order to observe the consequence of simultaneous immersion with a series sufficiently numerous to test the correctness of my expectations, a galvanic apparatus of eighty concentric coils of copper and zinc, was so suspended by a beam and levers, as that they might be made to descend into, or rise out of the acid in an instant. The zinc sheets were about nine inches by six, the copper fourteen by six; more of this metal being necessary, as in every coil it was made to commence within the zinc, and completely to surround it without. The sheets were coiled so as not to leave between them an interstice wider than a quarter of an inch. Each coil is in diameter about two inches and a half, so that all may descend freely into eighty glass jars two inches and three quarters diameter inside, and eight inches high, duly stationed to receive them.*

My apparatus being thus arranged, two small lead pipes were severally soldered to each pole, and a piece of charcoal about a quarter of an inch thick, and an inch and a half long, tapering a little at each extremity, had these severally inserted into the hollow ends of the pipes: The jars being furnished with diluted acid and the coils suddenly lowered into them, no vestige of the charcoal could be seen: It was ignited so intensely, that those portions of the pipes by which it had been embraced were destroyed. In order to avoid a useless and tiresome repetition, I will here state that the coils were only kept in the acid while the action at the poles was at a maximum in the experiment just mentioned, and in others which I am about to describe, unless where the decomposition produced by water is spoken of, or the sensation excited in the hands. I designate the apparatus with which I performed them, as the galvanic deflagrator, on account of its superior power, in proportion to its size, in causing deflagration; and as, in the form last adopted, it differs from the voltaic pile in the omission of one of the elements heretofore deemed necessary to its construction.

Desirous of seeing the effect of the simultaneous immersion of my series upon water, the pipes soldered to the poles were introduced into a vessel containing that fluid. No extraordinary effect was perceived, until they were very near, when a vivid flash was observed, and happening to touch almost at the same time, they were found fused and incorporated at the place of contact. I next soldered to each pipe a brass cylinder about five-tenths of an inch bore. These cylinders were made to receive the tapering extremities of a piece of charcoal about two inches long so as to complete the circuit. The submersion of the coils caused the most vivid ignition in the coal. It was instantaneously and entirely on fire. A piece of platina of about a quarter of an inch diameter in connexion with one pole, was in-

* See Plate.

stantly fused at the end on being brought in contact with some mercury communicating with the other. When two cylinders of charcoal having hemispherical terminations were fitted into the brass cylinders and brought nearly into contact, a most vivid ignition took place, and continued after they were removed about a half or three quarters of an inch apart, the interval rivalling the sun in brilliancy. The igneous fluid appeared to proceed from the positive side. The charcoal in the cylinder soldered to the latter would be intensely ignited throughout when the piece connected with the negative pole was ignited more towards the extremity approaching the positive. The most intense action seems to arise from placing a platina wire of about the eighth of an inch diameter, in connexion with the positive pole, and bringing it in contact with, and afterwards removing it a small distance apart from a piece of charcoal (fresh from the fire) affixed to the other pole.

As points are pre-eminently capable of carrying off (without being injured) a current of the electrical fluid, and very ill qualified to conduct caloric; while by facilitating radiation, charcoal favours the separation of caloric from the electricity which does not radiate; this result seems consistent with my hypothesis, that the fluid as extricated by Volta's pile is a compound of caloric and electricity;* but not

* According to the theory here alluded to, the galvanic fluid owes its properties to caloric and electricity; the former predominating in proportion to the size of the pairs, the latter in proportion to the number, being in both cases excited by a powerful acid. Hence in batteries which combine both qualifications sufficiently, as in all those intervening between Children's large pairs of two feet eight inches by six feet, and the 2000 four-inch pairs of the Royal Institution, the phenomena indicate the presence of both fluids. In De Luc's column, where the size of the pairs is insignificant, and the energy of interposed agents feeble, we see electricity evolved without any appreciable quantity of caloric. In the calorimotor where we have size only, the number being the lowest possible, we are scarcely able to detect the presence of electricity.

When the fluid contains enough electricity to give a projectile power adequate to pass through a small space in the air, or through charcoal, which impedes or arrests the caloric, and favours its propensity to radiate, this principle heat is evolved. This accounts for the evolution of intense heat under those circumstances, which rarify the air, so that the length of the jet from one pole to the other may be extended after its commencement. Hence the portions of the circuit nearest to the intervening charcoal, or heated space, are alone injured; and even non-conducting bodies, as quartz, introduced into it are fused, and hence a very large wire may be melted by the fluid, received through a small wire imperceptibly affected.

See Silliman's Journal, No. 6, Vol. I. Thomson's Annals, Sept. 1819. Tilloch's Philosophical Magazine, October, 1819.

with the other hypothesis, which supposes it to be electricity alone. The finest needle is competent to discharge the product of the most powerful machines without detriment, if received gradually as generated by them. Platina points, as small as those which were melted like wax in my experiments, are used as tips to lightening rods without injury, unless in sudden discharges, produced under peculiar circumstances.*

The following experiment I conceive to be very unfavourable to the idea that galvanic ignition arises from a current of electricity.

A cylinder of lead of about a quarter of an inch diameter, and about two inches long, was reduced to the thickness of a common brass pin for about three quarters of an inch. When one end was connected with one pole of the apparatus, the other remained suspended by this filament; yet it was instantaneously fused by contact with the other pole. As all the calorific fluid which acted upon the suspended knob, must have passed through the filament by which it hung, the fusion could not have resulted from a pure electrical current, which would have dispersed the filament ere a mass fifty times larger had been perceptibly affected. According to my theory, caloric is not separated from the electricity until circumstances very much favour a disunion, as on the passage of the compound fluid through charcoal, the air, or a vacuum. In operating with the deflagrator, I have found a brass knob of about five tenths of an inch in diameter, to burn on the superficies only; where alone according to my view, caloric is separated so as to act on the mass. Having, as mentioned in the memoir on my theory of galvanism, found that four galvanic surfaces acted well in one recipient, I was tempted by means of the eighty coils to extend that construction. It occurred to me that attempts of this kind, had failed from using only one copper for each zinc plate. The zinc had always been permitted to react towards the negative, as well as the positive pole. My coils being surrounded by copper, it seemed probable, that, if electro-caloric were, as I had suggested, carried forward by circulation arising from galvanic polarity, this might act within the interior of the coils, yet not be exerted between one coil and another.

* See Adams's Electricity, on points.

I had accordingly a trough constructed with a partition along the middle, so as to receive forty coils on one side, and a like number on the other. This apparatus when in operation excited a sensation scarcely tolerable in the backs of the hands. Interposed charcoal was not ignited as easily as before, but a most intense ignition took place on bringing a metallic point connected with one pole of the series, into contact with a piece of charcoal fastened to the other. It did not take place however so speedily as when glasses were used; but soon after the ignition was effected it became even more powerful than before. A cylinder of platina nearly a quarter of an inch in diameter, tapering a little at the end, was fused and burned so as to sparkle to a considerable distance around, and fall in drops. A ball of brass of about half an inch diameter was seen to burn on its surface with a green flame. Tin foil, or tinsel rolled up into large coils of about three quarters of an inch thick, were rapidly destroyed, as was a wire of platina of No. 16. Platina wires in connexion with the poles were brought into contact with sulphuric acid; there was an appearance of lively ignition, but strongest on the positive side. Excepting in its power of permeating charcoal, the galvanic fluid seemed to be extricated with as much force, as when each coil was in a distinct glass. Apprehending that the partition in the trough did not sufficiently insulate the poles from each other, as they were but a few inches apart, moisture or moistened wood intervening, I had two troughs each to hold forty pairs, and took care that there should be a dry space about four inches broad between them. They were first filled with pure river water, there being no saline nor acid matter to influence the plates, unless the very minute quantity which might have remained on them from former immersions. Yet the sensation produced by them, on the backs of my hands, was painful; and a lively scintillation took place when the poles were approximated. Dutch gold leaf was not sensibly burned, though water was found decomposible by wires properly affixed. No effect was produced on potash, the heat being inadequate to fuse it.

A mixture of nitre and sulphuric acid was next added to the water in the troughs, afterwards charcoal from the fire was vividly ignited, and when attached to the positive pole a steel wire was interposed between it and the other pole.

the most vivid ignition which I ever saw was induced. I should deem it imprudent to repeat the experiment without glasses, as my eyes, though unusually strong, were affected for forty-eight hours afterwards. If the intensity of the light did not produce an optical deception, by its distressing influence upon the organs of vision, the charcoal assumed a pasty consistence, as if in a state approaching to fusion. That charcoal should be thus softened, without being destroyed by the oxygen of the atmosphere, will not appear strange, when the power of galvanism in reversing chemical affinities is remembered; and were it otherwise, the air could have no access, first, because of the excessive rarefaction, and in the next place as I suspect on account of the volatilization of the carbon forming about it a circumambient atmosphere.* This last mentioned impression arose from observing, that when the experiment was performed in vacuo, there was a lively scintillation, as if the carbon in an aeriform state acted as a supporter of combustion on the metal.

A wire of platina (No. 16) was fused into a globule on being connected with the positive pole, and brought into contact with a piece of pure hydrate of potash, situated on a silver tray in connexion with the other pole. The potash became red hot, and was deflagrated rapidly with a flame having the rosy hue of potassuretted hydrogen.

The great apparatus of the Royal Institution, *in projectile power* was from six to eight times more potent than mine. It produced a discharge between charcoal points when removed about four inches apart, whereas mine will not produce a jet at more than three fourths of an inch. But that series was two thousand, mine only about a twenty-fifth part as large.

A steel wire of about one tenth of an inch in diameter, affixed to the negative pole, was passed up through the axis of an open necked inverted bell glass, filled with water. A platina wire, No. 16, attached to a positive pole being passed down to the steel wire, both were fused together, and cooling, could not be separated by manual force. Immediately after this incorporation of their extremities, the platina wire became incandescent for a space of some inches above the surface of the water.

A piece of silvered paper about two inches square was folded up, the metallic surface outward, and fastened into vices affixed to the poles. Into each vice a wire was screwed at the same time. The fluid generated by the apparatus was not perceptibly conveyed by the silvered paper, as it did not prevent the wires severally attached to the poles from decomposing water or producing ignition by contact.

In my memoir on my theory of galvanism I suggested, that the decomposition of water, which Wollaston effected by mechanical electricity, might not be the effect of divellent attraction like those excited by the poles of a voltaic pile, but of a mechanical concussion, as when wires are dispersed by the discharge of an electrical battery. In support of that opinion I will now observe, that he could not prevent hydrogen and oxygen from being extricated at each wire, instead of hydrogen being given off only at one, and oxygen at the other, as is invariably the case when the voltaic pile is employed. That learned and ingenious philosopher, in concluding his account of this celebrated experiment, says " but in fact the resemblance is not complete, for in every way in which I have tried it, I observed each wire gave out both oxygen and hydrogen gas, instead of their being formed separately as by the electric pile."

Is it not reasonable to suppose that an electrical shock may dissipate any body into its elementary atoms, whether simple or compound, so that no two particles would be left together which can be separated by physical means.

Looking over Singer's Electricity, a recent and most able modern publication, I find that in the explosion of brass wire by an electrical battery, the copper and zinc actually separated. He says, page 186, " Brass wire is sometimes *decomposed* by the charge ; the copper and zinc of which it is formed being separated from each other, and appearing in their distinct metallic colours." On the next page in the same work, I find that the oxides of mercury and tin are reduced by electrical discharges. " Introduce," says the author, " some oxide of tin into a glass tube, so that when the tube is laid horizontal, the oxide may cover about half an inch of its lower internal surface. Place the tube on the table of the universal discharger, and introduce the pointed wires into its opposite ends, that the portion of oxide may lie between them. Pass several strong charges in succession through the tube, replacing the oxide in its situation, should it be *dispersed.* If the charges are sufficiently powerful, a part of the tube will soon be stained with metallic tin which has been revived by the action of transmitted electricity." It cannot be alleged that in such decompositions the divellent polar attractions are exercised like those which characterize the action of wire proceeding from the poles of a voltaic apparatus. The particles were dispersed from, instead of being attracted to the wires, by which the influence was conveyed among them. This being undeniable, it can hardly be advanced that we are to have one mode of explaining the separation of the elements of brass by an electrical discharge, another of explaining the separation of the elements of water by the same agent. One rationale when oxygen is liberated from tin, and another when liberated by like means from hydrogen. In the experiment in which copper was precipitated by the same philosopher at the negative pole, we are not informed whether the oxygen and acid in union with it were attracted to the other; and the changes produced in litmus are mentioned not as simultaneous, but successive. The violet and red rays of the spectrum have an opposite chemical influence in some degree like that of voltaic poles, but this has not led to the conclusion that the cause of galvanism and light is the same. Besides, admitting that the feeble results obtained by Wollaston and Van Marum are perfectly analogous to those obtained by the galvanic fluid, ere it can become an objection to my hypothesis, it ought first to be shown that the union between caloric and electricity, which I suppose productive of galvanic phenomena, cannot be produced by that very process. If they combine to form the galvanic fluid when extricated by ordinary galvanic action, they must have an affinity for each other. As I have suggested in my memoir, when electricity enters the pores of a metal it may unite with its caloric. In Wollaston's experiments, being constrained to enter the metal, it may combine with enough of its caloric to produce, when emitted, results slightly approaching to those of a fluid in which caloric exists in greater proportion.

But once more I demand why, if mechanical electricity be too intense to produce galvanic phenomena, should it be rendered more capable of producing them by being still more concentrated.

If the one be generated more copiously, the other more intensely, the first will move in a large stream slowly, the last in a small stream rapidly. Yet by narrowing the channel of the latter, Wollaston is supposed to render it more like the former, that is, produces a resemblance by increasing the supposed source of dissimilarity.

It has been imagined that the beneficial effect of his contrivance arises from the production of a continued stream, instead of a succession of sparks, but if a continued stream were the only desideratum, a point placed near the conductor of a powerful machine would afford this requisite, as the whole product may in such cases be conveyed by a sewing needle in a stream perfectly continuous. As yet no adequate reasons have been given why, in operating with the pile, it is not necessary, as in the processes of Van Marum and Wollaston, to enclose the wires in glass or sealing wax, in order to make the electricity emanate from a point within a conducting fluid. The absence of this necessity is accounted for, according to my hypothesis, by the indisposition which the electric fluid has to quit the caloric in union with it, and the almost absolute incapacity which caloric has to pass through fluids unless by circulation. I conceive that in galvanic combinations, electro-caloric may circulate through the fluid from the positive to the negative surface, and through the metal from the negative to the positive. In the one case caloric subdues the disposition which electricity has to diffuse itself through fluids, and carries it into circulation. In the other, as metals are excellent conductors of caloric, the prodigious power which electricity has to pervade them agreeably to any attractions which it may exercise, operates almost without restraint. This is fully exemplified in my galvanic deflagrator, where eighty pairs are suspended in two recipients, forty successively in each, and yet decompose potash with the utmost rapidity, and produce an almost intolerable sensation* when excited only by fresh river water. I have already observed that the reason why galvanic apparatus composed of pairs consisting each of one copper and one zinc plate,

* I do not say shock, as it is more like the permanent impression of hot pointed wire, especially when an acid is used.

have not acted well without insulation,* was because electro-caloric could retrocede in the negative, as well as advance in the positive direction. I will now add, that independently of the greater effect produced by the simultaneous immersion of my eighty coils, their power is improved by the proximity of the surfaces, which are only about an eighth of an inch asunder; so that the circulation may go on more rapidly.

Pursuant to the doctrine, which supposes the same quantity of electricity, varying in intensity in the ratio of the number of pairs to the quantity of surface, to be the sole agent in galvanic ignition, the electrical fluid as evolved by Sir H. Davy's great pile, must have been nearly two thousand times more intense, than as evolved by a single pair, yet it gives sparks at no greater distance than the thirtieth or fortieth of an inch. The intensity of the fluid must be at least as much greater in one instance, than in another, as the sparks produced by it are longer. A fine electrical plate machine of thirty two inches diameter, will give sparks at ten inches. Of course the intensity of the fluid which it emits, must be three hundred times greater than that emitted by two thousand pairs. The intensity produced by a single pair, must be two thousand times less than that produced by a the great pile, and of course six hundred thousand times less than that produced by a good electrical plate of thirty two inches. Yet a single pair of about a square foot in area, will certainly deflagrate more wire, than a like extent of coated surface charged by such a plate. According to Singer, it requires about one hundred and sixty square inches of coated glass, to destroy watch pendulum wire; a larger wire may be burned off by a galvanic battery of a foot square. But agreeably to the hypothesis in dispute, it compensates by quantity, for the want of intensity. Hence the quantity of fluid in the pair is six hundred thousand times greater, while its intensity is six hundred thousand times less; and *vice versa* of the coated surface. Is not this absurd? What does intensity mean as applied to a fluid? Is it not expressed by the ratio of quantity, to space? If there be twice as much electricity within one cubic inch, as within another, is

* That is, with the same mass of conducting fluid, in contact with all the surfaces, instead of being divided into different portions, each restricted in its action to one copper and one zinc plate.

there not twice the intensity? But the one acts suddenly, it may be said; the other slowly. But whence this difference? They may both have exactly the same surface to exist in. The same zinc and copper plates may be used for coatings first, and a galvanic pair afterwards. Let it be said, as it may in truth, that the charge is, in the one case attached to the glass superficies, in the other exists in the pores of the metal. But why does it avoid these pores in one case and reside in them in the other? What else resides in the pores of the metal which may be forced out by percussion? Is it not caloric? Possibly, unless under constraint, or circumstances favorable to a union between this principle and electricity, the latter cannot enter the metallic pores, beyond a certain degree of saturation; and hence an electrical charge does not reside in the metallic coatings of a Leyden phial, though it fuses the wire which forms a circuit between them.

It is admitted that the action of the galvanic fluid, is upon or between atoms; while mechanical electricity when uncoerced, acts only upon masses. This difference has not been explained unless by my hypothesis, in which caloric, of which the influence is only exerted between atoms, is supposed to be a principal agent in galvanism. Nor has any other reason been given that water, which dissipates pure electricity, should cause the galvanic fluid to accumulate. From the prodigious effect which moist air, or a moist surface, has in paralyzing the most efficient machines, I am led to suppose, that the conducting power of moisture so situated, is greater than that of water under its surface. The power of this fluid to conduct mechanical electricity, is unfairly contrasted with that of a metal, when the former is enclosed in a glass tube, the latter bare.

According to Singer, the electrical accumulation is as great when water is used, as when more powerful menstrua are employed; but the power of ignition is wanting, until these are resorted to. De Luc showed, by his ingenious dissections of the pile, that electricity might be produced *without*, or *with* chemical power. The rationale of these differences never has been given, unless by my theory, which supposes caloric to be present in the one case, but not in the other. The electric column was the fruit of De Luc's sagacious enquiries, and afforded a beautiful and incontrovertible support to the objections he made to the idea, that the galvanic fluid is pure electricity, when extricated by the voltaic pile in its usual form. It showed that a pile really producing pure electricity, is devoid of the chemical power of galvanism.

We are informed by Sir H. Davy, that when charcoal points in connection with the poles of the magnificent apparatus with which he operated, were first brought nearly into contact, and then withdrawn four inches apart, there was a heated arch formed between them in which such non-conducting substances as quartz were fused. I believe it impossible to fuse electrics by mechanical electricity. If opposing its passage they may be broken, and if conductors near them be ignited, they may be acted on by those ignited conductors as if otherwise heated; but I will venture to predict, that the slightest glass fibre will not enter into fusion, by being placed in a current from the largest machine or electrical battery.

I am induced to believe, that we must consider light, as well as heat, an ingredient in the galvanic fluid; and think it possible, that, being necessary to vitality in animals, as well as vegetables, the electric fluid may be the vehicle of its distribution.

I will take this opportunity of stating, that the heat evolved by one galvanic pair has been found by the experiments which I instituted, to increase in quantity, but to diminish in intensity, as the size of the surfaces may be enlarged. A pair containing about fifty square feet of each metal, will not fuse platina, nor deflagrate iron, however small may be the wire employed; for the heat produced in metallic wires is not improved by a reduction in their size beyond a certain point. Yet the metals abovementioned, are easily fused or deflagrated by smaller pairs, which would have no perceptible influence on masses that might be sensibly ignited by larger pairs.—These characteristics were fully demonstrated, not only by my own apparatus, but by those constructed by Messrs. Wetherill and Peale, and which are larger, but less capable of exciting intense ignition. Mr. Peale's apparatus contained nearly seventy square feet, Mr. Wetherill's nearly one hundred, in the form of concentric coils, yet neither could produce a heat above redness on the smallest wires. At my suggestion, Mr. Peale separated the two surfaces in his coils into four alternating, constituting two galvanic pairs in one recipient. Iron wire was then easily burned and platina fused by it. These facts, together with the incapacity of the calorific fluid extricated by the calorimotor to permeate charcoal, next to metals the best electrical conductor, must sanction the position I assigned to it as being in the opposite extreme from the columns of De Luc and Zamboni. For as in these, the phenomena are such as are characteristic of pure electricity, so in one very large galvanic pair, they almost exclusively demonstrate the agency of pure caloric.

Art. XIX.—*An account of the Warm Springs, in Buncome County, state of North-Carolina; by the late* Edward D. Smith, M. D. *and Professor of Chemistry and Mineralogy in the South-Carolina College.*

(Communicated to the editor, by the lamented author, just before his death.)

Presuming that contributions to the natural history of the United States will not be unacceptable, I now offer some details respecting the situation and nature of the Mineral Springs of Buncome County, North-Carolina, which have, for some years past, been much visited by the inhabitants of the southern states. In the years 1816 and 1817 I had the opportunity of analyzing some of the water, which had been carefully bottled on the spot and conveyed in safety to me; and the results of this process were published in a newspaper of the day. Desirous however to examine these celebrated waters at their fountain head, I made an excursion, in July last, for this express purpose: and the information obtained by that journey, is now respectfully presented to the view of the public.

These mineral waters are found upon the margin of a river called the French Broad, about thirty two miles from Ashville, the county town of Buncome, and five and a half miles from the Tennessee line. Several springs have already been discovered, at various distances from each other, and the whole extent of ground, in which they rise, although not accurately ascertained, is supposed to be at least one mile. They are generally so near to the bank, that in moderate freshets the river comes into them, and it was asserted by one of the present proprietors that at a particular spot in the bed of the stream, about ten yards from the usual bank, there was a constant jet of warm water. The depth of the river is various, being in some places 10 to 15 feet, and in others very shoaly. The last spring which has been opened, is perhaps twenty yards further from the river than the former ones, but its temperature is not quite so high.—The supply of water in all of them is very abundant.

The original proprietor of these springs, a respectable and intelligent old gentleman by the name of Nelson, informed me that he supposed the first discovery of them to have been made about forty years since, at which time this part of the country was altogether uninhabited, and the persons who resorted to the waters, had to encamp in their vicinity. He has been personally acquainted with them, for upwards of twenty years, and made the first and lowest establishment for bathing, near to a ferry, which is opposite to his residence. Mr. Nelson further states that he has known sundry cases of palsy, rheumatism, cutaneous affections, &c. greatly benefited by the internal and external use of the waters. The large establishment, and the one that is now principally visited, is seated about half a mile higher up the river, and has at the present time two large baths, whose temperature at the boils of the springs is 104° of Fahrenheit; but at the surface the temperature of the old bath, which is very near to the river, is 100°, while that of the new which is higher up the bank, is but 94°. I was informed that this temperature was much increased, when there was a considerable swell in the river, but I had no opportunity of witnessing the fact.

A smaller stream of water, which is usually limpid and shallow, comes into the French Broad on its southern side, and separates the first bathing establishment from that which is now used. The stream affords the conveniences of a saw, and grist mill, within a very short distance of the establishment, and without the necessity of a mill-pond. The whole are situated in a beautiful and romantic spot upon a large flat, contiguous to the water, and embosomed in lofty mountains, among which the river winds, while the valley in this spot appears not to exceed a mile in width, and is much narrower in all others, both above and below. These mountains seem to consist principally of rocks, of which a considerable proportion in the immediate vicinity are compact lime stone, both blue and grey. About six miles above the springs there is said to be a vein of the sulphate of barytes, a specimen of which was given me; and in the vicinity of the ferry below, there is a cavern of lime stone, which may be penetrated with convenience for thirty yards and from the roof of which stalactites are pendant. Near to this cave there is another containing a large quantity of good yellow ochre.

There are said to be mines of cobalt, copper, and iron in the neighboring mountains, but these are lofty and not very accessible. I found that there was, from the local circumstances of the establishment, considerable humidity during the mornings and evenings, and a pretty high temperature for several hours of the day. There were also sudden and frequent thunder showers, but these were generally of short duration. These meteorological observations will perhaps lead to the conclusion, that this watering place would not be advisable for persons laboring under pulmonic or dropsical affections, and I did not learn that any such had been benefited by their residence.

After premising these remarks upon the situation and historical account of these springs and the country in their vicinity, I will proceed to detail the particulars of an analysis of the water, which was commenced on the spot in July, 1818, and recently concluded in my laboratory.

1. The appearance of the water at the fountain was limpid, although there was a continual ascent of air bubbles to its surface.

2. The taste was insipid, excepting the disagreeable impression made by its temperature, which has been already stated to be 104° as the water emerged from the sand.

3. There was no smell perceivable by myself, or by an intelligent friend, who aided my researches, although I was assured by several persons that in some seasons this water was impregnated with so strong and permanent an odour, as to be sensible after it had been conveyed to some distance. In the immediate vicinity of the drinking springs, there was undoubtedly an unpleasant effluvium, but this I attributed to the stagnation of common water in these low spots, and the presence of decaying vegetable matter. It should

be remarked that, during one of the seasons above alluded to, there were continual rains; but at the time of my visit, there had been an uncommon drought.

4. The application of the sulphuric and nitric acids to separate portions of the water, produced no effervescence or discoloration.

5. The oxalic acid produced slowly a white cloud.

6. The oxalate of ammonia occasioned an instant white cloud.

7. Nitrate of mercury caused a brownish yellow precipitate.

8. Sirup of violets produced no effect.

9. Turmeric paper was not altered.

10. Muriate and nitrate of barytes, each occasioned an immediate white precipitate.

11. Nitrate of silver produced a very slight, whitish cloud, when the water was fresh from the spring; but after it had stood two hours, the nitrate of silver occasioned a denser cloud instantly, and the precipitate became dark, when exposed to the sun.

12. Prussiate of potash and prussiate of lime produced no discoloration.

13. Acetate of lead occasioned an immediate white cloud.

14. Solution of soap in alcohol caused a supernatant white cloud.

15. Alcohol had no visible effect.

16. Phosphate of soda caused an immediate white precipitate.

17. Ammonia occasioned a slight supernatant cloud.

18. Carbonate of ammonia made no change of appearance, until phosphate nf soda was added, when there was an immediate white precipitate.

19. Neither the infusion nor the tincture of galls produced any effect.

20. Silver leaf seemed to be slightly darkened.

21. Fresh made lime water was applied at the fountain, but produced no effect. This experiment was repeated many times, because a general idea was entertained that carbonic acid was contained in the water and that the air bubbles, which were constantly ascending from the bottom of the spring, were really this gaseous substance. This

opinion was likewise corroborated by the following experiment made in the summer of 1816, by the late and much lamented Dr. Mc Bride, of Charleston.

"Lime water on being added, threw down a white, flaky precipitate. On decanting the water and adding a few drops of sulphuric acid, there was a violent effervescence and the smell of the carbonic acid gas or fixed air. The precipitate also disappeared." Concerning this experiment it may be observed that the inference drawn from it, respecting the presence of carbonic acid cannot be correct, for sulphuric acid, when applied to the carbonate of lime, would constitute another salt of considerable insolubility, and there could not be a disappearance of the precipitate.* Any one who will make the direct experiment, may be satisfied of this fact. Whatever may have been the cause of the precipitate in Dr. Mc Bride's experiment, repeated trials did not afford me any such results; but in order to be more satisfied upon the point, I placed in a tin vessel, of the form described in Dr. Meade's analysis of the Ballston and Saratoga waters, one quart of the mineral water and set it on a fire to boil, having previously inverted over it a decanter full of lime water. This lime water was ascertained to be good, by blowing into it some air from the lungs, which made it of a milky colour. The water in the tin vessel was boiled for some time, but not the least cloudiness was induced in the superincumbent decanter. From this decisive experiment the conclusion must be drawn that no carbonic acid was contained in the mineral water.

Most of the preceding experiments were repeated upon a portion of the water that had been boiled, but without any variation of the results.

Three quarts were then carefully evaporated and the fixed product secured in white paper, for further examination in a more convenient place.

Some of the air bubbles, which were continually arising in the springs, were received into inverted glass vessels. On testing these with lime water no discoloration ensued, but when placed over a burning candle, the flame was im-

* Unless a large portion of acid were added, when the sulphate of lime would be dissolved.—*Ed.*

mediately extinguished. From these two experiments it was inferred that this air was nitrogen or azotic gas. From the whole of the humid analysis the chemical reader will probably admit, that these waters contain, not only nitrogen gas, but sulphuric and muriatic acids, and lime and magnesia, all in a state of combination; and that neither carbonic acid nor sulphuretted hydrogen, or any combination of sulphur, as had been generally believed, were present. That sulphur is never recognized, as an ingredient of these waters, and that very wet seasons may not cause some combination of it, I am not prepared to deny; because in addition to the remark of the peculiar odour of the water in wet seasons, it may be stated that in two successive years, previous to my visit, I had the opportunity of examining the water brought in bottles to this place, and then detected sulphuretted hydrogen. Supposing it possible however, that the keeping of the water for several weeks, might induce a change of its properties, I brought away two bottles with me and six months afterwards examined them in my laboratory, but found the results of analysis to be the same as at the springs. I know not how to account for this variation of properties, unless on the former occasions the springs may have been little attended to, and from the decomposition of vegetable matter in them sulphuretted hydrogen may have been generated; or unless the causes, which occasion the increased temperature of the water, may so vary in differing seasons as to produce different decompositions beneath the earth's surface.

It was my intention to have proceeded with the examination of the fixed product, as soon as I returned to Columbia; but some unexpected and unavoidable circumstances have prevented until lately.

The results of this analysis are as follow:

1. On examining the papers, containing three powders, each of which had been procured by the separate evaporation of one quart of the mineral water, it appeared that each paper was damp, and stained of a light fawn colour. In two parcels, brilliant particles were visible to the naked eye; and, viewed through the microscope, they were evidently saline. The other powder shewed no marks of crystallization. The weight of the whole was twenty-eight grains, and allowing for loss in transportation, perhaps it may be said

with propriety, that each quart of water contains about ten grains of fixed product.

2. The whole amount (28 grains) was put into a small glass bottle, and alcohol poured on, to the depth of an inch. This mixture was frequently shaken, and stood for twenty hours.

3. It was then carefully filtered, washed with more alcohol, and the filter dried by a regular and moderate heat. The powder separated from the filter, was weighed, and amounted to twenty-three grains, and as the filter which had been weighed both before and after use, appeared to retain one grain, the quantity taken up by the alcohol, may be estimated at four grains.

4. A small portion of the alcoholic solution was diluted with water, and tested with sulphuric acid and with a solution of copper; but as no effect resulted, it may be concluded that neither barytes nor ammonia were present.

5. The remainder of the alcoholic solution was evaporated, but an accidental fracture of the evaporating vessel prevented the ascertaining of the nature of the residuum.

6. The portion (23 grains) which the alcohol did not take up, was then mixed with eight times its weight of distilled water and stood for forty eight hours.

7. This mixture was then filtered, dried and weighed. The residue was seventeen grains, so that six grains must have been dissolved by the water.

8. This watery solution was then evaporated, and the residue being re-dissolved in water, was tested as follows: Nitrate of barytes gave a white cloud, so did carbonate of soda. Oxalate of ammonia produced a thick white cloud. Nitrate of silver had no effect. It may be inferred then, that these six grains were principally sulphate of Magnesia, and that a small portion of sulphate of lime was also present.

9. Ten grains of the seventeen, that were not dissolved in solution (6) were mixed with ten ounces of cold, distilled water, and boiled for some hours. On filtering and drying, the undissolved residue was between one and two grains, so that nearly the whole of these ten grains was probably sulphate of lime.

10. A portion of the preceding clear solution was tested as follows: Oxalic acid produced a white cloud slowly; but oxalate of ammonia, an immediate and thick white cloud.

Nitrate of barytes and carbonate of soda, each occasioned a white cloud. Nitrate of silver made no change. The remaining solution, evaporated, re-dissolved and tested in a similar manner, shewed the same results. The inference then will be, that this solution contained sulphate of lime chiefly, with a trace of sulphate of magnesia.

11. The residue of one to two grains, being very light and bulky and of a dark ash colour, was moistened with water and exposed to the sun's rays, but after a day or two was accidentally lost.

In making up the summary of the preceding analysis, it may probably be stated as follows.

In the alcoholic solution (3) are present	
Muriates of lime and magnesia,	4 gr.
In solution (7) Sulphate of magnesia,	6 gr.
By solution (9) Sulphate of lime in 17 gr.	$14\frac{1}{2}$ gr.
Insoluble residue,	$2\frac{1}{2}$ gr.
Loss,	1 gr.
From three quarts of water,	28 gr.

It will be observed, that the results of the analysis of the fixed product denote the presence of the same substances as were detected by the humid analysis, and thus the one confirms the correctness of the other. The nature of these mineral waters, having been thus ascertained, it becomes an interesting inquiry, whether they can probably exert much effect upon the constitution. The great bulk of their ingredients would appear to be very inert, unless, according to the opinion offered by Dr. Murray, in his excellent analysis of the Dunblane and Pitcaithly waters, the process occasions a different combination of ingredients from that which originally existed, and then the muriate of lime, which is an active substance, would be present in a much larger proportion than appears from the analysis. Persons using these waters, are in the habit of drinking from three to four quarts in a day, and also of bathing twice. They generally remain in the bath from a half hour to an hour, and find it so pleasant, they are loth to leave it. It was stated to me by a very respectable gentleman, who has resorted to this watering place, for several summers past, that after drinking the water freely for several days, it generally had a brisk cathartic effect for a day or two, and after that produced no sensible result. This gentleman is afflicted with chronic rheumatism, and has always obtained decided relief from the long continued use of the waters, both internally and externally. Upon the record book of the establishment, there are sundry interesting cases of benefit, imparted to persons labouring under rheumatism, palsy, or loss of motion from other causes. I am inclined to believe that long continued bathing in water of such an elevated and constant temperature, must produce some effect in such cases as have been alluded to, independent of the mineral ingredients, and conjoined with them, it will probably be still more efficacious. The healthy, cheap and plentiful country, in which the Buncome Springs are situated, the novel and mountainous scenery, variety of company, &c. present many attractions to the invalid, the idler and the curious, and will no doubt, make this watering place, if properly attended to, an increasing source of profit to its proprietors.

South-Carolina College, March 1819.

Art. XX.—*Remarks on* Dr. Enfield's *Institutes of Natural Philosophy.—Third American edition*—1820.

For more than twenty years past, the compilation of Enfield has been extensively employed in this country as a text-book in Natural Philosophy; and at present, we believe, is used for this purpose by nearly all the higher seminaries of learning in New-England. The want of an elementary system more select and better digested in its materials, more free from erroneous statements and reasonings, and exhibiting a more faithful outline of the existing state of physical science, is beginning to be generally felt; but as the work of Enfield will probably be retained in our seminaries for some years to come, we have embraced the occasion furnished by the appearance of a new edition, to make a few such comments on it as may perhaps add somewhat to its value with the student, and at the same time prove not wholly uninteresting to those teachers who have but limited access to other authorities.

The Institutes of Natural Philosophy will be found on examination to be little more than an abridgement, without much alteration either in language or form, from different works on the same subject which appeared in the former part of the last century. The Hydrostatics, Pneumatics, and Optics, are chiefly taken from Dr. Rutherforth; as is also the Astronomy, with the exception of the four last chapters of Part II., which are borrowed from Rowning. The Mechanics does not appear to have been derived so exclusively from any single source. It is apparent, however, that Rutherforth furnished the arrangement. The filling up is from various authors. The chapters on the perpendicular and oblique descent of falling bodies, the vibration of pendulums, (excepting the cycloidal theory taken from Rowning,) and the motion of projectiles, are chiefly from Helsham. A considerable portion of the concluding section on central forces, is copied, nearly in its original form, from the Principia. The few pages of the original work devoted to Magnetism and Electricity, we presume, were written anew by Dr. Enfield;—but the additions made by the Editor of the second London edition, which amount to two thirds of the whole, are taken nearly verbatim from the publications of Cavallo.

The compiler of this work, while sitting with his pen in one hand and his author in the other, appears never to have indulged for a moment the illiberal suspicion that his author might be in the wrong. The consequence is, that whenever his originals erred, the error is faithfully transcribed in-into his abridgement. The number of these errors multiplied in his own hands, from the want of sufficient care to shape and adjust materials, detached from their original connexions, reduced in their dimensions, and sometimes brought together from heterogeneous sources,—in such a manner as to form parts of a connected and harmonious whole.—Nor is the praise of judicious selection much better deserved, than that of freedom from error. Propositions and scholia of little interest or importance compared with others which might have taken their place, often occur: complex and unsatisfactory demonstrations are admitted where those of superior clearness and elegance were attainable: and while one chapter of an original author is pared down to meagerness itself, another is left in a state of redundancy. Even in those parts of the work to which no objection can be made on the score either of accuracy or importance, occur abrupt transitions in the subject or manner of handling it, parenthetical propositions, and haltings or retrograde movements in the march of investigation, for which the student who is unacquainted with the secrets of book making, and honestly ascribes the whole to the ostensible author, will be utterly at a loss to account.

In a treatise on Natural Philosophy designed exclusively to introduce the student to the elements of the science, we are not so unreasonable as to look for originality in the materials. Accuracy and judicious selection in the principles, reasonings, and experiments, unity of plan, and clearness of arrangement, together with a good degree of neatness and precision in style, are all that can be expected, or even desired. The introduction of original speculations would in general rather impair than enhance the merits of a text-book for learners. But the merits just enumerated we certainly have a right to expect, from one who takes on himself the responsibility of adding to the number of books without adding to the amount of knowledge in the world ; while he contributes to withdraw from public notice, and accelerate the oblivion of those older authors, who deserve the gratitude of posterity for their original discoveries. We can make no better apology for Dr. Enfield in allowing so ill-digested a compilation to go before the public, than to suppose that he was hindered from giving it the necessary attention by the engagements of a laborious profession, or that he had not sufficiently familiarized himself with the subjects on which the wants of his pupils, (as he informs us in his preface,) imposed on him the necessity of writing. Like his distinguished colleague in the Warrington Academy, Dr. Priestley, he seems to have been not unambitious of the reputation of universal learning. Elocution, history, biography, sermons, metaphysics, prayers and hymns, alternately occupied his attention and his pen. To complete his claims, it might seem necessary that his name should be in some way connected with the departments of physical and mathematical science. How far considerations of this nature may have had influence in bringing the Institutes of Natural Philosophy before the public, we must leave for those who have better means of information concerning the character of the author than ourselves, to decide.

Whatever was the reason why this work originally appeared in so imperfect a state, it was at least incumbent on those who have had the charge of editing subsequent editions to give it a thorough revisal, and to correct its errors. Instead of this, they have been chiefly solicitous to add to its bulk; and while they have given it a far more motley and heterogeneous aspect than it originally possessed, by forcing asunder the parts of the original to make room for quotations from later authors,—quotations which seldom coalesce, which sometimes repeat, and sometimes clash with those parts of the original which are retained without alteration,—they have extended rather than diminished the amount of its inaccuracies.

From this last remark we must except the edition which has appeared the present year. It has been submitted to the revisal of a gentleman well known as a mathematician and an instructor; and we are happy to notice that a large number of the most palpable and embarrassing of the erroneous statements of former editions are rectified.

But although the present edition appears in a form considerably superior to either of its predecessors, we still regard it as very far from possessing the character which is demanded by the present state of learning in our country, and the mode of instruction adopted in our colleges. With the exception of the Electricity and Magnetism, and a few particulars in the Astronomy, it is borrowed from sources nearly a century old; and hence presents scarcely any idea of the progress made in the different branches of philosophy since the period of Newton. In mentioning this as an important defect in the work, we would not be understood to imply that the theoretical principles of philosophy were studied with less success at that period than at present, or that almost every elementary proposition which would now find a place in a text-book for schools might not be found in the sources from which Enfield borrowed his compilation. So far as mere theoretical investigations are concerned, the writers of the period to which we refer, afford an ample fund of valuable materials to a compiler. But it must be allowed that they pushed the application of mathematical reasoning to physical inquiries to a faulty extreme. They too seldom gave themselves the trouble to inquire how far their ingenuity in forming deductions was leading them astray from plain matters of fact, and how far they were building systems of principles for a world of material substances which existed only in their own imaginations. If it be desirable, in studying Natural Philosophy, to acquire just ideas of the properties and mutual actions of bodies as they actually are, those experimental details by which the results of theory are modified and corrected, must enter extensively even into an elementary treatise. But in this respect, the original work of Enfield is almost totally deficient. Like those from which it is borrowed, it contains little more than a naked series of mathematical principles;* with scarcely an intimation that any of them are at variance with facts. Nor do we think that the editors of later editions have been fortunate in their attempts to supply the deficiency. We look in vain to the additions they have made, for any account of the late researches of philosophers into the nature and laws of action of those modifying causes which were once regarded as too stubborn to yield to calculation, and which theory accordingly overlooked. The names of Bossut, Coulomb, Hutton, Dalton, Biot, Young, and other great experimentalists who have almost created a new era in philosophy, by their success in gleaning up the scattered laws of nature which Newton and his cotemporaries left behind them; in compelling empirical formulæ to perform the office of laws where the subject is incapable of theoretical investigation; and in ascertaining the precise values of those arbitrary constant quantities without which laws themselves are incapable of prac-

* While we regard this work as too exclusively mathematical in its contents, we would by no means wish to see its present mathematical *form* discarded. With the exception of electricity, magnetism, and a few topics included under other branches, to which this mode of discussion is certainly ill suited, we regard the form of proposition and demonstration into which Enfield has thrown his Institutes as constituting its chief recommendation, when compared with most other elementary works. It disciplines the student more effectually, and renders his task better defined, than a more loose and popular form; and at the same time facilitates the employment of the instructer and examiner. We will add, that so far as our own experience extends, the mode of discussing physico-mathematical subjects which was fashionable a century ago, that is, by a statement of principles in common language, and demonstrations annexed, is far superior, *for the purposes of elementary instruction*, to the modern analytical mode, in which the theorem terminates the investigation, and is expressed by an algebraic formula. The employment of the latter mode is doubtless occasionally necessary, and it is almost always the most concise; but the former, whenever it can be employed, has altogether the advantage in its power to interest, and to impress the imagination and memory of the student, while it is incomparably better fitted to the purposes of recitation.

tical application,—these names, we say, scarcely once occur in a work which embraces nearly the whole extent of the philosophical studies in our systems of liberal education.—We are aware that the best selection of topics for such a a work must often be a delicate task ; and that there will be room for differences of taste and opinion concerning it. Not every thing that is highly valuable will on this account be admissible. Many of those details which are of high importance in their applications to practice may possess none of that elegance which would attract the attention of the general scholar; and many investigations which combine elegance with utility may be inaccessible to him, from involving mathematical principles with which he is not familiarized, or requiring an extent of discussion to render them at all intelligible which would be inconsistent with the claims of his other pursuits. Among the great variety of theorems and principles which belong to the different branches of Natural Philosophy, our own choice, in making a selection for an elementary work, would be determined by the following requisites. 1. The theorem should possess, in a purely mathematical point of view, a good degree of elegance. 2. It should admit of satisfactory proof, either experimental or demonstrative :—if the latter, it should be such as to exercise without fatiguing the learner, and should as seldom as possible require a series of lemmas, or merely subsidiary propositions. 3. It should be very nearly, if not accurately conformable with fact,—or if otherwise, the modifications demanded by experiment should be capable of a neat and simple explanation. 4. It should have some perceptible bearing on what is practically useful,—or at least form a link in a chain of investigations which terminates in some practical result.

If tried by the foregoing tests, the contents of Enfield's Philosophy will be found extremely defective. We have no hesitation in asserting that a work of the same size with this, in which the selection was judiciously made, would not have more than half its contents, in *any* form, common with it,—and that, (without increasing the difficulties or diminishing the interest of the study, by crowding in a multitude of naked results unaccompanied by the necessary illustrations,) it might be made to comprise more than twice the amount of valuable facts and principles. To substantiate an assertion which may perhaps be deemed harsh, we will just glance at the contents of the Second Book,—a part which certainly affords a not unfavourable specimen of the execution of the whole. As all the improvements which we propose are predicated on the supposition that the size remains unaltered, (a supposition rendered necessary by the limited time which can be properly devoted to this subject in our colleges,) we begin with the general remark that room might be gained for several important topics now omitted, by abridgements in the demonstrations, particularly those in which variations are introduced, and various others in which prolixity contributes not at all to clearness.—The chapter on percussion might have been easily made to include, within its present limits, a general theory of impact in bodies imperfectly elastic, and a statement and reconciliation of the apparently jarring theories of Newton and Leibnitz concerning the measure of force in moving bodies. To that on the composition of forces, might have been advantageously subjoined the results of impact in spherical bodies, whether non-elastic or elastic, which meet each other from directions not in the same right line. If the theory of the cycloidal pendulum, detailed at length in ch. v. sec. 3. deserves to be retained, it is only for the sake of a theorem which Enfield has by a strange oversight omitted; we mean that which determines the *time* of vibration. This theorem is valuable principally as it also determines the limit of the time of vibration of the common pendulum, when the arc is made indefinitely small. But as the subject is now left, not only is no true information given to the student concerning the time of vibration in a circular arc, but the unaccountable blunder of Keill, Parent, Musschenbroek and others, in making it equal to that in the chord,* is imposed upon him.

* This is not indeed in so many words affirmed; but several of the demonstrations imply it, and become nugatory unless it is admitted. Thus in proving that vibrations in small unequal arcs are performed in nearly equal times, the inference is made from the chords to the arcs on the ground that "very small arcs differ very little from their respective chords in length or declivity." The same language had been used before by Helsham and Rutherforth. But it must be obvious to all who are in the least familiarized to the subject of ultimate ratios, that although the arc and its corresponding chord ultimately agree in "length," they differ totally in "declivity." In *all* states of the arc and chord, (and therefore when both are indefinitely small,) the declivity of the former, at the highest point, is twice that of the latter. The accelerating force down the chord is uniform; in the arc it is as the sine

The theory of equilibrium in the mechanical powers (chap. vi.) might have been stated in a more concise and popular form, grounded on the principle of virtual velocities, to make room for a brief account of prime movers, and the motion and maximum effect of machines. The subjects of friction, and the construction of wheel carriages, are now dispatched in half a page,—less than half the room occupied by the difficult and almost useless proposition on the wedge. These important and practical subjects ought to be discussed much more in detail; nor ought the former to be grounded on the experiments of Vince, to the exclusion of the much more important and diversified ones of Coulomb. In chapter VII. the mathematical theory of projectiles is pursued to the length of ten or twelve propositions; and we are left to an incidental remark of a single sentence inserted by the editor of the second edition, for all our information concerning the total discrepancy between theory and practice. Several parts of this chapter possess very little interest, even in a mathematical point of view; and had they been much more important than they are, they ought to have given way to such a statement of the principal results of experiment on the motion of projectiles as the writings of Robins, Rumford, and Hutton might have easily furnished. Several lemmas introduced from the Principia, into the concluding section on central forces, although needed for the objects which the original author had in view, are here entirely out of place. Such of them as were wanted should have been divested of their latinized idiom, and translated into a more modern and intelligible dialect. Several of the more important theorems relating to motion by a central force varying inversely as the square of the distance, might have been subjoined with the utmost advantage to the single one with which the Book now closes.—The subjects of rotatory motion, the funicular polygon and equilibrium of arches, the

of the distance from the lowest point, or ultimately as the distance itself. This last circumstance establishes the equality of the times of vibration in very small circular arcs and in the cycloid, on grounds independent of the higher calculus; for it is evident that the radius of curvature at the lowest point is the same for both curves. Instead, therefore, of its being true that the times of vibration in the arc and chord approach to an ultimate ratio of equality, they approach to a ratio of finite inequality. No one but the student can need to be informed that the former is the least, in the ratio of 0,7854 to 1.

strength and stress of materials, with various others of minor importance, are left entirely unnoticed. We are not prepared to decide how far these omissions are judicious. The attention of the student may certainly be distracted by attempting to crowd too great a variety of subjects within a narrow compass; and it must be admitted that most of the subjects just referred to, if introduced at all, must be treated at some length, to render them useful, or even intelligible. We should suppose, however, that some account of the principles which determine the transverse strength of beams, would not be misplaced, even in a work of this limited extent.

In these remarks, which might, if necessary, be equally extended to all the other branches, we would by no means imply that the editors of Enfield are censurable for not making *all* the changes in their author which would improve him,—or that the attempt to make these changes, had any one leisure and inclination for the task, would be an advisable one. It would be quite as easy, and on every account much better, to write a new system. We have made them to invite the attention of those who superintend the philosophical department in our public seminaries, to the importance of putting it in their power to dispense with their present text-book entirely, by furnishing one for themselves.

As much the greater part of the erroneous statements of former editions stand uncorrected in the last, we think it will be doing the student an acceptable service, for the present, to present him with a list of those which will be most likely to mislead him, or to embarrass his progress.—The remainder of this article being intended only for those who are sufficiently interested in the subject to follow us with a copy of Enfield in their hands, our comments will sometimes be made with more brevity than might otherwise be consistent with clearness.

Book I. Prop. 5. " Some bodies appear to pessess a power the reverse of the attraction of cohesion, called repulsion." Of the five experiments adduced in support of this proposition, the first four,—namely, the depression of mercury around iron, and in capillary tubes, the suspension of a needle by water, and the depression of the surface around a floating piece of tin-foil,—are so far from furnishing any evidence of a repulsive power in bodies, that they are mere examples of cohesion, modified by circumstances. If we suppose the force of aggregation between the particles of mercury to be more than *twice* their force of cohesion to iron and to glass,* it appears from the investigations of Clairaut, that a depression ought to be the consequence.—The suspension of a small needle on water is owing to a certain degree of viscidity in this fluid,—in consequence of which the particles of the uppermost stratum present more resistance to separation than can be overcome by the downward pressure of the needle. Those who are acquainted with the extended researches of Count Rumford on this subject, will find no more reason for ascribing the support of a needle on water to a positive repellency, than the support of a cannon ball on ice. Both are alike owing to the cohesion of the upper surface. The only difference is, that as the cohesion is many times the least in the former case, the weight of the supported body must be proportionally less, when compared with the surface it exposes.

Book II. Prop. A. This proposition, (besides that the demonstration is unsatisfactory,) is out of place ; as the chapter is confined by its title to the comparison of *uniform* motions. It ought to have been deferred to ch. v.

Prop. 22. Cor. 1. is evidently erroneous. A second "Cor. 1." is inserted under this proposition, which belongs to the preceding one ; for it is true only of non-elastic bodies.

Prop. 30. The demonstrations of the laws of oblique descent in the annexed corollaries, are rendered unnecessarily obscure by changing the denomination of the entire force of gravity, which was F in the preceding section, to unity. In a subsequent demonstration relating to the pendulum it is again changed to A. We mention these changes, not as involving any thing positively erroneous ; but as an illustration of our general remark concerning the want of care in the compiler, to reduce the notations of the different authors from whom he borrowed, to a common standard.

Prop. 37. The demonstration is defective, from not being extended, as it easily might be, to the supposition that mo-

* Perhaps it ought rather to be said,—to "the *film of moisture* which is ordinarily attached to the surface of glass." See Haüy—Traité de Physique, I. 225. Biot—I. 455.

tion is lost in passing from one plane to another. The demonstration of the 38th is also inconclusive, because it has not been previously shown that the total loss of motion in passing through a set of planes becomes evanescent, when the planes become indefinitely numerous, and their successive inclinations indefinitely small.

Prop. 47. The demonstration shews that we may form a body by assembling particles round a *given point*, such that the body shall balance itself about this point; but it by no means shews that when the *body is given*, a point about which it will balance itself can be found;—much less that this point, as the proposition implies, is the same for all positions of the same body.

Prop. 49. The diagram employed in the proof of this proposition is drawn so inaccurately as to render it scarcely intelligible. There was the less reason for this inaccuracy, as in Rutherforth, from whom the diagram is copied, it is drawn correctly.

Prop. 51. The demonstration of this important theorem is less general than the enunciation requires, by being confined to the case in which the bodies move in the same plane. The statement with which the first corollary begins is true only under such limitations as the student can scarcely be supposed able to apply.

Prop. 56. In the great majority of instances in which the screw is employed, the resisting force is not moved up through an inclined plane, as the demonstration supposes. It would be far more simple and satisfactory to infer the law of equilibrium directly from the relative velocities of the points of application of the power and resistance.

Prop. 57. Schol. 1. "In all compound machines there will be an equilibrium, when the sum of the powers are to the weight, as the velocity of the weight is to the sum of the velocities of the powers." No interpretation can be put upon this statement which will render it true. The error arose, we presume, in some such manner as the following. It was apparent that in compound machines, (or rather in machines where several powers put several resistances in equilibrio,) the sum of the products of the powers each into its velocity, was equal to the sum of the products of the weights each into its velocity. This equation had the appearance of being capable of resolution into an analogy;

and the resolution was accordingly made. But in doing it, two things were confounded which are widely different: the *sum of the products*, and the *product of the sums.*—It would have been better if the compiler had not attempted to deviate from Rutherforth. Supposing only one power, and only one resisting force which balance each other through the intervention of a series of mechanical powers,—the power will be to the weight simply as the velocity of the weight is to the velocity of the power.*

Prop. 60. Schol. The method here given of finding the initial velocity of a projectile, gives only that part of it which is in a direction perpendicular to the horizon. To obtain the whole velocity, this result ought to have been increased in the ratio of radius to the cosecant of the angle of elevation. But it would have been altogether preferable to omit noticing a method so entirely useless and even deceptive in practice, and to have substituted for it that by the ballistic pendulum.

Prop. 68. In the last edition, several palpable errors which formerly perplexed the demonstration have been corrected; but the reasoning is still far from being demonstrative. The erroneous figure of former editions is also retained. The circle GNV, instead of GML, should have had T for its centre, and GML should have been an ellipse having T for its farther focus.

Def. 16. Schol. It is improperly asserted in this scholium, that "the projectile and the centrifugal forces differ from each other as the whole from the part." These forces are dissimilar in kind, and are incapable of comparison. They stand to one another in the same relation as pressive and percussive forces. If the tangent which measures the projectile, and the subtense which measures the centrifugal force, be diminished indefinitely, as they must be before we can properly make the attempt to compare them, the latter becomes evanescent in respect to the former. The centrifugal is rather a *consequence* of the projectile force, than a *part* of it.

Prop. 70. "When bodies revolve in a circular orbit about a centre, the centripetal and centrifugal forces are equal." This proposition implies that in other orbits these

* See Rutherforth's System, Vol. I. Art. 72.

forces are not equal. But the demonstration is such as would prove them no less equal, in all cases whatever.—We must confess ourselves at a loss to assign any consistent meaning to the term "centrifugal force," in relation to orbits not circular. Is this force measured by the distance by which a revolving body would be more remote from the centre, in a given small time, if the centripetal force were suspended, than it actually is while the centripetal force acts? If so, the centripetal and centrifugal forces are always equal, for the same point of an orbit, whatever be its figure. Or is it measured by the absolute increase of distance from the centre, which would take place in a given small time, if the body were abandoned to its projectile force? If so, in passing from the higher to the lower apsis of an excentric orbit, the centrifugal force is a negative quantity.

Lemma 4. The inference concerning the equality of the arc to the chord and tangent in their vanishing state, is inconclusive when the tangent is less than the arc, as it will be in certain positions of the subtense. The demonstration may be rendered complete in the following manner:—AB : AD+DB : : AC : AB+BC. But AB+BC is ultimately equal to AC; hence AD+DB is ultimately equal to AB, and much more is the arc AB equal to the chord AB.

The first Part of Book III. which treats of Hydrostatics, presents us with several instances of explicit or implied error; particularly prop. 2, prop. 13, Schol. and propositions 24, 26, 31, and 36. But we have no room to dwell upon them; and shall therefore pass directly to the second Part, which is devoted to Pneumatics.

Prop. 51. The force with which wind strikes a sail of given dimensions, was stated in former editions as varying in the duplicate ratio of the *cosine* of the angle of incidence. In the last edition, the term *sine* is substituted for *cosine*. The phrase "angle of incidence" was before used in the same sense as in optics: it is now employed in the ordinary sense of mechanics. But this correction goes but little way towards freeing the proposition from exception. If the sail be supposed confined to move in the same direction with the wind, which the demonstration seems to imply, a resolution of the force on a third independent account was necessary, which would have reduced that part of the force which is effective to the ratio of the *cube* of the sine, instead of the square.* But as the variation of the force determined from experiment differs totally both from the square and the cube, it would have been better to erase the proposition, than to attempt to amend it.

Prop. 55. Schol. The mode in which the constant velocity of sound is attempted to be explained, (which, like the rest of the scholium, is copied from Rowning,) is wholly erroneous: nor do we think it easy to substitute an unexceptionable theory of the mechanism of aerial pulsations, without involving mathematical principles of a higher order than the student is supposed to be acquainted with.

Prop. 56. Schol. 3. "It is found by experiment, that air is necessary to the existence of sound, of animal life, of fire, and of explosion." This, like several other statements scattered up and down the work in which chemical principles are alluded to, needed correction to render it accordant with the present state of our knowledge on these subjects. The experiments of Biot and Chladni shew that sound is transmitted by solid bodies as well as gaseous ones, and that it may be conveyed to the organs of hearing without the intervention of air, by forming a communication between the sounding body and the head by means of a solid conductor.—That fire and explosion require air for their existence, is true only in the most loose and popular sense of the terms. In particular, that the explosion of gunpowder cannot be effected in a vacuum, as is implied in one of the annexed experiments, is an entire mistake.†

The articles on the barometer, thermometer, hygrometer, and steam-engine, are extremely defective in point of valuable information, compared with what might have been said about them within the same limits, and in several respects are calculated to leave erroneous impressions: but we must content ourselves with giving this general caution against placing implicit confidence in them.‡

* This theoretical determination may be seen, Gregory's Mechanics, I. 539, &c.

† Robins, Hutton's Math. Dictionary, &c.

‡ It may be proper just to state, for the information of those who may have access to no other rule than that given page 110, in making loose esti-

Book IV. Prop. 1. Scholium. The editor of the London edition of 1799, left the question undecided, as Mr. Cavallo had done, whether any other than ferruginous bodies are capable of magnetic properties. This scholium has been retained; although the experiments of Tourte of Berlin,* and Lampadius, place it beyond a doubt, that nickel and cobalt possess the same capacity, in this respect, with iron, except in an inferior degree. According to Lampadius, (see Thomson's Annals, 1815,) the "magnetic energies" of iron, nickel, and cobalt are as the numbers 55, 35, and 25, respectively.

Prop. 2. Schol. If it were worth the while to retain the experiments of Musschenbroek on the variation of the magnetic force at all, in place of the far more important ones of Coulomb, the numbers ought at least to have been corrected. Had the editor of the second edition taken these experiments from Musschenbroek himself, instead of taking them from Cavallo, he would have avoided the error of making the distances all ten times too large.† The denomination employed in the original statement (see Philos. I. 206. Ed. 1744,) is *tenths* of inches. instead of inches.

Prop. 10. To illustrate the mode of finding the declination of the needle by amplitudes of the heavenly bodies, the following example is stated: "If the magnetic amplitude is 80° eastward of the north, and the true amplitude is 82° towards the same side, then the variation of the needle is 2° west." This statement cannot be reconciled to *any* definition of the term "amplitude;" and it cannot be reconciled with the usual definition and the one given in the Astronomy, except by making all the alterations which follow: "If the magnetic amplitude be 10° N. of E. and the

mates of altitudes from the barometer, that the ascent corresponding to 1-10 in. fall of the mercury, instead of being one hundred and three feet, is at a mean, (that is, when the barometer itself is at 30 in. and the thermometer at 60°,) only about ninety-three feet.

* Nicholson's Journal, Vol. 26.

† If perfect exactness in such a case were of any importance, it would be necessary to recollect, that Musschenbroek's denominations were Rhinland measure; which are greater than the English in the ratio of 1,03 to 1.

We acknowledge ourselves indebted, for the above remark, to the suggestion of a scientific friend.

true amplitude is 8° towards the same side, then the variation of the needle is 2° east."

Prop. 10. Schol. 2. The late and accurate observations of Mr. Gilpin* and Col. Beaufoy on the diurnal variation of the needle in different months of the year, present wide deviations from the results here given from Mr. Canton. Both the observers just mentioned, make the extremes of the mean diurnal variation in different months, about 11′ and 4′; and both place the time of the maximum earlier in the year than was done by Mr. Canton. Col. Beaufoy (Thomson's Annals, 1819,) places it in April.

Prop. 11. Schol. 1. The dip of the needle is here represented as probably "unalterable at the same place."—Whatever be the cause of the dip, this supposition is extremely improbable, while the declination is known to be variable, and to be, in common with the dip, the result of the tendency by which the needle places itself in the magnetical line. Nor do the observations made at London during the last century, warrant the inference made in this Scholium. As measured by Whiston in 1724, it was 75° 10′: and nearly accordant with this result is that of Graham, obtained in the following year. Cavendish, in 1775, found it to be 72° 30′, and Gilpin, in 1805, 70° 21′. These observations, after every allowance is made for the imperfection of the instruments employed, leave no doubt that the inclination of the needle has undergone a gradual diminution in London, during the last century. According to M. Humboldt, (see Biot—Traité de Physique, III. 136,) a similar diminution has taken place, during the same period, in France.

Book VI. Prop. 13. Schol. 1. The statements concerning the ratio of the sine of the angle of incidence to that of deviation, in passing to and from water and glass, are true only under a limitation which is not distinctly pointed out,—namely, that the angle of incidence is indefinitely small.

Schol. 2. The partial reflection of light by the second surface of transparent media, when the angle is within the limit for light to be refracted, is erroneously ascribed to "inequalities" of the surface. If this were the true cause,

* Philos. Trans. 1816.

no distinct image of an object could be seen by light thus reflected.

Prop. 17. Exp. The effects of a single dense medium, bounded by a convex surface, on parallel, diverging, and converging rays, can never be illustrated by a convex lens, which produces *two* successive refractions,—one by a convex surface of the denser, and the other by a concave surface of the rarer medium. The lens presents the combined result of the former part of prop. 17, and the latter part of prop. 18. In particular, a convex lens can never render converging rays "less converging," as is asserted in the fourth paragraph under the Exp.

Precisely similar remarks might be repeated concerning the introduction of the concave lens to illustrate the several cases of prop. 18.—Both these experiments, if introduced at all, should have been placed after prop. 18; and the manner in which each illustrates *both* propositions should have been pointed out.*

Prop. 22. Cor. 2. The corollary is right; but the investigation which is given of it, is incorrigibly wrong. By comparison with the figure, it will be seen that it gives the position of the principal focus of a glass sphere *within* the sphere; and that of a sphere of water, coincident with the hinder surface. The proper mode of proceeding would be, first to determine the focus of parallel rays entering a denser medium by prop. 22; and then to find by prop. 23, the focus of rays converging (to the point just found,) when passing out of a denser medium into a rarer, through a concave surface of the rarer.

Prop. 26. "The image will not be distinct, unless the plane surface on which it is received be placed at the distance of the *principal* focus of the lens." For "principal," read—"corresponding to the distance of the object."

Prop. 35. "Though the distance of the object from the lens be varied, the image may be preserved distinct without varying the distance of the plane surface which receives it." The distance of the plane surface from *what?* The second mode of doing it, pointed out in the demonstration, is in-

* Both these propositions have materially suffered in point of clearness, from employing as diagrams sections of lenses, instead of media indefinite in the direction towards which the rays proceed after refraction,—as well as from the inaccurate manner in which some of the lines are drawn.

consistent with the supposition that the distance of the plane surface, either from the object, or the lens, remains unaltered. Those who will consult Rutherforth's Optics, Ch. VII. will see that this inconsistency has arisen from an attempt to blend into one, two propositions of which the conditions were different. We will add, although the remark has no relation to the last edition, that the mistake in the statement of the magnifying power of the double microscope (prop. 147.) arose from precisely the same source. Rutherforth investigated the two ratios on which the magnifying power depends in separate propositions,—first supposing the eye at the station of the object glass, and then at the limit of distinct vision. In uniting these two propositions into one, Enfield inadvertently retained the condition of the former.

Prop. 44. "Reflection is caused by the powers of attraction and repulsion in the reflecting bodies." This proposition is altered and abridged from the following in Rutherforth: "Bodies refract and reflect light by one and the same power, differently exercised in different circumstances." The illustration of this proposition by the original author is an excellent one, considering the state of optical knowledge at the time he wrote; but in the hands of his abridger, although all the suppositions made by Rutherforth are retained, and we are required to admit that "bodies attract those rays which are very near them, and repel those a little farther from them," yet no use is made of the attracting surface, and the most interesting part of the proposition, the reflection produced by the second surface of the medium, (in regard to which so much pains had been taken in the previous scholium to exclude other hypotheses,) is entirely omitted. The student is left to wonder why "attraction" is mentioned in the proposition as having any concern with reflection; and the identity of action in the medium by which refraction and reflection are produced, is kept out of his sight.

Prop. 46. Schol. Although perhaps nothing positively erroneous is advanced in this scholium concerning Sir Isaac Newton's theory of fits of easy transmission and reflection, we cannot but object to a naked statement of a theory, stripped of all the facts which it was formed to explain, and made at the same time in so obscure a manner as must impair the respect of the student for its illustrious author. The hypothesis of fits, however it may seem fitted to excite ridicule as exhibited in this scholium, is now justly regarded as one of the most striking displays which Newton ever made of his transcendant genius. In the hands of Biot and his companions in the career of discovery, it has acquired an importance of which Newton himself could have had no adequate conception.—Whether the principles of this now highly interesting and important department of Optics can be reduced to the level of a system of elementary instruction, is deserving of serious inquiry. A digest of the phenomena and laws of polarization, involving no difficulties which would render it inaccessible, or deprive it of its interest with those who aim at nothing more than general views of science, appears at least to be as yet a desideratum.

Prop. 58. "In all mirrors, plane or spherical, &c." This proposition, in regard to spherical mirrors, is true only of those pencils of reflected light which are indefinitely near the perpendicular.

Prop. 69. In the demonstration it is stated that "by prop. 31, the diameter of the image, when the object is given, is inversely as the distance of the object." This is not said, in prop. 31; nor is it true, except when the object is very remote. The image formed by a lens is not in circumstances analogous to that produced on the retina of the eye; for the lens has no provision for preserving the image distinct, for different distances of the object, without varying the distance of the plane surface which receives it.

Prop. 73. "When equal objects in the same right line are seen obliquely, their apparent lengths are inversely as the squares of their distances from the eye." The limitation, "in the same right line," has been very properly inserted by the editor of the present edition; but to render it correct, it wants another limitation which the proposition originally had as given by Rutherforth; that is, "When equal objects are seen *very* obliquely," &c. When the object is of finite magnitude, the obliquity must be very great, in order that the proposition may hold true,—unless indeed the object itself be very small; in which case it holds true for every degree of obliquity. But under this last modification, it requires a different demonstration; and is more properly referred to the subject of apparent velocity, than of apparent magnitude. As referred to the head of apparent velocity, the proposition might have been thrown into the following simple and not inelegant form: "When a body moves uniformly in a right line, its apparent velocity will be inversely as the square of the distance from the eye."

In demonstrating the 83d and 85th propositions, it is stated as the reason why the image produced by a convex or concave lens is erect, that the axis of the pencils which proceed from the extremities of the object "only cross one another at the lens." It should be, "because they only cross one another at the eye." The pencils which pass from the extreme points through a lens, do not, in fact, meet each other till they reach the eye. Figs. 8 and 9 convey no idea of the manner in which the pencils come to the eye, except in the single case in which the eye is in contact with the lens; nor is there any other diagram in the Optics which gives the student any information on this important point.—The remark scarcely need be added, that almost all the propositions in this chapter which state the effect of lenses on apparent magnitude, have unsatisfactory demonstrations. It is taken for granted that at whatever distance from the lens the eye is placed, the pencil which enters it from the same point of the object diverges as if from the same point in space. But the fact is, that as the eye recedes from the lens, the rays which enter the pupil from the same point of the object, gradually change: the axis of the pencil, instead of coinciding with the centre of the lens, passes above or below it, according as the point of the object is above or below. Hence it is improper to assume that the pencil from A (figs. 8 and 9) diverges as if from the same point D for all distances of the eye from the lens. The assumption is erroneous, except when the object is extremely small, and it ought not to be made even in this case without proof.*

Prop. 89. If this proposition were one of the least value, it would be desirable that it should have a more satisfactory demonstration than its present one, which on several accounts is wholly inconclusive.

* The remarks made in this paragraph are equally applicable to the propositions in the succeeding chapter, which relate to vision as affected by mirrors.

The statements concerning the *brightness* of the image, made in different propositions of this chapter, are not legitimately proved; for the number of rays received by the pupil from any one point of the object may be increased, and the brightness nevertheless diminished,—on account of the increase of apparent magnitude.

Props. 108, 110, and 111, assert unconditionally concerning the magnifying power of mirrors, what is true only in certain positions of the eye. If, for example, the object be nearer a concave mirror than its principal focus, and the eye be in the centre of concavity, the image, instead of "appearing larger" than the object, as is asserted in prop. 108, will appear of the same magnitude; and if the eye be brought still nearer the mirror, the image will appear the smallest.

Prop. 144. Schol. 1. "Of two refracting telescopes which magnify equally, the shorter will give a more imperfect image than the longer. For the image appearing equal in both, but being farther from the object-glass in the longer than the shorter, must be in reality larger or more magnified; whence the defect arising from the different refrangibility of the rays, will be more visible in the longer than in the shorter telescope."—The statement with which this paragraph begins is correct. The reasoning subjoined is evidently erroneous, and leads to a conclusion the reverse of what was first asserted. If two telescopes were exactly similar in all their parts, differing only in size, it is manifest that the imperfection of the image arising from unequal refrangibility, would be the same in both. But the smaller would have the disadvantage of rendering the object less bright, in the duplicate ratio of the linear dimensions. To render the brightness the same in both, the object glasses must be made equal; in which case the one of least focal distance, being a greater portion of a sphere, would produce the most imperfect image.

Schol. 2. The account of achromatic lenses in this scholium omits the essential circumstance on which the whole explanation turns. We are told that a convex lens of crown glass is to be united with a concave one of flint glass in such a manner that "the excess of refraction in the crown glass may destroy the colour caused by the flint glass." Here the student will naturally inquire, how the crown glass can possess an excess of refraction, without also possessing an excess of dispersive power? For the removal of this difficulty, no hint is given of the great fact which lies at the foundation of Dollond's improvements, viz. that the dispersive power of different media is not proportioned to their mean refractive power. Unless he has the sagacity to conjecture that this may be the case from the obscure statement above quoted, he will remain in ignorance of what has been justly regarded as the greatest discovery made in Optics since the period of Newton.

Book VII. We had hoped to see the numerical expressions for the principal magnitudes, distances, and angles which occur in Astronomy, corrected in the present edition so as to correspond with the present state of the science. But with the exception of two or three manifest errors of the press, and the general table at the end of part I., the numbers of former editions, many of which are a century old, are retained. We will therefore, once for all, give the corrections of those which may be considered as ascertained with the most precision. The student can, if he chooses, go over them with his pen.

Prop. 3. Cor. 133, 137, for	3985	read	3956.
Prop. 3. Cor.	229 : 230		311 : 312.*
Prop. 8. Schol.	23° 28′ 5″	(1820)	23° 27′ 57″
Do.	one degree		2° 42′†
Prop. 35.	32′ 47″		32′ 35½″
	31 40		31 31
	32 12		32 3
Prop. 51. Schol. line 9	ninth		tenth
	d. h. m.		*d. h. m.*
Prop. 116. Schol.	1 18 28,6‡		1 18 27,6
	3 13 17,9		3 13 13,7
	7 3 59,6		7 3 42,6
	16 18 5,1		16 16 31,8
Prop. 117. Cor. 179, 182,	194,000,000		190,000,000

* Delambre, Playfair, Lambton, Bowditch, &c.

† Laplace.

‡ These numbers are Flamsteed's. The corrections are given from Laplace.

Prop. 133.	240,000	238,200*
Prop. 135.	5201	5203
	9538	9539
Props. A, B, 182. Part. III.	2″	0″,5†
	100,000	400,000.

Prop. 13. To make the demonstration from fig. 10, consistent, EPLH ought to be regarded as a circle in the heavens; it is therefore improper to place the spectator at P. The diagram should have been constructed like fig. 2, with a small concentric circle to denote the earth.

Prop. 35. Cor. "Hence it appears that the earth, at the winter solstice or Capricorn, is in its perihelion." The student will be apt to infer, from this mode of expression, that the two points mentioned have some *necessary* connexion. But so far is this from being true, that the time when the earth is in its perihelion is about ten days later than that of the winter solstice. The angular motion of the earth in the interval (for 1820) is about 9° 50′.

Prop. 35. Prob. 6. The method of finding the bearing of two places on the earth's surface, here described, is manifestly erroneous, except when the places are very near each other. This part of the problem does not appear capable of a solution on the artificial globe.

Chapter III. on Twilight, has undergone several material improvements in the last edition. The Cor. to prop. 37, is however out of place, and should have been expunged. The demonstration of prop. 39, is freed from several theoretical errors; although we think the attempt to distinguish between the sun's centre and upper limb, in an angle liable to so much uncertainty as the sun's depression at the commencement of twilight, attended with no advantage sufficient to compensate for the additional complexness it gives the

* In calculating this distance, 57′ 11″ was retained as the mean equatorial parallax: this being the result obtained by Delambre and Lalande, and being employed in Burg's Lunar Tables.

† Delambre, Astronomie III. 142. Philos. Trans. 1818. Although Mr. Pond fixes the greatest possible limit at 0″,5, he supposes that in all probability the double parallax does not equal 0″,25, even for Arcturus and Lyra.

It is scarcely necessary to remark that when either of the foregoing numbers are employed in calculations, in different parts of the Astronomy, corresponding alterations must be made in the results deduced from them.

demonstration.—After all, we should have been much better pleased to see the proposition entirely omitted, than any attempt made to amend it. The hypothesis that the rays which come to the eye at the end of twilight are brought by a single reflection, is a very questionable one. The power of reflecting light possessed by the atmosphere, must depend on one or both of two causes: 1. It may reflect some of the rays which pass through it in consequence of a defect of transparency. 2. It may reflect in the same manner as light is ordinarily bent back into a denser medium. This last mode of reflection, if it ever takes place without an abrupt change of density, is evidently more likely to take place, in proportion as the variation of density is more rapid. Now whichever of these causes operates to produce twilight, it must evidently exist in a far higher degree in the lower, than in the higher regions of the atmosphere. Hence instead of a single reflection at the height of forty-two miles, two or more successive reflections may quite as probably transmit to the eye the light with which twilight closes.*—But even admitting the correctness of the assumption that twilight is produced by a single reflection, it is most obvious that no inference can be deduced concerning "the height of the atmosphere," or even the height at which it ceases to reflect light. The only legitimate conclusion is, that forty-two miles is the limit beyond which light is not reflected in sufficient quantity to affect the organs of vision. If, instead of this vague proposition, the law of atmospheric density at different altitudes had been inserted in its proper place in the Pneumatics, the subject would have been exhibited in a far more interesting and instructive form.

The subject of the moon's librations, in props. 78—82, is managed with singular infelicity. The introductory proposition should be, that "the time of the moon's rotation on its axis is equal to the mean time of its revolution round the earth,"—instead of beginning with the fact that "the moon always has nearly the same side toward the earth," and drawing the strange inference that "*if* the moon revolves about its axis, its periodical time must be equal to that of its revolution round the earth." The librations

* See Vince's Ast. I. Art. 206.

should be assigned each to its proper cause; that in latitude to the obliquity of the axis to the plane of the orbit, and that in longitude to the excentric form of the orbit,—instead of blending the explanations of both under the loose proposition, "the librations of the moon may be explained on the supposition that the moon has a revolution on its axis." In prop. 81, the equality of the times of rotation and revolution is inferred from the librations; while it is in fact a matter of direct observation, and must be presupposed in explaining the librations themselves. In prop. 82, the *elliptical* form of the moon's orbit is inferred from the libration in longitude. We very much doubt whether the species of oval to which the moon's orbit most nearly approaches could have been determined from direct observations on so trifling a change of phase. The proper mode of presenting this part of the subject would be, to infer the elliptical form of the orbit from the observed relation between the anomaly and the apparent diameter; and then to employ this conclusion for the explanation of the libration in longitude.

Prop. 83. Schol. In stating the results of Dr. Herschel's observations on the altitude of the lunar mountains, it is mentioned that "one was found to be about a mile in height; but none of the others which he measured proved to be more than half that altitude." By consulting the original memoir in the Philos. Trans. and another which he has published since, it will be seen that Dr. Herschel's results differ much less from the estimates of the older Astronomers, and from the recent and accurate measurements of Schröter, than is here represented. Dr. H. makes several over a mile, and one, nearly two miles in height.

Prop. 106. "If the moon, when new, is in one of its nodes, the eclipse of the sun will be central. It should be,—"to the inhabitants of some part of the earth it will be centrally eclipsed in the zenith." To those parts of the earth at which the moon is never vertical, a central eclipse can happen only when the moon is *not* in its node, at the the time of conjunction.

Prop. 113, which affirms a motion "*in antecedentia*," of the satellites of the superior planets while passing from one elongation to the next through their inferior conjunction, is no less erroneous than the propositions of former editions concerning the retrogradation of the primary planents; and, should, like them, have been rectified or struck out. All that can be said with truth is, that during the specified interval the motion of the secondary is retrograde *relatively* to its primary; and even this statement can scarcely be extended to the satellites of Herschel.*

Prop. 114. "The greatest elongations of a satellite on each side are equal." This proposition has several exceptions. The orbits of the third and fourth satellites of Jupiter have a very sensible excentricity; and the same is true of the fourth (now more generally numbered as the sixth) satellite of Saturn. See Laplace: Syst. du Monde. The latter, according to Delambre, (Ast. III. 510,) has an ellipticity nearly equal to that of our moon.

Prop. 123. Several of the particulars inserted in the annexed scholium from Sir I. Newton, have now become obsolete. In particular, the quantities of matter in Jupiter and Saturn, instead of being to that in the sun in the ratios of 1 to 1100 and 2360, are now known to be in the ratios of 1 to 1067 and 3534.†

Prop. 135, is founded on the erroneous theory of retrogradation previously laid down; and therefore should have been corrected.

Prop. 155. The demonstration of this proposition is in part fallacious. It is said to be contrary to prop. 51. cor. of Book II, that the centre of gravity of two gravitating bodies should move; and is inferred that if one of the bodies is projected in any direction, the other must acquire (by what means we are not told) an equal motion in the opposite direction. Now this is so far from following as a necessary consequence, that the other body will not in fact acquire any such motion; and if a projectile movement be

* We have not attempted, in the general list of corrections inserted, p. 146, to rectify the periodical times of the satellites of Herschel; for with the exception of the second and fourth, their distances from their primary are wholly conjectural; nor is even their number regarded by Dr. Herschel as yet fully ascertained. His last determination of the synodical revolutions of the second and fourth, given in the Philos. Trans. for 1815, is as follows:

II. 8d. 16h. 56′.5″.
IV. 13d. 11h. 8′ 59″.

The inclination of their orbits to the ecliptic he finds to be 78° 58′,—much farther from perpendicularity than has been heretofore supposed.

† Méc. Céleste. Part. II. Ch. 9.

given to one of them alone, the common centre of gravity of the two will not continue at rest. Nor does this contradict the proposition referred to in the Mechanics; for the common centre will move uniformly in a right line. The proposition should have stood thus: "The sun and any planet revolve round a common centre of gravity, which remains at rest, or has a uniform rectilineal motion."

Prop. 162. This theorem, as it stood in Rowning, was preceded by an investigation of the motion of the apses produced by a force varying in a greater or less than the inverse duplicate ratio of the distance. As nothing analogous to this investigation has been retained by Enfield, the assertion that when the force varies faster than in the inverse duplicate ratio of the distance the line of the apses will move forward, and *vice versa*, made in the course of the demonstration, is wholly gratuitous.

Prop. 163. The demonstration is not only irrelevant to the proposition, but from an inadvertent change in the conditions as laid down by Rowning, a blunder is carried through it and the annexed corollary. The demonstration affirms that if the moon is passing from the higher to the lower apsis and its gravity increases too fast, "it will approach nearer to the earth" than it would otherwise do, "and describe a portion of an orbit less excentric, or nearer a circle." The former statement is correct; but it contradicts the latter. So in the corollary we are told that "when the gravity of the moon towards the earth decreases too fast, the excentricity of the orbit will increase; and when her gravity towards the earth increases too fast, the excentricity will decrease." The fact is, that in both cases alike the excentricity will increase. It is when the gravity increases or diminishes *too slow*, that the excentricity will decrease. Those who will give themselves the trouble of consulting the prop. as it stands in Rowning, will find no difficulty in perceiving how a hasty abridger might shift the conditions of the demonstration.

Props. 164 and 166. Why two propositions so nearly identical should find a place in this chapter we can give no account,—unless that the compiler had forgotten that he had given a theorem on the motion of the nodes from Rowning, and therefore looked for one in some other author. So much at least is certain,—that prop. 166, and this only, among those which compose the chapter, is borrowed from Rutherforth.

Prop 168. Schol. This method of finding the direction of gravity includes only the effect of the centrifugal force. Including the joint effect of rotation and of figure, the direction is manifestly that of a perpendicular to the tangent plane of the earth's surface, or of a normal to the elliptical curve of the meridian passing through the given place.

Prop. 173. In the concluding paragraph of the demonstration, the relative forces of the sun and moon to raise tides are erroneously stated. The real forces are directly as the masses, and inversely as the cubes of the distances.

The concluding scholium of the Astronomy consists of extracts from a paper of Dr. Herschel's in the Philos. Trans. for 1795. These extracts are so unskilfully made, and are presented in so disjointed a form, as to afford scarcely any idea of the train of argument pursued in the original. But in the original itself, high as is the estimation in which the author is justly held as an observer, we must be permitted to think that there are several statements which cannot be defended. With the view of multiplying the points of analogy between the sun and the planets, and thus increasing the presumption that the former is inhabited, he endeavours to shew that both primaries and secondaries shine in some measure by their own light. The partial illumination of the moon, for example, during a total eclipse, cannot be entirely ascribed to the light which may reach it from the earth's atmosphere;—"because, in some cases, the focus of the sun's rays refracted by the earth's atmosphere must be many thousand miles beyond the moon." Dr. Herschel assumes as the basis of this calculation that the rays of the sun are bent by the atmosphere at only an angle of 31′. He seems to have inadvertently neglected the circumstance that the rays undergo a second equal refraction in passing out of the atmosphere. In consequence of this, the real inflection is 62′, (or rather 66′, taking 33′ as the mean horizontal refraction,) so that the focus of the sun's rays as refracted by the earth's atmosphere can never in fact be so distant as the moon. An observer stationed at the moon, even during a central eclipse of the sun, would see a luminous ring encircling the earth. The light thus thrown upon the moon's disc is amply sufficient to explain its partial illumination during a central eclipse. Were Dr. H.'s assumption concerning the amount of atmospheric refraction correct, his conclusion would not follow; for the same agency of the atmosphere which produces *twilight* to an observer stationed on the earth's surface, will produce the same effect to a second spectator, stationed any where *behind* the first, and in the same tangent plane of the earth.* Another obvious proof that Dr. H. was misled by his zeal to find points of analogy between the sun and the other bodies of the system, at least so far as the phosphorescent quality of the moon is concerned, is, that light is not given off in any sensible degree from the crescent which is unenlightened by the sun, just before and after opposition.

The attempt to remove an objection to the sun's being inhabited by supposing that "heat is produced by the sun's rays only when they act on a calorific medium," and that they are the cause of heat only "by uniting with the matter of fire which is contained in the substances that are heated," together with the arguments advanced in support of these strange positions, certainly ought, for the credit of one who has deserved so highly of astronomical science, to have been suppressed. They are too far behind the present state of Chemistry, and too little essential to the object which their author had in view, to deserve transcribing into the pages of an elementary work, which is intended to be employed in instruction.

In passing to the *Appendix*,—our limits will not allow us to notice a variety of errors which occur in the progress of the examples; nor a number of small inaccuracies unnecessarily introduced into the mode of projecting solar eclipses. The tables of epochs (which terminate with the present year) should have been extended; and might also have been advantageously corrected from those of Delambre and Burckhardt.—But the most important positive error, perhaps, which occurs in the Appendix, relates to the method of finding the arguments of the moon's latitude. In Ewing's Astronomy and all the editions of Enfield except the last, we have given over the IIId table, "Arg. I—

* Hence the 93d Proposition, which ascribes the light transmitted to the moon's disc during a total eclipse to "the *reflection* of rays of light falling upon the earth's atmosphere," is doubtless in part correct.

☽'s mean anomaly;" and over the Vth, "Arg. IV—☉'s mean anomaly." Both these arguments are wrong. Those who may have the curiosity to look into Mason's edition of Mayer's Lunar Tables, from which Ewing's were abridged, will see at a glance how these erroneous captions originated. They are in fact the 3d and 5th arguments of Mayer's tables; but Mayer's 3d table is omitted, and his 10th is made Ewing's 5th. The captions were inadvertently copied, although they belonged, in consequence of these omissions, to the wrong tables. In the last edition, the caption of the third table is altered to make it agree with the general directions for finding the arguments of Latitude given in Prob. 8th; but that of the 5th still remains erroneous, as well as the general rule under Prob. 8th. It should be, "subtract the moon's mean anomaly from the *second* argument," &c.; and the caption of table 5th should be, "Arg. II.—☽'s mean anomaly."

The principal part of the corrections and alterations made by the editor of the last edition have our entire approbation. Particularly in regard to two highly important propositions, the one relating to the law of refraction, in the Optics, and that on the sun's parallax, in the Astronomy, he has probably done the best that the elementary character of the work admitted. There are a few instances, however, of alterations, the propriety of which appears very questionable, and which justice to the labours of former editors requires us briefly to notice.

Thus in the first proposition, "Matter *may be, and mere extension* is infinitely divisible," the clause in italics is peculiar to the last edition. We recollect having seen in Hutton's Dictionary an attempt to establish a distinction between "actual" and "potential divisibility;" but we could not understand it; nor are we any more fortunate in regard to the language just quoted. If the term "divisibility" itself means nothing more than the possibility of being divided, to say that matter *may be* infinitely divisible is a solecism. The distinction between the divisibility of matter and that of extension seems to depend on the definition of the term. If by "divisibility" be meant merely the possibility of being ideally divided by mathematical planes without any separation of parts, then the property is one which belongs to matter and to extension in precisely the same sense. But if in the phrase "divisibility of matter" be included the additional idea of discerptibility, or the possibility of being separated into parts not in contact, then the property is one which belongs *in no degree* to pure extension. In neither case does the distinction made in the proposition as quoted above appear to have any foundation. That matter *is* infinitely divisible in the first sense, is almost self-evident: whether it is so in the last, (admitting the exercise of any supposable power which does not change the nature of matter,) is a question which lies beyond the reach of the human faculties.

We notice, in the second place, that three experiments, on the approach of light bodies floating on water to each other, or to the side of the vessel, have been transferred from prop. 5, where they were originally placed to illustrate the cohesion between solids and fluids, to prop. 4, where, if they illustrate any thing, it must be the cohesive attraction between two solid bodies. It is true that these phenomena are only indirect consequences of the attraction between solids and fluids; and a scholium was very properly added by the author, (which has been omitted in all the subsequent editions,) to aid the student in tracing their connexion with the proposition. But it is most certain that they have nothing to do with the cohesive force of two solid bodies. When there is an elevation or depression of the fluid around both of two floating bodies, they will approach: when there is an elevation around one and a depression around the other, they will recede. These are mere results of capillary action; and as such, admit of an easy explanation from the general theory of Laplace.*—A popular idea of the mechanism of these phenomena will be gained from the following experiment, by which we have been much amused, and which we do not recollect to have seen noticed. Two small globules of mercury, carefully laid upon water, will swim. Let these globules be brought within one or two inches, and it is surprising to observe the rapidity with which they dart together. If one of the globules is forced to the edge of the water, (the vessel being of such materials as to be capable of being moistened,) it

* See Méc. Céleste. Sup. au dix. Livre: Biot—Traité de Physique I. 462. Haüy I. 237.

will recede with an activity which might seem the effect of animation. But on holding the vessel in the light, the secret of these motions will be apparent. Each globule will be seen to have a depression around it, which perceptibly extends to the distance of more than half an inch. The globules will be seen to rush together, not from any mutual attraction, but because, in doing it, each *descends down an inclined plane.* Two needles, laid on water and kept parallel to each other, will exhibit similar appearances.

In the Optics, under Prop. 18. Exps. 22, 23, 55, 56, &c. the term *focus*, as used to denote the point *as if* from which diverging rays proceed after refraction or reflection, is changed into *imaginary radiant.* The latter term is doubtless the most descriptive of the actual condition of the rays, and by some writers is uniformly employed instead of *virtual* or *negative focus.* But to introduce this distinction increases the complexness of enunciation of several important theorems which are already too complex.* It were to be wished, for the sake of these theorems, that we had some term which should merely express the point where the lines of direction of a pencil of rays meet, *before* refraction or reflection,—without including the idea of divergency or convergency; and another to denote the same thing *after* refraction or reflection. As long as this is not the case, we are not cenfident that any advantage is gained by changing the denomination of *focus*, when virtual, to *imaginary radiant.* But if the change is made at all, it ought at least to be carried through. This has not been done by the Editor; and the consequence is, that several propositions contain an implied error. He has inserted "imaginary radiant" after "focus" in prop. 55; but in props. 22, 23, and 56, which equally required a similar addition, and in prop. 54, which required a substitution, neither has been made. Such an addition would, it is true, have rendered the enunciation of some of these propositions exceedingly perplexed; but consistency demanded that it should be done, or that the language of former editions should be left unaltered.†

* Such, in Enfield's Optics, are props. 21, 23, 54, 56.

† It must be admitted that the language of former editions, in this respect, was not entirely consistent with itself. Defs. 8 and 18, and the Schol. to def. 13, needed modification.

The erroneous theory of the stationary points and retrogradations of the planets in Ch. 4. Part. I. of the Astronomy has been very properly expunged from the present edition. An investigation is substituted, (p. 262,) which gives the formula $D\sqrt{\frac{v^2-V^2}{D^2 v^2-d^2 V^2}}$, for the sine of elongation of the superior planet, and $d\sqrt{\frac{v^2-V^2}{D^2 v^2-d^2 V^2}}$, for that of the inferior planet, at the time when each is stationary as seen from the other. Instead of these cumbrous formulæ, which require the calculation of the velocites, and are unfitted for logarithmic computation, we should rather have seen the investigation so conducted as to terminate in the equations, $\cot E = \frac{\sqrt{d(D+d)}}{D}$, and $\cot e = \frac{\sqrt{D(D+d)}}{d}$; E being the elongation of the superior, and e that of the inferior planet. These expressions are far simpler, besides being confined to terms of the distances.*

* We have taken no notice, in the progress of these remarks, of errors which are merely typographical, or which might have arisen from mistakes committed by the compiler in transcribing. We will therefore subjoin a list of such as affect the sense, and as the student will not probably be able to rectify for himself, with their corrections. Many of them are peculiar to the last edition.

Book II.	Prop. 30. Cor. 6.	For $\overline{\frac{2F}{1}}\Big\vert^2$ *read*	$\overline{\frac{2F}{1}}\Big\vert^2$.
	Ch. VII. Lemma 7, and Cor. 2.	For centrifugal *(three times)*	centripetal.
Book IV.	Prop. 10. Schol. 2. table at top.	For 12° 2′	19° 2′.
Book V.	Prop. 5. Exp. 6.	For cups	metallic cups.
	Prop. 11. line 2.	For electrified	unelectrified.
	Prop. 14. Exp. line 7.	For positively	negatively.
Book VI.	Prop. 17. Exp. line 21.	For diverging	converging.
	Prop. 126. Schol.	For 42° 20′	42° 2′.
Book VII	Prop. 13.	For half year	half a year.
	Def. 40.	For earth	earth's orbit.
	Prop. 57, end of Schol.	For $\frac{Pp}{P-p}$	$\frac{Pp}{p-P}$.
	Pag. 295. 8th col. against Merc.	For 14.24.5.28	24.5.28.
	3d col against Herschel.	For 1908352	1918352
	Do. head of last col. but one.	For mean distances	mean dist. of the earth.

ART. XXI.—*A Description of* ITHIEL TOWN'S *Improvement in the construction of Wood and Iron Bridges: intended as a general system of Bridge-Building for rivers, creeks, and harbors, of whatever kind of bottoms, for any practicable width of span or opening, in every part of the country.*

To establish a general mode of constructing wooden and iron Bridges, and which mode of construction shall, at the same time, be the most simple, permanent, and economical, both in erecting and repairing, has been, for a long time, a desideratum of great importance to a country so extensive, and interspersed with so many wild and majestic rivers as ours is. It has been too much the custom for architects and builders to pile together materials, each according to his own ideas of the scientific principles and practice of Bridge-building, and the result has been, 1st. That nearly as many modes of construction have been adopted as there have been bridges built. 2d. That many have answered no purpose at all, and others but very poorly and for a short time, while most of the best ones have cost a sum which deters and puts it out of the power of probably five-sixths of those interested in ferries, to substitute bridges, which would obviate the many dangers and delays incident to them.

That architects and builders adhere to their own ideas in the construction of not only bridges, but of buildings, is almost universally true; they are obstinately opposed to the adoption of any other mode than their own, consequently it is as true, and it is seen to be so, throughout the country, (and it is much to be regretted,) that in very few instances, either in erecting bridges or buildings, there is any model either uniform, or, in general, very good. But in bridges and public buildings, it would seem, something better might be expected, if men scientifically and practically acquainted with such subjects, would step forward, in a disinterested manner, and determine between principles which are philosophical, and those which are not, and between modes of execution which are founded in practice and experience, and those which are founded in ignorance and inexperience; and in matters of taste, if they would determine in favour of classic and well established taste, and that which is the offspring of unimproved minds and whimsical fancies, which are ever upon the rack to establish new things, the creation of their own imaginations; and which are therefore sure to be wrong for this good reason, that their authors are so.

Perhaps the following proposition comprises what is the most important to be determined with regard to a general system of Bridge-Building, viz.

By what construction or arrangement will the least quantity of materials, and cost of labor, erect a bridge of any practicable span or opening between piers or abutments, to be the strongest and most permanent, and to admit of the easiest repair?

In giving the best answer to this proposition, which I am capable of, after a number of years' attention to the theory and practice of this subject, I shall refer to the plates accompanying this article. The mode of construction is so simple and plain to inspection, as to require little explanation of them.

Figure 1, is an elevation of one of the trusses of a bridge; one, two, or three of those trusses placed vertically upon piers, are to be considered as the support of the bridge, and are to be of a height, at least, sufficient to admit a waggon to pass under the upper beams, which lie horizontally upon the top string-piece of the side trusses; and on these same side-string-pieces rest the feet of rafters, which form a roof to shingle upon. In this case, a middle truss is used, which will always be necessary in bridges of considerable width; the height of it will be as much greater than the side ones as the height or pitch of the roof. The height of the trusses must be equal to the whole height of the bridge required, and is to be an exact continuation of the work represented in Fig. 1.

The height of the trusses is to be proportioned to the width of the openings between the piers or abutments, and may be about one-tenth of the openings, when the piers are fifteen feet or more apart—a less span requiring about the same height, for the reasons before stated.

The diagonal bearing of these trusses, is composed of sawed plank ten or eleven inches wide, and from three to three and a half inches thick; it may be sawed from any timber that will last well, when kept dry. White pine and spruce are probably the best kinds of timber for the purpose, on account of their lightness, and their not being so subject to spring or warp as white oak.

The nearer those braces are placed to each other, the more strength will the truss have, and in no case are they to be halved or gained, where they intersect each other; but they are to stand in close contact, depending entirely on three or four trunnels, which go through each joint or intersection, and where the string-pieces pass over these joints the trunnels go through them also, and are each of them wedged at each end to keep the timber in close contact; a chain or clamp is necessary to bring the work tight together.

The trunnels may be made of white oak, one and a half inches in diameter. They are made very cheaply and excellently, by being rived out square, and driven, while green or wet, through a tube fitted to a block and ground to an edge at the top end; they are then to be seasoned before they are used.

The string-pieces are composed of two thicknesses of plank, of about the same dimensions as the braces, and they are so put together as to break joints as shewn at Fig. 6. This renders long hewn timber unnecessary, as also any labor in making splices, and putting on iron work.

For any span or opening not exceeding one hundred and thirty feet, one string-piece at top and one at bottom of each truss, if of a good proportion and well secured, will be sufficient, (see Fig. 2.;) but as the span is extended beyond one hundred and thirty feet, two or more at top and bottom would be required as shown in Fig. 1 where two string-pieces run over the two upper and lower series of joints or intersections of the braces, and in wide spans the floor-beams may be placed on the second string-piece as shown at Fig. 1.

Fig. 3, shows on a larger scale how each joint is secured, by which it is seen that the trunnels take hold of the whole thickness of each piece.

Fig. 4, is a section of a bridge of this construction, and shows the manner in which the braces and string-pieces come together, and also the manner of making the floor of the bridge, and of putting beams and braces over head, which are to be connected with the middle truss for the purpose of bracing the bridge against lateral rack or motion. Very flat pitched roofs will be preferable, as it will, in that case, be a greater support to the upper part of the bridge.

Fig. 5, is the floor or plan of the bridge, showing the mode of bracing and the floor-joist.

Fig. 6, is a view of the bottom or top edge of the string-pieces, and shows how the joints are broke in using the plank, and also how the trunnels are distributed.

This mode of construction will have the same advantages in iron as in wood, and some in cast-iron which wood has not, viz. that of reducing the braces in size between the joints and of casting flaunches to them where they intersect, thereby making it unnecessary to have more than one bolt and nut to each joint or intersection.

When it is considered that bridges, covered from the weather, will last seven or eight times as long as those not covered, and that the cheapness of this mode will admit of its being generally adopted, with openings or spans between piers composed of piles, and at a distance of one hundred and twenty to one hundred and sixty feet apart, then the construction of long bridges over mud bottomed rivers, like those at Washington, Boston, Norfolk, Charleston, &c. will be perceived to be of great importance, especially as the common mode of piling is so exposed to freshets, uncommon tides, drift-wood, and ice, as not to insure safety or economy in covering them, and consequently continual repairs, and often rebuilding them, become necessary. There is very little, if any, doubt, that one half of the expense, computing stock, and interest, that would be required to keep up, for one hundred years, one of the common pile bridges, like those at Boston, would be sufficient to maintain one built in this new mode, keep it covered, and have all or nearly all the piers built with stone at the end of the one hundred years. If this be the case, it would be great economy to commence rebuilding, by degrees, in this manner. The saving, in the one article of floor planks, if kept dry, would be very great, as by being so much wet they rot and wear out in about half the time.

For aqueduct bridges of wood or iron no other mode can be as cheap or answer as well; this mode has equal advantages also in supporting wide roofs of buildings, centres of wide arches in masonry, trussed floorings, partitions, sides of wood towers, steeples, &c. &c. of public buildings, as it requires nothing more than common planks instead of long timber—being much cheaper, easier to raise, less subject to wet or dry-rot, and requiring no iron work.

Some of the advantages of constructing bridges according to this mode are the following:

1. There is no pressure against abutments or piers, as arched bridges have, and consequently perpendicular supports only, are necessary; this saving in wide arches is very great, sometimes equal to a third part of the whole expense of the bridge.

2. The shrinking of timber has little or no effect as the strain upon each plank of the trusses, both of the braces and string-pieces, is an end-grain strain or lengthwise of the wood.

3. Suitable timber can be easily procured and sawed at common mills, as it requires no large or long timber—defects in timber may be discovered, and wet and dry rot prevented much more easily than could be in large timber.

4. There is no iron work required, which at best is not safe, especially in frosty weather.

5. It has less motion than is common in bridges, and which is so injurious and frequently fatal to bridges—and being in a horizontal line, is much less operated upon by winds.

6. A level road-way is among the most important advantages of this mode of construction.

7. The side-trusses serve as a frame to cover upon, and thereby save any extra weight of timber, except the covering itself—and the importance and economy of covering bridges from the weather, is too well understood to need recommendation after the experience which this country has already had.

8. Draws for shipping to pass through, may with perfect safety be introduced in any part of the bridge, without weakening it as in arched bridges, where the strength and safetyof the arches depend so much on their pressure against each other and abutments, that a draw, by destroying the connexion, weakens the whole superstructure.

9. The great number of nearly equal parts or joints into which the strain, occasioned by a great weight upon the bridge, is divided, is a very important advantage over any

other mode, as by dividing the strain or stress into so many parts, that what falls upon any one part or joint is easily sustained by it without either the mode of securing the joints, or the strength of the material being insufficient.

10. The expense of the superstructure of a bridge would not be more than from one-half to two-thirds of other modes of constructing one over the same span or opening; this is a very important consideration, especially in the southern and western States, where there are many wide rivers, and a very scattered population to defray the expenses of bridges.

11. This mode of securing the braces by so many trunnels, gives them much more strength when they are in tension-strain than could be had in the common mode of securing them by means of tennons and mortices, for tennons being short, and not very thick, compared with this mode, nor having so much hold of the pins or trunnels as in this case, will, of course, have much less power to sustain a tension or pulling strain, and it is obvious that this strain is in many cases equal to, and in others greater than, the thrust or pushing strain. It is also very obvious, that this pushing or thrust strain in the mode of tennons and mortices receives very little additional strength from the shoulders of the tennons, as the shrinkage of the timber into which the tennon goes, is generally so much as to let the work settle so far as to give a motion or vibration, which, in time, renders them weak and insufficient.

12. Should any kind of arched bridge, for any reason, be preferred, however it may be arched either at top or bottom, or both, still this same mode of combining the materials, will have all the advantages as to cheapness and strength, over the common ones of framing, as in case of the horizontal or straight ones before described. In cases where abutments are already built, it may sometimes be preferred.

Side-walks may with equal ease be constructed, either on the outside or inside of the main body of the bridge, which particular, as also the great strength of the mode, &c. may be better seen by examination of the models which are (or soon will be) placed in most of the principal cities of the United States, and no merit is either desired or claimed in this new mode of construction, by the patentee, which the mode itself does not command, even on the most strict philosophical investigation as to its mathematical principles, the easy, practicable, and advantageous application of materials, the advantages it possesses in mechanical execution, and its simplicity, strength, economy, and durability, as a general and uniform mode of Bridge-building.

Science and practice will, in a short time, decide on this question so important to this extensive country.

I shall conclude this article by a few ideas, taken from the celebrated Robert Fulton's treatise on canal navigation, page 117, and subsequent pages.

In England, the attention of engineers has of late years been much engaged on bridges of iron. These bridges, as experience produces courage, are progressively enlarging their dimensions, nor should I be surprised if genius should in time, produce the mechanic rainbow of one thousand feet over wide and rapid rivers. In crossing the rivers in such countries as Russia and America, an extensive arch seems to be a consideration of the first importance, as the rivers or even rivulets, in time of rain, suddenly swell to a great height, and in the spring, on breaking up of the ice, the immense quantity which is borne down with a rapid stream would, if interrupted by small arches and piers, collect to such a weight as ultimately to bear away the whole. It is therefore necessary that, in such situations, an arch should be extended as far as possible, and so high as to suffer every thing to pass through, or the inhabitants must, without some other expedient, submit their passage to the casualities of the weather.

The important objection to bridges of wood is their rapid decay, and this objection is certainly well founded when particular situations are alluded to where timber is scarce and consequently expensive. But in such countries as America where wood is abundant, I conceive it will be a fair criterion to judge of their application by calculating on the expense of a bridge of stone, and one of wood, and then compare the interest of the principal saved in adopting the wood bridge, with the expense of its annual repairs.

I have before exhibited the necessity of constructing bridges in America of an extensive span or arch, in order to suffer the ice and collected waters to pass without interruption: and for this purpose it must be observed that a wood arch may be formed of a much greater length or span than it is possible to erect one of stone; hence wooden bridges are applicable to many situations where accumulated waters bearing down trees and fields of ice, would tear a bridge of stone from its foundation.

It therefore becomes of importance to render bridges of wood as permanent as the nature of the material will admit.

Hitherto, in bridges not covered from the weather, the immense quantity of mortices and tenons, which, however well done, will admit air and wet, and consequently tend to expedite the decay of the weak parts, has been a material error in constructing bridges of wood.

But to render wood bridges of much more importance than they have hitherto been considered, first from their extensive span; secondly from their durability; two things must be considered, first that the wood works should stand clear of the stream in every part, by which it never would have any other weight to sustain than that of the usual carriages, secondly that it will be so combined as to exclude as much as possible the air and rain.

When the true principle of building bridges of wood is discovered, their progressive extension is as reasonable as the increased dimensions of shipping; which, in early ages, was deemed a great work if they amounted to one hundred tons burthen; but time and experience have extended the art of ship-building to two thousand tons, and in the combination and arrangement of the various and complicated parts, there certainly is more genius and labour required than in erecting a bridge of five hundred or one thousand feet span: but the great demand for shipping has rendered their formation familiar, and their increased bulk has gradually grown upon our senses. But had a man, in the infancy of naval architecture, hinted at a vessel of two thousand tons, I am inclined to think his cotemporary artists would have branded him as a madman.

Note.

Those who wish to purchase rights, and to obtain particular directions for building bridges according to this improvement, (the description of which is annexed,) will please to write to me at the City of Washington in the District of Columbia, where myself or an agent will at all times attend promptly to the business.

ITHIEL TOWN.

Art. XXII.—*On the Staining of Wood, and on Medical Electricity; by* John Hall, *Esq. of Ellington, Conn. Communicated in a letter to the Editor, dated May 30th,* 1820.

Dear Sir,

When I closed the letter which accompanies this, I forgot to mention *a stain*, as cabinet-makers would call it, for some sorts of wood used in the making of cabinet furniture. This *stain* consists simply of a decoction of walnut or hickory bark, with a small quantity of alum dissolved in it, in order to give permanency to the color. Wood, of a white color, receives from the application of this liquor, a beautiful yellow tinge, very little liable to fade. Indeed, so far as I have ascertained the fact by several experiments, the color does not appear to fade *at all;* and I have good reason to think that it will abide until it is *worn off.* So far as I have tried the experiment, the color retains its proper state, when not defended at all from the action of the light and the air; when protected by varnish, it will, of course, be still less liable to change. I have in my house an article of furniture stained in this manner, which has stood exposed to the near light of a window fifteen months, and the color appears at this time, if *any* change has taken place, even brighter than at first.

This stain is particularly adapted to several kinds of furniture which are commonly made of *maple.* It gives a beautiful and delicate tinge to the high posts of bedsteads, when made of that kind of maple which is called *curly* or *curled.* But to that kind of maple which is called *birds-eye*, it gives the finest appearance of any. This species of wood is commonly prepared, by cabinet-makers, by scorching its surface over a quick fire, which does not, at the same time, smoke. The wood, after being thus scorched, is made smooth in the usual way, and varnished. The scorching produces a great variety of dark shades and specks on the surface; these have generally been considered to possess considerable beauty, and the wood, so prepared, has come into pretty extensive use in the making of particular sorts of cabinet furniture. When birds-eye maple is thus prepared, except the varnishing, if it is then stained with the walnut dye, it receives much additional beauty. In the common mode of preparing that wood, the colors are *black*, of various shades and degrees of intenseness; and that kind of white, though somewhat tarnished, which is natural to maple. These colors are destitute of any other lustre than what the varnish merely gives them. But the application of the walnut dye gives a lustre even to the darkest shades; while to the paler and fainter ones it gives, in addition to this, a somewhat greenish hue; and to the whiter parts, various tints of yellow. The whole, together, has a very pleasing effect on the eye, and is very ornamental when used, with taste and judgment, in particular parts of some kinds of furniture. For *pannel* work, the yellow stain alone, without the previous scorching, has a very delicate and pleasing appearance. Both modes of staining give the wood very much the appearance of figured satin; and, for particular purposes, are altogether superior, in their effect, to mahogany. Such, at any rate, is my own opinion; and such, too, is that of all who have received specimens of work done in this manner.

In staining cherry wood, cabinet-makers generally employ some kind of red paint, rubbed in small quantity into the wood. This paint fills up the pores of the wood, and by that means conceals the natural *grain*. This concealment of the grain, causes the surface to look as if painted, and greatly detracts from the beauty of it. When this species of wood is stained with the walnut liquor, and reddened somewhat with a tincture of some red dye whose color is not liable to fade, a handsome tinge is given to it, which does not hide the grain; and which becomes still more handsome as the cherry itself grows darker by age. The effect of the compound stain on apple tree wood, is the same as that on cherry.

Walnut bark makes the most permanent yellow for dying cloth, of any of the vegetable substances used in this country for that purpose, with which I am acquainted. Care should be taken that the dye be not too much concentrated; when this happens, the color is far less bright and delicate; and approaches nearer to orange. It is hardly necessary to add, that the dye should be boiled, and kept, in a brass, or some other vessel into the composition of which *iron* does not enter.

On Medical Electricity.

Since I have taken upon me to write, I will add something on another subject. Soon after the general properties of electricity were discovered, and attention to them had become fashionable, it was suspected to possess medical virtues of great value, and of extraordinary character. Essays to prove those virtues were accordingly made, and with exactly the success which might have been anticipated from the peculiar character of the electric fluid, and the peculiar propensity of mankind to form, in the first instance, high-wrought expectations from something new and striking to the senses; and then to vibrate to the opposite extreme, so soon as the novelty is lost in habitual contemplation, and those senses are cloyed with repeated gratification, or disgusted with disappointment. For a while, it was believed by many, that electricity would have the same efficacy in the cure of all diseases, as the inventors of nostrums assert that their preparations possess. After this, public opinion changed; and now, for a good while, little reliance has been placed on the medical properties of the electric fluid in any case. As the truth, however, is oftener found to lie between extremes, so, I apprehend, it will be found in the present instance. That electricity does actually possess *some* valuable medical properties, I deem to be certain; and cannot but regret that trial of them is not oftener, but more judiciously made. I deem it to be equally certain, that these properties have, in a great measure, failed of proper credit, because electricity has been too exclusively applied to patients by *way of shocks*. Had it oftener been used by way of *insulating* the patient, and then extracting the fluid from the diseased part by moving a metallic or other conductor, frequently over it, I have no doubt that its application would have oftener been attended with success. But I do not intend to write a treatise—I barely give these hints; and will now state one class of diseases, in which I have found, by repeated experiments, beneficial effects to result from the use of electricity *by way of insulation.*

The kind of complaints to which I allude, is that peculiar soreness and pain which result from what we commonly call, *the taking of cold.* This soreness and pain, we all know, are often very troublesome, and difficult to be removed; and are usually seated in the joints, in the head, and muscular parts of the body. They are very common in cases of influenza, and very troublesome. I have tried insulation, in the manner just stated, on several persons affected with these complaints, and do not recollect that it ever has, in a single instance, failed of giving speedy relief. In every instance, I believe, the *pain and soreness* have been completely removed. The cough and expectoration still continue, but have generally subsided soon, and seem to yield more readily to the medicines commonly given for these complaints. Perspiration at once becomes more free, and the breathing less obstructed. These facts have been known to me for a considerable number of years; but such have been the general prejudice against the efficacy of electricity, on the one hand, and the inflated encomiums on its virtues made by empirics on the other, that I have seldom ever suggested them even to my friends. I however consider it my duty now to do so; and hope that the suggestion may contribute to the relief of some, at least, who may hereafter be afflicted with these complaints. In cases of influenza this relief is often of great importance; and it is to these cases, in a special manner, that the remedy seems to be adapted.—I have never yet known, and I have often made the experiment, that electricity has proved beneficial in *nervous* diseases; unless spasms, of certain kinds, are considered as properly belonging to that class. In *some* spasmodic affections, I have seen essential benefit result from electricity. What effect this fluid may have on pain and soreness, arising from other causes than the taking of cold, and that, whatever it is, which produces influenza, I am unable to say. It is proper that I should state further, that notwithstanding I have often made the experiment, I have never known the least benefit to result from giving electric *shocks* in any case whatever. Still I by no means intend to deny that shocks *may* be useful in certain diseases.

ART. XXIII.—*On Gas Lights. Communicated in a letter to the Editor, by* THOMAS JARMAN, *Esq. of Bristol, England.**

State-Street, New-Haven, 2d Jan. 1821.

My Dear Sir,

As you seemed to think the facts I mentioned to you this morning, worthy of notice, I beg leave to state them in writing.

The streets of the city of Bristol, in which I reside, were lighted with lamp oil till about two years ago, when a few persons united in forming a company for supplying the city with gas from pit-coal: I was one of that company; and we deemed it expedient to obtain an Act of Parliament for the protection of our property, and recovery of the annual income to be derived from the sale of our gas. In this we were opposed by the Corporation of the city, and the Commissioners for paving and lighting it; but they at length withdrew their opposition, on our agreeing to light the streets of the city with as many lamps as they chose at the rate of £5 per lamp, per annum; each lamp to have such a burner in it as would consume a certain quantity of gas per hour; and we were to be limited to a profit of ten per cent. on our capital employed; we engaging to employ at least £50,000 in the undertaking: that sum was immediately subscribed; and we accordingly sell our gas to the public at £5 per lamp per annum; and to individuals at various prices, differing according to circumstances, and to the demands made for it. To give you an instance:—I have a house in the city where my professional business† is carried on, and in which I use six rooms, and an entrance hall; the gas is conveyed into each of these places by pipes from the main pipe in the street; and I burn the gas till ten o'clock at night, for £25 a year: this is nearly about what

* In consequence of his having been present at a Chemical Lecture, in the Laboratory of Yale College, when Gas Lights were spoken of and exhibited—Mr. Jarman being on a visit to this country.

† That of a solicitor.

it cost me for candles before; but I have an unvarying and brilliant light in every room, without any trouble but the turning of a key. All the offices and shops (or stores) in Bristol, of any respectability, purchase the light in the same way, and from hence the profits arise. It is intended, however, to sell the gas by measure; as some abuses have crept in by individuals burning the gas longer than they contract for: a *Gas-Meter* has been invented, which, placed at the entrance into the house, ascertains the quantity of gas used. It is a box containing a wheel, which revolves more or less in proportion to the gas driven through it, and when it has made a certain number of revolutions, moves an index, which ascertains the number; and is so constructed that it cannot be altered to deceive the proprietors. Most of the churches, and other public buildings, take the light at various prices, proportioned to the time in which they use it; and the streets through which it already passes, are as light throughout the night, as in broad day. The Gasometer and other works are near the entrance into the city. I need not describe them to you, as you so perfectly understand them, and gave so accurate a description of them this morning as surprised me; you having only seen the very limited, *commencement* of the gas works in London, when you were there.* I had the honor of being Chairman of the committee appointed by the Company for conducting the Bill through the Houses of Lords and Commons; and while I was in London had great satisfaction in seeing the progress of the gas-manufactories there: all the principal streets are lighted by gas—so are most of the public buildings, and particularly the theatres; these latter have gasometers of their own; and the light produced is the most brilliant that can be imagined; the centre-light in Drury-lane theatre, passing through an immense number of cut glass lamps, arranged with great taste and elegance, resembles the light of a mid-day sun in splendour, and is too dazzling to look on. The light thrown on the stage from the orchestra is also very beautiful, and admirably managed. But there is a more important use made of gas, both in London, and other great cities; Manufactories are lighted with it, and carried on at a much less expense than before.

* In 1805.

A friend of mine works his glass manufactory by it through the nights of winter, and has a gasometer of his own. One of the taverns in Bristol is lighted by its own gasometer; and most of the coffee-houses in London are lighted by the public gas. At first, the management of the pipes and keys not being well understood, an offensive smell used to be produced; but now it is very seldom found; the purifying of the gas, by passing it through lime-water, is general; but a person at Exeter in Devonshire has obtained a patent for purifying gas, by passing it through lime unmixed with water, as I understand: it is said to be placed on perforated shelves in a receiver, through which the gas is made to pass in its way from the furnaces to the gasometer; and this is said to be a much more effectual way of removing the offensive smell than by passing it through lime water; but we have not tried it at Bristol.

I forgot to mention to you that the charcoal and tar, produced from the coal at the works, are profitable to us, and help to make up our ten per cent. I should also mention, that any surplus profit is to be applied to the reduction of the price for lighting the public lamps, as a remuneration to the public for permitting us to carry our mains (i. e. our main-pipes) through the streets.

No accident has ever happened in Bristol since the works began; except that one evening an unlucky mouse got into the first pipe, and by moving a valve, prevented the gas from passing into the mains, and consequently all the lamps went out, and the city was in darkness for half an hour; but it happened to be early in the evening and not very dark; and a repetition of the accident is now effectually prevented.

Bath, Cheltenham, and many other towns, are now lighted by gas. I believe fifty or sixty acts of Parliament have passed incorporating companies for this purpose; and when the committee waited on Lord Grenville (who is our Lord High Steward) for his support in the house of Lords, he told us he had no doubt the use of gas would be universal; he recommended us to visit a manufactory lighted by gas produced from oil, which he thought more beautiful than that produced from coal; and it certainly did appear to be more brilliant; but we have coal in abundance, and not oil. The coal we use is the small brush coal, such as smiths use, and it is cheaper than the other pit-coals.

I have now, I believe, repeated to you the principal facts I mentioned this morning. If they afford you any amusement I shall be highly gratified.

I am, dear Sir,

Your obliged and obedient friend and servant,

THOMAS JARMAN.

Art. XXIV.—*Notice of an argentiferous galena, from Huntington, and of another Lead Ore from Bethlem, Conn. with miscellaneous observations on Lead Ores—the latter extracted chiefly from authors.*—Editor.

The localities of galena, within the territory of the United States are very numerous.

We have published but a very small part, of those that have come to our knowledge, chiefly because the quantities discovered, have been in most instances, too small to make it an object to prosecute the research; and still, when we remember that the first hint of the existence of a valuable mine *may* arise from the occurrence of a minute quantity of ore, it is obvious that all such facts ought to be preserved, either in public or private documents.

In Dr. Bruce's Journal, (pa. 65,) some account is given of the valuable and interesting lead mines near Northampton in Massachusetts, and, in the present number of this work, an abstract is given of some of the principal facts stated by Mr. Schoolcraft, respecting the rich mines of Missouri. These mines, from their richness, and from the facility with which the ore is obtained, it is probable, will supply the demands of this country, for ages, and if they cannot entirely exclude the introduction of foreign lead, there appears little probability that many other American lead mines can enter successfully into competition with them.

We make this remark, not to discourage enterprize in other places, but to produce caution, in plunging into the heavy expenditures which inevitably attend mining operations—while the returns are always in a degree uncertain.

But, with respect to the poorer localities of lead, there is another consideration which may be worthy of attention; it is a well known fact that most galenas contain silver; of course, most of the metallic lead of commerce contains it. Among a considerable number of American ores of lead, which we have examined by chemical means, we have found *only one*, entirely without silver; this was the lead ore which is found near Shawnee Town, in the Illinois, along with fluor spar.

We have extracted silver from the thin sheet lead, which comes as a lining for the tea chests from China.

In most instances, whether in the case of ores, or of metallic lead, the proportion of silver obtained by us has been too small to admit of profitable extraction, but we have now the pleasure of stating an instance of a contrary character.

We have had occasion, more than once, to call the attention of our readers to the mine of Mr. Ephraim Lane, situated in the town* of Huntington, eighteen miles west of New-Haven.

The great diversity, especially of metallic substances, in this place, indicates a mining region, although it is difficult to say which of the numerous metals found there, will ultimately be the prevailing one, either in quantity or in value.

It will be recollected, that the excavation is very slight, having as yet, scarcely exceeded ten or twelve feet.

Galena has been constantly found, but in quantities too small for profit, if the lead alone were regarded. This galena is not the steel grained kind; it is the foliated—in plates of moderate size, usually not exceeding one-quarter or one-half of an inch in diameter. It is interspersed in a quartz gangue, and is obtained, as yet, with difficulty.

The occurrence of native silver some time since in the same mine, and indeed almost in contact with the lead, might well have raised an enquiry, whether this galena were not peculiarly argentiferous. On examination, this proves to be the fact.

* For the sake of foreign readers we will observe, that the word town is often used, in the northern and middle states, as a *territorial* term, meaning a certain *geographical area*, (usually six miles square,) often expressed also by the word township, and although it usually contains, within the territory, *a town* in the European sense of the word, it does not, *necessarily* imply such a nucleus of houses and population, both being sometimes scattered over the whole surface.

In order to extricate from it, a striking quantity of silver, it is not even necessary to reduce the sulphuret of lead to the metallic state. It is sufficient merely to lay some fragments of the lead *ore* upon a cupel, and to place this upon a fragment of a brick in the forge fire. This simple method of operating we learned from the proprietor, Mr. Lane, and repeated the experiment with entire success. The cupel is surrounded by ignited charcoal, and some pieces of burning coal are laid *in an arched form*, over the cupel, so as to preserve, at once, a good red heat, and to admit of the access of air. The forge bellows are very gently blown by an assistant, and, at the same time, a blast of uncontaminated air, from common hand bellows, is thrown upon the lead ore, in such regulated quantity, as to oxidize the lead, without cooling it too much, and the sulphur is in the mean time dissipated.

By proceeding in this manner, we obtained in a short time, *two per cent.* of good silver, estimated in relation to the *metallic* lead contained in the ore.

In another operation, after previously reducing the ore to the metallic state, and proceeding in exactly the same manner, we obtained *three and a half per cent.* of good malleable silver.

There is no reason to believe that these processes were conducted with more accuracy, than is attainable in the large way, and we are therefore justified in concluding, that Mr. Lane's lead ore is rich in silver, and is worthy of being explored for that object.

It was our intention to have given the result upon this ore in the humid way, and we had obtained the nitric solution, and, by the aid of common salt, precipitated both the lead and the silver in the form of muriat; the muriat of lead was then dissolved in boiling water, and the muriat of silver obtained upon a filter. But as we have not found leisure to complete the process; it must be reserved for another occasion. We think however that there can be no mistake in admitting that the lead in this ore contains one-thirtieth of silver,* and is therefore one of the richest argentiferous galenas.

We have been called upon to examine another lead ore, from Bethlem in Connecticut, about thirty miles N. W. from New-Haven.

* Mr. Lane's ore is accompanied by sulphat of lead, as an incrustation; according to him this is equally rich in silver.

It was discovered during the late autumn, in digging a well, and appeared to form a vein, or possibly a bed, at the depth of eighteen or twenty feet.

The country is primitive, but the specimens brought to us, appear to have been deposited in loose ochreous earth, by which they are enveloped.

The structure of this ore is a mixture of small foliated, granular, or steel grained, and fibrous; in some places it is so distinctly fibrous, as to indicate strongly a combination with antimony.*

Having reduced this ore to the metallic state, we examined it by cupellation, and obtained a distinct globule of silver, but it bore only the proportion of one-five thousandth part to the lead—viz. less than six ounces to the ton.

That of Southampton, (Bruce's Journal, pa. 69,) gave twelve ounces and one-eighth to the ton, viz. about one-two thousand four hundredth part; that of Missouri contains only a trace.

As this is a practical subject, which may prove of importance to this country, especially as the oxides of lead obtained during the extraction of the silver would go far towards paying the expense, we will subjoin a memorandum of facts respecting lead and its ores, which, in a very condensed form, we had occasion, some time since, to abstract from works of good authority, principally from the Chemical Essays of Dr. Watson, late Lord Bishop of Landaff, and from Aikin's Dictionary.

Notes on Lead.

The expense is not paid, in Great Britain, by less than twelve ounces of silver to the ton, or six-tenths of an ounce to one hundred pounds of ore; some say nine ounces of silver to the ton of ore, will pay the expense, including loss of lead.

The ore of Brunghill Moor, Yorkshire, contained two hundred and thirty ounces of silver to the ton, or more than eleven ounces to one hundred pounds.

Durham and Westmoreland, seventeen ounces to a ton.

* The Bethlem ore is said by the discoverers, Messrs. Gideon Allen and Abner Strong, to be in abundance, but as their attention has been directed to it principally on account of the silver it *might* contain, they have not, as yet, explored thoroughly for the lead.

That of POULLAEN in Brittany thirty-nine ounces.

Lead ore is dressed, washed, stamped, and roasted in a reverberatory.

In Derbyshire a ton of ore is put at once into the furnace.

Two thousand one hundred pounds of ore do not yield more than one thousand four hundred pounds of lead, or sixty-six per cent.

Three tons or six thousand pounds of ore are worked off at a smelting house every twenty-four hours.

Lead ore melted by a wood fire, yields one-tenth more lead than by pit-coal. (Watson III. 253.)

The cupola furnace is in general use for the smelting of lead ores in Derbyshire; (See Watson, III. 275,) it is a reverbaratory; this furnace may be constructed any where, and is not noxious to the workmen.

One ton is put in at a time, and three charges worked off in twenty-four hours; in six hours from the charging of the furnace the ore becomes fluid as milk; a bushel of lime is thrown in to absorb the slag, which is then raked to one side; a hole, previously stopped with clay is opened, and the reduced metal runs out.

By fusing the lead ore too soon, and raising the heat too high, much of the lead is volatilized, along with the sulphur.

Derbyshire lead is said to contain two grains of silver in a pound of lead.

Mine Est Kyr-Kyr, is asserted by some, to afford sixty pounds of silver in every ton of lead ore; by others only four.

There are some lead ores in Great Britain, which, although poor in lead, contain between three and four hundred ounces of silver in a ton.

The best kind of Derbyshire lead ore is worth £7 a ton. (Wat. III. 310.)

Steel grained lead ore is asserted to be much richer in silver than other kinds.*

There is no place in Derbyshire where silver is now extracted from lead.

It was done at Matlock a few years since, but is now abandoned, from the failure of the lead ore;—it yielded fourteen ounces to a ton.

* See the remarks on this subject, pa. 69, of the present Number.

At Patterdale, the ore yields fifty or sixty ounces of silver to a ton.

The poorest lead ores yield most silver.

From seven to ten thousand tons of lead are smelted annually in Derbyshire.

The tests or cupels are made of four parts of calcined bones, and one part unwashed fern ashes; wood ashes are sometimes used without washing.

If galena be free from pyrites the lead may be melted out without roasting, otherwise not. (Bl. II. 620.)

One-eighth of an ounce, or less, of gold or silver may be separated from one hundred pounds of lead by scorification.

The lead is recovered from the cupels by pounding them up, and mixing the powder with inflammable matters by the aid of heat.

Fourcroy (VI. 74) asserts that *every* sulphuret of lead contains silver; we believe very few are without it.

Galena, with small facets, or of a granulated texture, is apt to contain most silver; but this is, in our view, not an infallible criterion.

Fourcroy (VI. 82) gives the following process. Roast the ore, weigh, and fuse with two parts of black flux, or borax and charcoal and a little decrepitated salt, and try the button on the cupel, (pa. 84,) after the nitric solution is made, precipitate it by carbonat of soda, one hundred and thirty parts of the carbonat of lead contain one hundred of lead—ammonia dissolves out the silver,* but cupellation is best.

Iron precipitates both lead and silver. (Fourcroy.)

The proportion of silver in lead, varies from one-three hundreth to one-twelth.

The lustre of galena is impaired by silver; this metal is more commonly found in the octohedral than the cubical varieties.

Blende and calamine often occur with galena.

Antimony is commonly in argentiferous lead ores, which hardens the lead; and the processes for getting rid of the antimony are the same as for extracting the silver.

Cupels may be made of any infusible earth of little cohesion, (Aikin, I. 110,)—cores of ox horns are preferred at the tower.

* This *may* however be dangerous, as fulminating silver *may* be formed.

Analysis.

Galena, when pure, has the proportion of eighty-five lead, and fifteen sulphur; but five particular specimens gave the following more complex results:

Lead	54	69	68	64	63
Sulphur	8	16	16	18	12
Carbonat of lime and silex	38	15	16	18	19
	96	100	100	100	94

Pyrites are frequent in lead ores, and sometimes antimony, copper, gold, and silver.

Art. XXV.—*Circumstances connected with the formation of Ice on still waters, and with the continued action of cold upon the fluid beneath.*—Editor.

New-Haven, Jan. 12, 1821.

The recent cold weather, which, with an *uniformity* not common in this *maritime* region, has prevailed with little interruption, for nearly a month, varying between 3°* below 0, and ten or twelve above—(for the coldest parts of the twenty-four hours) has produced on our mill ponds ice of fifteen inches in thickness. This ice is remarkably firm and transparent, entirely free from intermixture of spongy portions, and resembles, very much, fine masses of rock crystal, with a slight cerulean tinge.

* This is not mentioned as the extreme cold of this climate, but only as the extreme hitherto observed by us, this winter; this occurred at eleven P. M. on the 10th inst. We have the mercury in Fahrenheit's thermometer, occasionally depressed here to 10° and 12° below 0.

P. S. Jan. 20. Since the above note was written, the thermometer has here (just before sun-rising on the 19th) indicated 12° below 0. In the interior it has been much lower, and in Maine, as the newspapers inform us, it has been 35° below 0, thus approximating to the congelation of the quicksilver. At Norwich, Conn. it has been 26° below 0.

Jan. 25. Yesterday the thermometer sunk 5° from sun-rising till ten o'clock, and was then about 0, and remained very little above through the day, although the sun shone bright; several times this winter, the maximum of cold has been several hours after sun-rising. This morning, at seven o'clock, the thermometer was 14° below—and at eleven last evening, it was 9° below 0. In other exposures it was, in the morning 16°, and even, in one instance, 17½° below 0—all these being greater degrees of cold than were ever observed here before: and the average of the winter, thus far, is colder than that of any preceding winter on record here. Still there have been particular days, whose average has been colder. On the 25th, it was 2 o'clock P. M. before the mercury rose to 0, and at 3 o'clock it was 2° above.

The filling of the ice-houses (which, within a few years, have become considerably numerous in this town,) has afforded good opportunities of observing some small circumstances, the mention of which may not be superfluous, although, perhaps, not entirely novel.

The first thing to be noticed is the regularity of the layers of ice produced by each night's congelation. In masses fifteen inches thick,* there are twenty-one distinct layers—quite as distinct as those of agate, or striped jasper, or of the annual rings produced by the growth of wood. These layers, near, and at the top, are from one and a half to two inches thick, and at the bottom, next the stream, they are from one-half to one quarter of an inch—giving an average of nearly three-quarters of an inch. Although, (owing doubtless to the different degrees of cold, in different nights,) the layers of ice do not decrease in an uniform ratio; their decrement is still tolerably regular, and when we compare the extremes (granting that the cold was not diminished, and the truth was it was rather increased on the whole,) we are struck with the wide difference, and, of course, with the almost non-conducting power of ice in relation to heat.

This is one provision, amongothers, made by the creator, to prevent very deep congelation, which would be attended with deplorable consequences. Had the accumulation of ice, in the present instance, gone on uniformly, in the highest ratio, the ice would, during these twenty-one nights have been forty-two inches, or three feet six inches thick, and during eight weeks or fifty-six days of such severe weather, it would have become 112 inches, or nine feet four inches thick, which would insure winter's cold, and consequent sterility, in the vicinity of that ice during the next summer; (for the heat would not be sufficient for its fusion,) and consequently perpetual cold would be established; the succeeding winter, and *all* succeeding winters, would only augment the effects.

It is now a good while, since Count Rumford pointed out the most important reason which prevents the entire congelation of deep waters in winter,—namely, that water cooled to 40° begins to expand, and continues to do so, thus be-

* Jan. 30. The cakes of ice are now twenty one inches thick, but still, although the recent cold has been much the most severe, the lower layers of ice are only from $\frac{1}{4}$ to $\frac{3}{8}$ths of an inch thick.

coming so light as to remain on the surface, till it freezes at 32°; of course, the upper layer freezes, while those below are still above the freezing point, and are now cooled almost solely by the very slow conducting power of ice and water—the currents of cold water down, and of warmer water up, by which almost exclusively the water was cooled, before it arrived at 40°, being in a great measure prevented, after the first film of ice is formed on the surface.

Mankind are little aware how much they are indebted to such *apparently trivial* laws for their comfort, and indeed for their very existence; for it is undeniable, that had the creator omitted to endue water with this unparalleled peculiarity of contraction, and had ice been as good a conductor of heat as the metals, the polar seas would, even in the early ages, have been frozen to the bottom; all other waters, not excepting the oceans within the tropics, would have been successively converted into a solid as enduring as granite; vegetable and animal life would have become extinct;—the very atmosphere might have congealed, and in the language of Dr. Black, all nature would have become a silent, lifeless, and dismal ruin.

In the case of congelation which has elicited these remarks, there was another circumstance worthy of observation.

The layers of ice were much more transparent in the direction of their length than in the opposite; this arose from the distorted refraction of light occasioned by innumerable air bubbles, from the size of duck shot to that of a small pin's head, which were, in every instance, to be observed at the junction of the layers, and at the top of each particular layer, excepting that on the surface, where there were none. If we mistake not, these peculiarities can be satisfactorily explained. It is well known that all natural waters contain air in solution, and that it is expelled by boiling, by the air pump, and by freezing.

On the surface of the water, when the first layer of ice was formed, there was nothing to retain the air bubbles; as they were evolved, they passed through the water and escaped. But after the first layer of ice was produced, the air bubbles that were extricated by the chilling of the water next below, were of course arrested by the ice, and during the succeeding night were frozen in and detained. Had the cold continued equally intense during the day as during the night, the air bubbles *might* have been equally diffused through the ice, but, as the nights (according to the usual course of things) are marked by a rather sudden and commonly by a considerable increase of cold, the layer of water about to congeal, was made suddenly to evolve the dissolved air, and this, from its levity, rising rapidly through the *as yet* fluid water, necessarily collected with considerable regularity, just at the bottom of the last formed layer of ice, but still completely within the new one.

It was observable that the layers of air bubbles were well defined and regular on the upper side, but irregular on the lower—many bubbles being below the general level, and appearing to have been arrested before they had time to arrive at the upper surface of the water.

MEDICAL CHEMISTRY.

Art. XXVI.—*On the Hydrocyanic or Prussic Acid, by* B. Lynde Oliver, *M. D. of Salem, Mass.*

Insanum quiddam esset, et in se contrarium, existimare ea, quæ adhuc nunquam facta sunt, fieri posse nisi per modos adhuc nunquam tentatos.
Bacon Nov. Organ. Aphor. VI.

TO PROFESSOR SILLIMAN.

Sir,

Having read in your excellent Journal of Science and Arts, a very interesting paper on the Prussic Acid, in which an invitation is given to physicians to transmit their remarks on the trial they may have made with this active agent; I now beg leave to avail myself of it, and hope that you will pardon my prolixity.

It is now more than nine years since I gave an attention to this subject,* nor did I then know, that the Prussic acid

* In Dr. Thatcher's interesting work, entitled, Observations on Hydrophobia, p. 280, the following note occurs: "The cherry laurel is the same as the lauro-cerasus, of which we have a particular account in Cullen's Materia Medica, as being one of the most deadly of all the vegetable poisons. A cautious use of it has been attempted in some diseases, and my friend and correspondent, Dr. B. Lynde Oliver of Salem, has recently em-

had been prescribed in Europe, nor have I since seen any evidence of such early prescription.* The inclosed certificate† will prove that, since 1811, the Prussic acid has been prepared in this town, and has also been kept for sale. I believe that many quarts of the article have been sold during the last nine years, and prescribed. At a sale at the Chemical Laboratory, not long since, a very considerable quantity was found on hand, and sold.

By referring to my common place-book, I find, that it was in the autumn of 1811, that I prevailed on Mr. John Hunt, Chemist and Apothecary, to make for me a small quantity of the Prussic Acid. It was prepared according to the process of Dr. Schaub (vide Med. Repos. Hexade 2d, Vol. I. p. 314,) and afforded the characteristic smell, and when tested, gave evidence of the presence of the Prussic principle.

ployed it, and contemplates prosecuting his experimental tests relative to its medical properties. The Prussic Acid is obtained from the lauro-cerasus, and is also a deadly poison to animals. There is evidently an affinity between the laurel and the wild black cherry, (prunus Virgina,) the kernels of which have long been known to prove poisonous. These several substances having attracted the attention of Dr. Oliver, were subjected to his experimental inquiries, and he has suggested the trial of them in hydrophobia. He proposes for trial the Prussic acid, as being readily obtained by a chemical process, and as affording the efficient principle in the lauro-cerasus. The leaves of ths black-cherry might subserve the purpose of a substitute. He judiciously observes, that it is sufficiently unpleasant to administer poisons before their precise dose is ascertained, but medicines and poisons are convertible terms, and differ only in their doses.'' See Murray's Materia Medica. Dr. Thatcher's Book was printed in 1812—but the correspondence of the parties was several years antecedent to the publication.

* This was 11th July, 1820, when the communication was dated—but a delay in printing of it, has given occasion to an addition of later date.

† *Anderson Township, Hamilton County, State of Ohio, Nov.* 16, 1820.

This may certify, that in the autumn of the year 1811, at the request of Dr. Benjamin Lynde Oliver, and by directions received from him, the subscriber, then an inhabitant of Salem, Massachusetts, and by occupation Apothecary and Chemical Operator, prepared a quantity of prussic acid, and after testing it in the presence of said Oliver, delivered a portion of it for the use of a patient then under said Oliver's care, And that the subscriber delivered the prussic acid (at the order of said Oliver,) for the use of a number of patients, previous to the winter of 1812–13, when he delivered it for the use of his brother, William Hunt, of Salem, Massachusetts. And further, that the Prussic acid was not known to the Apothecaries of Salem as a medicine, antecedent to Dr. Oliver's order on the subscriber for the preparation of it.

JOHN HUNT.

Some of the first experiments which I made with this powerful agent, gave rather flattering results, although it afterwards often failed in giving the relief anticipated. Such, however was the success attending my trials, that I was induced to recommend the acid to my medical brethren. Several of them administered it, and with a success that occasioned a demand for the article in the shops. Antecedent to my researches, the acid had not been seen in this section of the country, nor had any conjecture been made of its medical properties, that I have heard of by any person; but of this the early date itself of the certificate affords a presumption.

The circumstances which induced me to turn my attention to the subject were, the want of success attending the common modes of treating the phthisis pulmonalis, and my having a very near relation in the incipient stage of that disease,* I had read in Murray's Apparatus Medicarninum, (when treating on the subject of prunus lauro-cerasus,) the following, "Unica brevitate laborat Linnei (Amæn. ac T. 4, p. 30,) effatum, quod folia per Belgium usitatissima sunt pro infusione in morbis pulmones depascentibus (utor vero propriis ejusdem verbis) Phthisis eundem intellexisse, ex libro ejus de Materia Medica colligo, in quo hic morbus significatur." Some other hints to the same purpose, by other writers, are to be found in the same article. The experiments made with the aqua lauro-cerasus, by Dr. Brown Langrist, had also suggested to my mind the probability of the laurel proving a useful medicine. About the year 1810, a small quantity of laurel-water came into my possession; I prescribed it in the case of my relation with good effect, and likewise in the case of one other patient laboring under the same disease. But my laurel-water became exhausted in a short time. I then applied to the late Professor Barton of Philadelphia, to ask his aid in procuring for me some of the leaves of the prunus lauro-cerasus. He very kindly sent me a small quantity which was all that could then be procured. A tincture was made of the leaves, which, on trial, yielded the same result as the laurel-water. But here

* I have spoken of the disease as being in the incipient stage, as the expectoration was not purulent, but such progress had the malady made, that most of the persons who saw the patient supposed it would prove fatal; and one physician pronounced that the disease appeared like desperate phthisis.

again, the medicine was exhausted before the cure of the disease. This put me upon reflecting, that if I could procure the Prussic acid, that I then should be able to prescribe the efficient principle of the lauro-cerasus, and might then command any quantity of it. I therefore applied to the Chemist above mentioned, and was furnished with the desideratum. It was prescribed for my relative, and soon manifested its good effects in relieving the cough, promoting appetite, and shortly producing a complete suspension of the malady. In several other patients, it appeared to palliate the symptoms. In some other cases little or no effect was manifested. This failure in the acid, I am now inclined to think, arose from its degeneration and decomposition, either from the agency of the vehicle it was exhibited in, or from the dose not having been accommodated to its deterioration. Although this want of success in many of the cases lessened my confidence in the remedy, yet it did not prevent me from prescribing it. I soon after saw two more cases of phthisis which were cured by the acid. They had not reached the purulent stage.

I have generally found it necessary to increase the dose of the acid, until it manifests its effects on the system by producing a pain of the head or dizziness. There are, however, some constitutions found in which those symptoms do not readily take place from the action of any dose, in which it is prudent to give the acid, but who still derive benefit from its use : and on the other hand, some are found in whom a very small dose excites much disturbance in the system, and who can scarcely bear the medicine in any dose.

I am not certain that I have ever seen any permanent bad effects from its cautious exhibition. I have known, however, when the dose has been augmented too suddenly, a very great distress to be excited in the stomach, attended with dizziness and faintness, accompanied with a rapid pulse. These symptoms often being followed with retching, on the patient's lying down on the bed soon went off, and left her remarkably well afterwards.

I have seen two cases of mania, attended with obstructed catamenia, which were cured by the acid; the disease, however, recurred in one or both patients. I once exhibited the prussic acid to a patient, who had long laboured under an organic disease of the heart—the malady was attended with great palpitation of that organ, and pain at the breast, and insufferable sense of anguish on ascending an eminence; the patient told me that he could not "bear the medicine as it exasperated all his complaints." I had some doubts whether the disease was to be classed with Angina Pectoris, or the one before mentioned. Probably, both diseases sometimes proceed from the same source. Dr. Willan has remarked, that almost all the cases of Angina Pectoris he had known, arose from organic disease of the heart. Does it not afford some reason for conjecturing, from the bad effect of the prussic acid, that the group of symptoms denominated Angina Pectoris, may arise from a sudden loss of irritability in the muscular fibres of the heart? and do not the effects of stimuli in relieving a paroxysm of Angina Pectoris countenance the same conjecture? I have found the acid remarkably increase the appetite for food. I have known it to be useful in a case of stricture in the æsophagus, and asthma. I have seen it give more sudden relief in whooping cough, and in the late influenza, than any medicine I ever exhibited. I once prescribed it in a case of hydrophobia, but without success. The acid in this case, it was afterwards found, had lost much of its virtue, although it was not rendered entirely inert. In this case, the acid was given freely, but I now much regret that it had not been more freely given, or that it had not possessed more virtue.

I should hope, that the unfavourable result of this case, would not prevent the farther trial of the hydrocyanic acid in hydrophobia, as it seems to me, to be a medicine of much promise; and for the reasons before assigned, it seemed here not to have had a fair trial.

The prussic acid which I have used, has been much weaker than that of Scheele, or the preparation used in France and England. As Gay Lussac tells us, that the pure prussic acid will be decomposed in an hour; and as we know that of Scheele will retain its virtue much longer, may we not infer that a preparation which is still weaker, will retain its strength much longer? I am satisfied, that I have seen some of the Salem preparation, (which is originally weaker,) and have prescribed it after it has been made more than a year, when it has evinced its retention of its virtue by the cure of the disease it was prescribed for.

I do not recollect to have heard, that the laurel-water is liable to lose its strength by keeping, and this may be considered as a dilute prussic acid.

If the above facts be correct, may we not infer from them, that a weak preparation of the acid is better to be kept in the shops than a stronger? and also for another very important consideration, that the danger of too large a dose being administered, is very much lessened.

I should recommend the trial of the prussic acid in Angina Trachealis or Croup, but not to the exclusion of bleeding, and the other remedies which have had the sanction of experience. As the prussic acid has the power of repressing inordinate arterial action, and also the property of lessening the tendency to spasmodic action in the muscular fibre, we may expect, from the first, a diminution of the inflammation; and from the latter, that it would counteract the disposition to a fatal spasm of the glottis, which even a small portion of the adventitious membrane formed in croup, is liable to excite, if it happen to be placed near the glottis. Analogy, in other cases of internal inflammation of hollow cavities, leads to the conjecture, that in irritable habits, such spasm may occur even from the bare inflammation of the parts: a still farther argument for the employment of the acid.

I am, Sir, with great respect and esteem,
Your obedient servant,
B. L. OLIVER.

Art. XXVII.—*Reports and Memoranda of cases in which the Prussic Acid has been administered.*

I. By Dr. J. A. Allen, of Brattleborough, Ver. (Communication dated Aug. 4, 1820.

Miss P. Keyes, a young lady of about twenty, for three years had laboured under a protracted cough. It was of that species produced by catarrh, in which the mucous membrane of the bronchia appears to be the seat of the complaint. She had no symptoms which would denote the incipient stage of either tubercular or apostematous phthisis.

A great variety of medicines had been used without any sensible benefit. About a year since, she commenced the use of the hydrocyanic acid, in doses of two drops, every four hours, diluted in water. In a few days the cough began to abate, and in a week or two she was entirely free from the complaint. Since which time, her health has been almost uninterruptedly good. She finds, however, that a slight catarrh will produce a return of cough, but this has, usually, abated with the other catarrhal symptoms;—if not, a few drops have, always, produced a cure.

Another Lady, in whom symptoms of tubercular phthisis were well marked, experienced much benefit from the use of the acid in doses of two drops every four hours; the cough became less tedious, the hectic abated, and the pulse diminished from ninety to seventy-five per minute, in twenty-four hours from the commencement of the use of the acid; but the head became giddy to such a degree as to render it necessary to diminish the quantity taken. The patient continued, apparently, gaining for ten days, when there was an increase of the symptoms—an increased quantity of the acid again abated the symptoms, eight or ten days longer, when the violence of the symptoms returned, but could not be relieved by the acid, nor by any other medicine used.

I have used the acid in several other cases, with various degrees of success. From all of which, and from what has been published, I have no doubt that the hydrocyanic acid is one of the most valuable sedatives we possess. To digit. purp. it is to be preferred on account of its not producing those tremors, and that disagreeable depression which are sometimes known to follow the use of that *doubtful remedy.* The disagreeable effects from the use of the acid, will abate on a subduction of the medicine, but the unpleasant effects from the use of digitalis are well known to continue several days;—And, further, it may be asked whether the use of digitalis, in hectic cases, does not serve to undermine the already shattered constitution?

II. By Professor Dewey.

As our physician had some *hectic* cases, I made for him some prussic acid, according to Scheele's process. It has now been used for some weeks, with favorable results so far. It has been used for asthma with complete success in a case of long standing. In the whooping cough, its effects are very favorable, as tried thus far. In some instances it produces sleep—pleasant indeed—but the person would fall asleep when he seemed fully awake—sleep but a short time—but drop asleep again unexpectedly. In a case of almost constant cough, and laborious breathing when there was not a cough, and which had not been affected by any medicine tried for weeks, it effected a cure in two days, attended with renovated health. The patient had been sick for three months with fever. In one hectic case fast becoming past cure, the acid had a very good effect, and also in two others, one of which commenced with bleeding at the lungs, almost to death. It remains to be seen how permanent its influence will be. I suppose the acid has usual strength, for in no case have more than two drops been given in twenty-four hours.

III. From Dr. J. W. Webster.

Dr. Webster informs the Editor, that he has prescribed the Prussic acid in many cases, in the Boston Alms-House, especially in spasmodic asthma, and chronic coughs, with the greatest benefit. As an external application to irritable ulcers, it has also proved exceedingly beneficial.

May 13, 1820.

IV. By Dr. I. S. Comstock, Hartford.

Cases illustrating the effects of the Prussic Acid, as a remedy in Pulmonary Diseases.

Case 1st. A. M. aged about thirty, had been afflicted with symptoms of tuberculous phthisis for more than two years—had during that time made use of a great variety of medicines, and had taken a journey of several hundred miles on horseback, into a more temperate climate, without any permanent benefit. His cough, the most distressing symptom, was of the tickling kind, not attended with expectoration, but an unremitted irritation of the trachea deprived him of comfort and of rest. This was not at all times sufficient to produce the convulsive motion of the diaphragm; but only a heaving of the chest, a hurried respiration, and an expansion of the alæ nasi. When the cough occurred, the turns of which were frequent, particularly towards morning, it was dry, hollow, and gave that peculiar sound, as though the quantity of air respired was not sufficient to fill the tube through which it passed. Appetite tolerable—digestion more or less bad—bowels costive—countenance pale and hollow—emaciation considerable—able however to walk about, and attend to some business—pulse sixty-nine in a minute.

In this state, Sept. 2d, 1820, he began to take the prussic acid.

R Syrup Sugar i ounce.
Water vii ounces.
Prussic Acid 64 drops.

He began by taking three drachms of this julep three times a day. For a few days, no apparent effect was produced on any of his symptoms. On the fifth day therefore the dose was increased to half an ounce of the julep, five times a day, making twenty drops of the Prussic acid in twenty-four hours. The effects of the remedy now became obvious; and on continuing it for several weeks, and watching all the symptoms of the patient, and consequences of the medicine, with much attention, I am confident that the following observations on this case are well founded.

1st. The pulses being counted three times a day for eighteen days, it was found that no effect on the number of pulsations was produced. It was however obvious that the medicine had its influence over the heart and arteries—the peculiar tense, or windy feeling of the pulse being changed to comparative softness, and gave to the touch a more healthy and agreeable sensation.

2d. The costiveness was obviated by the remedy.

3d. The appetite, and digestive powers were improved.

4th. Its immediate effects were stimulant and cordial.

5th. Its secondary effects were soporific, so that the patient frequently found it difficult to keep himself awake after he had taken a dose of four drops. This effect was uniform for several weeks, but different in degree.

6th. Immediately after swallowing a dose of the prussic acid, the patient experienced a peculiar sensation, approaching to numbness, and which he described as beginning at the head, and gradually approaching the extremities. This sensation lasted only a few moments, and was followed by no disagreeable consequences.

7th. It seemed to produce a slight degree of stricture across the chest. This effect was not, however, so clearly ascertained as the others, this symptom not always following the use of the remedy.

8th. On intermitting the remedy, its good effects, particularly on the cough, became much more apparent than when the patient was under its immediate influence. This observation has been verified in several cases.

This patient, after taking the prussic acid for several weeks, became obviously much better in many respects.—The digestive powers were improved—the appetite better—sleep less disturbed by turns of coughing—countenance observed by every one to look more healthy. The cough, however, did not cease to be troublesome, and indeed seemed to be less affected by the remedy than any of the other symptoms, and it is but fair to state, that notwithstanding the indications of returning health, as above described, the medicine, either by continued use, or the influence of the cold season on the patient, seemed afterwards to lose its powers, and was finally discontinued. The patient, however, is still confident that the prussic acid has been of essential service to him, and will probably again resume its use.

Case 2d. C. A. laborer aged twenty-seven, of a healthy constitution, but bilious habit, on exposure to cold was seized with a violent catarrhal affection, attended with a distressing cough, which left him scarce any repose day or night; at night particularly, the cough became so exasperated as almost entirely to deprive him of rest. When I saw him, five weeks after the commencement of his complaint, his countenance was pale, languid, and shrivelled; and he was apparently worn out by the violence of his disease, and the want of ordinary sleep—pulse feeble, but not much accelerated—complained of great muscular debility, so that slight exercise produced copious sweating. For these complaints he had already taken the usual remedies prescribed by physicians, without any relief.

In this state, I prescribed for him the prussic acid in doses of three drops, three times a day, in a convenient vehicle. This quantity was to be increased, one drop each day, or until it produced some obvious effect. The good consequences of this course were immediate, and altogether beyond my expectations.

Having been for the last two weeks distressed by a constant irritation of the trachea, and unable to obtain much repose, he found the first night, after taking the remedy, that these symptoms were so much alleviated, that he enjoyed a night's rest, to which, for many weeks, he had been a stranger; and by persevering in the same course, for a single week, he was perfectly cured, without any other medicine.

Case 3d. L. C. aged six years, (October, 1820,) was siezed with a violent catarrhal affection, attended with a shrill and nearly convulsive cough, difficulty of respiration, and great anxiety. Pulse quick—tongue furred with a white coat—hot surface—and loss of appetite. Had taken various remedies without alleviating the cough, difficulty of breathing, or other symptoms. In this state, the third day after the attack, I prescribed for her the prussic acid in doses of one drop every two hours, in simple syrup. The promptness with which this prescription relieved my little patient of her most pressing symptoms, gave the highest satisfaction to her anxious friends, and to me an unequivocal pledge of the power of the remedy in such cases. After three or four doses, the cough and difficult respiration began to subside, and completely disappeared under its use in about two days.

This being the only case in which I have used the prussic acid when the system was laboring under considerable febrile affection, it may be proper to remark, that I did not observe the immediate action of the remedy to have the least influence on any of the symptoms of fever, which the case exhibited. The fever, being of the sympathetic kind, and depending on the irritation, which the remedy seemed so promptly to control, of course began to subside when its cause was diminished, and finally, was cured with it.

In this, and the last related case, it was as obvious to me that the symptoms of disease were cured by the prussic acid, as it is in ordinary cases that opium relieves those of the same, or of any other description.

Case 4th. A child aged two years, had been afflicted with the whooping cough about two weeks. I prescribed half a drop of prussic acid, in sweetened water, every two hours; to be increased to a drop on the next day. The mother, who knew nothing of the nature of the medicine, informed me that, on increasing the dose, the child became dizzy, and could not walk strait, but observed no other consequence. She was therefore advised not to increase the quantity above the half drop. The first effect was to diminish the aggravated, and distressing paroxysms of coughing which afflicted the patient, particularly during the night, and to procure some repose. The medicine being continued, the symptoms gradually disappeared, until at the end of about one week, I was informed by the mother that the child had no more turns of coughing, and was in fact cured of all disease.

Observations.

I have witnessed the operation of the Prussic acid in ten or twelve cases, all of them diseases of the lungs or catarrhal membrane.

That it acts with intense energy on the living system cannot be doubted by any one who has made experiments with it on animals or insects, and that it possesses great power as a medicine, when given in proper doses, will not be denied by those who have administered it as such.

But whether its effects are directly sedative, as supposed by Dr. Magendie, Orfila, and others, may reasonably admit of doubt. It is well known that the principle of life may be as completely (and even more quickly) destroyed, by a stimulant which shall, in an instant exhaust the sensorial power beyond a certain point, as by any means with which we are acquainted.

The effects of lightning and electricity are examples. Here not only the phenomena of life, but the principle of irritability itself becomes extinct in a second of time. And we know of a great variety of stimulants which produce the same effect, the time being in inverse proportion to the energy with which they operate.

But it may be fairly doubted, whether we are acquainted with any substance which affects the principle of life by directly destroying the source from which the sensorial power emanates, or which prevents its influence in any way, but by exhaustion.

The instantaneous operation of the prussic acid, in large doses, is then, in this respect, analagous to that of other powerful stimuli. But we are not acquainted with a single substance ever denominated sedative, which acts with any comparative promptness.

In case 1st, related above, it is stated that the prussic acid operated as a cordial and stimulant. As a proof of this, it is proper to state that the patient, whenever he felt unusual lassitude or fatigue from exercise, was for many weeks in the habit of taking a dose of four or five drops, particularly before dinner; which not only had the effect to relieve those feelings, but also to promote his appetite. That such effects necessarily involve the quality of a stimulant in the article taken, I believe will not be denied.

Its laxative power, which I have witnessed in several instances, is a further proof of the same quality. The fact also, that it sometimes produces stricture across the chest is another proof that it is not a direct sedative, but would seem to show that it possesses some tonic, as well as stimulant powers.

Its secondary, or sedative effects seem to be peculiar; and in greater proportion to the excitement produced, than is common to other stimulants. These effects seem also to be more permanent, particularly on the irritability of the membranes, but without producing any perceptible influence in retarding the action on the heart and arteries.

In the second and third cases it produced all the good effects in calming the cough and irritation, which we commonly expect from opium—but with this obvious difference, that the prussic acid seemed to cure those symptoms, which are only palliated by the use of opium. If future experiments should prove this to be the case, the prussic acid must become an article of the highest importance to physicians, since, besides its curative powers, its use is not followed by the disagreeable consequences which frequently attend opium, and might, undoubtedly, be given in many cases in which that article is inadmissible.

In catarrhal affections, attended with membranous irritation, cough, &c. whether recent or of long standing, I am satisfied that this is a medicine of peculiar powers.

In the first stage of catarrhal, or tuberculous phthisis, I am induced to believe, from observations made on five cases, that it will alleviate most of the urgent symptoms.—Whether it will cure patients actually laboring under consumption, in any stage of the disease, is, perhaps, as yet undecided. But by the controul which it appears to possess over the morbid irritation of the membranes, there is little doubt but it will, at least for a time, retard the progress of the disease, and prevent the approach of ulceration. This position seems, indeed, to have been proved in a considerable number of instances.

In cases where the lungs are already ulcerated, with the concomitants of the third stage of consumption, there is no reason to believe it does any permanent good. I have known one instance, however, of this kind, where it seemed to operate as a palliative, by obviating the costiveness, and lessening the disposition to cough.

One word concerning the mode of giving the prussic acid, and I have done.

As this article is given only by drops, I have found it most convenient to measure out a certain number of fluid drachms of the vehicle, as of syrup of Tolu or of sugar and water, into which is then dropped, one or two drops of prussic acid to each drachm. The dose is then a measured quantity of the julep.

I have known several instances where the medicine lost its effect by being exposed to the light, by taking out the cork several times a day from a vial of unmixed prussic acid, for the purpose of dropping out each dose, or from leaving the cork loose.

V. By Dr. A. S. Monson, of New-Haven.

I would notice the following case as illustrative of the beneficial operation of the prussic acid in incipient phthisis.

The patient had been subject to chronic catarrh for several years, to dyspnoea after much bodily exercise, and latterly to slight cough, expectoration, and pain in the breast; which symptoms, by recent additional colds, had been much aggravated.

The expectoration, mixed with florid blood, had now become purulent and dark coloured, of a very offensive odour, and a considerable haemoptysis soon supervened. The usual remedies were resorted to. The abatement of cough by the use of opium was not sufficient to counterbalance the inconvenience resulting to the patient from its use; nor was the haemoptysis (which was considerable every forty-eight hours) lessened by depletion, refrigerant medicines, spare diet, &c. &c.

The phosphorous acid most certainly and most speedily suppressed the hæmorhage from the lungs, but so long as the cough continued it was certain to return.

Under these circumstances, the use of the prussic acid was advised and commenced. By its prompt administration, the cough was soon subdued, and with it, the other concomitant symptoms. Its use was continued, as the cough appeared to demand it, for about forty days. The patient was bled twice, and during the latter part of the time, for several days, took the tincture digitalis to diminish the frequency of the pulse. With a view of lessening the offensiveness of the expectoration, he inhaled carbonic acid gas; but whether any advantage was gained by it was difficult to decide.

The fœtor diminished with the quantity of the expectoration, until what was expectorated became mere mucus, and finally ceased entirely. Small hopes were entertained of a recovery in this case, either by physicians, or by the friends of the patient. The expectoration was, on inspection, pronounced purulent, and the simplest test confirmed it to be so. The patient has often called on me to acknowledge his gratitude; and is, at this time, perfectly free from cough, and from every other symptom of disease.

Communicated by a Correspondent.

A writer, with the signature of W. in the last number of the New-England Journal of Medicine and Surgery relates three cases of the unfavourable operation of the prussic acid.

He commenced under the impression that the dose usually administered is from six to twelve drops, and says he began with four, and never increased the dose beyond ten drops given twice or three times a day. What physician, at all acquainted with the strength of this article as it is commonly employed in medicine, would not be prepared, on reading this paragraph, to expect worse consequences than what actually ensued.

But what result should we not anticipate from the unprecedented dose of eight drops to a child, only seven or eight years old!

It seems that the dose of the medicine was so great in the first case as to produce loss of sense and of motion; the same symptoms precisely which result from too great a dose of opium.

The unwillingness of the writer, at first, to refer these symptoms to their true cause, argues his inexperience in the use of the powerful medicine he was administering.

The second case above referred to, is one of a lady, who after taking a second dose of five drops, experienced a strange disturbance in the head, and symptoms of debility.

In this case "the patient had no suspicion she was taking a medicine possessed of any peculiar violence." Without adverting to the necessity of cautioning the patient of the power of any medicine, in order to ensure accuracy in the dose, we cannot help animadverting upon the impropriety of such bold prescription, in the case of a remedy of almost unexampled energy.

It is the gradual effect of the medicine upon the system, resulting from moderate doses, continued for some time, upon which all its medical efficacy depends.

Who can, with impunity, prescribe, in large doses, opium, digitalis, corrosive sublimate, or arsenic, or any of the more powerful articles of the Materia Medica? What violent and dangerous symptoms might we not reasonably expect, were we to prescribe for a dose, thirty-two drops of digitalis, or five grains of corrosive sublimate, or ten grains of arsenic? To obtain the salutary effect from any of them, they must be administered in smaller doses, and with the necessary precaution to the patient not to exceed the prescribed dose.

We would refer this writer to the researches and experiments of Magendie and others on prussic acid—by which we think he will be convinced that even prussic acid may be administered with safety if administered also with due caution.

MEDICUS.

* * * * * *

VI. A useful little volume has been published in New-Haven,* containing a transcript of Dr. Magendie's memoirs on the prussic acid, with prefatory remarks by the translator, Dr. J. G. Percival, with some additional cases of the use of the acid, and an appendix by Dr. Alfred S. Monson. It will afford much useful information to those who wish to employ this acid.

The following is Dr. Monson's process for preparing the acid:

Pour into a glass retort, eighteen fluid ounces of a saturated solution of prussiate of mercury, at the temperature of 65° of Fahrenheit; add to it two ounces and an half of iron filings; pour upon these, two ounces by weight, of strong sulphuric acid, and distil off two fluid ounces into a receiver containing one fluid ounce of distilled water. The receiver must be surrounded with ice, and covered with a cloth to render it dark.

To get rid of the colouring matter, together with some sulphuric acid, and iron that come over, it may be redistilled from dry carbonate of lime.

A tubulated receiver is employed: this is connected with the retort by means of one or two adapters of common length; the junctures are made perfectly tight, a tube of safety leads from the tubulure of the receiver into a little water, and a tube descends from the retort to the bottom of the receiver.

Remarks.

Dr. Monson, in the volume mentioned above, observes: "In forming the prussiate of mercury, I have observed, (and the same fact was noticed by Professor Silliman) that if only half as much of red oxid of mercury as of Prussian blue be used, as directed by Scheele, the whole of the Prussian blue is not decomposed, and more of the prussiate of mercury is obtained, by adding more of the red oxid, and boiling them again.

To ascertain the precise quantity required to produce a saturation, I have employed several proportions. From these experiments it results, that where the materials are of

* By Howe & Spalding, and A. H. Maltby & Co.

the best quality, two and a half parts by weight, of the red oxid, to four of the Prussian, blue, is the best proportion. I prefer using a larger quantity of water than is directed, to aid the mutual action of the Prussian blue and of the oxid of mercury.

Sixteen fluid ounces of distilled water, at the temperature of 65°, will hold in solution five hundred and thirty-five grains of crystalized prussiate of mercury.

* * * * * *

Memorandum.

Dr. Alfred S. Monson, of New-Haven, and Dr. J. L. Comstock, of Hartford, constantly keep the Prussic Acid for sale for the use of Physicians.

On the fidelity and accuracy of these gentlemen, entire reliance may be placed; and those who wish for supplies of the Prussic Acid are, by their permission referred to them. —Editor.

NOTICE.

This number, having already exceeded the size of any preceding one, and containing thirty-nine pages over the stipulated amount of matter, it is with great regret, that the Editor is compelled to postpone many miscellaneous articles which were in readiness. Among them were a Notice of the Achæologia Americana—of Professor Gorham's Chemistry—of the Revue Encyclopedique of Paris—of Mr. Brongniart's Geological opinions concerning certain American Formations, and of specimens sent by him to illustrate the art of making porcelain—of the American Geological Society, and of donations to it, especially of a splendid one by the President, Mr. Maclure—of some original Observations of Professor Hare—of new Localities of American Minerals—of articles of Foreign Intelligence, by Professor Griscom—and of others, by Dr. J. W. Webster, &c. &c. We hope to give most of them in our next, which may be expected (D. V.) in May.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

MINERALOGY, GEOLOGY, TOPOGRAPHY, &c.

Art. I.—*Account of the Native Copper on the southern shore of Lake Superior, with historical citations and miscellaneous remarks, in a report to the Department of War: by* Henry R. Schoolcraft.

(The following letter accompanied Mr. Schoolcraft's Report.)

Albany, Feb. 16th, 1821.

TO PROFESSOR SILLIMAN.

Sir,

Agreeably to your request, and the permission of the Secretary at War, I enclose you a copy of my report on the Copper Mines of Lake Superior. In preparing it, I have consulted the former travellers of the region, and by combining their remarks with my own, endeavoured to present, in an embodied form, all the information extant upon the subject. It has been a cause of regret to me however, that more time was not devoted to the mineralogy and geology of that section of country, but it appeared incompatible with the more important objects of the expedition, and I could only make use of the time that was allowed to me. In presenting the subject to the Secretary at War, I thought my observations would be more acceptable in a practical and business form, than as assuming the character of a scientific memoir, and in choosing an intermediate course, I have probably said more on the geology of the country than may be thought important to the statesman, and less than will we considered satisfactory to the professed geologist and scientific amateur. A few marginal notes have therefore been added, but I have been studious not to overload the original MSS. in that way. I do not send the views and geological charts accompanying the report to Mr. Calhoun, as it would be very inconvenient at the present period to copy them, and as the subject may be sufficiently understood without these embellishments.

With respect to the deductions, so far as science is concerned, it is hoped they will be read with candour, and I therefore submit them to your judgment and to that of the scientific public.

With great respect, and regard,
your most obedient servant,
HENRY R. SCHOOLCRAFT.

"VERNON, *Oneida Co. (N. Y.) Nov.* 6*th*, 1820.

"HON. JOHN C. CALHOUN, *Secretary at War*,

SIR,

"I have now the honor to submit to you such observations as have occurred to me, during the recent expedition under Gov. Cass, in relation to the Copper Mines of Lake Superior; reserving as the subject of a future communication, the facts I have collected on the mineralogy of the country explored generally.

The first striking change in the mineral aspect of the country north of Lake Huron, is presented near the head of the Island of St. Joseph in the river St. Mary, where the calcareous strata of secondary rocks are succeeded by a formation of red sand-stone, which extends northward to the head of that river at Point Iroquois, producing the falls called the *Sault de St. Marie* fifteen miles below, and thence stretching northwest along the whole southern shore of Lake Superior to the Fond du Lac, and into the regions beyond. This extensive stratum is perforated at various points by upheaved masses of granite and hornblende, which appear in elevated banks on the margin of the lake between Dead river and Presque Isle, and from the Porcupine mountains ten leagues to the west of the Ontonagon river. It is overlayed in other parts by a stratum of grey sand-stone, resembling certain varieties of grauwacke, of uncommon thickness, which appears in various promontories along the shore, and at the distance of ninety miles from Point Iroquois, constitutes a lofty perpendicular wall upon the water's edge called the Pictured Rocks, which is one of the most commanding objects in nature. So obvious a change in the geological character of the rock strata in passing from lake Huron to lake Superior, prepares us to expect a corresponding one, in the imbedded minerals, and other natural associations,—an expectation which is realized during the first eighty leagues, in the discovery of red hematite, prehnite, opal, jasper, sardonyx, carnelion, agate, and zeolite.

The first appearances of copper are seen on the head of the portage across Keweena point, two hundred and seventy miles beyond the Sault de St. Marie, where the pebbles along the shore of the lake contain native copper disseminated in particles varying in size from a grain of sand to a lump of two pounds weight. Many of the detached stones at this place are also coloured green by the carbonate of copper, and the rock strata in the vicinity exhibit traces of the same ore. These indications continue to the river Ontonagon, which has long been noted for the large masses of native copper found upon its banks, and about the contiguous country. This river *(called Donagon on Mellish's Map)* is one of the largest of thirty tributaries which flow into the lake between Point Iroquois and the Fond du Lac. It originates in a district of mountainous country intermediate between the Mississippi river and the lakes Huron and Superior, and after running in a northern direction for one hundred and twenty miles, enters the latter at the distance of fifty one miles west of Point Keweena, in north latitude 46° 52′ 2″ according to the observations of Capt. Douglass. It is connected by portages with the Menomonie river of Green Bay, and with the Chippeway river of the Mississippi, routes of communication occasionally travelled by the Indians in canoes. At its mouth there is a village of Chippeway Indians of sixteen families who subsist chiefly on the fish (sturgeon) taken in the river; and whose location, independently of that circumstance, does not appear to unite the ordinary advantages of Indian villages in that region.

A strip of alluvial land of a sandy character extends from the lake up the river three or four leagues, where it is succeeded by high broken hills of a sterile aspect and covered chiefly by a growth of pine, hemlock, and spruce. Among these hills, which may be considered as lateral spurs of the Porcupine mountains, the Copper Mines, so called, are situated, at the distance of thirty two miles from the lake, and in the centre of a region characterized by its wild, rugged, and forbidding appearance. The large mass of native copper reposes on the west bank of the river, at the water's edge, and at the foot of a very elevated bank of alluvion, the face of which appears, at some former period to have slipped into the river carrying with it the mass of copper together with detached blocks of granite, hornblende, and other bodies peculiar to the soil of that place. The copper, which is in a pure and malleable state, lies in connexion with serpentine rock, the face of which, it almost completely overlays, and is also disseminated in masses and grains throughout the substance of the rock.(1) The surface of the metal, unlike most oxydable metals which have suffered a long exposure to the atmosphere, presents a metallic briliancy ;* which is attributable either to alloy of the pre-

(1) In preparing this report, a more particular description of the geognostic character of this mass of copper was deemed unnecessary, but in presenting it for the perusal of the amatuers of natural science, it may be proper to add—that the serpentine rock is not in situ, nor is it so found in any part of the regions visited. To account for its appearance in a section of country to which it is geologically foreign, it would be necessary to enter into the enquiry "by what means have the loose masses of primitive rocks been transported into secondary countries"—an enquiry which is incompatible with the limits of this report, and which, moreover would, in itself, furnish the subject of a very interesting memoir. I will now however suggest, what has struck me in passing through that country—that the Porcupine mountains which are situated thirty miles west, are the seat of extinguished volcanoes that have thrown forth the masses of native copper which are found (as will be mentioned in the sequel) so abundantly throughout the region of the Ontonagon. This opinion is supported by the fact that those mountains are composed (so far as observed) of granite, which is probably associated with other primary rocks, and among them serpentine—that the red sand-stone rock at their base is highly inclined towards the mountains so as to be almost vertical, and apparently thrown into this position by the up-heaving of the granite—and also, that their elevation which has been calculated by Capt. Douglass and myself at 1800 feet above the level of lake Superior—their conical and rugged peaks, and other appearances, are such as frequently characterize volcanic mountains.

* This however, is no uncommon appearance of native copper.—Ed.

cious metals, or to the action of the river, which during its semi-annual floods carries down large quantities of sand and other alluvial matter that may serve to abrade its surface, and keep it bright. The shape of the rock is very irregular—its greatest length is three feet eight inches—its greatest breadth three feet four inches, and it may altogether contain eleven cubic feet. In size, it considerably exceeds the great mass of native iron found some years ago upon the banks of Red River in Louisiana, and now deposited among the collections of the New-York Historical Society, (1) but on account of the admixture of rocky matter, is inferior in weight. Henry, who visited it in 1766 estimated its weight at five tons. (2) But after examining it with scrupulous attention, I have computed the weight of *metallic copper* in the rock at twenty two hundred pounds. The quantity may, however, have been much diminished since its first discovery, and the marks of chissels and axes upon it with the broken tools lying around, prove that portions have been cut off, and carried away. The author just quoted observes "that such was its pure and malleable state, that with an axe he was able to cut off a portion weighing a hundred pounds." Notwithstanding this reduction it may still be considered one of the largest and most remarkable bodies of native copper upon the globe, and is, so far as my reading extends, exceeded only by a specimen found in a valley in Brazil weighing 2666 Portuguese pounds. (3) Viewed only as a subject for scientific speculation, it presents the most interesting considerations, and must be regarded by the geologist as affording illustrative proofs of an important character. Its connexion with a rock which is foreign to the immediate section of country where it lies, indicates a removal from its original bed, while the intimate connexion of the metal and matrix, and the complete envelopement of individual masses of the copper by the rock, point to a common and contemporaneous origin, whether that be referable to the agency of caloric or water. This conclusion admits of an obvious and important application

(1) See Bruce's Mineralogical Journal, p. 124, 218.

(2) See Henry's Travels and adventures, p. 205.

(3) Philips' Mineralogy.

to the extensive strata of serpentine and other magnesian rocks found in various parts of the globe! The Ontonagon river at this place is broad, rapid and shallow and filled with detached masses of rock out of place, which project above the water, and render the navigation extremely difficult, during the summer season. The bed of the river is upon sand-stone similar to that which supports the Palisadoe rocks upon the Hudson. There is an island nearly in the centre of the river which serves to throw the current against the west bank where the copper reposes, and which as it is the only wooded island noticed in the river, may serve to indicate the locality of this mineral treasure to the future enquirer.

Several other masses of native copper have been found on this river at various periods since it has been known to Europeans, and taken into different parts of the United States and of Europe, and a recent analysis of one of these specimens at the University of Leyden, proves it to be native copper in a state of uncommon purity, and uncombined with any notable portion either of gold or silver.

A mass of copper discovered by the Aborigines on an island in lake Superior at Point Chegoimegon eighty miles west of the Ontonagon, weighed twenty eight pounds, and was taken to the island of Michilimackinac some years ago by M. Cadotte, and disposed of. It was from this mass that the War Department was formerly supplied with a specimen, and from which the analysis alluded to, is also understood to have been made. About eleven years ago, a trader by the name of Campbell procured from the Indians a peice of copper weighing twelve pounds which they found on an island in Winnebago lake, about a hundred miles in a direct line east of the copper rock on the Ontonagon. This was also taken to the Island of Michilimackinac and there disposed of. Other discoveries of this metal in masses, varying from one to ten pounds are stated to have been made on the shores of lake Superior—the Fox river—the Chippeway—the St. Croix, and the Mississippi about Prarie du Chien, but the statements do not rest on sufficient authority to justify any particular enumeration. The existence of copper in the region of lake Superior appears to have been known to the earliest travellers and voyageurs. As early as 1689 the Baron La Hontan in concluding a description of that lake adds "that upon it, we also find copper mines, the metal of which is so fine and plentiful, that there is not a seventh part loss from the ore." (1) In 1721 Charlevoix passed through the lakes on his way to the gulf of Mexico, and did not allow the mineralogy of the country to escape his observation. "Large pieces of copper," he says in speaking of lake Superior, "are found in some places on its banks, and around some of the islands, which are still the objects of a superstitious worship among the Indians. They look upon them with veneration as if they were the presents of those gods who dwell under the waters; they collect their smallest fragments which they carefully preserve without however making any use of them. They say that formerly a huge rock of this metal was to be seen elevated a considerable height above the surface of the water, and as it has now disappeared, they pretend that the gods have carried it elsewhere; but there is great reason to believe that in process of time the waves of the lake have covered it entirely with sand and slime; and it is certain that in several places pretty large quantities of this metal have been discovered without being obliged to dig very deep. During the course of my first voyage to this country, I was acquainted with one of our order (Jesuits) who had been formerly a goldsmith, and who, while he was at the mission of *Sault de St. Marie* used to search for this metal, and made candlesticks, crosses, and censers of it, for this copper is often to be met with almost entirely pure." (2)

In 1766, Capt. Carver procured several pieces of native copper upon the shores of lake Superior, and about the sources of the Chippeway and St. Croix rivers, and published an account of these discoveries in his book of travels, which has served to give notoriety to the existence of that metal in the region alluded to, without however furnishing any very precise information as to its locality or abundance. He did not, from his own account traverse the southern shore of the lake, but states that virgin copper is found in great plenty on the Ontonagon or Copper Mine river, and about other parts of lake Superior, and adds—"that he observed many of the small islands, particularly those on the

(1) La Hontan's voyages to Canada, p. 214.

(2) Charlevoix's Journal of a voyage to North America, vol. 2. p. 45.

eastern shores, were covered with copper ore, which appeared like beds of copperas, (sulphat of iron) of which many tons lay in a small space." (1)

Five years after Carver's visit (A. D. 1771,) a considerable body of native copper was dug out of the alluvial earth on the banks of the Ontonagon river by two adventurers of the name of Henry and Bostwick, and, together with a lump of silver ore of eight pounds weight of a blue colour and semi-transparent, transported to Montreal, and from thence shipped to England, where the latter was deposited in the British museum after an analysis of a portion of it, by which it was determined to contain 60 per cent of silver. (2) These individuals were connected with a company which had been formed in England for the purpose of working the copper mines of lake Superior, among whom were the Duke of Gloucester, Sir William Johnstone, and several other gentlemen of rank. They built a small vessel at Point aux Pins, six miles above the Sault de St. Marie, to facilitate their operations upon the lake, and a considerable sum of money was expended, first,—in exploring the northern shore of the lake, and the island of Maripeaux, and afterwards,—in the mining operations which were authorized upon the banks of the Ontonagon. These transactions will be best illustrated by a quotation from the narrative account which Henry has himself published. After returning from the Canadian shore of the lake, and passing Point Iroquois, where the silver ore was found, he observes,—" Hence we coasted westward, but found nothing till we reached the Ontonagon, where, besides the detached masses of copper formerly mentioned, we saw much of the same metal *imbedded in stone*. Proposing to ourselves to make a trial on the hill, till we were better able to go to work upon the solid rock, we built a house and sent to the Sault de St. Marie for provisions. At the spot pitched upon for the commencement of our preparations, a green coloured water which tinges iron of a copper colour, issued from the hill, and this the miners called a *leader*. In digging they found frequent masses of copper, some of which were of three pounds weight. Having arranged every thing for the accommodation of the miners, during the winter, we returned to the Sault.

(1) Carver's Travels p. 67. (2) Henry's Travels, p. : 30.

"Early in the spring of 1772 we sent a boat load of provisions, but it came back on the 20th day of June, bringing with it, to our surprise, the whole establishment of miners. They reported that in the course of the winter they had penetrated *forty* feet into the face of the hill, but on the arrival of the thaw, the clay on which, on account of its stiffness, they had relied, and neglected to secure it by supporters, had fallen in;—that from the detached masses of metal, which to the last had daily presented themselves, they supposed there might be ultimately reached a body of the same, but could form no conjecture of its distance, except that it was probably so far off as not to be pursued without sinking an air shaft; and lastly,—that the work would require the hands of more men than could be fed in the actual situation of the country. Here our operations in this quarter ended. The metal was probably within our reach, but if we had found it, the expence of carrying it to Montreal must have exceeded its marketable value. It was never for the exportation of copper that our company was formed, but always with a view to the silver, which it was hoped the ores, whether of copper or lead, might in sufficient quantity contain."

Eighteen years after the failure of this attempt (1789) Mc Kenzie passed through lake Superior on his first voyage of discovery into the northwest, and in his description of lake Superior says,—"On the same side, (the south) at the river Tennagon, is found a quantity of virgin copper. The Americans, soon after they got possession of that country, sent an agent thither; and I should not be surprised to hear of their employing people to work the mine. Indeed, it might be well worthy the attention of the British subjects to work the mines on the north coast, though they are not supposed to be so rich as those on the south." (1)

The attention of the United States government appears first to have been turned toward the subject during the administration of President Adams, when the sudden augmentation of the navy rendered the employment of domestic copper in the equipment of ships, an object of political as well as pecuniary moment; and a mission was authorized to proceed to lake Superior. Of the success of this

(1) McKenzie's Voyages, p. 29.

mission, as it has not been communicated to the public, nothing can with certainty be stated, but from the enquiries which have been instituted during the recent expedition, it is rendered probable, that the actual state of our Indian relations at that period arrested the advance of the commissioners into the regions where the most valuable beds of copper were supposed to lie, and that the specimens transmitted to government were procured through the instrumentality of some friendly Indians employed for that purpose.

Such are the lights which those who have preceded me in this enquiry, have thrown upon the subject, all of which have operated in producing public belief in the existence of extensive copper mines upon lake Superior, while travellers have generally argued that the southern shore of the lake is most metalliferous, and that the Ontonagon river may be considered as the seat of the principal mines. Mr. Gallatin in his report on the state of American manufactures in 1810 countenances the prevalent opinion, while it has been reiterated in some of our literary journals, and in the numerous ephemeral publications of the times, until the public expectation has been considerably raised in regard to them.

Under these circumstances the recent expedition under Gov. Cass, entered the mouth of the Ontonagon river on the 27th of June, having coasted along the southern shore of the lake from the head of the river St. Mary, and after spending four days upon the banks of that stream in the examination of its mineralogy, proceeded on the first of July towards the Fond du Lac. While there, the principal part of our force was encamped at the mouth of the river, and the Governor, accompanied only by such persons as were necessary in the exploration, proceeded in two light canoes to the large mass of copper which has already been described. We found the river, broad, deep, and gentle for a distance, and serpentine in its course,—then becoming narrower, with an increased velocity of current, and before reaching the copper rock, full of rapids and difficult of ascent. At the distance of three or four leagues from the lake, it is skirted on either side by a chain of hills whose extreme elevation above the bed of the Ontonagon may be estimated at from three to four hundred feet. These hills appear to be composed of a nucleus of granite, rising through a stratum of red sand-stone, and covered by a very heavy deposit of alluvial soil full of water worn fragments of stones and pebbles, and imbedding occasional masses of native copper. Such is the character of the country in the immediate vicinity of the copper rock, and the latter is manifestly one of those imbedded substances, which has been fortuitously exposed to the powerful action of the river against an alluvial bank.

During our continuance upon this stream we found, or rather procured from the Indians, another mass of native copper weighing nine pounds (Troy) nearly; which will be forwarded to the War Department. This specimen is partially enveloped by a crust of green carbonat of copper, which is in some places *fibrous*, and on the under side mixed with a small portion of adhering sand, and some angular fragments of quartz, upon which it appears to have fallen in a liquid state. There is also an appearance of crystalization upon one side of it, and a portion of adhering black oxyd, the nature of which it is difficult to determine by ocular inspection. Several smaller pieces, generally weighing less than a pound, were also procured during our excursion up the Ontonagon, and in the regions east of it, but all, excepting those cut from the large mass, are somewhat oxydated, or otherwise encrusted upon the surface. The geological structure of the country in detail, and the mineral appearances of the shore about the copper rock and at other points along the river, between that and the lake, are also of a highly interesting character, but do not appear to me to demand a more particular consideration in this report.

The discovery of masses of native copper is generally considered indicative of the existence of mines in the neighborhood. The practised miner looks upon them as signs which point to larger bodies of the same metal in the earth, and is often determined, by discoveries of this nature, in the choice of the spot for commencing his labours. The predictions drawn from such evidence, are also more sanguine in proportion to the extent of the discovery. It is not, however, an unerring indication, and appears liable to many exceptions. A detached mass of copper is sometimes found at a great distance from any body of the metal, or its ores; and these on the contrary, often occur in the earth, or imbedded in rock strata, where there has been no external discovery of metallic copper to indicate it. So far as the opinions of mineralogical writers can be collected on this point, they teach,—that large veins of native copper are seldom found, but that it is frequently disseminated in masses of various size in the rocks, and among the spars and ores of copper and other mines; and when found in scattered masses upon the surface, is rather to be considered as a token of the existence of the sulphuret—the carbonate, and other ores of copper, within the circle of country where it occurs, than as the precursor to contiguous bodies of the same metal. "Native copper" says Cleveland, "is found chiefly in primitive rocks, through which it is sometimes disseminated, or more frequently it enters into the composition of metallic veins, which traverse these rocks. It is thus connected with granite, gneiss, micaceous and argillaceous slates, granular limestone, chlorite, serpentine, porphyry, &c. It also occurs in transition and secondary rocks. It accompanies other ores of copper, as the red oxyde, the carbonate and sulphuret of copper, pyritous and grey copper, also the red and brown oxides of iron, oxide of tin, &c. Its usual gangues are quartz, the fluate and carbonate of lime, and sulphate of barytes. At Oberstein it occurs in prehnite; and in the Faroe islands, it accompanies zeolite.

"Native copper is not rare, nor is it found in sufficient quantity to be explored by itself. It sometimes occurs in loose, insolated masses of considerable size." (1)

From all the facts which I have been able to collect on lake Superior, and after a deliberation upon them since my return, I have drawn the following conclusions:—

1st. That the alluvial soil along the banks of the Ontonagon river, extending to its source, and embracing the contiguous region which gives origin to the Menomonie river of Green Bay, and to the Ousconsing, Chippeway and St. Croix rivers of the Mississippi, contains very frequent, and some most extraordinary imbedded masses of native copper; but that no body of it, which is sufficiently extensive to become the object of profitable mining operations, is to be found at any particular place. This conclusion is support-

(1) Cleveland's Mineralogy, p. 450.

ed by the facts already adduced, and so far as theoretical aids can be relied upon, by an application of those facts to the theories of mining. A further extent of country might have been embraced along the shore of lake Superior, but the same remark appears applicable to it.

2d. That a mineralogical survey of the rock formations skirting the Ontonagon, including the district of country above alluded to, would result in the discovery of very valuable mines of the sulphuret, the carbonate and other profitable ores of copper; in the working of which the ordinary advantages of mining would be greatly enhanced by occasional masses, and veins of native metal. This deduction is rendered probable by the general appearance of the country, and the concurrent discoveries of travellers,—by the green coloured waters which issue in several places from the earth,—by the bodies of native copper found,—by the cupreous tinge which is presented in the crevices of rocks and loose stones,—by the geological character of the country, and by other analagous considerations.

These deductions embrace all I have to submit on the mineral geography of the country, so far as regards the copper mines. Other considerations arise from the facilities which that section of country may present for mining operations,—its adaptation to the purposes of agriculture,—the state, and dispositions of the Indian tribes, and other topics, which a design to commence metallurgical operations, at the present period would suggest. But I am not aware that any such views are entertained by government, and have not considered it incumbent upon me in this communication, to enter into details on these subjects. It may be proper, however, to remark, that the remote situation of the country containing the most valuable mines, does not, at the present period, favour the pursuit of mining. It would require the employment not only of the artificers and labourers necessary to conduct the working of mines, but also, of a military force to protect their operations,—first, while engaged in exploring the country, and afterwards, in their regular labours. For, whatever may be their professions, the Indian tribes of the north, possess strong natural jealousies, and in situations so remote, are to be restrained from an indulgence in the most malignant passions, only by the fear of a prompt military chastisement. In looking upon the southern shore of lake Superior, the period appears distant, when the advantages flowing from a military post upon that frontier, will be produced by the ordinary progress of our settlement;—for it presents few enticements to the agriculturalist. A considerable portion of the shore is rocky; and its alluvions are in general of too sandy and light a texture for profitable husbandry. With an elevation of six hundred and forty one feet above the Atlantic ocean, (1) and drawing its waters from territories all situated north of the forty fourth degree of north latitude, lake Superior cannot be represented as enjoying a climate very favourable to the productions of the vegetable kingdom. Its forest trees are chiefly those of the fir kind, mixed with white birch, *(betula papyracea*, the bark of which is so much employed for canoes by the northern Indians,) and with some varieties of poplar, oak, and maple. The meteorological observations which I have made, indicate however, a warm summer, the average heat of the month of June being 69°, but the climate is subject to a long and severe winter, and to storms, and sudden transitions of temperature, during the summer months. We saw no Indian corn among the savages upon this lake, whether the climate is unfavorable to its growth, or the wild rice *(zezania aquatica)* furnishes an adequate substitute, is not certain. A country lacking the advantages of a fertile soil, may still become a very rich mining country, like the county of Cornwall in England,—the Hartz mountains in Germany, and a portion of Missouri in our own country; but this deficiency must be compensated by the advantages of

(1) This level is predicated upon the following facts and estimates which I extract from my "Narrative Journal."

"Elevation of lake Erie above the tide waters of the Hudson according to the Report of the New-York Canal Commissioners	*feet.* 560
Estimate fall of Detroit river 20 miles at 6 inches per mile	10
St. Clair River 30 miles at 4 inches	10
Rapids of St. Clair River at the outlet of lake Huron, in the distance of three miles	9
Estimated fall of the river St. Mary, between the Detour and Point Iroquois, 60 miles at three inches per mile, (rapids not included)	15
Nibish Rapid	9
Sugar Island Rapid	6
Sault de St. Marie, (according to Col. Gratiot)	22,10
Level of Lake Superior	641,10

geographical position, contiguous, or redundant population, and the facilities of a ready commercial intercourse. To these, the mineral district of lake Superior can advance but a feeble claim, while it lies upwards of three hundred miles beyond the utmost point of our settlements on the north-western frontier, and in the occupation of savage tribes whose hostility has been so recently manifested. Concerning the variety, importance, and extent of its mineral productions, little doubt can remain. Every fact which has been noticed tends to strengthen the belief, that there are extensive copper mines upon its shores, while the information that has been gathered in the course of the late mission, renders it certain that not only copper, but iron, lead, plumbago, and sulphur are productions of that region, together with several of the *precious silicious*, (1) and *crystalized minerals.* It is rendered probable also, that silver ore is imbedded in the transition rocks of the region; and whenever it shall become an object with the American government, or people, to institute mineralogical surveys of the country, no doubt can be entertained but such researches will eventuate in discoveries of a highly interesting character, and such as cannot fail, both to augment our sources of profitable industry, and to promote our commercial independence. In the event of such operations, the facilities of a ready transportation, either in vessels or barges, of the crude ore to the Sault de St. Marie, will point out that place as uniting with a commanding geographical position, superior advantages for the reduction of the ores, and for the subsequent conversion of the metal either into ordnance or other articles. At this place a fall of twenty two feet in the river in the distance of half a mile, creates a sufficient power to drive hy-

(1) The Carnelion is first found on approaching the Pictured Rocks on lake Superior, and afterwards becomes very abundant along the shore extending to the Fond du Lac. Sandy lake on the head of the Mississippi is a good locality of this mineral, and it is found around the shores of the numerous little lakes in that region. In descending the Mississippi it is constantly met with in the alluvial soil. At the foot of the Falls of St. Anthony it is sparingly found; around the shores of lake Sepin it is very abundant, and it may be traced below Prairie du Chein, and even as low as St. Genevieve, as I have mentioned in my view of the mines. According to the classification of Werner, which is founded on "alternate bands of red and white," many of these specimens may be considered as Sardonyx. They are often associated with common chalcedony, with cacholong, and with certain varieties of agate and flinty jasper. In a few instances the common opal, in small fragments, is met with.

draulic works to any extent; while the surrounding country is such as to admit of an agricultural settlement.

I accompany this report with a geological chart of a vertical section of the left bank of the Mississippi at St. Peters, embracing a formation of native copper, and in which the superposition of the layers of rock, and the several subdeposites forming the alluvial stratum, exhibit a remarkable order. The curvatures in the lines of the alluvial stratum, represent a natural mound or hillock recumbent upon the brink of the river, which has partially fallen in, thus exposing its internal structure. The formation was first noticed by the garrison who quarried stone for quicklime, and for the purpose of building chimneys, at this spot. The masses of copper found are all small, none exceeding a pound in weight.

I have the honour to be sir,
with great respect, and regard,
your most obedient servant,
(Copy.) HENRY R. SCHOOLCRAFT."

Art. II.—*Miscellaneous observations relating to Geology, Mineralogy and some connected topics, in extracts of letters from Mr.* Alex'r. Brongniart, *member of the Royal Academy of Sciences, Engineer of Mines, &c. of Paris with remarks by the Editor to whom the letters were addressed.*

The observations of Mr. Brongniart, especially on some American localities will probably be interesting and instructive to others in this country, as they have been to us; this has induced us to give publicity to remarks which although not forwarded for this purpose, cannot fail to do honour to their respectable author.

His first letter, dated Oct. 9, 1819, is a reply to one accompanying American specimens transmitted to him, and about some of which his opinion was asked. Mr. Brongniart observes :—

"I transmit you to-day through the intervention of Mr Doolittle,

"1. A collection sufficiently complete, of substances adapted to the manufacture of porcelain, and illustrative of the principal changes and processes which these substances undergo, in arriving at the condition of Porcelain. The catalogue which is in the box will give you an idea of the order of these processes."

Mr. Brongniart, as is well known, is director of the great National manufactory of Porcelain, at Sevres, near Paris, and therefore, authentic specimens, of this kind received from him, must be regarded as particularly valuable. A mere translation of the catalogue, (which is however, full and detailed) without an exhibition of the specimens, would probably not be very useful. We will content ourselves with saying, that the specimens are very instructive, and conduct the observer, gradually, from the crude natural clay, sand, white feldspars, decomposed graphic granite, &c. through the regular series of changes, till we arrive at the finished vessel, possessing the whiteness, lustre, infusibility,* imperviousness to fluids, and delicate translucence, which are among the qualities that characterize one of the most perfect and beautiful productions of human skill. The tablets that illustrate the painting of the porcelain, are particularly elegant, and embrace most of the colours that are applied for the purposes of decoration.

Gold and platina are applied in the metallic state, and burnished so as to produce the proper lustre and colour of those metals. But, in most instances, the metallic oxids, applied by the pencil, are incorporated by heat, and actually form part of the substance of the porcelain, so that the colours cannot be discharged, and are scarcely liable to fade even by the action of light. Thus, cobalt gives an intense blue-chrome—a grass-green, and gold-rich purples and violets. The principle of their application is the same with that of glass and enamel staining, and the superb painted glass windows in the Gothic Cathedrals in Europe evince both the early perfection of the art, and the endurance of these colours, from century to century, in unfaded splendor.† These facts are finely illustrated by Mr. Brongniart's specimens, which will be freely submitted to the view of those whom either curiosity or interest may allure to this subject. Before return-

* By furnace heats.

† It is almost unnecessary to remark, that the colours of the animal and vegetable kingdom which form our common dyes are inapplicable in cases where they must be *burnt it*, as it is termed; they would of course be destroyed.

ing to the letter, we will add (a fact that appears not to be generally known in this country,) namely, that the *steel lustre* on porcelain is metallic platina, and that the *copper lustre* is metallic gold to which this particular tinge is imparted by an umber basis below—the gold being partially pervious to light and the only metal that is so. It is sufficiently curious that the gold is applied to the porcelain in the condition of fulminating oxid ; the oil of spike is used to make it adhere, and the fulminating properties are gradually destroyed without an explosion.*

The time will arrive, when the manufacture of porcelain will become a great object in this country, and we cannot be too early in acquiring the requisite information.

Mr. Brongniart goes on to mention,

"2. Some minerals and rocks from the environs of Paris and from France, and even from foreign countries, which (he adds) I hope will be interesting to you."

Among these specimens are many illustrating the mineralogical survey of the environs of Paris, made by Messrs. Cuvier and Brongniart; they are particularly valuable in that connexion, and especially as giving precise ideas of the signification of *the terms* used by those gentlemen.

"3. Distinct copies of some of Mr. Brongniarts works—he observes,

"I would also have added a copy of my essay upon the classification of mixed rocks, published in 1813, &c. but I have only one perfect copy. Besides, I have since that period made many changes in this classification, and I intend, as soon as possible to publish a new and much more complete edition than the first."

This remark is cited that Geologists may avail themselves of Mr. Brongniart's aid, as soon as his new edition shall appear; we shall not fail to give our readers the earliest notice of it.

In justice to the numerous contributors to this work, we feel authorized to publish the following remarks upon the American Journal, which if it were *exclusively* or even *principally* our own production, we should of course suppress.

"I have received sir, and I continue to receive, with regularity, your Journal of Science and Arts, and I return you my par-

* A private communication from London to the Editor.

ticular thanks for your kindness in sending it to me. I have not only myself derived from it both pleasure and instruction, but I have put in the power of various persons to enjoy it also, and they as well as myself find it very well executed and consequently very interesting. I was gratified to observe that you had been so kind as to insert the notice upon the manner of collecting petrifications; a notice which I had not myself published except for the promotion of my own views; still I tender you my acknowledgments.

"But I reserve for the end of this letter, the object that has interested me most, and that which has been with me a subject of instruction and of very varied reflections—namely, the rocks and petrifications, which you have had the kindness to send me and which I received in October last.

"I have already made an incipient study of them, and I intend to return to it when I shall be able to combine all the means adapted to determine exactly or rather more *precisely* these fossil organized bodies. I shall confine myself then for the present, to the communication of some of the reflections, which these rocks have excited, and of some of the determinations which I have made respecting them; these determinations are made in accordance with the classification of mixed rocks which I published in 1813.

"The serpentine of New-Haven, of which you have sent me so beautiful a specimen, constitutes one of the ornaments of my cabinet and is referred with great precision to my species, ophicalce veinee*, (viz. veined serpentine limestone.)

"The rocks which accompany the Anthracites of Wilkesbarre and of Rhode-Island are, according to my classification, the †*Phyllades pailletees;* one of them contains the impression of a leaf of fern, whose species appears to me a little different from all those of Europe which I possess.

"I shall be very desirous that circumstances may permit you to enrich me still further, with specimens bearing the impressions of vegetables, and of all other fossil organized bodies, which are found in your coal formations, or in those of anthracite, and finally in all your bituminous formations.

* This remark was quoted in Vol. 2, p. 165, under the head of American Verd Antique Marble.

† The Phyllades of Mr. Brongniart are schists with an argillaceous basis, containing mica, quartz, feldspar, amphibole, marl, &c.

It is a very important object for Geology, to ascertain the resemblances and differences which exist between the impressions in the different countries of the terrestrial globe. I have been much occupied in this labour, and my son, who is devoted more particularly to botany, than to other branches of natural history, has aided me effectually in this work.

"The bituminous formation of Westfield, near Middletown, appears to me very different from the formation of coal and anthracite of Wilkesbarre and Rhode-Island. You also remark that this coal (if nevertheless it be true coal) is found only in thin veins, that it is bituminous, &c. This formation appears to me to have the strongest resemblance to that of the bituminous marl slates of the copper mines in the country of Mansfield and Hesse. The presence of copper is not an essential thing, and besides, it may be that pyrites or some other metallic sulphurets accompany this bituminous formation; what is certain and very remarkable, is, that this bituminous slate is perfectly similar to that of Mansfield and that the impression of a fish, which we find in that which you have sent me, is entirely like one of the species of fishes found in the Mansfield slates—it is the Palœothrissum freislebenense of Mr. Blainville—a species of fish altogether peculiar; and which has been no where found, except in these formations of bituminous slates—often metalliferous, of the mines of Mercury of the Palatinate, and of Musse, near Autun, department of the Saone and Loire. Indeed sir, the resemblance is so striking, so complete, that if it had not been sent by such a person as yourself, I should have feared that it was a rock with the impression of a fish, which had been formerly transmitted from Hessia to America, for some cabinet, and which through inadvertency, had been erroneously labelled.

"For the purpose of convincing you of these analogies, so remarkable on account of the great distance, and still, so complete, notwithstanding this distance, I send you a specimen of the bituminous slate of Mansfield, with the impression of a fish, and a very imperfect, but sufficient piece of those from the environs of Autun. If you are desirous of a greater number of the former specimens, on being made acquainted with it, I will procure them for you. You perceive sir, how this first and singular specimen has excited my curiosity, and what a pleasure you will do me if you can procure others for me. It will be very interesting to obtain *a suite* of all the fossil organized bodies which are found in the bituminous formation of Westfield; I am inclined to think for instance, that impressions of genuine ferns will be found there; it is a thing to be verified by farther observations."

Unhappily for science, the research which led to the discovery of the impressions of fish, alluded to by M. Brongniart, has been abandoned. There is no doubt however, that the specimens were genuine.

The person who brought them, obtained them at the depth of about 40 feet, while exploring for coal, four miles west of Middletown: he brought his chaise box full of them to New-Haven; he had probably never heard of the fish of Mansfield and Hesse, nor had he any theories, of any kind, to serve; his single object being the discovery of coal for purposes of profit. It is remarkable that the coincidence which struck Mr. Brongniart so powerfully, and in which he looked for the additional, although adventitious fact of the existence of copper, holds, perfectly, even in that particular. The great formation of which the Westfield locality is a portion, may be denominated the trap formation of New England. Except on the south where it touches the sea at New-Haven, it is bounded all around by primitive country. It extends more than one hundred miles from the sea coast into the interior, and varies in width from three or four to twenty-five miles; ridges of columnar green-stone trap, stretching generally from north to south, in the direction of the length of the formation, and sometimes attaining the height of seven or eight hundred feet, constitute the most prominent feature; they repose on a sand-stone rock—(considered by Mr. Maclure as the old red sand-stone) formed by the ruins of primitive rocks sometimes unseparated, and varying in its composition from a pudding or breccia with very large fragments, to a fine grained sand-stone, and this in its turn passes into an argillaceous sand-stone, and in some places into slaty clay. Beneath the sand-stone rock, lie slaty rocks (we mean argillaceous schist or thonschicfer) of various qualities, often divided by thin veins of coal and jet, impressed with what appear to be reeds and other elongated vegetables, and frequently the rock is, throughout, so bituminous as to burn on the fire. It was in such strata as these, that the fish were found at Westfield, beneath argillaceous sand-stone. Now, throughout this whole trap formation, copper is found—principally in the sand-stone rock beneath the trap. It is in the form of copper pyrites, of oxid of copper, of green and blue carbonat, and of native copper.* Many shafts have been opened for working it, and the Connecticut state's prison for convicts is in the abandoned pits and galleries, wrought many years ago, for copper, in the sand-stone beneath the trap, in the township of Granby in Connecticut. The existence of the copper then, in this region, fulfils another condition of resemblance between the countries alluded to by Mr. Brongniart, and those in this region. We would add, that although no more fish have been obtained at Westfield, because the pit has long been filled with water, they have been found in various other places in the same formation. Particularly at Sunderland in Massachusetts, in rocks that pass under Connecticut river; they were discovered by that excellent observer, Mr. Edward Hitchcock, who says they are very numerous. They are found in the argillaceous sand-stone. The additional interest imparted to our trap region by the remarks of Mr. Brongniart, with the peculiar nature of the country, will, we trust, induce some of our geologists to examine the entire formation with more scrupulous care, and to give a connected report of the whole. It is a feature almost *unique*, in American geology, and should not be allowed to remain without a complete and skilful delineation, especially as the prehnite, zeolite, chabasie, analcime, laumonite, chalcedony, agate, &c. which are found imbedded in the trap, impart an additional interest to the research.

We return to Mr. Brongniart's letter :—

"The compact blackish limestone from the environs of Lake Ontario, contains petrifactions, which I have not yet been able exactly to determine. I suppose that there is one species of Orthoceratite, and I observe among them many entrocites. But these generic determinations are too vague, and therefore ever inadequate. The case is the same with the sand stone of Cayuga, containing terebratulites of

* For some remarkable examples of very fine specimens of the latter, see Vol. I. pa. 55, of this Journal, and Bruce's Journal, pa. 149; the former of these pieces weighed six, and the latter ninety pounds.

which I shall perhaps be able, at some future time, to give you the exact name.

"I had intended to adopt a more exact order, in the minerals and specimens which I send you, but I have made up the box by little and little, and it would require too much time to commence it anew. You can easily arrange the rocks and minerals from the environs of Paris, by means of the numbers transmitted by me; the same as those that Mr. Cuvier and myself have published in the Geology of this country, which work you will find in the case.

"I am afraid that I may have included in this box, many things which you already have, but, being without any thing to direct me in my selection, I have preferred sending some useless pieces, rather than omit any thing which I imagined might interest you.

"If you should entertain the intention of sending me some minerals and rocks of your country, I will take the liberty of indicating my wishes more particularly.

"Every thing that relates to the secondary formations and to the fossil organized bodies which they contain, specimens from the formations west of the mountains, and especially from the limestones, of all formations, with their petrifactions, from the coal strata with their impressions—*of these I am particularly desirous.*

"I perceive that your position will not allow you, in person, to collect specimens of these rocks, which in general appear to be very remote from your residence; but I suppose that by means of your pupils and correspondents, you can procure some of the objects so useful in my geological researches."

"I ought not sir, to make all these demands of you if I had not received proofs of your civility, and were I not aware of your zeal for the progress of natural science. I am desirous, in return, to render you similar services here, and I beg of you to make use of my good will in this respect."

In a subsequent letter from the same gentleman, dated Nov. 3, 1820—There are remarks relating both to Europe and this country, which we are not disposed to withhold from our readers.

"I have been performing a tour, exclusively geological, through the whole of Italy, for the purpose of examining the extent and the nature of the tertiary* formations, analagous to those in the environs of Paris. I have not only traced these formations quite to Rome, but I have fully ascertained, by conversations with M. Brocchi, that they are found also at the extremity of Calabria near Regio.

"I have had moreover, a long time, in my collection, a piece of madrepore which came from this region, and which led me formerly to suppose, the existence of such formations, among those that were so far removed from what we had been accustomed to consider as their centre; I have learned from him that they exist under the volcanic rocks of Ischia; † finally, I saw them near Geneva, at a great elevation, in the environs of the small town of St. Remo, and on my return at the foot of the southern side of the Alpes, from Bassano to the environs of Verona at Rouca, Bolca &c. I am occupied in digesting a notice upon the analogy of these formations with ours, and I have learned with much satisfaction that Mr. Buckland, who on his return from Italy, also saw the same places, observed the same analogy, an analogy which holds in almost all the characters, and especially in the group ("l'ensemble") of fossil shells, and other marine bodies, which they contain.

"Thus a definite position is assigned in the strata of the globe, to the celebrated fossil fish of Bolca, that is, in the tertiary formations in analogy with those in the environs of Paris, and with those of other places. Mr. Beudant has just found these same formations in Hungary, and Mr. Prevost, one of my former pupils, has recently discovered them near Baden in the environs of Vienna, in Austria. He has prepared a memoir on this subject, and will soon read it to the Institute.

"But this analogy, so striking and complete, between the rocks and the tertiary formations, in countries very remote from each other, is not the only one which exists, and which has strongly impressed me as well as Mr. Buckland.

"The greater part and possibly the whole of the rocks which compose the crust of our globe, present, in their nature, in their structure, and in their order of superposition

* We presume coinciding generally with the secondary formations of Werner. *Ed.*

† A small Island, scarcely four leagues from Naples.

resemblances so striking, that often it would not be possible in a collection, to distinguish a psammite* or a compact limestone which came from England, from one, from the environs of Vienna or of Rome, provided the labels did not give us information as to the different places.

"We are certain of these resemblances, as to all the countries of Europe, and from indications sufficiently clear, we presume them for Asia, Africa, America and the islands.—It remains to establish them in a manner evident and certain, and to prove that they exist at such great distances.

"It is for you sir—it is for the numerous and well informed geologists, who inhabit the greater part of the American states, to follow up these observations, and to put it in our power to compare, with precision, the American formations with ours; with this view I have already sent to you, and to other American naturalists, and I will continue to forward, suites of European Rocks.

"You have also transmitted those that were, in this point of view, very interesting, and which I have already had the honour to acknowledge.

"I ask the continuance of these interesting relations, so useful to the sciences and to true philosophy and so honourable to myself.

"I have just terminated a work which I began five years ago, upon a family of organized bodies, called trilobites.—I received the last year, from the Royal Academy of Sciences, an impression in plaster, of an American trilobite sent to the academy by Dr. David Hosack of New-York, and which came from the region of Albany. I pointed out in my report, the similiarity between the formations in which this fossil was found and those in England, France, Sweden and other countries of Europe, where the same animal remains have been found, but at first, I could not establish any difference between that of M. Blumenbach and that of M. Hosack,—the plaster cast which represented the latter, was so ill defined, that no exact judgement could be passed upon the differences or resemblances.

"In repeating these observations, and comparing again, this impression with two other specimens of trilobite, one of which also, came from America, they were united by Mr.

* A micaceous sand stone (in Mr. Brongniart's nomenclature.)

Ducald. I have discovered characters sufficiently distinct to establish a particular species, remarkable for the largeness of the eyes, and which I denominate *Calymene macrohptalme*. I learn from these specimens, and from some others which I have received, in different ways—that trilobites exist in America, as well as in Europe, that the animals differ very little (if indeed they *constantly* differ at all) from those of Europe, and that they are, in both cases, found in the schists phyllades, or in the transition limestones, or at least, in those which are very ancient.

"But sir, these are only first impressions; I address them to you, and to all the American geologists, that you and they may enable us either to reduce them to certainty or to abandon them.

"My son who accompanied me into Italy, and who (as observed in a former letter) is more particularly devoted to Botany, continues his research upon the determination of fossil plants. You were so good as to send me pieces, which in relation to this subject were very curious, but, unfortunately the impressions were not sufficiently diversified or exact, to determine the differences and resemblances of the plants, belonging to the coal formations of Europe and America.

"I must then again commend myself to your zeal for the advancement of the sciences, and to your kindness towards myself. I shall here terminate this letter, which, already too long, would be much more extended still, if I were only to glance at the various subjects for reflection which my late travels have presented."

Thus we have taken, we trust, not an improper liberty with the letters of Mr. Brongniart. We have made the most important parts of them public, because we believed we could in no way so effectually promote his liberal and laudable views, as by exhibiting them in his own language. In addition to the observations upon this subject on page 7 of this volume, we would say, that geological deductions drawn from the comparison of a great number of particulars, collected from many different countries, exhibit a good example of the Baconian or inductive course of reasoning, and afford us the fairest prospect of arriving at truth. Such a research is as different from the visionary hypotheses with which geology formerly abounded, as the analytical course of modern chemistry, is from the ancient assumption of the four elements.

We may without impropriety, urge on all the friends of geology, the importance of aiding Mr. Brongniart in his great enterprize. No man is better qualified to conduct it to a successful issue, and after the specimen which we already have, of manly, perspicuous and interesting writing in Mr. Brongniart's Elements of Mineralogy, so well known in this country, we cannot doubt, that the results of the present research will be communicated to the world in a form equally alluring and useful.

We take the liberty therefore to invite our friends and the friends of science, especially beyond the mountains, and more especially in the vicinity of the various coal and other secondary formations, to collect and forward such specimens as are alluded to above, and such as are described in Mr. Brongniart's note, published in the first volume of this work. His address is Paris, Rue St. Dominique, No. 71, but we will, when desired, cheerfully act as the medium of communication, still giving due credit to the individuals who may make efforts on this occasion, so interesting to science, and which may be so honourable to the American character.

ART. III.—*Miscellaneous notices and memoranda of facts, relating to American Mineralogy, and Geology, Localities of Minerals, &c. &c.*

1. *Cursory notice of some parts of North and South Carolina;* by DR. TIMOTHY DWIGHT PORTER, *one of the faculty of the Un. of S. Car. in a letter to the Editor, dated*

COLUMBIA, S. Car. Oct. 18, 1820.

Dear Sir,

I HAVE recently returned from a hasty ride of about four hundred miles, into, and through the Northwestern portions of this state. The limitation of my time was a matter of regret to me, as it prevented almost entirely any of my favorite researches. The country which below Columbia is very nearly a perfect level, and after, as it were ascending one stair at this place, (which is situated on the falls in the Congaree, and is said to be the boundary of the primitive formation,) continues to exhibit the same appearance for a day's ride toward the mountains, then becomes undulating; and the hills gradually increase in height, and steepness, till they rise into mountains near the Blue ridge. The rocks at the falls, at Columbia, are granite—next to these in one spot, I noticed on the east side of Broad river, at about eight miles distance from Columbia, green-stone; on the other side of the same stream none of this latter rock met my observation on the route westerly, to Pendleton District, but instead of it, sand-stone, stratified : and partially disintegrated granitic and shistose rocks. The surface of the earth was covered very extensively, in every part of my ride, with loose irregular fragments of quartz, varying in size from an inch or two to two feet in diamater. I saw no masses of quartz in place—but no particular examination was made. The appearance of the country is precisely the same with that of Virginia where the titanium was found; [See Vol. II. p. 143 of this Journal.]—and here too, the same mineral was met with. Crystals of quartz, many of them handsome, were collected in the road in different places. The celebrated Table Mountain lay near my route, and was visited; that great mass of granite, eight hundred and twenty-two feet in height, and almost absolutely perpendicular, extending near a mile with the same smooth and even front, but so covered that no termination is to be seen from the station of the spectator, produces strong impressions of grandeur.

A new road is now cutting across the Saluda mountain, and passes through granite, some of it very fine and handsome, much like the Chelmsford Granite, used in Boston. In one spot a vein of gneiss lies in the granite, in the side of the mountain—but perhaps *vein* is not the word proper to express the truth in this case, block might be better. At about fifteen or twenty miles from the mountains on my return to Columbia, green-stone began to appear, crossing my path, and alternating with granite : it continued for thirty miles or more to meet me, passing to the South. Some of the specimens were very fine grained and handsome, others of coarser texture, exhibiting much the same variety as the New-Haven mountains. I had very little opportunity to search for particular minerals ; a few fell in my way, and of course were not neglected. A very few small specimens will accompany this letter. The four sided and terminated crystals* were furnished me by a ramble in Buncomb, N. C. they scratch quartz, *with difficulty.* The onyx-like striped specimen was found near the same place, by Col. Blanding or Mr. Poinsett, probably the latter.

2. *Confirmation of the genuineness of the locality of American Corundum, mentioned p. 7 of this Volume. Extract of a letter from Mr. John Dickson to the Editor, dated Charleston, March* 9, 1821.

As to the locality of the Corundum I thought it had been noted. I think it was Laurens District; at all events it was picked up by my own hands, if not in situ, in a place to which no geological or mineralogical specimens had ever *been carried*, and which it could have reached only by one of the usual and natural accidents which displace minerals of all kinds, and leave them at greater or less distances from their beds. I am sure it is American and Carolinian. I hope to revisit the upper country in three or four weeks, and shall pay particular attention to this point, and I am in hopes of obtaining other specimens equally well marked. I shall be able then perhaps to correct any mistakes I have made on former occasions. My brother, Dr. S. H. Dickson, will accompany me on this tour, and we

* *Crystals of Zircon.*—The crystals alluded to here are parallelopipeds, with rectangular bases—a four sided pyramid is set upon the prism, sometimes at both ends, and in such a manner, that the angles of the base of the pyramid correspond with those of the prism—the crystals are very smooth, of a light, almost drab brown colour, and they have a somewhat varnished appearance, a little resembling the vesuvian. The edges, sides and solid angles have great neatness and finish. They scratch quartz, carnelian, and other siliceous stones, and even slightly impress beryl. The specific gravity is 4.—they are completely infusible by the common blow-pipe, but before the flame of Hare's compound blow-pipe melt into a white enamel.

All these characters induced us from the first, to think the crystals found by Dr. Porter, to be zircon, and in this opinion we are supported by Prof. Cleaveland, to whom we have since transmitted a specimen. It will be observed that the specific gravity is somewhat less than that commonly attributed to zircon, and the angle formed between the planes of the prism and the corresponding ones of the pyramid, differs a little from those laid down in the books. The crystals are from one fourth to three fourths of an inch long, and from two eighths to three eights of an inch in diameter. This interesting locality should receive farther attention.—[*Editor.*]

shall both be gratified if we can add any thing to the stock of useful knowledge by the best observations we can make.

3 *Lime for water Cement.*

The following notice of the lime used in the sub-aqueous constructions of the great canal in the state of New-York, we owe to the kindness of W. W. Woolsey, Esq. The specimens alluded to have been received, but we have not yet been able to subject them to any experiments.

Extract of a letter from Benjamin Wright, Esq. chief Engineer of the Erie Canal, to W. W. Woolsey, Esq. of New-York, dated Rome, June 24, 1820.

Dear Sir,

The specimen of Argillo-ferruginous limestone, herewith presented, is found in great abundance in the counties of Madison, Onondaga and Cayuga, in the state of New-York. When found *in place*, it is always under the blue lime, which is uniformly overlaid with grey lime. The grey is the upper stratum, and is found in large heavy blocks; the whole six or eight feet in thickness. The blue which next occurs, is various in thickness, and from it is made the beautiful white lime. Under the blue lies the first described, which is found to be a superior water cement, and is used very successfully in the stone work of the Erie canal, and believed to be equal to any of the kind found in any other country. I cannot give you the analysis—if convenient to give a sample to Mr. Silliman for his examination, it might be useful to the community to have its properties fully understood, and if he thinks it merits a place in his useful publications I presume he will give it. I do not know that it is found in the counties west of Cayuga, but presume from the geological character of that county it may be found in all the country west to Niagara, and probably further west. It is pulverized (as it will not slack) and then used by mixing two parts lime and one part sand. It hardens best under water, and it is believed its properties are partially lost if permitted to dry suddenly, or if not used soon after mixing.

Mr. Canvass White, a friend of mine, has obtained a patent for it when used for *hydraulic purposes*, and it is believed it will answer an excellent purpose for rough casting.

&c. For cisterns it will be much used, no doubt, and for all the principal erections of stone work for canals, it is indispensable.

Respectfully, I am,
Dear Sir, your Obedient Servant,
BENJAMIN WRIGHT.

W. W. Woolsey, Esq.

We are informed by Mr. Woolsey that the price of this lime, pulverized and burnt and delivered at Utica, is twenty cents the bushel. Mr. W. remarks, that " Mr. Wright is a gentleman equally distinguished for respectability of character, and high attainments as a civil engineer," and that " his accuracy may be relied on."

Postscript, April, 3, 1821.

In February we had an interview with Mr. White, from whom we obtained the following result of the analysis of the hydraulic lime, by Dr. Hadley.

Carbonic acid, - -	35,05
Lime, - - - -	25,
Silex, - - - -	15,05
Alumine, - - - -	16,05
Water, - - - -	5,03
Oxid of iron, - - -	2,02
	98,20

To this notice we add the following extract of a letter from Myron Holley, Esq. one of the Commissioners of the great canal, dated Albany, 20*th January*, 1821.

Mr. White, one of our Engineers on the Erie canal, and a man of good character and useful attainments, especially on subjects connected with his profession, discovered, in the course of the season before last, the material for making an excellent water-proof-cement, existing in great abundance in the western district of this state. And we have made extensive and profitable use of his discovery in the locks and other mason-work of the Erie canal. It is probably superior to Parker's Roman-cement, in quality, and may be afforded at less than half the expense of that. It will, therefore, probably soon come into general use throughout our country, whenever such cement is required. Mr. White has some specimens of the stone which constitutes the principal material of his discovery, which he intends presenting to you.

4. *Micaceous Iron ore, for oligiste of Hauy.*

We have recently seen this ore in very thin delicate plates from Virginia, and from Mr. Lane's mine in New Stratford, Conn. That mentioned (pa. 50, Vol. I.) as occurring near Bellows Falls on the Connecticut river, we are informed by Professor Hall, is found at Jamaica, in Vermont, twenty miles directly west of Bellows Falls. It is a remarkably beautiful but very fine grained variety—in its structure much resembling the finest grained Dolomite of the Alps; the plates however, although thus minute, are distinctly visible, but their coherence is so feeble that they crumble easily between the fingers; the grains are not affected by the magnet. We have recently received a specimen of this fine mineral from Dr. I. A. Allen, of Brattleborough. He states that it is found in Ball Mountain, which rises five hundred feet above the water in West river. Dr. Allen will supply specimens by exchange or otherwise. From the adhering matter, this ore would appear to be imbedded in mica slate.

5. *Notice of the Salem Sienite, Jasper, Amygdaloid, &c.*

The uncommon beauty of the polished specimens of this rock, induce us to give the following particulars derived from the Rev. Elias Cornelius.

The specimens accompanying this were taken from a rock which is found in Salem, Mass. near the eastern extremity of the peninsula, or neck of land upon which the town is situated.

The rocks in its neighborhood are either pure granite, or that variety of it called sienite, the hornblende of which is diffused in different proportions, from a few specks scarcely discernible, to very considerable quantities.

The only difference between the rock which has so recently been wrought, and that which is commonly found is, that it has a finer texture, and is capable of the highest polish—its hornblende being also diffused in a kind of porphyritic manner.

The mass from which it is taken lies upon the side of a hill—in the form of a ledge, and may be split into slabs without digging, or any similar difficulty. The quantity appears to be very considerable.

We have received from Dr. B. L. Oliver, handsome polished specimens from Salem, some of which we are inclined to call Jasper; those which we are told are called Porphyry at Salem, appear to be rather amygdaloid; the foreign imbedded substances are rather ovoidal, or almond shaped concretions, than crystals; the latter, imbedded in some basis, being necessary to constitute a true porphyry.

6. *Microscopic crystals of Iron Pyrites.*

Extract of a letter to the Editor, dated Baltimore, Oct. 22, 1820.

The object of the present letter is to send you inclosed, some of the most minute, cubic and octahedral, and other varieties of crystals of sulphuret of iron that I ever saw; they were sent to this place from Scotville, Kentucky, as *flowers of silver.* I pronounced them at once to be pyrites, and thought them powdered fragments, but the lens betrayed the crystals, which are beautiful and well defined. I do not recollect seeing in any cabinet such small ones, and I feel desirous that you should possess a specimen. If you think it worth while to notice their discovery in Kentucky, you can do so. I am very truly, yours,

R. GILMORE.

These crystals are singularly beautiful; they are so minute, that they look like brass filings.—[*Ed.*]

7. *Limpid Quartz, from Fairfield, New-York.*

Localities of quartz are innumerable, and even transparent crystals are very common, but we have received some quartz crystals (among other minerals which we may notice on a future occasion) from Dr. Porter of Plainfield, Mass. which for their perfect transparency equal any thing, of the kind, that we have ever seen; they do not exceed one fourth or one third of an inch in diameter, and the largest that has been obtained is only three fourths.

8. *Agaric Mineral.*

Professor Hall in a letter to the editor, states, that a substance found in Vermont, and there called chalk, effervesces with nitric acid in precisely the same manner that English chalk does; it answers all the purposes to which *Spanish white* is applied, and is used in making putty; and is from the Lyndon, Caledonia County, where it exists in inexhaustable quantities. The specimen transmitted by Prof. Hall, corresponds with his description, and has every appearance, as he intimates, of a disintegrated carbonat of lime, whose minutely divided parts have been feebly reagglutinated. It so strongly resembles agaric mineral that we have ventured to give it that name.

9. *Marbles of Kentucky.*

We have received from Mr. Joseph W. Edmiston, handsome specimens of compact marbles from Kentucky—they are stated to be from the counties of Clark, Jessamine and Woodward. Their colours are yellow, smoke and ash grey and they are considerably variegated by darker clouds.—Being from a secondary country, their structure is wholly compact, and they are, most remarkably different from the highly crystalized marbles of the primitive countries.

10. *Fetid Crystalized Limestone.*

We formerly mentioned a *fetid* crystalized limestone transmitted by Prof. Dewey. Mr. Samuel Morey of Oxford, New-Hampshire, has transmitted another, which although fetid by friction and percussion is very distinctly crystalized and its colour greyish white. It is from the vicinity of Oxford, from a quartz mountain in a country highly primitive.

These facts connected with that mentioned by Dr. Hayden, (Vol. 1, p. 307) and by Prof. Dewey, seem to evince that the fetid odour of minerals cannot always be traced to organized matter.

11. *Fluor Spar on the Genesee River.*

[Communicated by Mr. John Boyd, a member of the Senior class in Yale College, from Winchester, Conn.]

Fluor spar in transparent cubical crystals imbedded in fetid limestone, is found in the bottom of the great Western canal, on the east shore of the Genesee river, at Brighton, Ontario county, N. Y.

Chalcedony is found among the loose masses of rock below the Genesee falls, at Carthage, Ontario county.

We have seen this fluor, it is very well characterized, the crystals are from one half to three fourths of an inch in diameter; being deposited upon a black limestone, and being themselves transparent and white, with a slight tinge of blue, they form a pleasing contrast with the limestone.—*Ed.*

12. *Chalybeate Spring at Litchfield.*

Extract of a letter to the Editor from James Pierce, Esq. dated Litchfield, August 22, 1820.

I have recently discovered in this town a chalybeate spring that promises to be of considerable utility. It issues from an extensive bed of sulphuret of iron, situated on the eastern side of Mount Prospect, four miles west of the village of Litchfield. The spring is copious and perennial, exhibiting in its course much oxid of iron, ochre, and a white deposit. The extract from gall nuts, or an infusion of white oak leaves produces a copious precipitate of the gallate of iron, changing the colour of the water nearly black; neither lime-water or sulphuric acid effected any change. A dense white precipitate was produced by acetate of lead, indicating probably a muriate or a sulphate. A peculiar smell, by popular opinion attributed to sulphur, is perceptible at the spring; the hands retain this smell for hours after washing in its waters. An astringent effect and soreness of the throat is produced by a free use of the spring. Iron is evidently the chief mineral ingredient of this water, but I was destitute of tests for satisfactory examination. A yellow deposit is observable in vessels containing standing water from this spring, and less effect is produced upon the water by astringent extracts. A patient afflicted by the rheumatism, attended by much debility has been greatly relieved by a free use of the spring for a few days, and a complete cure is anticipated.

Mount Prospect, above mentioned, is a rocky, wood clad, elevated ridge, of two miles extent. From its summit an interesting and diversified view is presented of villages, and lakes, and of a well cultivated, healthy country. Sienite, rendered porphyritic by crystals of feldspar, is the predominant rock of the mountain; it presents ledges of considerable height and extent. Beds of sulphuret of iron are observed on both sides of the mountain, sometimes exhibiting a white efflorescence. Native sulphate of iron has been collected on this mountain, and used in dying by the adjacent inhabitants. The spring is already much resorted to, and has excited considerable interest.

Postscript.

In an additional letter from Mr. Pierce, dated March 20, 1821, we are informed that the above mentioned "mineral spring has attained considerable reputation, and effected cures of obstinate rheumatic complaints, that have resisted ordinary remedies: its water has been sent for weekly from Hartford, and has been considered equal to that of the Stafford spring."

13. *Chalybeate Spring at Catskill—Marl and Tufa, at the same place.*

Extract of a letter to the Editor from James Pierce, Esq. dated Litchfield, March 20, 1821.

I discovered at Catskill last fall, a copious, never failing chalybeate spring, within half a mile of that village, as rich in iron as any water in America. With an extract from gall nuts or oak bark, it makes a tolerable writing ink.

Though adjacent to a turnpike where hundreds are daily passing, and exhibiting abundant ochreous indications, its chalybeate character had remained unsuspected. It is now much frequented, being found very beneficial as a tonic.

In the neighborhood of Catskill I have met with several beds of rich marl; the proprietors were ignorant of the use of this earth in agriculture; and in the same vicinity, rocks and extensive beds of calcareous tufa, deposited by streams issuing from caverns in limestone hills.

14. *Catskill Lyceum, &c.—Extract from the above letter.*

The attention of the well informed residents of Catskill has been of late excited to the study of mineralogy, botany, chemistry and agriculture, and they have recently organized a scientific institution under the name of the Catskill Lyceum of Natural History, composed of between twenty and thirty resident, and as many corresponding members, who evince much zeal, and have formed a small cabinet of minerals and plants. The corresponding members are mostly of the learned professions, and resident in the counties of Greene, Columbia, Delaware, Ulster and Otsego, generally elected at their own solicitation. I think that in time, the Catskill Lyceum will become a numerous and efficient society, well calculated to disclose the resources of the region in which it is located.

I have occasionally read to this society papers on natural History, dwelling more particularly upon mineralogy, exemplifying the remarks by specimens to render the external characters of minerals more familiar; I have endeavoured to induce research by drawing their attention to valuable minerals, which, from the geological character of the river valley, and adjacent districts, may be met with; as silver, lead, copper, plumbago, iron, gypsum, alum, salt, coal, marble and marl. I have found in different parts of the Catskill mountains, extensive ledges richly impregnated with alum, and salt licks in the same region. Some springs of Columbia and Greene county hold in solution muriate of soda. I have found new localities in the valley of the Hudson for galena, plumbago, and iron.

If I make Catskill my residence the ensuing summer, I will explore the Catskill, Shuongunck and Highland ranges.

I have embodied many new facts relative to the natural History, scenery and inhabitants of the Highlands of New-York and New-Jersey, obtained by personal examination.

15. *The Globe had a beginning.*

Mr. Amos Eaton, lecturer on Geology and Botany at Troy, Professor in the Castleton Institution, &c. infers that the earth is not eternal, because the ruins of its rocks in the form of gravel, sand, &c. being constantly borne down by the rains, torrents, &c. to the sea and other low situations, there ought by this time to be no "projecting rocks," not one "naked cliff," but all should have been "alluvial."

By collecting and drying the sediment from the water of the river Hudson, opposite to the city of Albany, during three days of the great freshet of April, 1819, he found that it amounted to a certain quantity for every quart of water; the quantity of water being duly estimated from the dimensions of the channel and the rapidity of the current, Mr. Eaton computes that twelve hundred tons of alluvial earth passed in three days.

16. *Hill of Serpentine.*

Extract of a letter from Dr. William Atwater, dated Westfield, Mass. March 12, 1819.

With this letter I send you some specimens of stone which abound in this neighborhood. In the second number of your Journal of Science, &c. there is an account of the different strata in the Southampton level leading to the lead mine, in which the writer, Mr. Amos Eaton, mentions a vein or quarry of serpentine rock between this town and Russel. The dark coloured specimens are, I presume, from the same quarry as the one to which he refers. The green coloured specimens are from a mountain fifteen or twenty miles distant. The mountain, or bluff, which is perhaps as large as east rock at New-Haven, is wholly composed of this kind of stone or marble.

The specimens mentioned above are very dark green serpentine, with numerous patches and spots of talc, and other magnesian minerals imbedded; the polished pieces are handsome, and large slabs, such as might probably be obtained, would be ornamental in architecture.—*Ed.*

17. *Fetid Dolomite.*

Extract of a letter from Professor Dewey, to the Editor.

I have found dolomite in Lee, east of Stockbridge, perfectly *fetid*—as much so as any of the fetid carbonates of lime. On breaking, the odour is strong, and continues for some time; and friction gives it off abundantly. The stone has the appearance of dolomite, and not of the fetid limestones, and a solution of it in sulphuric acid gives magnesia in abundance. Dolomite is very abundant indeed in this county. I find that most that is usually called limestone, is dolomite.

18. *American Wavellite.*

On the subject of the Wavellite mentioned p. 249. Vol. II. Professor Dewey in letters to the Editor remarks:

Since I wrote you, I find that Wavellite is mentioned in Aikin's mineralogy as occuring in stalactical forms in England; Professor *Cleveland* does not mention this. There is indeed no doubt in my mind, that the new mineral found at Richmond, is Wavellite. Continued for one hour in a high red heat, it lost thirty six per cent. of water—I had before known it lose thirty three per cent., and thirty. The continuance and the degree of heat obviously throw off more water, and I find very little besides alumine left. I think it must be called *hydrargillite.* It occurs in an earthy form, and has been found in another town. I intend to send you a more full account of it.

19. *Geological survey of the County of Albany, &c.*

Under the direction of the Agricultural Society of the county of Albany, a geological survey of that county has been recently executed by Dr. Theodore R. Beck and Professor Amos Eaton, with a particular reference to the improvement of agriculture. The attempt is novel in this country, and is creditable both to the patrons and agents in this work, which appears to be executed with laudable fidelity and ability. We wish it may be followed by similar efforts in other parts of this country. We observe also, among numerous other important subjects discussed in the fourth volume of the Transactions of the Society for the promotion of useful arts in the state of New-York, an elaborate paper on alum, by one of the above gentlemen, namely, Dr. Theodore R. Beck.

He has concentrated much useful information on this important practical subject and the paper may be advantageously consulted by those who wish to obtain the most important facts without the trouble of consulting numerous authors.

Dr. Beck's memoir contains the following remarkable fact:—A distinguished American general was interred, several years since, at the town of Erie, on the border of the lake of the same name. His son, three or four years ago, removed the remains to Chester county, in Pennsylvania. "On raising the body, it was found in a high state of preservation, so much so, that the features were readily recognized by those who had previously known the general. The flesh was indurated to such a degree that it could not be separated from the bones by a knife."*

In short, the body appears to have been a perfect natural mummy; the preservation is imputed to aluminous salts which abound so much there that "quantities of crystalized alum are found on the surface of the ground."

20. *Alum in decomposed mica slate.*

Among the sources of alum, there is one which we have never seen mentioned by any author. It is from the decomposition (not of clay slate, which all authors mention, but) of *mica slate.* We have been frequently presented with specimens of alum *formed in decomposed mica slates,* as from the towns of Preston, Waterbury and Huntington, in Connecticut, and indeed we have seen but a few instances of American alum, derived from any other source.

* If we are not in an error, this body had been interred more than twenty years.—Ed.

It is, as we are informed, so abundant in some places, that the people use it in dying, without resorting to any other supply. We are not aware that this source of alum has been observed in other countries. We have not room to discuss the origin of the alum in these cases; but we will add, that in some decomposed mica slates, we have seen sulphur in a state of freedom, mixed with the proper constituents of the rock, and burning abundantly with the characteristic flame and smell when thrown on the fire. Indeed, is it not probable that alum will be obtained from more rocks and minerals than have yet been thought of for this purpose. The very remarkable example of Breccia from Mount D'Or in Auvergne in France, mentioned in volume two page 356 is an example in point.

21. *Remarkable locality of Garnet.*

Garnet is a mineral of such frequent occurrence in primitive countries, that it would be useless to attempt to point out all its localities. In Connecticut it is most abundantly diffused through the vast strata of mica slate and gneiss, but especially of the former. The garnets mentioned in the following account are remarkable for the neatness of their crystalization—the planes are smooth, the angles, and edges well defined and they are bounded, each by *twenty-four trapezoidal faces;* not unfrequently they occur in pairs; their general size is from that of grape shot to that of musket and pistol balls; they are imbedded in a mica slate, composed almost entirely of Mica which is in plates and possessed of so little cohesion, that both on the outside and inside of the rock, it crumbles easily between the fingers.

22. *Garnet Rock.*

Extract of a letter from Mr. Lloyd Seeley, to the Editor, dated Weston, Ct. May 27, 1820.

" Garnet Rock or the precipice in and about which, garnets are found in abundance and perfection, is situated one mile and an half South of the Congregational meeting-house in the town of Reading, and about one half mile North-west of the junction of the two largest branches of the Saugatuck river, which unite a short distance above the south boundary of the town of Reading. This precipice is about sixty rods North-west of the house of Mr. John Gray, and about seventy-five rods West of Mr. Seth Andrus' house. The North-west branch of Saugatuck river runs a winding course in a southerly direction at the foot of the hill, on the top of which are the rocks under consideration. At the passage of the river in this place are erected on the east side, a carding machine, and on the west, a saw-mill, not laid down on the map of the State. Thirty rods west of these two buildings on the west side of the stream, I found the garnets to be most abundant.

The hill on which are the rocks and precipices, is perhaps sixty or seventy feet high, and of very steep ascent. On the top of the hill, the rocks are situated, and at the base of these rocks on the South-east side, the garnets will be seen by the most inattentive observer, projecting from the rocks in a manner resembling musket balls, shot half way into a board. These rocks are overshadowed with trees of red cedar which grow in their interstices. This kind of trees extend to the North and West of "Garnet Rock" for more than a hundred rods, while on the South and South-east, an extensive, uncultivated plain is presented to the eye, so that an observer acquainted with the description of this spot, would be able to tell where it was, when he was at a distance of some miles.

The inhabitants seem to be gratified, in being guides to strangers who wish to visit the place, and even assisted me in my endeavours to procure garnets for those friends who esteem them as valuable scientific curiosities.

I have been thus particular in my description of the local boundaries of "Garnet Rock," so that whoever needs it, may be at no loss to find the spot which must afford to every scientific visitor, pleasure in proportion to the interest he feels in the progress of geological, and mineralogical knowledge.

23. *Curious variety of Carbonat of Lime resembling Agaric Mineral.—(Communicated.)*

Four miles south of Manchester, (Vermont,) on the great road from Bennington to Rutland, there is a mass of disintegrated lime-stone, from which is made a beautiful lime for plaistering rooms.

Immediately west of the road, is a narrow marsh thirty or forty rods wide, at the western extremity of which, a steep bank rises, perhaps twenty feet in height; through this bank at right angles to it, a chasm has been worn by a small stream, to the level of the marsh adjoining. The banks of the chasm thus formed, disclose a mass of loose earth of a dusky white, exhibiting an appearance very much like that of a bed of slacked lime, somewhat aluminous, when triturated between the fingers; it has a degree of lubricity; when it is soaked by the water, it adheres to the shoes like common clay, difficult to rub off.

In some places in the vicinity of the stream, where the earth has been penetrated by the water, and dried again by the action of the sun, the surface exhibits nodules of the size of a walnut, minutely perforated, appearing like a very compact moss, its organization also, like that of moss, being very easily destroyed, by compressing it with the thumb.

Detached pieces are found, possessing a curious structure. At first it would seem that they were pieces of turf, the roots of which had been incrusted with lime; but the whole is easily reduced to a fine white powder by trituration. In some cases this ramification is very minute and very beautiful, in others it is coarser and very irregular. Some exhibit the appearance of the incrustation of a limestone cave, but without polish and very porous.

This earth is very easily deprived of its carbonic acid, and is converted into a finely pulverized quick-lime resembling wheat flour.

The quantity must be considerable, as the whole bank appears to be composed of it. J. R

24. *Virginia and Illinois fluor spar.*

In Dr. Bruce's Mineralogical Journal, Vol I. p. 79 there is a notice of this Virginia fluor spar, communicated by the late Professor Barton of Philadelphia.

Through the kindness of the late Richard P. Barton, Esq. of Virginia, and of his son, Mr. D. W. Barton a member of Yale College, we last summer, received a box of this fluor spar. Some circumstances may be mentioned in addition to, or in illustration of Professor Barton's account. It appears that "the fluor spar is found at the foot of the north mountain on the east side, twenty five miles south west of Winchester, and it appears to be confined to a small spot of ground not exceeding twenty or thirty yards square." Although this fluor spar is spoken of as occurring in loose pieces, it evidently cannot be far from its native bed, which must be in the lime-stone of the contiguous mountain.

Among the specimens sent to us, the violet fluor is, in some instances *inlaid* like mosaic, in large, white, and brilliant fragments of rhomboidal calcareous spar; the contrast produced by the violet fluor in its white bed is beautiful.

This fluor spar is highly phosphorescent when thrown on red hot iron in the dark.

We do not observe any crystals among our specimens, although the cleavage and fracture shew the usual crystaline structure.

In exposing some pieces, recently to phosphorescence, we observed the fragments thrown around by decrepitation were frequently very distinct tetrahedra, thus giving us, spontaneously, the integrant molecule ordinarily obtained by dissection.

P. S. Since writing the above, we have learned the following additional particulars from Mr. D. W. Barton.

The fluor spar may be said to be at the foot of the north mountain, as the ascent is not perceptible until you arrive at this spot. It is found on a small ridge of yellow clayey soil, deposited in the space intervening between two walls of lime stone, which is the common rock in the country; indeed within this vein (which is probably twenty or thirty feet wide) the crystalized carbonat of lime alternates with the fluor spar.

The direction of the vein is parallel with the range of the mountain, i. e. nearly north and south. The land has once been cultivated, and the fluor spar near the surface has been broken by the plough and dispersed over a space of forty or fifty yards in extent. The locality has never been diligently explored, and it is therefore not ascertained whether the mineral exists in masses of considerable magnitude. However, all the researches that have hitherto been made indicate that it does.

Illinois fluor.—In Vol. I. p. 52, of this Journal the fluor found near Shawnee Town (Illinois,) is mentioned. We understand it continues to be discovered in increasing quantities, and in a recent letter from Shawnee Town, we are informed that it has been found in loose masses as large as twenty-four pound shot; they are of a fine violet colour and the surface is covered completely with cubical crystals; they have every appearance of having been formed in beds of clay.

25. *Manganese and Sulphat of Lime in Virginia.*

In a letter from the late Rich. P. Barton, Esq. we are informed that the manganese mentioned by Dr. Barton (Bruce's Journal, Vol. I. p. 80,) is found in considerable quantities ten or twelve miles east of the locality of the fluor spar, but not in the same mountain.

Very lately also, plaster of paris has been discovered in Jefferson county at the foot of the Blue Ridge, and near Shanandoah river, twenty-five miles north east from Winchester. I believe, adds Mr. Barton, that in no other instance has sulphat of lime been found on the east side of the Alleghany mountains in Virginia. On the west side much has been found, on the Holston and on the Kenawa.

26. *Alum-stone and other minerals in Ohio, with remarks on vegetable remains.*

Extracts of letters from Caleb Atwater, Esq. of Circleville.

Speaking of the slate rocks of Zanesville, Ohio, of which some account was published (page five) in this volume, Mr. Atwater remarks :

Alum-stone is frequently found one two and three feet in thickness, remarkably rich. Immediately above the shale, I have found it in such situations in great abundance and in many places.

The flint beds of Ohio, are somewhat different from those of England, and I intend to point out that difference at some future day, and also to send you a complete set of specimens from our flint beds. Copper, I suspect, frequently occurs in our flint beds ; I must collect what I deem to be such. The green carbonate of copper is said to occur in great abundance in the flint beds of Athens county, about sixty miles from this place.

Since I wrote to you, I have procured engravings of the fossils found in the coal fields of England. I was thus enabled to compare ours with them, and the result of this comparison, I hope to be enabled to lay before you, within a few months. The bamboo, I think, certainly grew in England, but I see no cassia, nor palm leaves. The largest roots found in iron stone in England, appear to have belonged to some plant resembling the water lilly.

27. *Notice of a Dolomite and description of a soft green rock—by Mr. George Chase, in a letter to the editor dated, Randolph, Vt. Nov. 8th,* 1818.

(See Vol. I. p. 241 of this Journal.) In addition to the very singular limestone which I mentioned in a former letter, there is on a farm in Northfield fourteen miles to the northwest, a limestone—white as snow—perhaps it may be called a Dolomite. In Roxbury, there is a rock of which the following is a description. " Will not strike fire—can be scratched with a nail—slightly unctuous—general appearance of the mass green—small pieces *grass-green*—this colour when the stone is wet, is very lively—small pieces *harden* by exposure to the blowpipe, but a large piece put into the fire seemed to *break* easier after burning than before—the spots or specks throughout the stone of a whitish colour, effervesces feebly with nitric acid—those parts of the deepest green do not effervesce—scaly and splintery fracture—well fitted to be sawed and cut being free from rifts—magnet does not take up small pieces which have been exposed to the heat—there is occasionally in this stone an appearance of minute scales of mica." In Bethel, a town adjoining, a rock similar to this is cut into pieces fitted for hearths, &c. but its colour is different, being of a bluish grey. I can think of nothing in your cabinet it resembles more than grauwacke slate, but the composition is evidently different, since this is a *primitive* country. The geological situation of this rock is between the clay and mica slate.

Is not the above rock chlorite slate with some intermixture of carbonat of lime? Its infusibility is however against this supposition; we have not seen any specimen.—Ed.

28. *Pumice Stone floating on the Mississippi.*

It is mentioned by a western correspondent that at every rise of the Mississippi, pumice stone floats down from the *heads of the Missouri river.* Mr. Schoolcraft in his book mentions similar facts; the pumice stone has been observed floating even below Natchez.

Every one will see the obvious inference with respect to volcanoes in the west.

29. *Fossil Bones found in East-Windsor, Connecticut.*

In Vol. II. p. 146 of this Journal, mention is made of bones found imbedded in red sand-stone through which they were sinking a well; and the suggestion was made that they *may possibly* be human.

The following extract of a letter from John Hall, Esq. of Ellington, Connecticut, dated May 27th 1820, expresses a different opinion.

Doctor Porter, a respectable surgeon, resident on the spot was present a considerable part of the time while the well was digging, and had the best opportunity for forming a judgement of the nature of these bones. He says that the bones did not belong to a human body, but to some animal; and that the animal must have been about five feet in length. The *tail* bone was easily discovered by its numerous articulations distinctly visible when the bones were first obtained; and by its being projected, in a curvilinear direction beyond the general mass.

Dr P. further says that he critically examined the bones as they appeared when first extricated from the rock; that some of them, indeed, resembled particular bones in the human body, but would also compare with certain bones of other animals. He further confirms what, indeed, is otherwise evident, that the bones, after exposure sometime to the air, begin to crumble fast, and lose much of the appearance which they presented at first. He has specimens of the tail bone now in his possession.

30. *Coal found in Somers and in Ellington, Connecticut.*

Additional extract from the letter mentioned above.

I saw, a few days ago, a lump of coal which came from Somers. I was informed that a considerable quantity might be obtained near the spot from which this was taken. My informant was unable to describe the kind of ground from which the coal came; all that he knew was, that it was *woodland.* I believe that I never told you that I discovered a small quantity of that substance on my farm last summer, it was found imbedded in shelly sand-stone, in a hollow between two hills, in ground of the secondary formation. It was in the form of thin lamellæ and burned freely when ignited by a candle. The quantity found was very small.

31. *Geological character of the limestone of the Missouri Lead Mine region.*

Remark.—In the "notice" of Mr. Schoolcraft's view of the Missouri lead mines, (p. 65 Vol. 3,) doubts were expressed by us respecting his account of the limestone of that region; we doubted whether it could be primitive, and were inclined to think it must be of the tranistion class; we addressed a letter to Mr. S. for specimens and explanation on this point; the "*notice*" however was *printed* before Mr. Schoolcraft's letter arrived, but his letter was *written* before he had seen the "notice."

Extract of a letter to the editor from Mr. H. R. Schoolcraft, dated Albany, Jan. 31st. 1821.

I hasten to reply to your obliging favour of December 28th, which has this moment come to hand. Its delay is attributable to my unexpected tarry at this city instead of New-York; and although it is probable that it is now too late to make use of my reply in the way contemplated, it may still be thought acceptable.

"As to the primitive character of the Missouri mining country" I am happy that your enquiry offers me the opportunity of saying that subsequent observations upon the upper Mississippi, where the same formation exists, and a more minute examination of specimens brought from Missouri in 1818, have convinced me that the mines are seated in *transition limestone.* Its texture is crystaline and granularly foliated and some specimens are translucent on the edges, but it is to be remarked, that neither the crystalization or translucency are perfect, such as we see them in well characterized specimens of primary limestone. A farther examination has also disclosed to me organic petrifactions of madreporites, and other relics, very sparingly imbedded, and sometimes not to be noticed for miles in succession, even where the abrupt nature of the country exposes it to examination. The metalliferous formation is overlayed by a stratum of calcareous carbonate manifestly *secondary*, but this appears to have been much broken down, and washed away, as it is only seen capping bluffs and eminences.

As to the primitive region which I have described about the sources of the river St. Francis, you can place every reliance upon it. It will be necessary, however, carefully to distinguish the limits which I have fixed to this formation, and which, I believe, are defined with sufficient precision in the work. The rock here is red granite, consisting, mainly of *feld* spar and *quartz*, with very little *mica*. It is traversed by veins of green stone, which is in some places rendered *porphyrytic* by large greenish and flesh-coloured crystals of feld spar. Of all these I shall take a pleasure in furnishing you duplicate, on my arrival at New-York, in the spring, as my specimens are now there, and I shall have no means of access to them before that time.

Art. IV.—**Instructions for conducting Geological Investigations, and collecting Specimens; by* Rev. Professor Buckland, *of the University of Oxford, England.*

(Communicated for insertion in this Journal by Prof. Hare of Philadelphia.)

In collecting specimens to illustrate the geology of our country, one great object is to obtain those substances which are of most common occurrence in it.

* In Vol. I. (p. 71) of this Journal, we published the instructions of Mr. Brongniart for collecting geological specimens, especially those containing organized remains. Wishing to give as wide a circulation as possible to this species of information, so eminently needed in this country—we now publish the instructions of Professor Buckland which, if we mistake not, will be found like those of Mr. Brongniart, to be drawn up with that skill which we might indeed expect from men so thoroughly versed in the subject.

The best authorities to be consulted are engineers, miners, masons, well-diggers, and quarry-men: the latter have in the course of their work, constant opportunities of collecting what is most valuable, viz. fragments of stone containing in them the petrified remains of animals and vegetables; and it requires no knowledge of geology to obtain from such persons good information and specimens.

It is desirable to get from every country specimens of all the varieties of rocks occurring in it; *e. g.* of building-stone, free stone, marble, limestone, slate, and all kinds of common rocks and also of every variety of fossil shells, plants, bones and metallic ores, with a list of all the places where similar rocks and similar organic remains are known to exist.

If several varieties of stone occur in the same cliff or quarry, specimens of each should be taken and numbered according to their order of succession, marking the uppermost No. 1. and thence descending. The thickness and quality of each bed should be also mentioned, and whether they contain shells, plants, or pebbles in them; if they do, specimens of each should be collected.

If the rocks are stratified, i. e. divided into beds, it should be noticed whether they are horizontal or inclined, or contorted.

If inclined it should be stated at what angle, and towards what point of the compass.

If contorted, a sketch would be desirable.

Slight sketches of any sections of strata on the sea-coast, showing their inclination, and marking the changes that occur in their substance and colour, will be of great value.

Where there are wells, it will be desirable to get a list of the strata sunk through in digging them, giving the thickness of each from the surface downwards.

In volcanic districts to get a list of volcanos now in action, and of the craters of volcanos; stating their position and distance from the nearest town.

To get a list of all places known to contain coal, bitumen, salt, alabaster, metallic ores, and precious stones; specifying their kinds, and to what extent they have been worked.

In cases of coal-pits, specimens of the coal itself, and of the different strata sunk through to obtain it, especially those which have impressions of plants on them, will be valuable. Also a list of the number and thickness of each of the beds of coal and their supposed extent, stating whether limestone or iron ore, or springs of bitumen occur near them.

Fossil plants, corals, shells, fish, and bones of all kinds, with a portion of the rock in which they are found, are of all specimens the most valuable. Also fossil tusks and teeth and horns of elephant, rhinoceros, hippopotamus, ox, stag, &c. &c. which abound in diluvian gravel over Europe, North America, and Siberia.

If there be any example of petrified human bones, specimens of them, accompanied by portions of the substances in which they occur, and a minute description of their situation and circumstances, are particularly requested: they should be sought in beds of diluvian gravel, which are spread abundantly over the surface of all great vallies in the world.

Rules for selecting and conveying specimens.

In selecting specimens of common rocks, the best size is that of a common flat piece of Windsor soap, taking not the outside bit, but the second slice that is struck from the block by the hammer.

Every specimen should be ticketed with the name of the place where it is found, or with a letter or number referring to a catalogue describing it: in case of places little known, their distance from the nearest important town, and in what direction should be specified.

Every specimen should be wrapped in a separate piece of paper, and the whole closely packed with moss or hay, in a barrel or strong box, to be sent by ship to London, directed to "Rev. Professor Buckland, Museum, Oxford, to the care of Mr. Hunneman, 5 Mead-street, Dean-street, Soho, London." The bill of lading, with notice of the arrival of the vessel, should be sent to Mr. Hunneman, who is Mr. Buckland's agent, and will duly forward the package to Oxford.

It is desirable to get sent to England a list of the best maps and books descriptive of foreign countries, specifying how far they are correct, and their time and place of publication; and also a list of the names and address of all the naturalists that may be resident in them, stating to what department of natural history they have given most attention, and whether they would be willing to correspond with persons in England who are devoted to the same pursuit.

Art. V.—*Bursting of Lakes through Mountains.*

(Communicated for this Journal by the author.)

TO PROFESSOR SILLIMAN.

The modern theories of the earth have certainly gone too far in ascribing geological appearances to second causes. We have specimens of what I deem this kind of extravagance in Volney's Views, in the Notes on Virginia, and in the Appendix to the American edition of Cuvier's Theory. In the Notes on Virginia we are told, that the Blue Ridge at Harper's ferry was torn asunder by the pressure of waters on the north west. The writer of the appendix has improved upon the hint, and maintains that the North River at West Point, the Delaware below Easton, the Schuylkill to the south west of it, and the Susquehannah below Harrisburgh, find their way through the mountains, by passages torn open by the pressure of Lake Ontario, of which that mountain was formerly the south eastern boundary!

It requires but a slight acquaintance with the courses of the mountain, its figure and altitude, and the configuration of the valley along its north west side, to be satisfied, that all these hypotheses are not only improbable, but certainly unphilosophical.

The Highlands from West Point are extended almost unbroken into Georgia. In Jersey, this range of mountain is known by the name of Kittatinny, from a tribe of Indians of that name that occupied a considerable extent of district along its base, near where the Delaware river passes through it: in Pennsylvania it is distinguished by the name of the South Mountain: and in Virginia it is known by the name of the Blue Ridge. I would adopt the Indian name, and denominate the whole, the Kittatinny mountain. North east of Harrisburgh, it sweeps round to the south east, crosses the Susquehannah above Columbia, and returns in a circular course until it regains its ordinary direction, south east of Carlisle. That bend is the lowest part of the range. Its altitude for twenty miles is at least five hundred feet less than that of the Highlands at West Point. The valley between the Kittatinny mountain and what I call the Powhattan range, known by that name in Virginia from the father of Pocahontas, is continued from the North River into Georgia, without interruption from even one ridge. I have travelled along it nearly five hundred miles, at least I am acquainted with it from Newburgh to Fincastle in Virginia. The tide flows across this valley in the North River, of course it is here much lower than at Fincastle, which is two hundred miles from the sea-board. So that the waters of James River might be brought by a canal into the Hudson river near Newburgh.

To say nothing of the unphilosophical hypothesis that represents the mountain torn asunder at six points simultaneously, it is most evident, that the supposed lake could never have risen within five hundred feet of the summit of the Highlands at West Point, as they would have discharged themselves over the summit of the mountain below Harrisburgh. The same remark applies with still greater force to the passage of the Potomac, at Harper's Ferry.

But what is most decisive, the height of land on the route of our northern canal, is only one hundred and fifteen feet above the head of the tide at Still Water, on the Hudson. Hence the waters of the lake would have discharged themselves by lake Champlain and the Sorrel into the St. Lawrence, before they could rise within fourteen hundred feet of the summit of Butler Hill, near West Point.

Is it not the best theory of the earth, that the Creator, in the beginning, at least at the general deluge, formed it with all its present grand characteristic features ?*

If the above short dissertation comports with the design of your Journal it is at your service.

Truly yours.

J. W. WILSON.

Newburgh, 29*th March*, 1821.

* The Creator undoubtedly brought all matter into being and established the laws which govern it; the operation of those laws then is always a fair subject of discussion, and although it is the *shortest* it is not the most *instructive* course, *to cut the knot* where it may be *untied.—Ed.*

Art. VI.—*Geological and Mineralogical Observations on the North West Portion of Lake Huron; by Dr.* John I. Bigsby, *of the Medical Staff of the British army in Canada, and Assistant Secretary under the 6th and 7th Articles of the Treaty of Ghent.*

TO THE EDITOR OF THE AMERICAN JOURNAL OF SCIENCE.

Sir,

I very respectfully beg your acceptance of a few geological observations on the north west portion of Lake Huron; collected under rather favorable circumstances in the summer of 1820.

The part of Lake Huron under examination is contained within the Latitudes 45° 46′ and 46° 20′; and by the Longitudes 83° and 84°, with some exceptions of small importance.

At the upper part of this space the waters of Lake Superior are received, through the medium of the straits of St. Mary and the minor Lake, George; and by three channels, the sum of whose breadth perhaps does not exceed a mile—as the interval of three leagues or more between the north and south shores of Lake Huron, is here (lon. 84° lat. 46° 20′) principally occupied by the large islands of La Crosse and St. Joseph.

St. Joseph, with which we are more immediately concerned, is compact in shape and woody, rising to the height of five hundred feet in the centre. It is about sixty-five miles in circumference. Its most southern point is at Fort St. Joseph, in the latitude of 46° 5′—six miles north of Drummond Island.

This latter island is the most western of the great Manitouline chain; which in the latitude of 45° 58′, divides the Lake into two unequal parts. One extremity approaches to within a mile of the South Main, in lon. 83° 52′, and the other is contiguous to Cabot's Head.

Drummond's Island is an assemblage of rocks and morasses, seventeen to twenty miles long, by five in average breadth.

The lesser Manitou, which next presents itself in the line, is of a similar character, and is about seven miles in diameter.

Of the Grand Manitou, which now succeeds, little is known. Its western termination is remarkable for its majestic precipices.

The northern mainland is high, barren and rocky; the southern shore, being of a secondary formation, is level, and abounding in marshes and the densest woods.

The north west portion of Lake Huron, (whose outline has just been traced) in common with the rest of the earth's surface, exhibits many evidences of change and convulsion: when, and in what manner effected, I am not prepared to state; but they are obvious.

The original form of the bed of the Lake may be described as a triangular valley of great extent, divided in an easterly direction by the Manatouline Ridge into two unequal parts, the northern being rocky and of variable elevation; and the southern more uniform in its level, and generally lower: in its present form, the bed of the Huron Lake is covered with the debris of distant countries: its rocks are furrowed and abraded; its loftiest heights overthrown, (of greenstone, one of the most tenacious of minerals, as in the narrows of St. Joseph) separating large tracts from the Main; and finally, passages from ten to twelve miles wide and ten long, are forced in the Great Manitouline barrier itself. These violences, and particularly the first and last, indicate a more general and powerful agency than that of a gradual accumulation of the waters of Lakes Huron and Superior, whose united surplus requires only an outlet of three hundred yards in breadth (R. St. Clair) in place of the four Manitouline Detours. The effect of a gradual accumulation of water would have been to have filled the north division of Lake Huron, and in the end, to have inundated the lower grounds on the south and east by an embouchure at the point of least elevation in the Great Ridge. I am inclined to the opinion that an enormous body of water has rushed over these countries (a "debacle") swept from distant lands, the collossal fragments of rock so frequent in the Lake; and formed the breaches called the detours; perhaps at the same time when the passages of the Hudson and Shenandoah were opened, and the heights of Quebec, and the marshes of Montreal were covered with the ruins of annihilated mountains.

These fragments are incredibly numerous in Lake Huron, and may be divided into two geological classes, the foreign and the native. The former are the more plentiful, and are round and smooth. They are seen every where but are collected principally in the interior of the coasts and islands either in confused heaps, or in parallel ridges, and crowning the highest acclivities in great numbers and the fragments are of various dimensions. They belong almost exclusively to the older orders of rocks, and are therefore of a northerly origin. Granites, gneiss, mica slate, and porphyries prevail, of kinds which I never saw in situ, although I have skirted the north shore for two hundred miles, and have traversed the wilderness to the east north east for six hundred miles. Mica slate I never met with in a fixed state, excepting a few strata of the black variety at the Falls des Chat, on the Ottawa.

The other class is small, angular and ragged. They are most frequent on the beaches, whither they are driven by the waves.

A curious fact is presented by many parts of Lake Huron, and very strikingly in the north channel to St. Mary's. It shews that the debris of the present day is nearly stationary. The containing shores of this channel are of different formations, the one being of limestone and the other of greenstone; each shore is lined with its own debris, and without admixture. A few well rolled granites, puddingstones and an occasional greenstone do however occur among the calcareous matter.

In the spring the ice occasionally removes fragments of great size. During the winter it surrounds those which are placed in the shallows, and on being broken up in April by mild weather, and a casual rise of water,* it carries them to some other shore. Remarkable instances of this are found on the islets near the south end of St. Joseph, where a few yards from the water and little above its level, are deposited rolled stones *some yards* in diameter, with a furrow extending from them to the water, most probably tracing the last steps of the route to their place of rest.

Changes in the form of the bed of the lake indicate very strongly changes also in the nature and quantity of its water.

* This is very commonly observed on the wind's blowing a few days from the opposite quarter.

I believe (together with Dr. Mitchill of New-York) that it has been formerly salt, and that in the course of time it has been diluted by rivers, rains, snow, and dews: a constant drain materially assisting. The sturgeon, a sea fish, is frequent in this lake and in great perfection. The falls of Niagara prevent their access from the sea. The very immensity of the flood which has buried a continent, identifies it with the ocean. But I need not multiply proofs after Dr. Mitchill's powerful arrangement of evidences.

Many of the facts just stated, shew that the waters of Lake Huron have been in much greater quantity than at present; and to them may be added the marshy alluvions, and the extensive collections of sand around the bases of precipices, and on the sides of heights. Ancient beaches are not uncommon at some distance from the water, as on the Lesser Manitou. It is likewise evinced by the belts of rolled masses which gird every slope, and even mark the successive retreats of the lake.

The dense vegetation which covers the islands and environs of Lake Huron, restricts our geological inquiries in a great measure to the immediate edge of the water; a narrow border where the nature and stratification of the rocks are disguised by a multitude of causes.

The rocks of the districts embraced in the tour of 1820, belong to the transition and secondary classes of Werner.

The transition formation occupies the north shore of the lake and some of its subordinate islets, from lon. 83° 42′ to the foot of Lake George. From the small portion submitted to examination, it is difficult to detect their relation with the rocks around them, and even their comparative ages I was unable to assign positively, from their never over-lying each other, and from their various and often indistinct inclinations. They appear to be intermediate to the primitive regions on the north and the secondary on the south.

With respect to the surrounding rocks, those on the north and north east being situated in inaccessible fastnesses, I am ignorant of their nature. On penetrating for two miles in that direction by means of a marshy creek, I found no change. On the north west the transition is succeeded by the first slaty sandstone. On the west and south horizontal limestone is universal. Easterly they are bordered by a very extraordinary rock which, as far as my limited experience or reading avails me, is unexampled. I refer to a rock which has induced the Canadian voyagers to give to the tracts around the Missassaga river the characteristic appellation of "Le Serpent."

The extent of this rock in any direction I have not ascertained. I first observed it on the northern mainland, fifteen* miles above the river Missassaga, and afterwards, for many miles towards the river Thessalon, when morasses and luxuriant forests conceal all traces of stratification, until we reach the neighborhood of the greenstone, about to be described.†

It is an intermixture, in the large, of a light coloured greenstone, and a granitous compound of minute texture, (consisting of white quartz and red feldspar, the latter being in excess.) These substances mutually penetrate and traverse each other in nearly equal quantities, so that either may be considered matrix or vein at pleasure; and each is indicated externally by knotty, straight, waved, or stellular configurations of its own proper color, which is lively and strongly contracted. *(See plate, fig. 1.)*

The direction of this "Serpent" rock is north west, with a south west dip at an angle of 70°. Accompanying it, in the lake, a few granite mounds rise above the water, holding a northerly course, an example of the low level of the primitive rocks in America.

We have here an instance of a third rock being formed from the intimate union of two others, pre-existing and contemporaneous, which have met in the same state of fluidity, and have been enabled by violent agitation or strong currents, to insinuate themselves into each other's structure in a very equable manner.

Its geological relations and its origin, place it among the transition class of rocks.

Easterly from this locality for twenty miles or more, porphyritic granites, gneiss and trap, alternate along shore in groups forming islets, naked rocks and reefs, the granite and

* I was wind-bound for two days there.

† Previous to this, a league or so, a few vertical strata shew themselves among the marshes, which circumstance did not permit me to examine; but from their brown color, close texture, &c. I conjecture them to be a trap; particularly as fragments of that rock of a brown color are common on the adjacent islands.

gneiss having a northern direction, and the trap a south west course.

These last named rocks are distinctly primitive, and are supported on the north and north east by others of that order, as for instance, for thirty-seven miles further to the east is a large trappose* formation, at the west end passing into greenstone, but at the eastern being nearly a pure hornblende, highly crystalline, and rising in precipices which reflect a metallic lustre in certain positions. The islands of La Cloche are of this substance, which occasionally becomes a clinkstone, and has given to this picturesque cluster its present name.

The rocks for two hundred miles to the north east of this spot are, with the exception of a little white marble, invariably small grained quartzose gneiss.

Having now cursorily noticed the geology of the country in connection with the transition rocks of the north west portion of Lake Huron, I shall enter upon their description.

A greenstone in various modifications occupies the north main, from lon. 82° 42′ to the head of the Narrows of St. Joseph, a distance perhaps of twelve miles. In the extensive marshy bay, east of the broad promontory† in the middle of this distance, this rock forms islets (either barren or fringed with a scanty vegetation,) rising from the water in round and smooth ridges. It is the same here as at the lower end of the promontory, where it is a dark greenstone, very compact, yet shewing a schistose tendency in its weathered portions. It is rather thickly studded with *rolled* masses of from one to eighteen inches in diameter, of the red granitous ingredient in the Serpent rock—a curious fact. In some parts of this headland these fragments are so numerous as to give to the rock the character of a conglomerate; the imbedded substances being a large proportion of the whole.

They disappear gradually, but entirely or nearly so, and the form of a splintery greenstone slate is now and then assumed, differently colored, commonly of a dark leaden blue,

* With a south west direction and vertical. Among them at one place I observed a few granite strata running north.

† The want of appellations for the different localities is severely felt in speaking of unfrequented countries.

but running both abruptly and insensibly into cream or straw yellow, red, blue, and light green. It clearly observes a north west course, either at a high angle north east, or vertically. This greenstone is a slate on the south east side of the excellent harbor at the west end of the promontory.

The greenstone of the contiguous large island (proceeding north west) is at first for a short distance brown, in shades, and slaty, and then becomes almost pure hornblende, splitting into thick blocks, and containing few or no nodules; occasionally however changing to a reddish hue from a predominance of feldspar, as the flattened rhombs of that mineral in the fissures would seem to indicate. The rock soon after continues to the end of the island in the form it wore on the promontory, with smaller granitoid nodules. Sometimes the splinteriness is remarkably great. The direction, &c. continue the same.

At the spot where the hornblende is most abundant, thin waving veins of ligneous asbestus traverse the rock for some yards. The matrix is so difficultly frangible that I could not remove specimens more than two inches long. It shews itself by insensible gradations; the centre only of the vein being perfect. Here are also vertical veins of quartz half a foot in diameter, containing cavities lined with hexahedral prisms of great size. The surface of the rock occasionally takes a polish and becomes undulatory. In the concave portion there is often a round congeries of small and very brilliant rock crystals of a honey yellow color, which attracts the eye immediately. The only other foreign minerals I found are galena, in a thready vein three yards long, dipping obliquely into the rock, and calc spar.

The bluff at the lower end of the narrows (which are two and a half miles long) is also greenstone passing into the slaty species, and is here penetrated by a strong seam of quartz, containing much of what I conceive to be copper pyrites in mass, and in obscure octohedral crystals. The sound part yields readily to the knife, and is every where encircled with yellow and green crusts of various shades. I am at present unable to apply the proper tests from not having access to the specimens.

On passing upwards along the line of precipices constituting the narrows of the north channel to St. Mary's, we find the rock to take a reddish brown hue, and to become very splintery; so much so that the precipice frequently changes into a *steep* declivity of schistose débris. At the head of the narrows the greenstone is much less disintegrated, and dips into the clear and deep waters in compact walls of almost pure hornblende. The contiguous islets (filling up the interval of a mile between St Joseph and the main,) are of a similar formation, and are composed of aggregated ridges, rising to a great height, and presenting to the current rapid slopes of smooth rocks or perpendicular cliffs.*

The head of the narrows being the seat of a strong current, is one of the north west limits of Lake Huron. Advancing still north westward we come to the lower of the two basins (included between the north main and St. Joseph) which separate Lake Huron from Lake George on this side. The shores of the lower basin being marshy or alluvial, as is to be expected at the entrance of so confined a pass as that of the narrows, no strata are met with as far as I am aware, until we arrive at the rapid formed by the line of islets, dividing the lower from the upper basin. Here a new order of rocks occurs.

It is of quartz and is of the transition class, as appears from its associations, its inclination and the breccias and nodules which it frequently contains. It prevails from hence to Lake George, (five and a half miles.) Its direction is distinctly north west, with a dip either vertical or obscure; but at the islets of Encampment Douce, at the foot of the rapids of the Great Nibish, this is perhaps not quite so evident from the innumerable rents and dislocations, and from original displacements.

On the third large island from the rapid of the basins, (above mentioned) a parallel stratum of almost sienitic greenstone occurs, and the same is seen on the main three miles north north west. It may be a continuation of the stratum of the rapids.

The composition of this quartz rock varies much. It is here an aggregation of minute grains of vitreous quartz cemented by the same substance, opaque and of a milky white colour. It is easily frangible, and becomes soft and powdery on exposure to the weather: the external surface however is frequently hard and smooth in patches. Its frac-

* Dir. N. W. dip. vertical.

ture is earthy-conchoidal. The only substance I met with in its fissures was brilliant and well-formed quartzose prisms of a red colour.

The north shore only of the upper basin exhibits any stratification and it is of the transition quartz; but whether precisely of the same species as that of the rapid of the basins I know not. At Encampment Douce it changes; in becoming crystalline, compact, translucent at the edges, conchoidal, and in passing occasionally by imperceptible shades into a feldspathic form; the fracture being then foliated, fragments schistose, lustre shining, and the translucency at the edges very slight. It is very commonly studded with nodules of red and brown Jasper, averaging an inch in diameter, and often arranging themselves in the form of belts or stripes of from one to five feet in breadth, mingled with round pebbles of white and black quartz. Every part of the north west portion of Lake Huron abounds in a conglomerate of this rock; rich in Jaspers of all colours, and occurring in blocks of great magnitude. I never met with this species in situ.

Small proportions of black and brown hœmatite are not unfrequent in the rock of Encampment Douce, and are associated with a bluish black, scaly, ore; of iron I suppose. Quartz is sometimes met with in a state of crystallization.

I have not traced the transition farther than two miles up the Great Nibish rapids.

Having finished the observations on this class of rocks, the following inferences may not be out of place.

The "Serpent" rock was not deposited in the Wernerian method of gradual deposition, but it is the product of the forced union of two nascent formations; and which it is most easy to conceive took place horizontally, and not in their present inclination: thereby pointing out an after-depression or elevation.

All this applies equally to the greenstone conglomerate: of which it may be remarked that it is of a different era from the "Serpent" rock, though composed of nearly the same ingredients. The granitous compound is here in the form of rolled balls; which indicates that it had previously existed independently, had been reduced to fragments and subjected to attrition.

It may be conjectured that these two rocks owe their origin to the trap and granite on the north east, or that they have been evolved from the same repository but in closer combination.

The Huttonian theory explains these phenomena, by providing powers and materials.

Further evidences of the convulsions to which this part of Lake Huron has been submitted, are afforded by the six distinct species of conglomerate in the state of debris, and as many of breccia which every where abound ;* and by the brecciated and vesicular limestones of Michilimackinac.

Most probably the first flætz sandstone is the rock in juxta position on the north west, with the transition quartz just described.

It have not visited in favorable circumstances the line of junction, and I saw the former first distinctly at the falls of St. Mary, among the petty rapids of the marshy islets around the falls. In the summer of 1819, while travelling in a canoe, at dusk, I observed in Lake George not long after leaving the inclined strata, a number of islands with moderately high cliffs of horizontal rock, breaking into parallelopipeds, which perhaps are the first flætz sandstone, especially as much of its debris is found with *sharp edges* on the rapids of the Great Nibish.

The portage of the falls of St. Mary furnishes the best means of examining the stratification of this mineral. The stores of the North West Company are founded upon it; and it is traced, imperfectly covered with mould and herbage to the insular channels of the falls, in horizontal or slightly inclined layers of some thickness. It breaks and splits readily. It is soft. Its colours are principally brown and dull white or red, occasionally with yellow spots or circlets. It is the sandstone of the Genesee country N. Y. without so large an impregnation of iron.

This rock is every where surrounded by morasses.

In returning through Lake George into Lake Huron by either side of Isle a la Crosse, we gradually emerge from swampy musquito grounds into a calcareous formation, as is seen by the debris on the beaches. No fixed stratum, I believe, is met with but on the North side of St. Joseph, or in the

* These are classed in the Appendix.

latitude of the Manitoulines. With the exception of the narrow selvage of transition and primitive on the North mainland, the whole of Lake Huron rests on secondary limestone. I have myself noticed it encroaching on those classes as far East as the river des Francois on the North shore —and found it to be the only living rock in the South and in the Manitouline chain of Islands; including that of St. Joseph.

The calcareous basin of Lake Huron (and the remark may be extended to Lower and Upper Canada) differs from those of Europe* in essential particulars: in being often non-crystalline and full of organic remains while in contact with the oldest rocks—without observing their direction and inclination. Again in the Canadas, limestones deposited in the midst of flætz countries are sometimes highly crystalline and crowded with fossilized animals.

The following facts illustrate these observations.

Between the mouth of the River Des Francois and the groupe of Islands named La Cloche, there are several isles of some magnitude whose centre or nucleus is of gneiss, lofty and barren—girded by a broad zone of dark coloured horizontal limestone which is loaded with vegetation. I landed on one of them and found the rock to be soft and knotty, and full of organic remains. The same appearance occurs between La Cloche and Messassaga.

A gentleman of the party met with an island off the River Thessalon composed of a number of parallel ridges of granite much disturbed and broken; whose intervals contain horizontal limestone thus. [See the Plate, fig. 2.]

In the rear of the promontory of the Cedar Island, passage near Kingston, on Lake Ontario, I observed horizontal compact, dull, brown limestone overlying gneiss in a similar manner. Farther east, in the contracting portion of Lake Ontario, this Rock forms the immediate bank with the primitive emerging behind it thus. [See the Plate fig. 3.]

The intervals of these mounds are often (as in Lake Huron) filled with secondary limestone.

An occurrence nearly the same takes place at the Falls of Montmorenci near Quebec.

Repeated instances are met with in the thousand islands near Kingston where white quartzy sandstone, rests, in horizontal layers on granite.

* Europe, however, does contain a few similar examples.

The crystalline grey or brown limestone of the Island of Montreal, of the Falls of the Chaudiere on the river Ottawa; and of the Falls of Montmorenci, and Point Aux Trembles near Quebec, are examples of secondary strata assuming the structure of the primitive class. Their fracture is slaty in the large, and imperfectly conchoidal in the small. They yield to the knife, but not to the nail. Their fracture-surface is full of rhomboidal facets, and resembles that of Hornblende. They are at the same time full of bivalves, turbinites, branches of coral, of fibres of wood, and of small drusy cavities of pearl-spar and yellow Blende.

A strong odour of sulphur is exhaled on percussion.

The limestones of the North West portion of Lake Huron vary considerably in character and contents; and may be divided into three principal species, viz. that of St. Joseph and the islets on the north shore—that of the Manitouline Range and that of Michilimackinac.

To commence with that of St. Joseph, as being nearest the elder rocks, it is of various shades of brown, which are usually light. It is soft, knotty, schistose, and of an imperfect conchoidal fracture.

It seldom shews itself in ledges of more than two yards high, and then is much shivered; the fragments being blunt, and weathered. The lower strata are often of a greenish tinge—not occasioned by decaying vegetables and only affecting the surface, but also the deeper and sound portions. This variety is remarkable for its number of what appear to be clove brown shells, oblong, and of the size of millet seeds. On Isle Vert, (six miles East of St. Joseph, and two from north shore) this substratum rests upon a very dark blackish brown limestone so schistose as to be in fact a shale, as truly so as that of Niagara. It contains no shells. It is under water. Rhomboidal, pearl, and dog-tooth calc spar are the only minerals I met with in this limestone.

An enumeration of its organic remains is placed in the appendix. I have to lament that I am not more familiar with this interesting part of Geology.

The limestones of the Manitouline Range although in part on the same level with the species just described, differ from it in many respects; and thus themselves are not always the same. That a basin of secondary deposition, should contain on the same level, rocks of different character, is a curious fact, and appears to lead to the conclusion that the great solvent medium (according to Theories) may have been, at the same moment, charged with several forms of mineral substances in fields or districts; and without any evident barrier to prevent their commixture—a supposition which involves a perfect state of repose or a steady motion as in rivers, equality of specific gravity and of fluidity, &c.; of none of which conditions are we assured.

In Lake Huron the brecciated and vesicular species of Michilimackinac, the quartzose of the Grand Manitou and Drummond, and the odorous variety of the Lesser Manitou are on the same level.

The soft and brown kind of St. Joseph and the light coloured schistose and non-organic* of the Lesser Manitou are both on the level of the Lake also.

Lake Ontario presents similar appearances; extending to sandstone. At Sackets Harbour thirty-five miles from Kingston the limestone is of a very deep blue, and commonly largely studded with very convex bivalves. At the latter place on the same plane, the limestone is brown and blue, without a shell (as far as I saw) and abounding in tremolite. At Gauanoque at the head of the one thousand islands, on the same level with the limestone of Kingston is a white quartzy sandstone which continues to line the descent of the St. Lawrence to Montreal, covered by limestone. Further, if it be allowed (and I believe it must be) that during the first three miles from Lake Ontario, the Genessee River does not ascend eighteen feet, we shall then have the first flætz sandstone of that locality, the blue and brown limestone of Sackets Harbour and Kingston, and the white sandstone of Gauanoque on the same parallel of height.

I have been induced to enter into these digressions, from their being the vehicles of new facts respecting the Geology of unexamined countries.

To return, the rocks of the Western part of the Manitouline Islands are so deranged, and so concealed by debris and vegetation that it requires opportunities superior to mine to ascertain correctly the nature of the successive strata from the level of the Lake to the summit of the Grand Manitou.

* Without organic remains.

At Collier's Harbour, the British post at the west end of Drummond Island, a little higher than the water there is a light brown limestone, hard, with few or no organic remains, but full of superficial spherical excavations.* No fixed rocks are then visible until an elevation of eighty feet is attained, when low precipices of a whiter and much harder limestone protrude through the sides of the slope. They are either somewhat slaty, or broken into large cuboid blocks. It is here the singular organic remains of the locality are found.

On the North side of the Lesser Manitou and toward the east end, the rock at the level of the lake is of two kinds, the one, white, hard, and so slaty as to resemble a shale, and without fossil remains, the other, is plentifully supplied with these substances and is dark, soft, full of knots, and very much less slaty. The interrupted low cliffs which range along the acclivity of the Island from thirty to seventy feet above the water, furnish a dull brown granular, rather hard, slaty limestone, which gives out a disagreeable odor on percussion and is free from shells, as far as I could observe.

This island does not seem to agree in its geological formation with Drummond Island. Its rocks are very much concealed by vegetation and debris. It is proper to register every observation respecting these countries, as from their remoteness, total want of attractions and moreover from the difficulty of subsistence, visits to them will be very rare and brief.

The west end of the Grand Manitou, at the level of the lake has a flooring similar to that of Collier's Harbor, and at the height of ten—thirty feet, a slaty rock like that of the cliffs of the Lesser Manitou; but inodorous. This is in the middle of the detour. Toward the south end of this channel there is a rocky bluff divided into enormous cubes, piled upon each other to the elevation of fifty feet or more. The foot of the higher precipices (which in the middle of the Detour rise two hundred and fifty feet) and the beach in general is strewn with the quartzose limestone of Drummond, and abounds in the same kind of organic remains.—

* These are tolerably accurate parts of spheres, commonly one and a half inch in diameter, and containing on their inner surface another series of cavities. They are so numerous as sometimes to run into each other.

Masses of honeycomb and chain madrepores are frequently met with two or three yards in diameter; but the material of which they are composed being more calcareous they are not so beautiful as those at Collier's Harbour. A description of the organic remains of the Manitoulines (as far as they have been examined) will be found in the Appendix.

The island of Michilimackinac, (situated close to the straight dividing Lakes Michigan and Huron; and in the latter) is of an oval form and nine miles in diameter; the long sides being lofty precipices rendered picturesque by their fantastic shapes and luxuriant shrubbery, and the short sides, pebbled beaches.

The rocks are calcareous; and the clear idea of their nature is afforded by the south-east extremity of the north-east precipice which may be described as follows:—A few soft strata, very thin, white and horizontal, shew themselves at the top; but below this the limestone becomes yellow and ragged. Much of it is compact, but it is more usually occupied by vesicles (as from bubbles of air) encrusted with crystals of quartz in botryoidal clusters. A few of them are three or four feet in diameter, and contain smaller cavities in several series. Other parts contiguous to this, are an aggregate of angular fragments of slaty limestone cemented as if by semifusion, and with interstices lined with quartzose crystallizations. The size of the fragments varies from one to eight inches. They also are of an ochry yellow. The bottom of the cliff is in horizontal strata, which are moderately thick, very soft, even so as to write, and of a white, or bluish colour. I have been thus minute, on this spot as the herbage does not permit an examination at any other except in small patches where similar appearances were noticed.

The north-west half of this long side of the Island declines in height very gradually and consists of debris excepting a few schistose strata at the top. Not far from the end a road is making up the steep (1819.) Here the limestone contains a few blue and white striped flints, which are remarkable for being broken, small, and angular. They are also met with on the beach. I met with no organic remains. A friend saw a single bivalve. There are indeed several fragments of the limestone of the Lesser Manitou on the shore, penetrated by a multitude of short incisions as with the point of a knife.

The other long side possesses the same geological features as the one just described. The breccia perhaps abounds more here. The slaty portions are found at *every level* and at one place in strata two feet thick. About the middle there is a cave, about three yards in its greatest depth, formed by the concurrence of several of the cavernous, bowl-shaped hollows, thus creating one of great dimensions; whose interior is subdivided into smaller cavities seriatim.

The beach is covered almost exclusively with limestones slaty, vesicular and brecciated. I saw the vesicular species after it had been exposed to the heat of a kiln. It had suffered a change of colour only from its ochry yellow, to a brown or black.

The stratified limestone burns profitably.

Two, if not three eras and modes of formation are here clearly distinguishable. The first and oldest is the slate, which is seen to floor the lake for miles around. Upon it are supported two calcareous masses which mingle with each other and with short slips of the schist in the greatest disorder; and having a few of the broken flints interspersed. In all probability they are veins of strata which have been overwhelmed by a sudden violent force.

Heat may have been the means of raising, comminuting, and partially melting this bed of limestone. Steam, a principal agent, may have insinuated itself into the more yielding portions; and the whole, has finally, consolidated.

Appendix.

As this paper has already assumed an inconvenient size, I shall content myself with noticing in the briefest manner possible, the conglomerates, and a mineral with which I am acquainted. The description of the organic remains, must also be greatly limited.

The conglomerates are curious, and are met with principally in the shape of debris. Their matrices are of two kinds, quartz and greenstone. The quartzose species exhibits three forms—its nodules are sometimes exclusively, translucent white quartz. In other instances they are masses of greenstone; but by far more commonly they are of jasper,* red, green, ash, and greenish brown and black, either uniform, or in stripes and clouds. The first and last of these species often run into each other.

The greenstone conglomerates are also of three kinds—that of quartz nodules, of the granitous compound, of the "Serpent rock," and of greenstone nodules.

Breccias of the same composition with these conglomerates are not uncommon.

Near Collier's Harbour and on an islet near the Grand Manitou a curious mineral occurs in rolled fragments of close grained granite.

It is in the form of octohedral crystals with rounded edges—one specimen was found three inches in length and two and a half in breadth. A section discovers the following appearances. The external coating is a slender layer of dark copper colored mica in promiscuously arranged fragments, succeeded by an inner ring of a substance resembling hornblende, which insensibly passes into a yellowish green mass of fibres radiating from the centre of the crystal, where, however they disappear in the form of a whitish yellow powder. [See plate, fig. 4.]

The organic remains of the limestone of St. Joseph include numerous and very extraordinary appearances similar to what Dr. Lloyd of Oxford in his Ichnographia calls Alveoli—cylindrical tubes or cases, of various sizes—sometimes giving off branches,—belemnites, coralites, impressions of weeds, four species of entrocite, five of bivalves, trochites and turbinites.† There are also, honey comb and chain madrepores, and many singular impressions &c. which are perhaps non-descript; but no adequate idea can be formed of them without accompanying sketches.

Drawing No. 5, is one fourth of the size of a relic taken from a small island off the river Thessalon on the north coast of Lake Huron. It was found imbedded in a large fragment of limestone. The raised and more perfect portion is elevated above the matrix, one and a half inches. The mass separates into two parts in the line of the delin-

* In some rare examples, masses of greenstone accompany the jasper, indicating the destruction of a greenstone, previous to the formation of the jasper conglomerate.

† The shells in Lake Huron, at present existing, are tellinites, nautilites, cochlites, turbinites and various bivalves.

eated rent. The interior consists of calc spar. At the right end there is a smooth cylinder one inch in diameter and two and a half inches long, issuing obliquely from the body of the Remain. I can offer no conjecture as to the nature of this substance, except that they are orthoceratites.* They have been called fossilized sturgeon, but the direction of the flakes in that fish, and an examination of a transverse section forbid the idea. They were first noticed in 1820 by a surveying party.

All these remains are calcareous.

The fossilized remains of the Manitouline range must be the subject of a separate paper, as together with those of St. Joseph, and the necessary drawings, they occupy fifty-five pages. They are composed of quartz, frequently so fine as to approach to the form of calcedony.

Numbers 6 and 7 are varieties of organic remains abundant in the quartzose limestone of Collier's Harbour: in which they are wholly or partially imbedded. They are composed of quartz with a small proportion of lime. Their colour is brown of different shades. The external surface is more or less situated longitudinally. The interior is filled with a granular, sandstone-like substance, or presents radii issuing from the centre, or irregular cavities lined with quartz and botryoidal calcedony. They are more or less flattened, but sometimes they are nearly circular. No. 6 is the most common form. The usual length of a joint is an inch. I have seen one, two inches long, and with a moderate breadth. The latter dimension has never exceeded two and a half inches or been less than one inch. No. 6 is illustrative of the ordinary expansion at the socket part of the joint. No. 7 presents great expansion at this part with moderate size. Fragments only have been found. I have seen fifty. The longest is twenty-seven inches, which tapers gradually to one extremity, a circumstance not observed in any other case. Two fragments of similar form have been met with lying parallel and contiguous. In another example one is partially imbedded in the other without mutual derangement. These substances greatly resemble vertebræ. of what animals I know not. They belong to members of

* Judging from the drawing, these remains appear to us similar to some found south of Lake Ontario, and which Mr. Brongniart thinks are orthoceratites.—Vid. p. 222 of this Vol.—[*Editor.*]

the same family, but their diversity of form indicates different organizations and consequent faculties and habits. It is remarkable that these remains have no processes, nor place of insertion for other bones.

Quebec, March 25, 1821.

Extract from the letter which accompanied the preceding memoir.

Possibly too great stress has been laid on limestone of recent formation being found in contact with granite without observing its inclination.*

The want of a more detailed Topography of these districts is greatly felt: from its length and tediousness, it is incompatible with the plan and interests of a periodical work. I hope the epitome I have prefixed will suffice. It would have been impossible to have furnished engravings for all the organic remains—their description occupies fifty six pages. The Topography and Geology with its appendix fill one hundred and twenty pages of *matter* equally condensed with those now before you. This has been presented to the Earl of Dalhousie.

* We do not think so; this fact as well as many others mentioned by Dr. Bigsby is very curious and interesting.—[*Ed.*]

BOTANY.

Art. VII.—*Floral* and Miscellaneous Calendar for Plainfield, Mass.* 100 *miles West of Boston, (Lat. supposed about* 42° 30′ *N. and Lon. West from Lond.* 73°—*more than* 100 *miles from the ocean—country hilly and elevated,) by* Dr. Jacob Porter.

Remark.—Floral Calendars, *very much in detail,* having been objected to by some persons, the editor has selected only what he supposed the author deemed the most interesting observations, from a calendar still more in detail. It appears by this Journal, that in the course of five months, about twenty rainy days occurred, and in the same period there were fourteen cloudy and foggy days, but without rain. The notices of temperature, and weather being unaccompanied with any thermometrical observations, have been generally omitted, except where some connected circumstances rendered them interesting.—Ed.

1819.—Jan. 24.—Common chickweed partly, and hair-cap moss fully blown.

Feb. 8. Before this date, the roads were settled and travelling good.

26. Heavy snow.

March, 17, 18. Snow in some places ten or twelve feet deep, and so hard as to bear men and animals.

April 2. The first blue-bird seen. In some places the snow is still above the tops of the fences, entirely concealing them. The farmers are now tapping their sugar-maple trees, which are very abundant here, and furnish the domestic supply of sugar ; the tapping of the trees began before March 26.

3. Warm. The song of the robin heard for the first time.

7. Summer bird heard to sing.

11. The aments of the alder and poplar considerably swelled.

13. At sunrise a very large and beautiful rainbow. The ground is about two thirds bare, though in some places, the fences are entirely concealed by the snow. Several chirping birds are seen.

14. The first butterfly seen ; the bees are also beginning to venture abroad and the song of the marsh quail has been

* The dates may be considered as being generally those that relate to the earliest events of the kind.

heard for a few days past. Making sugar is now the employment of our farmers.

15. So warm that we sat with open windows. The alder in blossom, its beautiful aments waving gracefully over the snow. The buds of the hazel are also tipped with red.

16. The threelobed hepatica or liver leaf begins to show its buds.

17. A severe storm of rain, snow and hail, attended with some thunder and lightning.

21. The hazel and hepatica in blossom.

22. The croaking of the frogs is heard for the first time.

23. Found the clatonia or spring beauty in flower at Worthington. Some deep snow-banks still.

24. Sun eclipsed.

26. Farmers are now beginning to plough.

27. Roundleaved violet in blossom.

28. Woodpeckers and blackbirds appear.

29. Swamp willow in blossom.

May 1. So warm that an umbrella is agreeable. Erythronium or adders tongue in blossom.

2. Early corydalis or colic weed and two species of sedge in blossom; the trees are beginning to put forth their leaves, the chirping of the wren is heard, and the groves are full of music.

3. Lombardy poplar and Canada violet in blossom.

4. Observed the balm of gilead, red maple, yellow birch, rhomboidal trillium, sessileleaved uvularia or bellwort, the delicate chrysosplenium or golden saxifrage and field equisetum in flower. The sun shines with a scorching heat, and vegetation is surprisingly rapid. Here and there however, a bank of snow is still to be seen on the hills.

5. Found the elm, fly, honeysuckle, colt's foot and strawberry in blossom at Cummington. The large poisonous leaves of the veratrum or poke root and the wooly heads of the polypods are starting up every where by our brooks. The first swallow seen.

6. The white birch, sugar maple, sweetscented white violet and bluish houstonia in flower at the same place. Very warm; the first chimney swallow seen. It is the season for sowing English grain. In the woods the leaves are not large enough to form much shade, but the long delicate aments of the yellow birch, waving over our head, appear

like the fringe of an umbrella. The herbaceous plants are flowering every where, and the petals of the roundleaved violet, in particular, resemble specks of gold scattered around the path.

8. Found the viburnum, the blue violet and the delicate three leaved panax in blossom. This beautiful species of panax is very abundant with us.

9. Found the beech tree and threeleaved arum or indian turnip in flower.

12. The yellow violet and prostrate mitella in blossom. The first snake seen.

14. The currant bush and red berried elder in blossom.

17. The plumb tree and dentaria or tooth root in blossom. Plumb trees do not succeed well with us, many of them having large black excrescences on their limbs. Peach trees do not succeed at all; indeed, very few at present attempt to cultivate them. The root of the dentaria has a sharp spicy taste, not unlike that of horse radish. "Radices," says Michaux, "ab indigenis, loco sinapis, pro ciborum condimentis exsiccantur."

18. The wild red cherry tree, aronia or shad tree, cowslip and dandelion in blossom.

19. The small veronia or smooth speedwell and two species of granaphalium in flower.

20. The threeleaved coptis or gold thread and dewberry in blossom.

21. Pleasant. Farmers are engaged in planting their potatoes and indian corn, which has been deferred till now on account of the late storm. The first yellow bird seen.

22. Warm and pleasant. Found the apple, peach and red cherry trees, the iron-wood, june-berry, and anemone, twoleaved mitella, painted trillium, wild gooseberry bush, caulophyllum, slender rush, two species of ranunculus and two of saxifrage in flower on the banks of Westfield river, Cummington.

23. Pleasant. The moose-wood wild currant and rose-flowered convallaria in blossom. The last is the rosy streptopus of Michaux.

24. Ash tree in flower. The bob of lincoln and king-bird, seen for the first time.

25. Shepherd's purse and common cerastium, or mouse ear chickweed in bloom.

26. Windy and cold; in the morning a beautiful rainbow.

27. Dwarf cornel and hispid gaultheria in flower. The latter is sometimes used by the common people as a substitute for tea.

28. Clear and cold. This morning the ground is white with frost.

29. Frost this morning.

31. Our orchards are now in full bloom.

June 1. Large convallaria in flower.

2. Pleasant. Found the red oak, butternut, choke cherry, common ranunculus, clustered and umbelled convallaria, veratrum or poke root, water erysimum, trientalis, water cress and a beautiful species of gooseberry bush in flower, the most of them on the banks of Westfield river, Cummington. The delicate trientalis is the only native plant, that we have of the seventh class.

4. Visited the bog in Goshen, where I found the black chokeberry, the glaucous kalmia, the dwarf and rosemary leaved, andromedas, a species of eriophorum or cotton grass, the stemless cypripedium or lady's slipper, and two species of vaccinium in flower. To the botanist this is an interesting spot, and I would take the liberty of recommending it with emphasis to the attention of botanists. The pine, larch, mountain ash, sarracenia and many other very interesting trees, shrubs and herbaceous plants grow here. This bog is about three fourths of a mile east of Keith's Hill in Cummington. Observed the thorn bush and two-leaved convallaria in blossom by the road side.

5. Sarsaparilla in blossom.

6. The redberried actea or baneberry, medeola or indian cucumber, white clover and strawberry blite in flower. The white clover is the shamrock of the poets. The strawberry blite grows wild in this place. I have also observed it a few yards from the sulphur spring at Ballston Spa.

7. Very warm; towards night a thunder shower. Black cherry tree, blueyed grass and common sorrel in blossom.

8. In riding to Northampton, I observed in flower at Goshen the yarrow, celandine, yellow oxalis, or upright wood, sorrel and raspberry bush; at Williamsburg the locust tree, high blackberry and thimble berry, garden and wild columbine, red clover and common potentilla; and at Northamp-

ton the barberry bush, two species of honeysuckle, one of them growing wild, two species of azalea or swamp pink, narrowleaved kalmia, spotted geranium, red top and foxtail grass, besides lilac, snow ball, rye and many other exotics.

9. Extremely warm; towards night a severe thunder storm. Common iris or blue flag in flower at the same place. The first fire fly seen.

10. The prunella, small ænothera and delicate krigia in flower at Northampton; longstalked smilax at Williamsburg.

12. In the morning, sharp thunder and lightning with torrents of rain; in the afternoon pleasant.

13. The white flowered oxalis or stemless wood sorrel in blossom.

14. Virginia hydrophyllum or burr flower in blossom.

15. Pleasant. Strawberries which are excellent and very abundant here, are now beginning to ripen.

16. Warm. Found the red connel, golden senecia or ragwort and threeleaved convallaria in blossom at Cummington.

17. Mountain ash, Norway potentilla and common alsine or chickweed in blossom.

18. Another species of cotton grass and a very delicate species of spergula in bloom. In the afternoon a thunder storm with some hail; in the night, another tremendously severe, with large hailstones and torrents of rain; the hail in some parts of the town, so large as to break the glass.

19. Windy. Found the grape vine, broadleaved kalmia, purple sarracenia or meadow cups, common galium or cleavers, white weed, large veronica or marsh speedwell and circea or enchanter's night shade in blossom at Cummington. The fantastic sarracenia grows also at Goshen, Ashfield and Hawley. Doctor David Hunt also informed me that he has found at Northampton, numerous specimens of the sarracenia with yellow blossoms.

20. Very pleasant. The sanicle, small geranium and exquisitely beautiful and delicate linnea in flower. The last mentioned plant may be found on the margin of a small brook, about a mile east of the meeting house. I have also discovered it in the east part of Savoy, on each side of the county road leading from Plainfield to Adams. All the specimens that I have seen, are didynamous.

21. Pleasant; clouds uncommonly beautiful. Yellow water lily, potamogeton or floating pond weed, plantain, climbing polygonum and glechoma or ground ivy in blossom.

23. Common fleabane in blossom.

25. Found the broadleaved ledum or Labrador tea, three leaved menyanthes, common avens, craneberry and a handsome species of sedge in blossom, at the bog near Hawley meeting house, a most interesting spot. Observed the common cynaglossum or hound's tongue and the woody nightshade or bittersweet in flower by the road side.

26. False flax in blossom.

27. Some of our fields and pastures are now so completely covered with the blossoms of the common ranunculus, here called the yellow weed, as to have the appearance of being wrapt in sheets of gold.

28. False mustard in blossom.

29. Red and wild rose, mitchella and a species of panic grass in blossom.

30. Sage in blossom, and indian corn beginning to tassel.

July 1. Lilyleaved malaxis in blossom.

2. Flax, motherwort, sow-thistle, mimutlus or monkey flower and climbing celastrus or saff tree in flower, the two last on the banks of Westfield river, Cummington.

3. Blackberried elder, bristly aralia, large ænothera, round leaved mallows and small flowered hypericum in blossom. In the evening a comet seen in the northwest.

4. Fair. Mullen, common asclepias or milk-weed, fringe flowered orchis and one-sided pyrola in blossom.

5. Frost this morning. Air uncommonly clear and weather very fine. Found the large flowered raspberry, common hypericum or johnswort, agrimony, Virginia or tall anemone, field thyme, two species of avens and two of galium or cleavers in blossom, on the south side of Deer Hill, Cummington. Spiked epilobium or willow herb and commom nettle, also in blossom. The red raspberry is beginning to ripen.

7. Roundleaved orchis in blossom.

8. Roundleaved hypericum, Canada or narrowleaved hypericum and purple vervain in flower, and currants beginning to ripen. Farmers are beginning to cut their grass.

9. Very warm. Mustard, catmint, buckwheat, common

spergula or tangle weed, and the climbing red flowered bean in blossom ; the last attracts the humming bird.

12. Found the common sumach, white spirea, panicled andromeda, upright lysimachia, tuberous cymbidium, white nymphea or fragrant water lily, adder's tongue, arethusa, comarum or marsh fivefinger, common typha and a handsome species of scutellaria or skull cap in flower, and juneberries ripe at Goshen bog. The fragrant nymphea grows also at Ashfield.

13. Weather very fine. Umbelled chimaphila, common stachys or hedge nettle, and knot grass in flower.

14. Wheat, cockle, spotted polygonum or heart's ease, common gnaphalium or life everlasting, and cud weed in blossom.

15. Cloudy. Potato in blossom.

16. Bass wood in blossom.

17. Maize in blossom.

18. Spikenard, ginseng, penthorum and coloured willowherb in blossom.

20. Nettleleaved vervain in flower. The farmers are busily engaged in hay making.

21. Cloudy, the sun shining at intervals with a scorching heat. Found the clematis or virgin's bower, tansy, heartleaved lysimachia, hop, yellow nodding lily, impatiens or touch me not, and a delicate species of veronica in flower, the most of them in the meadows at Cummington. The hop grows wild at this place. The spring and summer have been, thus far, very favourable to vegetation; indian corn and potatoes, very flourishing; grass, not so good as usual, owing, probably, to the open winter; peas, fit for the table. Crickets begin to chirp.

22. Very warm. Found the hydropeltis or water shield, cordate pontederia, sheathleaved dulichium or bog rush, roundleaved drosera or sundew, transparent eriocaulon or pipewort, and a species of prinos in flower at the Crooked Pond. During the latter part of the season, this is a very interesting place of resort to the botanist.

23. Weather the same. Wormwood, water pepper and pig weed in blossom. The first mentioned plant is naturalized and very common in this and the neighboring towns.

24. Found the common amaranth, elecampane, ampelopsis, sideflowering skull cap, one flowered monotrapa and

whorled eupatorium in blossom, the most of them at Cummington. The asters are also beginning to blossom.

26. Spear thistle in blossom.

31. Cucumbers fit for the table.

August 2. Whiteflowered cynoglossum, common eupatorium or thoroughwort and linearleaved epilabium in blossom. Notwithstanding the extreme heat of the summer, it is still very healthy; no prevailing disease.

4. Tall ambrosia or Roman wormwood in blossom, and high blackberries ripe.

6. Green corn fit for the table.

7. Intensely warm. There are at present some cases of dysentery among us.

8. The golden rods, of which we have several species, are beginning to blossom. I once used a tincture of the root of our most common species in brandy, as a tonic in my own case of spitting blood from the lungs, with very considerable benefit. The proper dose for an adult, is a table spoonful, two or three times a day.

9. Finger grass in blossom. Grasshoppers very abundant for two or three weeks past.

10. Warm and pleasant; clouds cumulous and very beautiful. Annual flea bane, burdock, chelone or snake head, wild sunflower, fennelleaved cicuta and two species of sagittaria in flower; all, except the two first, on the banks of Westfield river.

11. Potatoes fit for the table.

12. Currant bushes defoliating.

13. Found the downyleaved spirea, or hardhack, and longleaved drosera in blossom, and high blue whortleberries ripe at the crooked pond. Small berries or the common gaultheria.

18. Collinsonia, pennyroyal and commom hieracium in flower at Cummington.

19. Simple sparganium in flower at Hawley. Farmers engaged in harvesting their wheat, rye and oats; crops very excellent.

23. Early apples ripe.

24. Very clear and pleasant. Some frost this morning on low grounds. Hemp in blossom.

27. Common tobacco in blossom.

28. Berries of the mountain ash turning red.

31. Visited the crooked pond. The leafless utricularia, water lobelia and floating villarsia or spur stem grow here in great plenty, but the growth of these interesting plants has been so much retarded this season, by the flowing of the pond, that they have not yet blossomed. The last year, I found them in flower the eighteenth of this month. The utricularia grows also at Ashfield and Hawley, the villarsia in a pond near the village of Sand Lake, New-York.

September 1. Common bidens in blossom.

2. Farmers cutting their stalks.

4. Beech drop and bladderfruited nicandra in blossom.

5. Indian corn ripening very fast.

6. Black cherries ripe.

9. Drooping neottia and largeflowered bidens in blossom, and common elder berries ripe. The leaves of our forests are beginning to assume the livery of autumn.

11. Farmers beginning to make their cyder.

15. Frost this morning. Clear, cold and windy.

16. Spearmint and witch hazel in blossom.

22. Leaves of the beech tree turning yellow and falling.

29. Maple and yellow birch defoliating, the leaves of the maple being, many of them, of a bright scarlet.

30. Artichoke in blossom. Farmers harvesting their corn ;—crops abundant and very excellent.

1820.—March 19. The first woodpecker seen. Flies brisk and lively. The crust of the snow, owing to the late storms of hail and rain, is so very hard that a small dwelling house has been moved about a quarter of a mile upon it!

20. Farmers are beginning to tap their sugar maples.

23. Blue birds appear.

24. Robins appear.

29. In warm situations the aments of the alder are considerably swelled.

April 6. Buds of the willow considerably swelled.

7. A fall of snow.

11. Farmers busy in making sugar.

16. Found in warm woods the three-lobed hepatica in flower. The first butterfly seen. In many places the snow is still two or three feet deep.

18. Alder in bloom. The croaking of the frogs heard for the first time.

19. Poplar and claytonia in blossom.

20. So warm that we sat with open windows. The round leaved violet in blossom. The first miller seen.

22. Red maple, swamp willow, and dog's tooth violet in blossom.

23. Martins arrived.

24. Wild strawberry, chrysosplenium or golden saxifrage, tuberous corydalis, and two species of sedge in blossom.

25. American elm, Lombardy poplar, and sessile leaved uvularia in flower.

26. The song of the wren heard for the first time. Dark purple trillium in flower.

29. Sugar maple in blossom.

30. Two leaved mitella and three leaved panax in flower. The month of April has been uncommonly warm and pleasant; and vegetation is remarkably forward, indeed, it is a common remark with us that it was never known to be so forward at this season of the year.

May 1. Fly honeysuckle in blossom.

2. Ash tree, and blue, Canada and yellow violets in blossom.

3. Currant bush in blossom.

4. Viburnum, sweet gale or Dutch myrtle, and sweet-scented white violet in flower.

5. Dandelion in blossom.

6. Yellow willow in blossom.

7. Indian turnip and wood anemone in flower.

8. Beech tree, shad tree and red-berried elder in flower.

9. Iron wood in flower.

10. Plum tree and heart leaved tiarella in flower. The buds of the mountain ash appear.

11. Pennsylvania saxifrage in blossom.

12. Apple tree, red cherry tree, and heart leaved epipactis in blossom. In the afternoon a copious thunder shower with some hail.

13. Thunder shower with hail.

14. Cowslip, chickweed, and smooth veronica in flower.

18. The first swallow seen. The three leaved coptis or gold thread, and bluish houstonia in flower. Farmers planting potatoes and Indian corn.

21. The first bob of lincoln seen.

22. Common cerastium or mouse ear chickweed in blossom.

23. Indian corn, that was planted very early, starting from the ground. Common ranunculus or yellow weed in blossom.

24. Caulophyllum, glaucous kalmia, painted trillium, and water cress in flower at Cummington. Our apple trees are now in full bloom.

26. A severe storm of rain and snow.

27. This forenoon the hills in Ashfield, Goshen and Windsor are white with snow.

28. Frost this morning. King birds appear.

29. Quince, wild columbine, golden smyrnium, and clammy azalea in flower at Conway.

June 3. Rosemary leaved andromeda, (see the figure on the plate) and small ænothera in flower at Goshen.

5. Grasshoppers appear. Black cherry tree, and white flowered oxalis in blossom.

7. Virginia hydrophyllum in flower.

8. Fire flies appear.

10. Red and white clover in flower.

12. Strawberries ripe, and green currants fit for the table.

14. Crickets begin to chirp. Upright wood sorrel, and golden senecio in flower.

15. Mountain ash in flower.

16. Norway potentilla in flower.

17. Prunella and Philadelphia fleabane in blossom.

21. Linnea and circea or enchanter's nightshade in flower.

23. Mullen in blossom.

24. Red rose in blossom.

26. Broad leaved kalmia in flower.

27. Onesided pyrola in flower.

28. Mitchella in flower, and red elder berries ripe.

30. Farmers beginning to mow. Wild rose, black berried elder and common asclepias in flower.

July 1. The weather for some time past has been extremely warm and dry. Round leaved pyrola in flower.

2. Common hypericum and fimbriate orchis in flower.

3. Red raspberries ripe. Spiked epilobium, large flowered raspberry, and transparent pipewort in blossom.

6. Virginia hypericum in flower.

7. Phytolacca or poke and umbelled chimaphila in blossom.

8. Farmers very busy in hay-making. Locusts begin to sing.

10. Elecampane, gay cypripedium, and inflated babelia in flower. Currants ripe.

12. Indian corn in blossom, and red garden cherries ripe.

13. Thimble berries ripe.

17. White flowered cynoglossum in flower.

18. Nettle leaved vervain in flower.

20. Green peas fit for the table.

22. Virginia demalis, common elymus, topseed, and a species of aster in flower at Cummington.

24. Button bush in flower.

26. Cucumbers fit for the table.

31. Spearmint in blossom.

August 4. Burdock in blossom.

5. Downy neottia in blossom.

6. Common golden rod, and Virginian versia in blossom.

7. Rye fit for the sickle. Decurrent gnaphalium in flower.

8. White fringe flowered orchis and bulb, bearing cicuta in flower at the bog near Hawley meeting-house.

10. High blackberries ripe, and green corn fit for the table.

15. Potatoes fit for the table. Grasshoppers so abundant for some time past as to be very injurious to vegetables, particularly to grass and Indian corn.

22. Currant bushes defoliating.

24. Common gratiola in flower. Springs remarkably low. Many rocks in the North Pond, which I do not recollect ever to have seen before, appear above the water. On one of these we cut the figures 1820.

25. Berries of the mountain ash turning red.

26. Watermelons ripe.

29. Black elder berries ripe.

30. Black cherries ripe.

Errata in the Calendar, &c.

Page 275, date May 19, for *granaphalium* read *gnaphalium*.
" 278, " July 2, for *mimullus* read *mimulus*.

FOSSIL ZOOLOGY.

New-York, 11*th mo.* 21*st*, 1820.

BENJAMIN SILLIMAN.

Respected Friend—At the request of C. S. Rafinesque, I take the liberty of forwarding his description of a supposed fossil medusa, contained in a paper sent by him to the Academy of Natural Sciences of Philadelphia some time ago. The paper by some accident got mislaid, or it should have been forwarded long before.

I remain with best wishes, and sincere respect,

Thy friend.

REUBEN HAINES.

Art. VIII.—*Description of a fossil Medusa, forming a new genus.* Trianisites Cliffordi, by C. S. Rafinesque.*

The genus *Medusa* of Linneus is now become, by the multiplied observations and discoveries of many zoologists, an extensive tribe of animals, containing a great many genera and more than two hundred species. I have myself discovered in Sicily and in the Atlantic ocean many new ones, which are partly enumerated in my former works, and I mean to describe now a *fossil one*, which has been discovered in Kentucky, by my worthy friend John D. Clifford of Lexington, in whose collection I have seen it. I believe that this is the first instance (at least in the United States) of an animal of that tribe being found in such a fossil state, and I do not at present remember any author's mentioning any species found fossil in Europe. This may therefore be entirely a new discovery, to which we are indebted to the unwearied researches of Mr. Clifford; the only merit I claim is of having ascertained that his specimen does not belong to any known genus, and is therefore an extinct one. It is

* Now Professor of Botany and Natural History in Transylvania University, Kentucky.

well known that the animals of that tribe are of a soft gelatinous substance and structure, they do not leave any exuviæ after their death, and they are very easily destroyed by the contact of any hard substance, whence it is no wonder that their fossil remains are so rare : yet in the specimen under consideration, the animal appears quite perfect, and is embedded in a crystallized limestone; the mode of its fossilization is therefore very singular. We must either suppose that this extinct species was of a harder cartilaginous substance, or that the liquid in which it was swimming or floating, was coagulated at once : it even appears probable to me that both circumstances may have occurred, since the specimen is in its proper natural position, and not in the least compressed nor altered; but the whole of it is changed into a similar stone to that which surrounds it: the animal however is become rather silicious as usual with fossil mollusca or polyps.

Genus Trianisites.—(See the engraved figure.)

Generic definition.—Body with three unequal peduncles or appendages underneath, the middle one with a mouth or opening at the extremity, surrounded by two fascicles of short tentacula. Back simple, not ombrelled.

Generic observations.—The generic name derives from Greek words meaning, *three unequal appendages.* In the natural arrangement this genus will belong to the real family *medusa*, and to the sub-family *branchypia*, having peduncles or appendages underneath and no wing nor bladder on the back, next to the genus *pelasgia* of Peron and Lesueur; but it differs from it, and indeed from any other of that tribe, by having a sort of trifid body, and the tentacula only near the mouth. The following species is the type of the genus.

Trianisites Cliffordi.

Specific definition.—Back subconical and subacute, axillas obtuse and unequal, peduncles compressed transversally obtuse, the shortest larger, the longer one smaller and opposed to it, the middle one nearly as long, extremity fimbriated by the tentacula.

Description.—Length or height of the specimen six inches, breadth above three inches. Back rounded convex conical, nearly acute, dividing itself gradually underneath in three branches or peduncles, all unequal in length and size, the axilla or sinuses of the division are also unequal and obtuse. The lateral peduncles are quite detached from the middle one, and slightly curved outside: they are both situated obliquely, and slightly compressed in the direction of the obliquity. The longest peduncle is also the slenderest and quite obtuse at the end; the shortest which is opposed thereto is the thickest and slightly obtuse at the end; its length is only about two and a half inches, while the longest is about four and a half inches long. The central peduncle is quite straight, obliquely compressed also, attenuated at the end and about four inches long, the opening is terminal and furnished above on each side by a large fascicle of tentacula, assuming a kind of fringed appearance; they are capillary, flexuose and thickly fasciculated, longer than the central peduncle and reaching the end of the longest peduncle, the outside tentacula appear to be the longest. The longitudinal section of the animal shows an appearance of internal vessels as in many medusas: three central faint vessels appear to run through the peduncles in a slightly flexuose form and to unite near the back, while the whole circumference shows many short capillary vessels deriving from the surface, extending obliquely inside, but not reaching quite to the central vessels. A transverse section shows the curious respective obliquity of the peduncles, and that their inward circumference is slightly striated by those small superficial vessels.

Specific observations.—This interesting animal remain was found in 1817, by Mr. J. D. Clifford, near Lexington in Kentucky, in an upper stratum of compact bluish limestone, granulated and crystallized: the specimen is quite imbedded in it, of the same appearance, but rather smoother and of a paler colour. It was not accompanied by any shell nor other fossil, but stood alone, and rather below the stratum where so many shells are found. I have dedicated the species to its discoverer, in whose rich museum it is to be seen.

C. S. RAFINESQUE.

Philadelphia, 12th January, 1819.

PHYSIOLOGY AND MEDICAL CHEMISTRY.

Extract of a letter to the Editor, from Mr. Isaac Doolittle, dated Paris, Nov. 9, 1820.

Dr. Magendie's Memoir on absorption has excited considerable sensation among the faculty here; he has been so obliging as to confide to me his manuscript, from which I have made the accompanying translation, for your Journal. Dr. Magendie has looked over my translation, and found it correct.

Art. IX.—*Memoir on the Mechanism of absorption in Animals of red and warm blood; by* F. Magendie, *of Paris.*

Read before the Academy of Sciences, at Paris, on the 9th October, 1820. Translated from the French, of the author's manuscript; by I. Doolittle.

Whenever any substance, whether liquid, gazeous, or in a state of vapour, is kept for a space of time in immediate contact either with an external or internal surface of our bodies, that substance is *absorbed;* or, in other words, it passes into the sanguiferous vessels, mixes and circulates with the blood, and produces thus on our organs, effects, either salutary or hurtful.

This Physiological effect is especially remarkable in the action of poisons: a single drop of hydro-cyanic (Prussic) acid, placed on the tongue of a dog, causes death in a few seconds, by being carried to the brain with the blood. I have often produced effects equally prompt, by the application of substances reputed much less powerful than Prussic acid, by simply taking care to increase proportionally the rapidity of the absorption.

A result of this nature was well calculated to excite curiosity; but our aliments, our drinks, our medicines and even the air itself, become useful to us only after being absorbed. We contract, by means of absorption, many diseases, some of which are even, dangerous. In a word, our very existence is so closely connected with this phenomenon, that were it to cease for a moment, death would be the almost immediate consequence.

No study is therefore, at the same time, more curious, and more important than that of absorption.

The first step to be taken, after establishing the reality of the phenomenon, was to discover the instruments; or in other words, which are the organs that exercise the absorbing faculty. I have had the honour to present to the Academy several memoirs on this subject, which have been received with approbation.

The following general consequences result from my former researches;

1st. The veins are endowed with the absorbing faculty;

2ndly. It is not demonstrated that the vessels which absorb the chyle are capable of absorbing other matter;

3dly. The absorbing power of the lymphatic vessels, other than the chylous, is not yet established on satisfactory evidence.

From these general facts may be deduced a great number of secondary facts; we may here comprehend, for example, why the absorption is slow in some cases, and very rapid in others; why certain substances appear to produce greater effects when absorbed in certain points than when absorbed in others; why certain organs entirely deprived of lymphatic vessels, such as the eye, the brain, &c. possess nevertheless strong powers of absorption.

The solution of these questions was doubtless matter of some importance; but the main question was not yet agitated; it was not known by what mechanism the absorption was effected.

The most accredited books contain no satisfactory solution on this point; their authors have proceeded as the human mind generally does in most cases where it is in a state of complete ignorance, on points on which it would be highly important for it to be enlightened. It begins by supposing certain beings and then endows them with the faculties necessary to produce the effect observed; and it generally happens that it repeats its own history without being aware of it.

In the case before us, authors began by supposing *radicals*, *orifices*, *absorbing mouths*, *&c.*; these *radicals*, these *mouths* do not fall under our senses; this is what might have been expected; but they have the faculty of *pumping*, of *sucking*, of *absorbing* the substances with which they are placed in contact; these operations are not performed without discernment; they are done with the nicest sense of discrimination; those organs choose with great exactness what ought to be taken in and what rejected; and it is not until after due examination that they determine to exercise their absorbing power.

It is sufficient merely to doubt of the truth of such explanations to become at once sensible of their absurdity; but they seldom produce this effect. Such is the charm which they exercise over our minds that we are easily led to believe them true; and we afterwards repel with passion whatever might tend to undeceive us.* It is, however, time that such deceptions should disappear from the doctrine of Physiology.

I believe I do not exaggerate in asserting that hitherto, nothing positive has been advanced relative to the mechanism by which absorption is effected in animals of red and warm blood.

Some experiments which I have made this year seem to me to throw some light on this important subject; when I shall have related the circumstances, the judgment of the Academy will show me whether I am mistaken, or whether I have hit upon the truth.

In a public lecture on the mode of action, of medicines, I was showing the effect of a certain quantity of water, at the temperature of 40° Centigrade, (104° Farenheit) introduced into the veins; in making this experiment, the idea struck me to observe the effect of the artificial plethora thus produced, on the absorbent faculties; consequently, after having injected nearly a *litre* (almost an English quart) of water, into the veins of a dog of a middling size, I introduced into the pleura a small dose of a substance, the effects of which were well known to me. It struck me as singular that those effects did not appear until several minutes after the time in which they are ordinarily seen. I immediately repeated the experiment on another animal, and obtained a similar result.

In several other essays the effects were observable at the time when they should manifest themselves, but they were

* At least in the present state, and with the absurd system of education in which we are brought up.

much weaker than would have been produced in the usual state of the body, by the dose submitted to absorption, and were prolonged much beyond the ordinary term.

Finally, in another experiment, where I had introduced as much water (about two *litres*) as the animal could support and remain alive, the effects were altogether imperceptible, the absorption was probably prevented. After waiting near half an hour for the effects which are generally developed in two minutes, I reasoned as follows: if the distention of the veins is the cause of the non-absorption, that cause ceasing to operate, the absorption should take place. I therefore immediately caused the jugular vein of the animal to be opened, and I saw with great satisfaction, that the effects became manifest in proportion as the veins emptied themselves.

I then thought of making the contrary experiment; that is, to diminish the quantity of blood and to see whether the absorption was more rapid; the result proved my conjectures well founded. About half a pound of blood being extracted from an animal, the effects which would not have occurred until the expiration of two minutes, manifested themselves in less than thirty seconds.

It might nevertheless be suspected that it was less the distention of the blood-vessels than the alteration of the blood which retarded or prevented the absorption. To overcome this objection I made the following experiment; a very copious bleeding was practised on a dog; the quantity of blood was immediately replaced by an equal quantity of water of the temperature of 40° (Centigrade) a determinate quantity of the solution of *nux vomica* was introduced into his pleura, the effect was as prompt, and as intense as though the nature of the blood had undergone no change.* It is then to

* Several attempts were made which, though they could not answer the purpose for which I intended them, may, nevertheless, be usefully noted here, as they seem to open a new field for discoveries.

To change the nature of the blood, I at first thought of injecting oil into the veins, supposing that this innocent substance would circulate with the blood without inconvenience; the result did not answer my expectations; the animal subjected to the experiment died in a few instants after the injection of an ounce of oil into its jugular vein. On examining the organs, after the death, I observed that the oil had obstructed all the ramifications of the pulmonary artery, and had thus stopped the circulation and the respiration, by preventing the passage of the blood to the left side of the heart by the pulmonary veins. The oil had produced the same effect as an inert the distention of the blood vessels that the diminution or total want of absorption must be attributed.

From that moment I became, as it were, completely master of the phenomenon, which, until then, had been to me an impenetrable mystery. Being now able to produce or prevent its developement, to render it prompt or tardy, intense or feeble, at pleasure, it was difficult that its nature should entirely escape my investigation.

In reflecting on the constancy and the regularity of the phenomenon, it seemed to me impossible to connect it with what the physiologists term *vital action*, such as the action of the nerves, the contraction of the muscles, the secretion of the glands, &c. It was much more reasonable to compare it with some physical effects: and among the conjectures that may be permitted on the subject, that which would make absorption depend on the capillary attraction of the vascular membranes on the absorbed matter, was undoubtedly the most probable; this supposition agrees perfectly with all the facts observed. For, if we suppose this cause to preside over the absorption, solid substances insoluble in our humours, being unable to traverse the membranes of the small vessels, should resist absorption, which is exactly the case: solids which, on the contrary, are capable of combining with our system, or of dissolving in the blood, would be susceptible of being absorbed, which is also conformable to observations. The greater number of liquids, whatever be their chemical natures, being capable of wetting, or being promptly imbibed by the vascular membranes, should be rapidly absorbed, this conclusion is confirmed by experience, even with the caustic liquids. In this hypothesis, the greater the distention of the vessels the less marked would be the absorbing power, and the moment might arrive when that power would be no longer sen-

and impalpable powder, suspended in water, and which causes immediate death if it be injected into the jugular vein, because it obstructs the last divisions of the pulmonary artery. (See Vol. I. of my Elementary treatise of Physiology.) Not having súceeded in the introduction of oil, I had recourse to a slight solution of gum-dragon, which produced exactly the same effect as the oil. After these trials I contented myself with injecting water after having withdrawn the blood. These facts show how important it is that every thing which enters into circulation with the blood, should arrive there in exceeding small particles, and after being, as it were, *strained* through the agents of absorption. This use of the absorbing organs had not, I believe, been heretofore observed.

sible. The absorption would be more rapid in proportion as the vessels became more numerous, and their size diminished, because the absorbing surfaces would become more extensive.

This action of the membranes once acknowledged, nothing can be easier than to comprehend how absorbed substances are transported towards the heart, since they are constantly drawn forward by the current which exists in the interior of even the smoothest vessels.

I was so much the more willing to admit this supposition as I well remembered that, on poisoning an animal by piercing its thigh with a Java dart, all the softer parts which surrounded the wound, to the distance of several lines, turned to a brownish yellow colour, and assumed the bitter savour of the poison.

But a supposition which best connects a certain number of phenomena, is, at bottom, but a more convenient manner of expressing them; and only assumes the character of a theory after being confirmed by direct experiments, sufficiently varied to leave no room to doubt.

It therefore became necessary to continue my researches in order to determine at what point my supposition would become inadmissible.

The affinity of the vascular membrane for the substances absorbed, being supposed to be the cause, or, at least, one of the causes of absorption, this effect ought to take place as well after the death as during the life of the animal. This fact could be easily verified, for the vessels of a certain size; it is true that, taking into consideration their diameter, their thickness and their smaller extent of surface compared with the capacity of the canal, the experiment should present but a feeble though still appreciable absorption.

I took therefore one end of the jugular vein of a dog, which, in an extent of more than three centimeters (about one and a quarter English inches) did not receive any branch, and stripped it entirely of its surrounding cellular substance; I attached a glass tube to each extremity, by which means I established a current of warm water in its interior; I then plunged the vein in a slightly acidulated liquid, and carefully collected the liquid of the interior current.

From this disposition of the apparatus it is evident that no communication could exist between the interior current and the exterior acidulated liquid.

During the first minutes of the experiment the liquid which I gathered did not change its nature, and after twelve or fifteen minutes it became sensibly acid; the absorption had taken place.

I repeated this experiment with veins taken from the human body, the effect was the same.

This phenomenon manifesting itself in the veins, I could see no reason why it should not equally take place when applied to the arteries; I consequently made the experiment on the carotid af a small dog which had died the preceding day, the result I obtained was exactly similar; I remarked moreover, that the absorption became more rapid in proportion as the acidity and temperature of the exterior liquid were increased.

If the capillary absorption was produced on the large blood vessels after death, why should not a similar effect be produced on the same vessels in a living state?

If experience did not give me this result, all my reasonings would be overthrown, and my supposition destroyed. And I felt so much the less confidence in the success of the experiment as I kept in mind the observations which we daily hear of the changes which death operates in the physical properties of our organs.

Nevertheless, as I had often found in my researches, the advantages of doubting the exactness of generally received opinions, I determined on making the following experiment.

I took a young dog, of about six weeks old, at which age the vascular membranes, being very thin, are better adapted to the success of the experiment. I uncovered one of the jugular veins and isolated it completely throughout its whole length. I stripped it carefully of all its appendages, especially of the cellular substance, and of some small vessels which adhered to it: I placed it on a card in order to prevent its having any point of contact with the surrounding parts. Thus prepared, I dropped on the surface of the vein, and opposite the middle of the card, a thick aqueous solution of alcoholic extract of *nux vomica*, a substance which acts with great energy on dogs; I was very careful that no portion of the poison should touch any part except the vein and the card, and that the current of blood in the interior should be unobstructed. Before the expiration of the fourth minute the effects which I anticipated began to manifest themselves, feebly at first, but afterwards with so much activity that I was obliged to have recourse to pulmonary inflation to prevent the death of the animal.

I intended to repeat this experiment, but I was unable to procure any other than a full grown dog, much larger than the former; the coats of his veins were consequently much thicker. The same effects were produced, but, as might have been expected, their appearance was much more tardy; and they were developed only after the tenth minute.

Satisfied with this result as to the veins, I was desirous of ascertaining whether the arteries possessed analogous properties. Yet the arteries are not, in the living animal, in the same physical condition as the veins; their texture is less spongy and offers more consistence; their tubes are much thicker in proportion to their diameter, and they are, moreover, constantly distended by the blood thrust forward from the heart. It was, therefore, easy to foresee that, if the phenomenon of absorption did really take place in the arteries, the effects would become visible much later than in the veins; this belief was fully confirmed by experience in the case of two large rabbits; after having stripped with the greatest care, one of the carotids in each of them, it was more than a quarter of an hour before the solution of *nux vomica* could traverse the sides of the artery.

Although I ceased to wet the artery as soon as the effects became visible, one of the rabbits died. And, to assure myself that the poison had really traversed the coats *(parois)* of the artery, and that it had not been absorbed by the small veins which might have escaped my dissection, I carefully detached the vessel which had served for the experiment, and opened it throughout its whole length; the persons who were present tasted with me the small portion of blood which remained adhering to the interior surface of the artery, and we all found in it the extreme bitterness of the extract of the *nux vomica.*

Absorption by the large vessels was, therefore, well ascertained to exist, as well during life as after death. It remained only to furnish direct proof that the smaller vessels possessed the same faculty; their multiplicity, their extreme tenuity, their thinness and the great extent of their coats, were so many conditions which would tend to favour the production of the phenomenon.

To develope it after death, it was necessary to find a membrane in the vessels of which a current could be established which should imitate the circulation of the blood. I at first made choice of an *intestinal part* ; but was obliged to renounce my experiment on account of the extravasation which took place in the cellular substance, and because the liquid found great difficulty in passing from the artery into the veins. I next took the heart of a dog which had died the preceding day, and forced a quantity of water at the temperature of 30° Centigrade (86° Farenheit) into one of the coronary arteries, the water returned with facility, by the coronary veins, into the right auricle whence it ran into a vase fixed for the purpose; I then poured half an ounce of slightly acidulated water into the pericardium. At first, the injected water gave no signs of acidity, but at the end of five or six minutes it presented unequivocal traces of acid. The effect was then evident for the small vessels of a dead animal, and I had no occasion to recur to new essays, or to sacrifice other animals to prove that the same effect exists in living ones. The experiments related in my memoir *on the organs of absorption in mammiferous animals (mammifères)* leave no doubt on this subject, according to the judgment of the academy itself.

But one possible objection remained to be removed, which was, that the membranes which are permeable after death, do not seem to be so during life ; in the dead body the bile transudes into the peritoneum, and tinges with yellow all the parts which environ the gall-bladder, which effect does not appear to take place in the living animals; the fact is true, I have witnessed it too often to be disposed to deny it; but it does not appear to me to be indispensably necessary to draw thence the conclusion that the membranes are impermeable during life; for if we suppose that the sides (coats) of the vesicle (gall-bladder) in the living animals admit the process of the bile, the sanguiferous current which exists in the small vessels of which these sides or coats (parois) are principally composed, would carry off the bile as fast as it impregnated them; this effect cannot take place in the dead body, since the circulation no longer exists to carry off the matter which the vessels imbibe.

Besides, I have often observed that even in living animals, the membranes are penetrated and coloured by substances with which they are in contact. For instance, if a certain quantity of ink be introduced into the pleura of a young dog, in an hour's time the pleura, the pericardium, the intercostal muscles, and the surface of the heart itself will be sensibly tinged with black. (1)

It appears then to be established beyond all doubt, that all the blood vessels, whether arterial or venous, great or small, in dead bodies or in living ones, possess in their coats (parois) a physical property by which we may perfectly explain, and to which we may reasonably refer all the principal phenomena of absorption. To affirm that this property is the sole cause which produces that effect would be going beyond the limits assigned by sound logic; but in the present state of known facts, I am acquainted with none which tend to invalidate this explanation; on the contrary, they all tend to confirm the exactness of it.

For example, Lavoisier and Mr. Seguin have proved, by a series of interesting experiments, that the skin, while covered by its epidermis, does not absorb water, nor any other substance. But the epidermis is of a different nature from the vascular membranes; it is a sort of varnish which does not imbibe, as every one may observe on his own body while bathing; but as soon as the epidermis is taken off, the skin absorbs like all other parts of the body, because the sides of the vessels are then immediately in contact with the substances destined to be absorbed. Hence the necessity of placing beneath the epidermis the substances to be absorbed in innoculation and vaccination; hence, also, the necessity of long continued frictions; and, often the employment of greasy substances, to facilitate the absorption of certain medicaments by the skin covered with its epidermis; hence, likewise, the preference given to those parts of the body where the epidermis is thinnest for the application of medicaments by friction.

I will cite, as another example, the absorption which takes place by all parts of our bodies of the most irritating substances, and even of substances which are capable of producing chemical changes in our organization. This effect is entirely opposed to the supposition that absorption is a

(1) This effect is observable with still greater facility in smaller animals, such as rabbits, guinea pigs, mice, &c. &c.

mere vital action, and that the absorbing orifices exercise a sort of choice; but it carries with it no degree of improbability when once absorption is assimilated to a physical operation.

These consequences have a relation not only to a healthy state of the body; but how many pathological phenomena may not be more easily understood and explained by comparing them with the experiments which I have related!

The cure of the dropsy, of obstructions, and of inflammations by bleeding; the evident want of the action of medicaments in violent fevers, when the vascular system is strongly distended; the practice of some physicians who purge and bleed their patients preparatory to administering active medicines; the employment of Peruvian bark during the recess, and for the cure of intermitting fevers; the general or partial Edema in cases of organic affections of the heart or lungs; the use of ligatures applied to members that have been stung or bitten by venomous animals, to prevent the deleterious effects that would otherwise ensue, &c. &c.

As to the influence that the knowledge of these facts may in future have over the manner of treating different affections, it appears to me likely that every physician sufficiently enlightened to relinquish ancient prejudices, will find in the single circumstance of the greater or less absorbing power of the blood vessels, in proportion as they are more or less distended, a fruitful source of curative indications.

From the above experiments I conclude that the capillary attraction of the smaller blood-vessels, appears to be the cause, or, more properly, one of the causes of what is termed venous absorption.

This conclusion does not, in any manner, interfere with the absorption of chyle which is effected in the small intestines by the chylous vessels; an absorption with which I shall occupy myself specially hereafter; still less does it interfere with the absorbing power of the lymphatic vessels; nevertheless, the experiments above described seem to indicate that if, in most cases, these vessels do not absorb, this circumstance is owing to the want of a current in their interior, and not to any particular quality of the vessels them selves, which possess the same physical properties as the veins.

In supposing that I am not mistaken, either in the facts which I have related, or in the consequences I have deduced therefrom, I should even then, only have explained the absorption of substances which are soluble in our humours; gases and vapours cannot be submitted to capillary attraction, and yet, every one knows that these bodies are absorbed, and that often, with great rapidity. An animal plunged into sulphuretted hydrogen gas, and immediately withdrawn, is often struck with death. I have seen rabbits die fron a single inspiration of prussic vapour. How can these phenomena be explained?

To understand them, we must remember that the membranes of animals seem to offer but a feeble resistance to the free circulation of the gases and vapours. Blood contained in a bladder, reddens at its surface as though it were in immediate contact with oxygen gas; pure hydrogen gas, confined in a bladder, promptly acquires its detonating quality, if the bladder remain exposed to the atmosphere. On the other hand, we are acquainted with many physiological facts in which the living membranes conduct in the same manner. The venous blood reddens in the lungs, when it is separated from the air only by the vascular membrane; the same effect is produced in the gills of fishes. The beautiful experiments of Mr. Edwards have recently proved that the skins of certain reptiles offer a phenomenon entirely analagous.

I have myself lately proved that, in birds and young mammiferous animals, the blood reddens, and assumes the arterial qualities, in the jugular vein when uncovered and exposed to the air, if the precaution be taken to slacken the circulation by a slight pressure on the lower extremity (extrèmitè cardiaque) of the vein.

It appears, therefore that the absorption of the gases and vapours, should be attributed to the permeability of the living membranes to those bodies. The theory of that permeability is not yet well understood, notwithstanding the efforts of some celebrated men, such as Priestly and Dalton; but here physiology must stop, and depend for its future progress, on the advances of physical science.

Art. X.—*On the application of Medico-Chemistry to Calculous Affections; by the late* Edward D. Smith,* M. D. *Professor of Chemistry and Mineralogy, in the South-Carolina College.*

The benefits which are continually resulting from chemical investigations, are peculiarly striking in the application of such investigations to the advancement of medical science. For, although it must be confessed that a rash enthusiasm may have unwisely attempted to explain the mysteries of some Phenomena, that are observed in the living system, by the analogy of the results of the action of chemical agents upon dead matter, it must be granted that there are cases, in which the useful application of chemical knowledge is conspicuous. Animal chemistry is undoubtedly a complicated subject, and from its nature, must necessarily be involved in much obscurity; but ingenious and patient analyses have already developed some facts in connexion with this branch of the science, that are exceedingly important and interesting and well calculated to display some of the causes of imperfection in the healing art. The labours of Scheele, Wollaston, Fourcroy, Vauquelin, Pearson, Berzelius and others, in the analyses of urine and urinary calculi, have diffused upon these subjects, a light that is very cheering to the friends of science and humanity. We are now enabled to take a clear and satisfactory view of what was heretofore involved in much doubt; and instead of timidly groping in the blind paths of empiricism, we may walk boldly upon the highway of correct principles. This is the sure road, and if we are careful not to deviate from it, must gradually conduct us towards the attainment of our object. It has been truly observed by the editors of the Edinburgh Review "that calculous complaints are among the worst of human maladies, and that to investigate the nature of the stone, for the purpose of discovering solvents, which might remove it, has accordingly been long considered as one of the noblest problems in practical chemistry, and

*This is the last communication for this Journal with which the editor was favoured by the respectable and estimable author of this memoir; it was transmitted a little before his death, but it has not been convenient to publish it before.—Ed.

among the best services which that science could render to the healing art."*

In this grand and humane enterprise, omitting the mention of inferior names, the genius of a Black was exerted in vain; and we are now reluctantly compelled to concede that it is hopeless to search for solvents of calculous concretions in the living system. But, although the researches of the chemist have, in this instance, failed to discover a remedy for a deplorable evil, they have nevertheless produced a great benefit by suggesting the means of *preventing* a calamity, which they cannot remove when it is once formed. The able experiments and reasonings of Mr. Brande, the present chemical lecturer at the Royal Institution, London, aided by the practical experience of Sir Everard Home, have greatly elucidated this subject and are calculated to afford much instruction and consolation to the scientific and philanthropic inquirer. From their investigations, together with those of the philosophers already named, it would seem that the components of calculi are often different from each other and that upon their specific nature must depend the use of the *preventive* remedy.

Here it is that chemical knowledge is of signal benefit and affords us a clue in a labyrinth, that would otherwise be impervious. A kind providence often furnishes premonitory symptons of threatening dangers, and by a timely attention to these, an impending evil may be averted. Thus it has been ascertained by chemical analysis, that the urine is a very compound fluid, containing both acids and alkalies in various states of combination, but so adjusted as that the whole should present an apparently uniform and homogeneous mass in the healthy state—by disease, these circumstances may be altered, and there may be an undue predominance of acid or alkaline matter, both tending to produce calculous concretions and requiring different modes of treatment. Observation has proved that the greater number of these concretions consist of uric acid, principally, while the remainder are formed by certain neutral salts, or earths, which ought to be held in solution by an excess of acid, but are deposited in the bladder in consequence of disease. Happily, before any such depositions take place,

* See No. 33, 1810.

a change in the qualities and appearance of the urine generally indicates the approaching mischief and affords the opportunity of arresting its progress. When the uric acid is in excess, it occasions irritation in the urinary passages and finally, a discharge of very small crystals, like red sand: and when the alkaline salts predominate, a fine white and sandy substance is voided.*

A previous knowledge of the subject and a proper attention to these indications will generally enable us to apply correct remedies and thus to destroy in the germ what would be irremediable at maturity.

Without stopping to investigate the fact, whether there may be a short and direct communication from the stomach to the bladder, or whether this communication may depend upon the retrograde action of the absorbents, it will be sufficient to assert what has been proved by numerous experiments, that the character of the urine can be changed by substances, that are taken into the stomach. Its natural state of free acidity can be entirely altered and it can be made obviously alkaline in its nature; and upon this circumstance has been grounded the practice of administering alkalies for the relief of gravelly complaints. This seems to have been the practice of the ancient Greek physicians, as stated in the second volume of Johnson's Animal Chemistry, and it is well known to have been that of the moderns, from the era of Mr. Steven's celebrated lithontriptic down to the present time. A little reflection will satisfy that this mode of practice has been too empirical; for if chemical analyses have demonstrated that calculous concretions are sometimes of opposite natures, it must be allowed that the same remedy cannot be adapted to every kind. It is then surely incumbent upon the physician to ascertain the real nature of the case; and, from the want of knowledge to do so, there can be no doubt that such diseases, instead of being relieved, have often been aggravated. To this difference in the constitution of calculous matter it is owing that both the strong and the weak acids have sometimes been used with eminent benefit; and yet the indiscriminate prescription of acids would frequently produce the most serious injury.

* London Medical and Physical Journal, Vol. 30, page 327, &c.

Admitting, however, that satisfaction has been obtained with regard to the peculiar nature of the disease, a question of much importance still remains to be discussed.

In the case of a tendency to form uric calculi, which are supposed to be the most common, it is not a matter of indifference what particular alkali is used to counteract this tendency. "Mr. Brande clearly shows that an alkali, administered to a calculous patient, stands no chance of reaching the uric concretion in a caustic state; for the urine contains both phosphoric and carbonic acid uncombined. But experiment clearly shows that neither carbonates nor sub-carbonates exert any sensible action on uric acid: in other words the affinity of the uric acid for alkalies is weaker than the affinity of carbonic acid for the same bodies: therefore alkaline liquors cannot act as solvents of the uric calculi."*

Experiments made upon healthy urine, tend to show that the internal use of sub-carbonates of pot-ash and soda occasions a considerable and speedy deposition of the phosphates (a circumstance, that ought to excite a caution in the fashionable use of soda-water, by persons in health) probably by neutralizing the free acids, which hold these salts in solution; while the similar use of the alkaline earth, magnesia, does not produce this effect but in a very limited degree. Hence the inference has been drawn, that in calculous cases, which need alkaline remedies, magnesia is to be preferred; and the particular mode of its action has been accounted for, both by the assumption that the disposition to generate uric acid in undue quantity commences in the stomach, and by the fact, that magnesia from its insoluble nature, will remain in the stomach long enough to combine with any acid that may be formed there—if this acid does not exist in the stomach, the use of the sub-carbonates of potash and soda does little good; because, from their great solubility, they are carried too rapidly out of the seat of disease and being conveyed into the bladder, may produce injury there by causing a deposition, which would not otherwise have taken place, while magnesia, retarded by its insolubility, acts efficaciously upon the acid and is totally neutralized by it. In case of no acid existing, then both the sub-carbonated alkalies and magnesia will be injurious.

* Edinburgh Review. November 1820.

as will be noticed hereafter. The carbonated alkalies will be likely to prove less injurious than the sub-carbonates, because their greater proportion of acid will tend to prevent the deposition of the phosphates in the bladder: but at the same time they are equally inert as the sub-carbonates as to the acids* in the stomach.

The preceding reasoning is amply confirmed by direct experiments, upon cases of uric acid, with alkaline carbonates and sub-carbonates and with magnesia. The result proved that the use of magnesia greatly relieved or entirely removed the symptoms of uric acid, while the other remedies produced no such effect.

I have been led to pay more particular attention to this subject, from the circumstance of my own case, which is believed to have been of the nature alluded to, and a succinct account of which may serve to shew a practical connexion between some remarks that have already been, and some that are yet to be made.

During a considerable portion of the year 1817, I had lived in a very sedentary manner and for some part of the time was unusually abstemious in diet, closely confined in the damp walls of a new brick building, which was frequently neither well ventilated nor warmed. In November, I experienced several short and pungent attacks of a pain in the right side, and near the region of the kidneys, which were removed in a little time by a stimulating potion ; but at length, in a few hours after drinking a glass of wine, from which I had long abstained, a severe and most distressing paroxysm came on and continued for several hours. Some of the symptoms indicated a violent, flatulent cholic, while from others it might be concluded that either rheumatism, or the passage of calculous matter fron the kidney to the bladder was the cause of suffering. Considerable eructations took place, there was acute and fixed misery in the loin and hip of that side, and frequent shooting and lancinating pains down the right thigh urethra, &c. but there was no nausea of the stomach nor febrile affection. Stimulating potions were used, and also embrocations and

* We presume that the writer intended to restrict this remark to the uric acid, for it is notorious that the carbonate, &c. neutralize and remove acids in the stomach.—Ed.

enemas without relief. Castor oil was also given; but the suffering continued for several hours, until at length sleep was gradually induced, and I awoke with no other sensation than a soreness of the parts, which had been affected. No such violent attack occurred again, neither did the urine at any time, exhibit any other appearance of disease than an unusually rapid separation of its mucous particles. In a little while however, it was observed that a few hours of close application to study, standing for a short time, or any exposure to cold, always induced a considerable pain in the back, hip and urethra; and when this pain was present, the calls to void urine were more frequent and its passage through the canal occasioned great irritation—and finally this acrimony increased so much as to produce slight hæmaturia and the discharge of small membranaceous filaments. Abstraction from mental employment, equal and comfortable temperature, and moderate exercise, together with a regular and more generous diet, afforded much temporary relief. To make this benefit more permanent a journey, of several weeks duration was undertaken; but there was such a constant succession of wet and cold weather that I returned with deteriorated health, and the distressing sensations in the urethra became so great, that frequently they prevented sleep, and these sensations were much aggravated by the use of any indigestable food and particularly by wine. The whole system began to sink under continued suffering and gloomy apprehensions, and in this state I resolved again to consult an ingenious medical friend, of this town, who had before aided me with his advice. It was his opinion that an acrimony of the fluids was exhibiting itself in the urine and was probably the principal cause of the symptoms, and if not arrested that it would terminate in the formation of calculous concretions. The subcarbonate of soda had been already used without apparent benefit and therefore, for the reason stated in a preceding part of this memoir, it was determined to make use of magnesia. Doses of a tea spoonful each, twice in the day, were exhibited for several days, and, although at first considerably purgative, they soon ceased to be so. The unpleasant sensations were gradually ameliorated, and at the end of four days disappeared altogether. Since that time occasional imprudencies in diet or much confinement have occasioned slight returns of the complaint, but two or three doses of magnesia have never failed to remove it. And it appears to be not an unfair inference that the injurious acrimony was generated in the stomach and therefore quickly and efficaciously counteracted by the internal use of the alkaline earth.

To attempt a practical improvement of the preceding details, I would offer the following suggestions.

1. Has not the doctrine of the humoral pathology been too hastily and entirely discarded, and would not the admission of it, to a certain extent, tend to elucidate some of the phenomena, connected with our subject?

The extravagance of theorists, in almost any department of science, has sometimes carried them so far beyond the bounds of rational induction, as to involve in one common condemnation both truth and error; and this perhaps, has been the fate of the Humoral Pathology. Very lately this subject has been ably treated by Professor Cooper, of Philadelphia, in his ingenious discourse upon the connexion of chemistry with medicine, and in which it has been plainly shewn that the applications of chemical science throw much light upon the reprobated doctrine. As an additional proof to what has been there and elsewhere stated of active substances being found in different viscera of the human body, after being taken into the stomach, it may be observed that Mr. L'Heiminier, an able French chemist and naturalist, now resident in Charleston, found the phosphate of mercury in the urine of a child, that had been taking calomel internally for some time previously.

2. Is it not of great importance that those, who undertake to practice the healing art, should be well acquainted with the principles of chemical science, inasmuch as it is only by such an acquaintance that they can, in many cases, be directed to a correct understanding of the subject before them? The observations which have been made respecting the use of remedies in calculous complaints, obviously indicate the necessity of a well informed and discriminating judgment, and they prove farther that a particular knowledge is requisite for the successful treatment of the diseases of such compound fluids, as are found in the living system—the very nature of such fluids demanding an accurate and competent attention to the various changes, which may be produ-

ced in them by the long continued use of particular substances. Thus, although a tendency to form uric calculi indicates the propriety of using alkaline remedies, it is certainly of consequence what peculiar alkalies are employed and a judicious selection can proceed only from an acquaintance with the specific and distinguishing properties of each. May it not be apprehended that a want of due attention to this subject has retarded the progress of medical science, and ought not any opinion in favour of such neglect, to be combatted as a dangerous error?

3. From the knowledge of the composition of urine and of urinary calculi, should not even the really scientific physician proceed with caution in the use of his remedies? This query is connected with the fact, that not only do different calculous affections require distinct and totally opposite remedies, but also on another circumstance. A remedy, which is demanded in a certain state of things, may, by its too long continuance, not only counteract the evil, which it was intended to do, but it may produce an opposite and equally injurious state. In such a case the chemical knowledge of the prescriber could alone direct the course, that should be pursued. From the analyses of healthy urine it appears to be granted that when it is first voided, an acid character predominates, and it is believed that a certain degree of this predominance is necessary, for the purpose of holding in solution the various neutral salts, with which the urine is charged; now, if this be the fact, it is easy to conceive that an increased quantity of this acid will occasion disease of one kind, and a diminished proportion that of another.

If therefore, in the attempt to remove the former state, the remedies employed, be pushed too far, there can be no doubt that the latter would be induced.

To possess then the knowledge, that would be requisite for maintaining in equilibrium these easily alternating conditions of the system, as also to select the preferable remedy for any determinate class, must be highly advantageous, if not indispensable. Numerous experiments, connected with this subject, have induced Mr. Brande (London Medical and Physical Journal, Vol. 30) to draw the following therapeutical conclusions.

1. "That where alkalies fail to relieve the increased secretion of uric acid and to prevent its forming calculi in the kidneys, or where they disagree with the stomach, magnesia is generally effectual; and that it may be persevered in for a considerable time, without inconvenience, where the tendency to form excess of uric acid remains.

2. "When the alkalies or magnesia are improperly continued, after having relieved the symptoms connected with the formation of the red sand or uric acid, the urine acquires a tendency to deposit the white sand, consisting of the ammoniaco, magnesian phosphate and phosphate of lime.

3. "The mineral acids (muriatic, sulphuric and nitric) diminish or entirely prevent the deposition of the phosphates, but are apt to induce a return of the red gravel.

4. "That vegetable acids, especially the citric and tartaric, are less liable to produce the last mentioned effects, even when taken in large doses for a long time; and that carbonic acid is particularly useful in cases, where the irritable state of the bladder prevents the exhibition of other remedies."

Under this head perhaps it would be well to notice that, in some cases, the long continued use of magnesia in large doses seems to have produced bad effects, by occasioning a mechanical constipation of the bowels, (see Journal of Science and the Arts, No. 2)

4. As calculous complaints are maladies of such a grievous nature, would it not be practicable to prevent them by an early and assiduous attention to diet, habits of life, &c.—and is it not probable that such attention would be efficacious, from the analogy between arthritic and calculous affections, as ascertained by Dr. Wollaston's analysis of gouty concretions?

In cases of gout, even where accompanied with an hereditary diathesis, it is well known that a rigid adherence to a particular plan will greatly mitigate, if not prevent, that disease; and analogical reasoning would infer the probable success of a similar practice in cases of calculus. To acquire the information that would be valuable here, it would be necessary to have accurate accounts of the ages, employments, diet and constitutions of those, who have been known to be afflicted with calculous complaints. In a late valuable work on calculous disorders, Dr. Marcet, of London, has furnished some information of this kind, and it is much to be regretted that his materials were so scanty. From his table it appears that out of five hundred and six calculous subjects only twenty-eight were females. Upon this fact some useful reasoning might perhaps be founded. The habits of females are, commonly speaking, more sedentary than those of males, and yet it has been generally admitted that men, of sedentary lives, are more liable to calculi than others; but may it not be questioned whether in such cases the influence of diet has not been too much overlooked? Is it not a general fact that females are more temperate in their diet than males; and again, resorting to the analogy with gout, do we not find that the proportion of women, affected with this disease, is much less than that of men? With regard to calculous complaints, I am aware that anatomical reasons would make their occurrence less frequent in women than in men; but this difference can scarcely account for the vast disproportion, which has been observed.

Dr. Marcet's table shows that nearly one half of the calculous patients were under fourteen years of age, and that these children were only from the poor classes; a strong argument in favor of the influence of diet in promoting such diseases. That the diet of an animal has an important effect upon the disposition to produce particular calculi may be inferred from what is stated by Dr. Wollaston, (London Med. and Phys. Jour. Vol. 25) respecting the proportion of uric acid found in the excrements of different birds, which had been nourished by different kinds of food. From this it appears, that those which consumed the most animal matter, furnished the greatest proportion of uric acid, while the herbiverous animals exhibited an inconsiderable quantity.

To the supposed influence of diet it may be objected that persons, sedentary from their occupations or from their being confined by wounds, &c. to the horizontal posture, are peculiarly liable to urinary calculi: but this liability may probably be attributed to the following causes. 1. Such persons are subject to indigestion, whatever may be their diet, and then the acid is found too abundantly. 2. Finding that their situation makes vegetable food peculiarly indigestible and productive of inconvenience, they may resort chiefly to animal, which is far more productive of the acids.

In connection with this part of the subject would it not be a valuable, pathological fact to ascertain, whether females in general, and male children are more subject to one peculiar kind of calculus than to another; and whether this is likewise the case, with regard to male adults, at different periods of life?

It might also be an useful inquiry, what influence climate has in producing such a state of the system as favors the formation of calculous matter. We are told that such diseases are exceedingly rare, either in very hot or very cold countries; and to discover whether the extremes of temperature prevent such alterations of the digestive powers, as take place in more temperate climates, would therefore be an interesting physiological fact.

From all that has been now said, may it not be inferred that, with respect to uric calculi at least, their formation is generally preceded by an impaired state of the digestive organs, which state may be produced either by diet too luxurious or too much impoverished, by occupations of too sedentary a nature, by uninterrupted mental pursuits, by confinement, even in active employments, to a close room, &c.: a combination of two or more of these causes being sufficiently injurious, although one alone might not be so. And if this influence be correct, the propriety of using remedies that act chemically upon the fluids, while the other plain indications are likewise attended to, is sufficiently evident.

Hoping that this imperfect essay will incite the inquirer after knowledge to investigate, for himself, the sources of information as to this interesting subject, among such I would take the liberty to mention the 22d, 23d, 24th, 25th, 30th and 34th volumes of the London Medical and Physical Journal, and Dr. Marcet's treatise upon calculous disorders, observing however that of this last work I have seen only a review, but that I entertain no doubt of its being the most satisfactory which has yet appeared.

January, 1819.

MECHANICS AND ARTS, CHEMISTRY AND PHYSICS.

Art. IX.—*On some recent improvements in the construction of the Printing Press; with a particular notice of that lately invented by Mr. John I. Wells, of Hartford, Ct.* *by* A. M. Fisher, *Professor of Mathematics and Natural Philosophy in Yale College.*

The principal defect in printing presses of the ordinary construction, so far as the mechanism employed to procure a gain of power is concerned, consists in the want of adaptation of this power to the variable resistance which is to be overcome. The elastic substances interposed between the form of types and the platen, present at first a comparatively trifling resistance; but it gradually increases as the platen descends, and must finally be made immensely great, in order to attach the ink with sufficient firmness to the paper. But to overcome this resistance the mechanical advantage furnished by the screw is perfectly uniform. To make up for the want of an increasing advantage in the mechanism, the pressman is obliged to place his body in such an attitude that his weight shall conspire with the force of his muscles, and to exhaust on the bar as much motion as he can accumulate in a pull of three feet, in order to give it a species of percussive effect. Hence the employment of *pulling* at the common press has been always regarded as one of the severest kinds of labour; nor has it been represented without reason as often "destructive of health and life."

It has long been an object with those interested in the improvement of the art of printing, to introduce into the press a variable power, which shall increase with the resistance to be overcome, and thus render the pull on the bar a nearly equable one throughout. The earliest contrivance for this purpose which appears to have been in any degree successful, was that of Mr. Roworth, a London printer.* In his press the screw was dispensed with, and a plain spindle substituted in its place. To the under side of the head or

* See art. Printing, Rees' Cyc. for a more full account of this construction.

summer, where the spindle was inserted, was attached a species of inclined plane, rounded off so as to have a variable inclination. Through the spindle immediately beneath ran a cross bar, which plied against this winding surface, and forced the spindle down as it was turned round; rapidly at first, but more slowly as the inclination diminished, and at last with a velocity as trifling as was shewn by experience to put the press into the best working state. In a press recently invented by Mr. Medhurst, an ingenious Englishman, the power is gained by means of two iron rods, one on each side of the spindle. These rods pass down from the summer to the top surface of a circular enlargement of the spindle, and rest at each end in hollows which allow them a racking motion. The two extremities of each are equidistant from the centre of the spindle, but are placed in a winding position when the platen is raised. The bar turns the spindle partly round, and moves the lower ends of the rods so that they come towards a vertical position, and bear down the platen with that kind of increasing mechanical power which every one has seen exemplified in bringing a prop erect by driving at right angles against the bottom.*

But in most of the recent attempts to improve the construction of the printing press, a kind of mechanical power has been resorted to in different forms, somewhat different from either of the foregoing; one which is well known to every theoretical and practical mechanician, but which has scarcely acquired a distinct name. To attempt to reduce it to the head of the lever or wedge, as has been sometimes done, appears an unwarrantable extension of the meaning of these terms; and yet I know not how to designate the principle better than to call it that of *combined levers.* It is the power of thrusting possessed by the outer extremities of two straight rods, placed obliquely end to end or riveted together, when the moving force is applied to bring them straight. Let a pair of compasses, or a carpenter's rule the two halves of which shut together with a joint, be opened nearly straight and placed between two parallel obstacles: on taking the rivet between the thumb and finger and varying the angle, it will require no skill in mechanics to discov-

* The principle of this combination will be investigated in the Supplement.

er that there is a gain of power, which gradually increases as the two halves approach a straight line, and becomes immensely great at the moment this position is attained. The *thrust* of two such arms is precisely the same, and varies according to the same law for different angles, as the *pull* in the simplest case of the funicular polygon; that is, when a rope is tended by a certain force and is drawn aside from a rectilineal position by pulling at the middle.

This principle is introduced in different forms into the Ruthven, Stanhope, and Columbian presses. In that invented by Earl Stanhope it is employed to give a diminishing velocity to the screw: in the Columbian press of Mr. Clymer, it is employed to give a diminishing velocity to a large lever of the second kind, which is substituted for the screw. These two presses, especially the latter, from their durability, the neatness and uniformity of the impression they produce, and the diminution of labour they occasion to the pressman, have been justly held in high estimation. To the excellence of the Columbian press, honorable testimonies have been borne in foreign countries: among others has been a present of six thousand rubles to the inventor from the Emperor of Russia.

But of all the presses which act on the principle of compound leverage, the one recently invented by Mr. Wells, of Hartford in this State, appears to possess the highest recommendations. It has now been in operation in various parts of the country more than two years,—a period sufficiently long to furnish an experimental test of its excellence; and it seems due no less to the interests of the mechanical arts in this country than to the ingenious and worthy inventor, that a more particular account of it than has hitherto appeared should be given to the public.

A perspective view of this elegant piece of mechanism is given, plate II, fig. 1. The frame is of iron, cast (with the exception of the feet) in a single piece; and is of such form and dimensions as to be incapable of springing, while the press is in operation. The platen (4) is of cast iron, and is of the dimensions of an entire form. The circular projection in the middle, with six radiating pieces, gives it an ample degree of firmness. The platen is immediately acted on by bringing nearly into a straight line the two main levers (6) and (17). These levers, in presses of the medium size, are fifteen inches each in length; and in the position represented in the figure, which is that of the greatest obliquity, they want two and a quarter inches at their point of contact of being straight. The lower end of each lever is four inches broad, and is rounded off into a portion of a cylindrical surface of half an inch radius. A piece of steel fixed within the circular projection in the middle of the platen has a hollow bush or bed of corresponding figure: in this the lower end of the lever (17) is set. The upper end of this lever is hollowed out in the same manner to receive the lower end of (6); and the upper end of (6) to receive a projection from the under side of the top of the frame. At (5) there is a provision for raising or lowering this projection by slips of sheet iron or tin, and thus adjusting the position of the levers to the best working state. The ends of the levers and the beds in which they rest are overlaid with steel, and the beds are so contrived as permanently to retain a small quantity of oil. (9) is a spindle of wrought iron fastened at the upper end by a screw and nut to the shorter arm of the balance lever (7), and branching below into three parts, each of which is attached by an adjusting screw to the platen. This answers the double purpose of keeping the platen steady, and enabling the weight (18) attached to the longer arm of the lever (7) to lift the platen and carry back the bar immediately after each pull. The platen is still farther guided by lateral projections which run in grooves connected with the cheeks of the press.

The mode in which the movement of the working bar (12) is transmitted to the main levers, will be best understood from Fig. II. which is a representation of the parts 11, 12, 13 and 15, as they would appear to an eye looking down upon the press from above. The bar BA (the lever worked with the hand) is inserted into a strong cast iron roller (13), which turns in sockets secured to the right cheek of the press. From this roller, about six inches above the bar, proceeds an arm AC three inches in length, and to the extremity of this is connected by a joint the driving lever CD, twenty-one and a half inches long. The extremity D is connected in a similar way with the iron rod EF, one end of which slides in a pewter guide (represented by 10, in Fig. I.) while the other end is fastened by a hook and eye to the upper main lever (6), at the distance of an inch from the bottom. (16) is a bar check, which limits the revolution of the bar to a precise arc. The *carriage* part of the press, which stands in front of the upright iron frame, presents nothing materially different from the Columbian press, and will not require a particular description.

The operation of the mechanism will now, it is believed, be sufficiently apparent. When the bar BA is brought round, the roller A and the arm AC are made to turn with it: this drives forward the lever CD, and this in its turn gives motion to EF, which by means of the elbow at F brings the two main levers (6) and (17) towards the position of a straight line. As the movement of the bar is continued, the mechanical advantage not only increases from the gradual approach of the two main levers to a vertical position, but from the approach of AC and CD towards a straight line. The combination is therefore one which is eminently adapted to effect that rapid increase of power near the end of the pull, which has been already mentioned as the great desideratum in the construction of this part of the printing press. To determine the actual gain of power at the beginning and at the end of the pull, measures have been taken from an individual press, of the lines necessary for the computation. When the bar was thrown back, the angle ACD (of the triangle ADC formed by joining the three centres of motion with straight lines) was found to be $=113° 52'$, CDA$=7° 12'$, and the distance of the centre of motion of the two adjacent ends of the main levers from the straight line joining their outer extremities $=2\frac{1}{4}$ inches. The length of AC was $3\frac{1}{6}$, and the distance from A to the part of the handle where the hand was generally applied was 24 inches. Hence, as will appear from the theorems annexed to this paper, the gain of power will be found by compounding the four following ratios: 24 to $3\frac{1}{6}$, Cos. 7° 12′ to Sin. 113° 52′, 15 to $2\times2\frac{1}{4}$, and 14 to 15; which gives a total of 20 to 1.

At the end of the pull, the angle ACD$=172°$, the angle CDA$=1° 3'$, and the distance of the vertical levers from a straight line, according to the specification of the inventor, which was found nearly exact, = half an inch. Hence the gain of power will be found by compounding the following ratios: 24 to $3\frac{1}{6}$, Cos. 1° 3′ to Sin. 172°, 15 to $2\times\frac{1}{2}$, and 14 to 15; which gives a result of 763 to 1.

It thus appears that the power gained is about thirty-eight times greater at the end than at the beginning of the pull. While the re-action of the elastic substances which form the tympan is small, the mechanical advantage is small, and the platen is brought down rapidly; but as the resistance increases, the power gained undergoes somewhat more than even a proportional increase, so that during the last moments of the revolution, the pull actually grows somewhat easier. In consequence of this, although the bar is stopped suddenly by the action of the check, nothing of that violent jar is produced on the arm, which is so serious an inconvenience in the common press; and to relieve which most pressmen find it necessary to sacrifice a part of the force exerted by inserting an elastic heading over the tenons of the summer.

Let us now compare for a moment the mechanical advantage furnished by this combination with that furnished by the screw of the ordinary press. In all presses alike, the perpendicular motion of the platen may be regarded as a constant quantity. It must necessarily rise a sufficient distance to allow the thickness of the tympan frame to pass freely under it. The distance allowed for this purpose appears to be in general about $\frac{3}{8}$ of an inch. But in addition to this, in the screw press, we must allow at least $\frac{1}{8}$ of an inch for the spring of the summer; making the vertical distance described by the interior relatively to the exterior screw half an inch. Then supposing the length of the pull to be no greater than in the Lever press, the mechanical advantage gained will be uniformly 44 : 1. But if we suppose, as is generally the the case in fact, that the distance described by the hand is greater by about a foot, (although the increase of the distance is in reality only an exchange of one disadvantage for another,) the power gained will be uniformly 66 to 1. Hence, on the most favourable hypothesis, the strength of the pull at the last point, independently of the force already accumulated in the body, need be but $\frac{1}{12}$ as great in the Lever as in the screw press; or $\frac{1}{6}$ as great, if but half a form is worked at once with the latter.* It

* The force actually exerted at the last point of the revolution of the bar in the Lever press, was found by measurement to be on an average, for the lightest kinds of work 30 lbs.; for the heaviest, 45.

must not be supposed however that this ratio is a fair criterion of the *total* strength exerted. This is probably about half or $\frac{2}{3}$ as great, in the former as in the latter. When a pressure is to be produced between the paper and form of types of from 25 to 35,000 pounds, it is not in the power of mechanism to supersede the application of a considerable aggregate force to the bar. The superiority of the Lever press lies much more in the *equalization* of the force which it occasions, than in the reduction of its total amount. It is true at the same time that the Lever press does considerably diminish the *total* force of the pull; but it is chiefly by permitting a diminution in the thickness of the elastic substances which form the tympan, and dispensing with the spring of the summer,—not from the peculiar nature of the mechanism which effects the gain of power.

By admitting the two main levers (6) and (17), or the two horizontal ones AC and CD to come much nearer to a straight line, a far greater mechanical advantage might have been obtained; but it would have been of no practical use. The inventor has rightly judged that it is time to stop the bar when it begins to move sensibly easier. If it were permitted to go further, the platen could descend but an extremely minute interval, and consequently the elastic reaction of the tympan and blankets would remain nearly stationary. At the same time, the positive disadvantage would be incurred of rendering it impossible for this elastic force to produce the return of the bar.

There are a variety of circumstances relating to the Lever press, aside from the peculiar nature of the power it employs, which recommend it to the attention of the owners of printing establishments.

1. The force exerted being exactly gauged by the pin which stops the bar, the impression of different successive sheets will be absolutely uniform, except the trifling and scarcely perceptible difference which may arise from the variable thickness of the paper.

2. For the same reason, the pressman will find it much less easy, if disposed, to do his work imperfectly. Indeed from the superior facility with which the press is worked, the temptation to slight his task is in a great measure removed.

3. The whole of a form being worked at once, and the platen admitting a superior evenness of surface and exact-

ness of movement, the different pages of the same sheet will present a neater and more uniform appearance than when worked with a wooden platen and two pulls. This remark is especially applicable to the duodecimo page.

4. By admitting a less thickness to the tympan and its contents, it produces a less rapid wear of the hair strokes of the letter.

5. The ribs on which the carriage runs have the peculiar construction seen in the figure, by which the friction is much reduced, and the waste of oil diminished.

6. From the best estimate which can be made, this press will in a course of years be attended with an actual saving of money to the purchaser.*

Many of the foregoing advantages, it is readily conceded, are such as this press possesses in common with that of Mr. Clymer; but without detracting from the merits of the latter, there is little danger in hazarding the prediction that its use will be speedily superseded; and that as it has thrown

* The grounds of this conclusion are the following. In the first place, the wear is almost nothing. With the exception of the main roller (13) which with its sockets is of cast iron, and the joint C, (Fig. II.) all the moving parts slide over an extremely small arc; and these are made of hardened steel. The writer has examined the parts most exposed to wear in a press which has been in constant operation nearly two years, and the effects of friction were found wholly insignificant. The slight roughnesses which had been left on the surfaces by the manufacturer were scarcely affected. It is obvious, however, that the wear of many of the parts might become very considerable before the action of the press would be sensibly impaired; and that others might be replaced at a trifling expense. The original cost of a common wooden press is about one hundred and seventy dollars; and the annual expense of maintaining one will consist of the following items: interest on the original cost $10,20; principal to be replaced, supposing the average time of wearing-out to be twenty-five years, $6,80; repairs, including accidents and insurance, $10,00. The interest on the first cost of the Lever press is from 18 to 21 dollars; principal to be replaced in all probability not $2; repairs &c. perhaps $4,00. This estimate is made out from inquiries addressed to different printers who have been conversant with both.

The foregoing particulars are such as chiefly interest the proprietor of a printing establishment; but no inconsiderable additional advantage has been conferred on the public by Mr. Wells, in lightening the task of the journeyman. Not only is the pull rendered far easier, as has been already shewn at length, but the number of pulls is reduced one half. Those who might apprehend a reduction of wages from an acknowledged reduction of their labour, can scarcely be expected to be among the most forward to proclaim the extent of their obligations to the inventor of the Lever press; but if, as the writer has been credibly informed, it has in some instances been hired by individual journeymen at an annual expense of fifty dollars, in preference to using the common presses offered them by their employers, a stronger testimonial to its superiority from this class of persons could not be desired.

prior inventions into the back ground, it must in its turn yield to the progress of improvement. The points of superiority in the Lever, over the Columbian press, appear to be the following. 1. It is afforded at two thirds of the expense. 2. The mechanism is lighter, and more compactly stowed. 3. From the greater simplicity of structure, it is less liable to get out of repair, and is more easily put in order when out of repair by a person of common mechanical skill. 4. The surfaces which move in contact are so contrived as to be kept oiled without being taken in pieces. Accordingly, those who have had trial of both, so far as the writer can learn, both owners and workmen, give the preference to the Lever press.

High as is the perfection to which this press has been brought by its inventor, it would be strange if it were absolutely incapable of improvement, or if farther experience should not point out some changes for the better. Among the infinite variety of which the adjustment of the levers is capable, there can be but one which is absolutely the best; and it is scarcely supposable that this one has been yet attained. A slight variation of the position and form of the working parts in different successive castings, promises more effectually than any thing else to make known those slight improvements of which they may still be capable. Several of the parts appear to possess superfluous strength. The cheeks might probably be reduced to one half their present size with advantage. The top and bottom of the frame must be made strong, because they require to be incapable of springing as well as of breaking. But while this is the case, the strain on the sides so far as it is produced by the two main levers is wholly a longitudinal one, and the re-action of the driving lever against the right side is comparatively small. Admitting the re-action of the platen, in performing the heaviest work, to be thirty-five thousand pounds, the two sides would possess sufficient strength to prevent their being drawn asunder if made of sound cast iron three-fifths of an inch square. But if reduced to one half their present size, they would possess sixteen times this degree of strength. The driving lever also, if made very nearly straight, as it might be without interfering with the main levers, might be diminished one half or two thirds in size. On other improvements of a more problematical character which have suggested themselves, it will not be necessary to enlarge.

SUPPLEMENT.

As the power gained by different combinations like those referred to in the preceding pages seems to have scarcely attracted the notice of writers on Mechanics, I shall subjoin an investigation of such as are most likely to occur in practice, for the information of those who may be concerned in the invention or improvement of machines which contain such combinations, and to whom it may be sometimes important to know with precision the mechanical advantage they gain by different supposed arrangements of machinery, and the strain to which the different parts are subjected.

PROP. I. Let CB *(Plate* III. *Fig.* 1.*)* be a straight rod, moveable about C, and BA another rod, connected by a joint with CB at B, and with its other extremity A confined to move in the line CA produced: it is required to determine the power which applied at B, in a direction at right angles to CB, will overcome a given resistance acting on the point A, in the direction AC.

The power will be to the resistance, in this, as in all other cases, in the inverse ratio of the velocities of their respective points of application. We have therefore only to investigate, for any given position of B and A, the velocity with which B moves, or the circular arc DB increases, compared with that of A's motion on the line CA. For this purpose, draw the perpendicular BP, put AB$=a$, CB$=b$, AC$=x$, BP$=y$, and DB$=z$. Then $x=\sqrt{a^2-y^2}+\sqrt{b^2-y^2}$; and taking the fluxions, $dx=\frac{-y\,dy}{\sqrt{a^2-y^2}}+\frac{-y\,dy}{\sqrt{b^2-y^2}}$.

But $dz=\frac{-b\,dy}{\sqrt{b^2-y^2}}$; hence by division $\frac{dx}{dz}=\frac{y\sqrt{b^2-y^2}}{b\sqrt{a^2-y^2}}+\frac{y}{b}$.

This expression gives the ratio of the velocities of A and B; and hence is to unity as the power is to the resistance. But by reinstating the values for which x, y, &c. were substituted, it admits of simplification. Reducing the terms to a common denominator and restoring their values, it becomes $=\frac{BP}{AP}\cdot\frac{AC}{CB}=\frac{\sin BAC}{\cos BAC}\cdot\frac{\sin ABC}{\sin BAC}=\frac{\sin ABC}{\cos BAC}$. That is, the power is to the resistance overcome, as the sine of the angle made by the two rods, is to the cosine of the angle, made by the rod to which the resistance is opposed and the direction of the resistance.

Cor. 1. If the power, instead of being applied at B, is applied at any other point X in CB or CB produced,—power : resistance : : CB·sin ABC : CX·cos BAC.

Cor. 2. If the rods CB, BA become equal in length, $\sqrt{b^2-y^2}=\sqrt{a^2-y^2}$, and the general expression is reduced to $\frac{2y}{b}$. That is, the power is to the resistance as twice the cosine of half the angle contained by the rods is to radius,—or as twice the distance of their point of junction from the line joining their outer extremities is to the length of either.

Cor. 3. If the power, instead of acting in a direction perpendicular to CB, act in the direction of BP, it is easily inferred that power : resistance : : tan BAC + tan BCA : 1.

Prop. II. It is required to determine the ratio of the forces which keep each other in equilibrio when the point A (Fig. 2.) is confined to move in any other given line AH.

From C draw Cb equal, and infinitely near to CB, and from b as centre with BA as radius, intersect AH in a. Join b, a, and draw the perpendiculars ar and bs. Ar is ultimately equal to Bs. For Ar—Bs=AB—rs=ab—rs= (as may be easily shewn) $\frac{(ar \backsim bs)^2}{AC+rs}$. This being an infinitesimal of the second order, is ultimately evanescent in respect to Ar, and consequently Ar—Bs=0, or Ar=Bs. It follows that Aa : Bb : : sec BAH : sec bBs : : sec BAH : cosec CBA : : sin CBA : cos BAH. But Aa and Bb measure the velocities of the points A and B; hence power : resistance : : sin ABC : cos BAH. This result includes that of the last Prop. as a particular case.

Prop. III. Let the extremity A, instead of moving in a straight line, be confined to move in a circle, by being connected with the rod AC′, moveable about the fixed point C′ : the power applied to B will be to the resistance acting at A with which it is in equilibrio, as the sine of CBA is to the sine of C′AB.

For draw through A the line AH perpendicular to AC′: then the initial motion of A will be in the line AH, and by the last Prop. power : resistance : : sin ABC : cos BAH.

But, BAH = comp. BAC′; therefore power : resistance : : sin ABC : sin C′AB.*

Cor. 1. When the the radii stand in opposite directions as C′A, CB′, ABC becomes a reflex angle of more than 180°; but the sine of any arc is the same (except in regard to its sign) as the sine of its supplement to 360°; hence, as before, the two forces applied at A and B′ will be in equilibrio when they are to each other as the sines of the angles AB′C, C′AB′ to which they are respectively applied.

Cor. 2. The same result may be extended to the case in which A and B are confined to move in any lines whatever, straight or curved, to which a tangent can be drawn. For let AH and B*b* be the tangents at the points A and B; and power : resistance : : cos AB*b* : cos BAH, or (drawing the normals CB, C′A,) : : sin CBA : sin C′AB.

Remark.—The foregoing results will equally apply when the rods CB, BA, &c. are curved, and when in consequence of being inserted into different parts of the same roller, they are not in the same plane;—provided that CB, BA, &c. are taken as the perpendicular distances from the central line of one roller to that of another.

Prop. IV. Let there be three levers CA, C′B, C″D, (Fig. 3.) moveable about C, C′, and C″, as centres, and having their other extremities connected by straight rods AD and DB: the power applied to A will be the resistance acting at B perpendicularly to C′B, as sin CAD × sin C″DB is to sin ADC″ × sin DBC′.

This proposition evidently follows from the first Cor. to the last, and is equally true for all possible positions of the centres C, C′, C″, and of the rods CA, C′B, C″D.

Cor. When CA and AB come into the position of a straight line, sin CAB vanishes, and the power gained will be *infinite.* If the rods be so disposed that C″D and DB come into the position of a straight line at the same time, the power gained at the moment of attaining this position becomes *infinite upon infinite.*

Prop. V. If any number n of equal rods be connected by rivets at their middle and ends as in Fig. 4, the end C

* This proposition determines the mechanical advantage gained at any given part of the revolution of the bar, in the Stanhope press.

being fixed, and A being moveable along CA; the power applied at B″ and acting perpendicularly to CA is to the resistance overcome at A, as twice the tangent of BAC is to $n-1$.

Suppose in the first place that the power is applied at B: by Prop. 1. Cor. 3. it will be to the resistance : : 2 tan BAC : 1. But the nature of the combination requires that the rods should in all states be parallel to each other; hence velocity of $B' = 3 \times$ vel. B; vel. $B'' = 5 \times$ vel. B, &c., and power at $B'' = \frac{1}{5}$ power at B; so that power at B″ : resistance at A : : $\frac{1}{5} \times 2$ tan BAC : 1 : : 2 tan BAC : 5. In the the same manner it may be shewn, whatever be the number of rods combined, that power : resistance : : 2 tan BAC : $n-1$.

Prop. VI. (Fig. 5.) Let the two levers of Prop. I. instead of being united at B, act on each other by means of circular cheeks BD, B′D, having equal radii BO, B′O′, less than BA: it is required to determine the power which, applied to B at right angles to BA, shall overcome a given resistance acting at A in the line AC.

To simplify the investigation of the relative velocities of B and A, let it be supposed that when B suffers an indefinitely small change of position, A and C move equally in opposite directions. Then the centres O, O′, of the arcs B D, B′D, will describe lines perpendicular to AC; and if the motion of B be continued, the point of contact D, the centres O,O′, and the points B, B′ will all fall upon AC together. Let *ab* (Fig. 6.) be the position which AB assumes when it has moved an indefinitely small distance: the point *o* will be in the perpendicular OP, and *ao* will be equal to A O. Drawing the perpendiculars, *bg*, *oh*, A*e*, and placing *f* at the intersection of AO and *ao*, it may be shewn as in the demonstration of Prop. II. that $Bg = Oh = ea$. Hence $Ae : ho$: : tan OAP : cot OAP : : $\sin^2$ OAP : $\cos^2$ OAP : : $OP^2 : AP^2$. By sim. tri. $ae : ho :: Af : fo$. But fO may be taken as $= fo$; therefore $Af : fO :: OP^2 : AP^2$. By composition, $fO : AO :: PA^2 : AO^2$; hence, putting A to denote the angle BAP, $fO = AO \cos^2 A$. Likewise $oh = Ae . \frac{\cos 2A}{\sin 2A}$, and $Ae = Aa . \sin A$; so that $oh = Aa . \frac{\cos 2A}{\sin A}$. By sim. tri. $gb : oh :: Bf : Of$; that is, (by substituting the values already found,)

$gb : Aa. \frac{\cos 2A}{\sin A} :: OB+AO. \cos^2 A : AO. \cos^2 A$. Dividing the second and fourth terms by $\frac{\cos 2A}{\sin A}$, we obtain, $gb : Aa :: OB+AO. \cos^2 A : AO. \sin A$. But gb represents the velocity with which B moves, reduced to the direction of a perpendicular to BA, and Aa denotes the cotemporaneous velocity of A. Hence the power is to either of two equal resisting forces applied to A and C as $AO \cdot \sin A : AO \cdot \cos^2 A + OB$.—If the angle BCA be not too large, we may suppose C immoveable, and the whole resistance applied at A. We shall then have power : resistance applied at $A :: 2AO \cdot \sin A :: AO \cdot \cos^2 A + OB$.

Cor. When A is so small that $\cos^2 A$ may be considered as $= 1$, power : resistance $:: 2AO \sin A : AB$. When the two ends B,B′, are immediately applied to each other, as in Prop. I. the ratio is that of $2 \sin A : 1$. Hence when two levers act by circular cheeks, they furnish a mechanical advantage greater than that of two simple levers of equal length at the same angle of obliquity, in the ratio of the length of the lever to the excess of this length above the radius of curvature of the cheek.*

Prop. VII. Let two equal rods AB, A′B′ (Fig. 7) resting on the immoveable points A,A′, support the circular plane BEB′ at two opposite points of the circumference B,B′; and let this plane be capable of turning round and sliding parallel to itself on the fixed line CF, which passes through its centre and rises perpendicularly from C the middle of the line AA′: if DE be drawn parallel to CA, the power acting at the circumference B, is to the weight resting on B′EB which it will support, as the sine of BDE to radius CA, is to CD.

* This principle (which may be called that of *excentric rollers*) has the farther advantage of entirely avoiding friction between the adjacent surfaces. It deserves an inquiry whether the immense power which can be thus commanded does not admit of being advantageously introduced into certain kinds of machinery. Possibly it would be an improvement to construct the adjacent ends of the two main levers of Mr. Wells' press in this form.

It would be easy to assign the ratio of the power to the resistance for different obliquities of AB and CB′, when BD, B′D, are elliptic arches having AB, CB′ for their semitransverse axes. But the result would be of no practical importance, on account of the difficulty of grinding the surfaces BD B′D to an exactly elliptical form. *Whatever* be the nature of these curves, the proportion given in the Cor. will be true for very small obliquities, if BO, B′O′ be taken equal to the radii of curvature at the points B,B′.

Draw BP perpendicular to DE and join AP. Then the plane ACDP is perpendicular to the plane BEB′; and BP drawn perpendicular to their line of common section is also perpendicular to the plane ACDP, and therefore to the line PA which it meets in that plane. Hence APB is a right angled triangle, and $AP^2+PB^2=AB^2$. If BD be put $=r$, $AC=r'$, $AB=a$, $CD=x$, and $BE=z$, BP will become $=\sin z$, $DP=\cos z$, and AP^2 $(=DC^2+\overline{AC \backsim PD}^2)$ $=x^2+(r'\backsim\cos z)^2$. Hence $\sin^2 z+x^2+(r'\backsim\cos z)^2=a^2$. Expanding $(r'\backsim\cos z)^2$, and substituting r^2 for $\sin^2 z+\cos^2 z$, we have $x^2+r^2-2r'\cos z+r^2=a^2$. Taking the fluxions, $2x\,dx=2r'\,d(\cos z)=-\frac{r'}{r}2\sin z\,dz$; and by resolution, $dx:-dz::\frac{r'}{r}\sin z:x$. But dx and $-dz$ express the velocities of the points to which the weight and the power are respectively applied; so that power : weight $::\frac{r'}{r}\sin z:x::$ sin BDE to rad. AC : CD.

Cor. 1. When $BDE=0$ or $180°$, sin BDE vanishes, and the gain of power becomes infinite. But DE is evidently the position which BB′ assumes when AB and A′B′ come into the same vertical plane. Hence the weight infinitely exceeds the power necessary to support it, when the two rods come into the same vertical plane. When the angle EDB is so small, or the line DC so large, that the variation of DC may be neglected, the power necessary to support a given weight will vary as the sine of EDB, the angular distance from the position at which it becomes evanescent.

Cor 2. Every thing else being the same, the gain of power from this combination will increase in the same proportion as the distance of the lowest points of the rods from C is diminished.

Cor. 3. If, as will generally be the case, the two extremities of each rod are equidistant from the central line CF, or $AC=BD$, the power will be to the weight simply as BP : CD.

Art. XII.—*Some account of the Copperas mines and manufactory in Strafford, Vt.; by* Dr. John Locke.

The mine is situated about twelve miles from Dartmouth College, and about five miles from Thetford, Vt. It is near the summit of a hill which rises probably two or three hundred feet above the bed of the streams in the vallies below.

The gangue in which it occurs is mica slate, the strata of which, are very highly inclined to the horizon, and present their long ridges above the surface in various parts of the hill, particularly at its summit. There are occasionally veins of quartz in the slate. The rocks for several miles around are, as far as I observed, principally mica slate. There are no particular indications of iron at any considerble distance from the mass of the mine, but the transition from the slate to the pyritic ore is abrupt. The mine has been opened obliquely up the hill, about twenty rods in length and four in breadth. The ore has been traced near half a mile, running pretty much in the direction of the strata of the slate.

The ore consists of an aggregate of quartz and undecomposed pyrites in small grains. In its granular aggregation, the ore resembles the quartz and feldspar in fine grained granite. The pyrites constitutes the greater proportion. Many specimens contain abundance of needle shaped crystals of schorl. Its fracture possesses a metallic lustre, and most of it approaches in colour to pale brass, from which it varies to steel grey.

The ore is very compact and is obtained for manufacturing by drilling and blowing. In manufacturing it into copperas it goes through the several operations of decomposition, lixiviation and evaporation, each of which constitutes a distinct operation. For several years the manufacturers effected the decomposition in the following manner: the ore was broken into fragments of a foot or less in diameter, and heaped upon inclined scaffolds erected and floored with plank for the purpose. Thus exposed to the action of air and moisture it very gradually decomposes at the surface. Thus from the same mass of ore a solution was obtained, year after year, either by the rains or by the application of water by other means. The solution was received from the inclined scaffolds in plank cisterns.

For three or four years past they have adopted a more expeditious method of decomposition, which was discovered in the first place by accident. They break the ore into much smaller fragments, three inches and less in diameter, and throw them into a convenient heap, taking care to leave air holes at the base, so as to allow the air to pass freely through the heap. On applying water the decomposition commences, and so much heat is evolved, as presently to raise the temperature of the heap to such a degree as to charr wood, boil water, sublime sulphur, &c. Great quantities of sulphurous acid gas are evolved during the process, and in the course of three or four weeks the whole becomes deintegrated and ready to fall into the state of powder. It then by lixiviation with water, yields all its copperas at once; the process is performed in a plank cistern.

When I visited the mine last summer one of these artificial volcanoes happened to be burning. The sulphurous acid produced had run down the side of the hill below, and killed the grass and leaves of the trees for several rods, as completely as though they had been scorched by fire. It was even dangerous to approach it except on the windward side. I thrust a stick into it and it was charred to blackness in a few minutes. I obtained needle-shaped crystals of sulphur which had evidently been formed on the external surface of the heap by sublimation. I was informed that the sulphur usually melted and ran down into the cavities, and that it frequently burned with flame in various parts of the heap.

The manufactory in which the processes of evaporation and crystalization are performed, is placed on the declivity quite below the mine. This gives great facility to all the operations, allowing the various reservoirs to be so arranged one above another that the liquor may be transferred from one process to another merely by means of a trough.

The bottoms of the evaporating vessels are of lead, and about ten feet square; the sides are of wood about three or four feet high. The bottom is supported by a number of parallel brick walls, placed at a small distance from each other. The avenues or arches between these walls communicate at one end with the arch in which the fire is placed, and at the other with the common flue.

The ore is a sulphuret of iron with a small proportion of copper; and the solution, first obtained, is a sulphate of iron and copper with an excess of acid. During the process of evaporation a leaden vessel, having its sides perforated and containing fragments of old iron is suspended in the liquor. The iron at the same time that it neutralizes the excess of acid, decomposes the sulphate of copper and the copper is precipitated in the form of a fine powder which the workmen call "copper mud." In a conversation with Professor Cleaveland upon this subject he observed, that he could not conceive why the copper did not form a pellicle upon the iron. I think its detachment is referable to the constant and active operation of the acid in the hot liquor, removing the copper as fast as it is deposited. Hydrogen gas which I collected in tumblers and burned, is evolved during the solution of the metallic iron in the acid liquor. When the liquor is first heated it becomes turbid with some earthy material, probably alumine.

After the liquor has been sufficiently evaporated it is drawn off into cisterns to crystalize. Branches of trees are put into them as a nucleus for the crystals. When the crystalization has proceeded as far as it will go, the remaining fluid is drawn off, and returned to the evaporating vessels. The cistern remains lined several inches in thickness with crystals, like a geode. The branches have a fine crop of foliage and fruit composed of beautiful green crystals. The crystals are very large and perfect, presenting numerous brilliant facets which are often several inches broad. I obtained some which were perfect four sided prisms with a rhombic base six inches in length and half an inch broad.

Every thing about this mineral manufactory is curiously reddened with iron rust. When a dry day succeeds a rain or a shower, the whole mine becomes covered with a white crystalline efflorescence like a hoar frost, and the rain water which runs down into the cavities of the mine becomes so strong a solution as to crystalize. Wherever the solution dribbles from the rocks, or leaks from the cisterns, large stalactites are formed so precisely like icicles that they would not be distinguished from them were it not for their green colour. These stalactites are very numerous at some seasons and present a very beautiful spectacle.

An ingenious method has been contrived to catch the wash of the whole mine. There has been cut in the compact ore, quite across the lower edge of the mine, a channel, into which by its inclination the mine discharges the wash of every shower, together with the natural oozing from the hill above. A trough conveys the fluid from the channel to the boilers. To increase the effect of this natural brook of copperas, the ore has been broken into large fragments, and heaped along the upper side of the channel, there to undergo a slow decomposition precisely as it does upon the scaffolds mentioned above.

The mine where it has not been opened is covered with oxid of iron which consists principally of incrustations of vegetables.

In the part where I examined these incrustations they are about three feet deep. The vegetables seem to have been enveloped by a thin uniform crust, but having decayed and disappeared the crust remains an empty mould or pattern of the vegetable. The general figure of the vegetable is pretty well preserved in the external form of incrustation; but the internal cavity is wonderfully perfect, the sinuosities of the bark, the veins of the leaves and the striæ of the buds are preserved to microscopic minuteness. The impressions are so perfect that it is difficult for one to convince himself that the real vegetable is not there. All the vegetables that we should expect to find upon a given spot of ground, in the woods, seem to occur there. I could in general recognize the species and even the varieties. Among the specimens I obtained were the following: hemlock branches and cones; nuts, burrs, and leaves of the beech; hazel nuts and a species of golden rod which I recognized by a peculiar swelling often produced upon this plant by an insect. I could not ascertain that any animals had ever been found incrusted. The incrustations are divided into several strata by layers of oxid, which have a structure so compact as to present a fracture almost or quite vitreous.

The superintendant told me that four men manufactured one hundred tons of copperas in a year, besides carrying on the business of a small farm.

A small quantity of the ore has been found which had undergone a spontaneous decomposition and was thought to be very rich. The superintendant told me, that a barrel of it afforded three hundred and thirty-three pounds of copperas. When I considered the quantity of iron the liquor dissolves, and the water it acquires in crystalization, this statement seemed less incredible than at first.

I have deposited specimens of the gangue, of the ore in its various conditions, the crystals, &c. in the New-England Museum, Boston. JOHN LOCKE.

Art. XIII.—*Remarks on some points of Modern Chemical Theory, with a notice of "the Elements of Chemical Science, in two volumes, with plates; by* John Gorham, M. D. *Member of the American Academy, and Professor of Chemistry in Harvard University, Cambridge."*

Homo naturæ minister et interpres.—*Bacon.*

The present period is distinguished by wonderful mental activity; it might indeed with great propriety be denominated the *intellectual age of the world.* At no former period, has the mind of man been directed, at one time, to so many and so useful researches. Name whatever department of human knowledge you please and you can at once, find men of talent and industry vigorously engaged in pushing its interests, and extending its boundaries, while the press is prolific, beyond all former example, in productions upon every art and every science. Even that department of knowledge, whose elements admit of no extension or modification, is *as a practical subject,* pressed with unprecedented vigor and success into the still savage recesses of all the continents except one, and to the remotest islands sprinkled in the Indian, the Southern and the Pacific oceans. Every thing that relates to man's duties and rights, as a moral, social and intellectual being—all that concerns his mental powers in their varied operations, and all that respects the physical existences around him, is explored with unceasing industry and perseverance. The physical sciences have, in this general career of intellectual effort, attracted a distinguished degree of attention, and the civilized world is filled both with *amateurs* and with *labourers* in every department of this unbounded field. A century has now passed, since (principally by the labours of Newton) the mechanical laws of the universe have been, as to their most important features, definitely settled; the last century has added comparatively little to the fabric, although the endless relations of quantity continue to afford inexhaustible topics for the researches of theoretical mathematics, and we may add also, innumerable practical applications of these theoretical speculations. After all the labour that has been bestowed on the subject, the study of the external forms and of the internal constitution of natural things has not been exhausted,—in a word, Natural History and Chemistry continue to afford an endless variety of topics of observation and research. Every year new minerals, animals and plants present themselves to the mineralogist, the zoologist and the botanist, respectively; this is true, even in the oldest countries, in those that have been most minutely and faithfully explored, and every voyage and every tour of discovery, in unknown or imperfectly known regions, adds abundantly to the stores of natural history. It is however true that in the greater number of countries the most conspicuous and important objects have been already observed and described, and particular naturalists have, in a sense appropriated them as their peculiar property; it is also true that in new countries conspicuous subjects occasionally occur, but most of the objects now found are more minute and less valuable than those that were before discovered, and the labour of the present period is often bestowed rather on the gleanings of the field, than on its first abounding harvest. With that science, whose object it is to ascertain the composition of bodies, the case is however widely different. It is, in all probability, in its very nature, inexhaustible. Its domain being co-extensive with the physical creation, (or rather with that portion of it which is accessible to man,) chemistry is bound to *attempt* the analysis of all things, in earth sea and air. It is required of it to unfold, not merely the immediate state of combination, in which the parts exist, but to discover as well their ultimate elements, as their proximate principles. Great diversity of opinions has existed respecting the *elements* of bodies; these opinions have vibrated between *the four* assumed by the ancients, and the *forty*, *fifty*, or more admitted by the moderns. The progress of discovery has tended constantly to increase their number, and yet without any *absolute certainty, that any of them are really elementary.* Indeed, it is obvious, that this certainty can never be attained, for were the great number of elementary bodies, now admitted as such, to be ultimately reduced to *two*, (which is physically possible)—and although it is self evident that there cannot be fewer than two elements;—still it is clearly possible that the two which appear to be elements, may be in their turn, decomposed—each may contain one new body and one before known or possibly each may consist of two new bodies, and these again may contain each one new body or more; and thus, when the subject has apparently reached the point of greatest simplicity, it may again become more complex and ultimately carry the enquirer farther than ever from the desired result.* This is one great reason why the researches of chemistry are boundless. Another is, that independently of our theoretical views as to the number and nature of the elements, we can never know when we have formed every possible combination; the progress of chemistry has constantly evinced that compounds are produced which, as we have every reason to believe, exist no where in nature, and not a few of them are possessed of astonishing properties. For these reasons principally, chemistry has, in our times exhibited more fluctuations, than any other science; immense activity has been exerted in its various departments and a great number of ingenious and able men, spread over all enlightened countries, have been and still are constantly occupied in its numerous and diversified operations. From all these causes it has arisen, that chemistry has, during the last twenty or thirty years, produced more elementary books than perhaps any other branch of science. This has resulted, in a considerable degree, from the necessity of the case, because the progress of the science has been so rapid, that it has required but a few years to throw a particular edition of a good elementary work into the back ground, and therefore new editions and new books have been frequently multiplied. In this view of the subject, (although there were already many good works on chemistry,) Professor Gorham had undoubtedly the same right as other authors who have preceded him, to give the science a new *elementary treatise.*

* We do not mean to say that this will be the fact; its possibility is sufficient for our purpose. In point of fact, it appears *probable* that *most* of the bodies now admitted as elements will retain that character.

It appears, however, from his preface, that this was not his original motive; he remarks: "the work which is now offered to the public, was originally intended, by the author, as a text-book to the lectures delivered by him, to the medical students, and under graduates of Harvard University." This object, was unquestionably a correct one, for it would generally be advantageous to every class, to have the peculiar course of instruction which they are to receive laid before them in a concise and perspicuous printed form, for most students in a college have no time to do any thing more than to follow their instructor, in the shortest route possible, and in general it is of very little use to recommend to them the perusal of various authors; the greater part of them will obtain little more than what they get either from the lips or the pen of their immediate instructor.

But Professor Gorham goes on to remark: "while arranging the materials, it was thought that by extending it (the work) to a greater length, and dilating more upon the general principles of the science, it might still answer the purpose above mentioned, and at the same time, be adapted to a class of readers who might wish to acquire a knowledge of the laws of chemistry, without entering much into its practical details."

In stating his design, the author observes, that "a work which on the one hand shall be more diffuse than that of Dr. Henry, and on the other, less extended than the elaborate and profound system of Drs. Thompson and Murray, will be sufficient to include the most important facts in chemistry without tasking the memory of the student with a mass of matter, the knowledge of which, though indispensable to the operative chemist, must be uninteresting to the general scholar." He observes with sufficient modesty; —"This work is a compilation; it has no claims to originality, though from the unsettled state of some parts of the science, there is room for the exercise of the judgement in determining the value of opposing doctrines."

Perhaps this work may be regarded as occupying a niche not exactly filled before. It does not claim to present a system of chemical knowledge with the fullness of the great works of Fourcroy, Thompson, Murray and Thenard, but among the works of middling and minor size—as those of Brisson, Jacquin, Heron, Park, and the Conversations on chemistry—La Grange and the abridgments of Thompson and Murray, Chaptal, Lavoisier, Accum, Brande, and even Henry,* it has, we believe, a right to claim a peculiar character as being more full than any of them, and more philosophical than most of them, while it is not encumbered with more of the details of the practical parts of the subject, than are necessary to illustrate the philosophy of the science, which appears to be the great object of the work.

It would be saying a great deal to affirm that any work can surpass the fine elementary treatise of Dr. Henry, provided we take into view its particular destination. It combines in a happy manner, the perspicuous exhibition of principle, with ample details of experiment. These are stated with great precision—the selection is happy, and we believe that few of Dr. Henry's statements relating either to principle or practice can be seriously invalidated. His book has maintained its standing for more than twenty years, and has passed through nearly half that number of editions. It is not perhaps likely to be soon superceded—it had its feebler youth—it now flourishes in vigorous maturity, and it promises ultimately to enjoy a green old age. There is indeed little interference between the works of Dr. Henry and Dr. Gorham. Each has its appropriate object and mode of execution, and we think Dr. Gorham having resolved to go beyond his original plan of a text book, has been judicious, in giving his work the form of a general treatise on the philosophy of chemistry. It bears more resemblance to the elements (in two volumes) of the late lamented Dr. Murray, than to any other book, but it is fuller, and much more recent than his latest edition.†

The plan of Professor Gorham's work is thus stated by himself: "The first part is devoted to the general laws of the science, and to the properties and modes of action of the powers or agents which are concerned in the production of chemical phenomena. In the second part, are detailed the properties and relations of ponderable bodies and their com-

* The American reader will not need to be informed that in addition to the foreign works enumerated in the text, Drs. Ewell, Cutbush, and Bache have each published in this country a work on the elements of chemistry.

† It will of course be understood that we do not allude to Dr. Murray's large system in 4 vols.

pounds. This part is formed into two divisions; in the first, is given an account of the properties of *inorganic* matter; the subject of the second is *organic* matter; and organic matter has been as usual, divided into vegetable and animal."

Mineralogy and geology have been very properly omitted; those topics are too extensive to be adequately included in a chemical treatise, without swelling its size very inconveniently.

For these subjects, Professor Gorham refers his readers to "the excellent work of Professor Cleveland," and we may be allowed to add, that we think this reference altogether judicious.

Professor Gorham's work (which we have heen prevented by the pressure of occupation, from recommending before) is now too well known to make it necessary to give an analysis of its plan and contents. We shall therefore limit ourselves to a few remarks intended principally to recommend this performance to the attention of those who may feel interested in chemical science, and who still have never perused this valuable production. The work is embraced in two octavo volumes, containing together, nearly eleven hundred large and full pages, neatly and correctly executed, and illustrated by seven good plates.

The subordinate arrangement of the subjects bears a strong resemblance to other modern chemical works, and we are not disposed to object materially to any important feature in Dr. Gorham's arrangement, except so far as we would raise similar objections against the arrangements of most authors of the present period.

Perhaps there has been of late years, too great a facility given to the admission of new principles, when the evidence of their existence has been slender, and in some instances, far from being satisfactory. This we imagine, is the case with the principle called fluorine. On any evidence which we now possess, it can hardly be entitled to a place in a system—certainly not, if it is to form the basis of important inductions, and of analogical reasoning. The new view of chlorine, for example, can scarcely derive much support from so feeble an ally, and the student, on reading the article fluorine, is disappointed in finding how little it amounts to, after all. At present, we apprehend fluorine is scarcely entitled to a more distinguished place than in a memorandum, printed in connexion with the article fluoric acid or better perhaps in a general appendix, containing similar things. The same is probably the fact with some other principles, both elementary and proximate, and it would, we imagine, conduce to the progress of the science, and to the comfort and advancement of learners, if newly discovered things, when their character is dubious, were kept longer in waiting at the door, until their title to admission and their proper place were very clearly made out. In chemistry, as in other branches of knowledge, we are too apt to proceed upon the presumption, that we know every thing, and we construct our arrangements accordingly; but, our errors it is probable, are not few, and our deficiencies, must without doubt, be very numerous. The unexpected discovery of some new and important principle, frequently produces a very extensive influence on the relations of other bodies, and of course on the state of the science. How great was the change produced by the discovery of oxigen, and of the constitution of water, and of the atmosphere, and how ramified and important, are the relations which the new views of chlorine introduced into almost every part of the science of chemistry. The subject of chlorine is one respecting which, we may perhaps differ from most of those whose opinions we respect.

In the first place, we are far from thinking that it is expedient, to introduce this difficult and complicated subject, into the early part of a course of lectures or of a treatise. It is impossible, either upon the old or new theory, to examine, with success, the numerous and important facts in which chlorine acts a part, without an acquaintance with a large number of bodies and without a considerable familiarity with chemical phenomena and reasoning. We are aware that if it be, as many chemists suppose, a distinct principle of combustion, analogy would lead us to place it where Dr. Thomson, Dr. Gorham and others have done—that is, next to oxigen; but if it be really a distinct principle of combustion, it never comes within the experience of mankind in any common case, nor in any case, except in philosophical or manufacturing experiments. The discussion of any part of its properties, and even the mention of its name, may therefore be omitted, without the slightest inconvenience, till we have gone on so far in the subject as to have introduced, in a natural and familiar way, all those precursors which are necessary to announce so important a body, and then we may begin upon its history with the commanding advantage, of being freed from the necessity of anticipating, and of being always perfectly intelligible.

It was one of the great charms of Dr. Black's mode of instruction, that he carried his pupils forward in their course, with an ascent so gentle, that they scarcely perceived that they were mounting, till they learned it from the constantly increasing extent of the horizon.

We are aware that it is not the supposed analogy with oxigen alone, which induces the early mention of chlorine; writers and teachers are allured, by the imposing extension of the analogy so as to include four principles of combustion, namely, oxigen, chlorine, iodine, and fluorine. Of the last we have already remarked that its very existence is extremely hypothetical, and its nature is if possible still more so. The fact is otherwise with iodine; this is a well established and well characterized body—but except the attraction to the positive pole in the voltaic arrangements, which property it enjoys in common with oxigen and chlorine, what peculiar claim has it to be ranked as a supporter of combustion. Certainly it is in no common sense a supporter of combustion, and the solitary fact that its vapour supports combustion, or something that appears like it, in the case of potassium, can scarcely be considered as giving it a title to rank along with oxigen and chlorine to the former of which, it is in all other respects, and to the latter in most respects, so unlike. Indeed this very remarkable body is so peculiar in the *tout ensemble* of its properties, that it appears at present better to give it a niche by itself whenever it may appear most convenient; but we are disposed to think that it ought not to be introduced very early, and that wherever it may be placed it should be postponed to chlorine.

As to the new theory of chlorine itself this is not the place to discuss a subject, which, traced into all its ramifications, and discussed in all its important bearings, would alone occupy a volume. We are aware that most chemists have adopted the new views, and that in the most recent systems

* Excepting its electrical relations.

and elementary treatises they are now inwrought into the whole texture of the science. But the late acute and logical Dr. Murray never became a convert to those views, although he did in the latter part of his life perhaps virtually abandon the old ground; Professor Berzelius, whose name stands as high as that of any man, was a vigorous and formidable opponent of the new views, and we have not heard that he has changed his opinions. If we may be permitted to express an opinion, but without any intended disrespect to the highest authorities of the day, we would add that there appears to have been rather too much haste to adopt the new theory, in all its bearings—not only its proofs, but in its hypotheses and conjectures, and to carry them in the form of doctrine, into every part of the science. In the supposed play between oxigen, hydrogen, chlorine and the metallic bases of the fixed alkalies and earths to produce the muriates and the chlorides respectively; a maze in which they are made to pass, insensibly, into one another, back and forward, and that often with no perceptible change of properties, and often also with no better proof than the convenience of these supposed changes; in this dance of affinities there is as large a claim on our acquiescence in the authority of names, as can well be found in the history of science. A moistened chloride becomes a muriate and a dried muriate a chloride, and yet Thenard informs us, that a crystal of common salt although formed in the midst of water is still nothing but a chloride; but this crystal moistened or perhaps dissolved becomes a true muriate. Who can believe, rather we should say, who ought to believe that where there is so total a change in composition there should be so little in external and physical properties.

The non-combustion of charcoal too in chlorine, which does admit of explanation upon the old view, confessedly admits of none at all upon the new: it is true this is now called an *ultimate fact*, but what is this more than to say *over again*, that the thing cannot be explained. Those very judicious writers, Dr. Henry and the Messrs. Aikins, in their Chemical Dictionary (at least in the last editions of, or additions to those works that we have seen,) take a more cautious ground and giving many of the most important explanations upon both theories, reserve their final opinion for a day of greater clearness and certainty. If the patronage of authority were necessary, we should not be afraid to be found in such company.

We are aware that the new theory of chlorine has the advantage of the old in some important points, and that the old is liable to some formidable objections, but we cannot help thinking that it will ultimately appear that there is something yet to be discovered on this subject, which will evince that it is not now fully understood by either party, and that light will break in which will clear up the dark places in both theories, or substitute one which is better than either. At present the state of the subject seems to demand caution and reserve, and we are inclined to think that it is still incumbent on a teacher and of course on a writer, to give the double explanations which unfortunately are almost every where equally applicable to the phenomena connected with this singular topic. We can discern no disadvantage in this course, and it is certainly adapted to give a fuller view of the whole ground than if we exhibit one side alone.

It is not one of the least of the disadvantages of the new view that it has led to a copious list of new names and derivatives, thus adding to the onerous burden, which the spirit of neology, so prevalent in modern times, is daily imposing upon us. Thus the student must now learn that muriatic acid is hydro-chloric acid and muriates are hydro-chlorates, &c. In the same manner the prussic acid (we mention it for illustration and not as being connected with chlorine,) has become the hydro cyanic acid, and the prussiates are hydro cyanates or cyanurets, and in the view of Mr. Porrett the prussic acid should be called the chyazic acid, or the ferruretted chyazic acid, and the compounds chyazates or ferruretted chyazates, &c. Surely, this multiplication, especially of cumbrous and ill-sounding names, is very unfortunate and is to be justified only by imperious necessity.

But unfortunately, a new discovery is no sooner made, or supposed to be made, than we have a crop of new terms, grounded of course upon the assumption, that all is correct in the statement of facts; but perhaps in a short time, an additional discovery or a correction of a former one imposes the necessity of a new series of terms, or of important modifications of former ones, and thus the nomenclature is constantly fluctuating. We would not be so unreasonable as to say, that there should be no changes in the language of chemistry, but they should be as few as possible, and they should not be lightly made upon every trivial occasion.

To the term chlorine we do not however object; on the contrary we think it a happy word, concise and well sounding, and being derived from a sensible property of the body, namely its colour, it does not involve controversy, or take for granted a subject in dispute. The derivations from it are also good and nothing can be better imagined than chloric, acid chlorates, oxid of chlorine, chloride, &c.; for whether chlorine be simple or compound, these terms will ever remain correct. But, when the terms derived from hydrogen are added to those from chlorine, we not only have cumbrous expressions, but they are involved in all the fluctuations of a disputed theory. As there was no necessity of precipitancy on this point, and no harm could have resulted from continuing to use the words muriatic acid, muriates, &c.—we should prefer them to hydro chloric acid gas, liquid hydro chloric acid, hydro chlorates, &c. We are perfectly aware that these terms are in entire consistency with the original principles of the French nomenclature, and it may be ultimately proper to adopt them. But as a principle we object to precipitancy in new modelling a nomenclature, especially where the changes must be numerous and important.

It is the rage of the day to make new words, and it is without doubt, proper, on many occasions, but great caution and thorough consideration should direct every such step; otherwise it will retard instead of promoting the progress of science.

These remarks are meant to be of a general nature, and are not to be understood as bearing in any peculiar manner, on Professor Gorham's work. He has gone no farther on this head, than he is supported by some of the first authorities in the scientific world. In closing these miscellaneous remarks, we hasten, with pleasure to express our general opinion of the merit of the elements of Dr. Gorham. This work is not surpassed by any one with which we are acquainted, as a perspicuous, chaste and philosophical treatise. The doctrines of chemistry are stated with sufficient fullness and they are well connected, so as to form (as far as the present state of the science admits of it) a regular and connected system. The statements evince a correct and discriminating mind, and there is sufficient evidence that the author has thoroughly studied his subject. We believe few chemical works may be relied upon with more safety, both as regards the statement of facts, and the fair and philosophical inductions that are drawn from them. It is said that a foreign chemist of eminence has remarked that this work contains more of the *science* of chemistry than any other. As Americans we *may be* gratified with such an observation, not because we would wait for an European decision of the merits of an American work before we ventured to admire it ourselves; for we have both in literature and science, enough of native talent and learning, to justify original efforts and opinions of our own; sustained not in the spirit of vanity and of self adulation, but in the firmness of independence, and in that spirit of self respect which is at once our right and our duty. We are happy in saying that, in our view, Professor Gorham has executed his difficult task, with much faithfulness and ability, and his country has occasion to be proud of his work. His style is pure, perspicuous and concise, without becoming dry and repulsive; indeed we may say it is characterized by an elegant simplicity, and the reader finds himself in company with one who is at once instructive and agreeable.

We consider it as no small thing, that this country has, in so short a time, produced two elementary treatises, of so much merit as those of professors Cleaveland and Gorham, and we are not afraid that either of them will suffer by close examination either at home or abroad.

In this country it is no small thing to have set so good an example, and we trust that its future scientific treatises will be marked by equal correctness and ability.

Art. XIV.—*Miscellaneous Chemical Notices.*

1. *Chlorine and Hydrogen—danger from their mixture.*

Ever since Mr. Cruickshanks, of Woolwich, England, pointed out the mutual action of chlorine and hydrogen, these gases have been freely mingled, by chemical demonstrators, and no one has (so far as we are informed) indicated any danger, unless the direct rays of the sun were allowed to fall upon the mixture. In common with others, we have been accustomed to mix these two gases, in presence of the classes, and, without apprehension, to leave them to their own mutual action. The result, it is well known, is the *production* or *evolution** of muriatic acid; which, when the vessel stands over water, or is opened in contact with that fluid, is instantly absorbed.

Being aware of the danger arising from the mixture of chlorine and hydrogen gases, when exposed to the sun's *direct* rays, we have been sufficiently cautious on that head. In one experiment, we mingled, in equal volumes, about three quarts of the gases; they were introduced,—first the hydrogen, and then the chlorine,—into a strong flask of green glass: the vessel was wrapped in a thick coarse towel, corked, and laid on the snow, (January, 1820,) by the side of a brick wall, where the sun's meridian rays were received without any interposing obstacle. We now removed the towel, with all possible speed, and ran to the distance of thirty feet; where we had just time to observe marks of a powerful action, as evinced by a white fume, rapidly undulating through the flask, when it exploded, with great force, and a violent report, reducing the glass to very small fragments, some of which struck us, as well as other observers.

The present season, (February 16, 1821,) being desirous of showing this interesting experiment to the pupils, the gases were, in the presence of the classes, mixed as before, in a similar vessel, and in about the same quantity. The audience, consisting of two hundred, or more, formed a large circle, out of doors: the flask was placed in a wooden box, which was carried into the sun's rays; then, by hand, we suddenly threw up the lid, and slipped into a contiguous door of the laboratory. There was scarcely time to escape, and, indeed, hardly an appreciable interval of time, before the explosion occurred, with such violence, as not only to rend the glass, but to blow the box into pieces, which were thrown all around.

* According as the phenomena are explained by the new or the old theory.

In this instance, as well as in the other, the undulating white fume was observed; and, in both cases, the air around and above, for several yards, was filled with a dense white cloud, which appeared to be muriatic acid gas, condensed by the moisture of the air. These facts are not stated because they are new, (as they evidently are not,) but they will serve to give additional force to the caution derived from another fact which we are now to mention.

Being desirous to ascertain whether this remarkable effect could be produced by the radiation of a common culinary fire, we filled a common Florence-oil flask (well cleaned) half full of chlorine gas, and were in the act of introducing the hydrogen in the pneumatic cistern. There was not only no *direct* emanation from the sun, but even the *diffuse* light was rendered much feebler than common, by a thick snow storm, which had covered the sky-light above with a thick mantle, and veiled the heavens in a singular degree, even for such a storm. Under these circumstances, the hydrogen was scarcely all introduced, before the flask exploded, with a distinct flame;* portions of the glass stuck in the wood work of the ceiling of the room, and the face and eyes escaped, by being out of the direction of the explosion: nothing but the neck of the flask remained in hand. This occurrence, then, proves, that a mixture of chlorine and hydrogen gases may explode spontaneously, even in a diffuse light, and even in a very dim light. We have not seen this fact mentioned by any writer, and have therefore been thus minute for the sake of cautioning others. It is evident, that the explosion of considerable quantities of these gases, when the operator is near, must be attended with great danger; and it is therefore obvious, that some peculiar precautions are requisite when this experiment is repeated. Such precautions have occurred to us, but, as we have not had opportunity to put them in practice, we forbear to state them at present.

The progress of chemistry has been such in this age, as frequently to demonstrate, that tremendous energies are slumbering all around us; we grope on in our experiments, walking, without solicitude, over hidden mines; and, frequently, the first hint we have of their existence, is derived

* As reported by bystanders—we did not observe it.

from some thunderstroke, from whose effect, the experimenter is happy if he escape uninjured.—*Editor.*

N. B. In the first experiment, related in this notice, the flask was not covered while filling, but it was done in an under-ground laboratory, where the light was imperfect: in the second experiment, the flask was filled in an upper room, when the sun shone out of doors, but the flask was covered by a thick towel: in the third, although in an upper room, it being a very dim light, no precaution was used, and the glass was not covered; on the other hand, there was no heat from any adventitious cause, nor could the effect be attributed to any thing peculiar, for we had made this mixture many times before, under similar circumstances, without any explosion.—*Ed.*

2. *Chlorine produces heat in the skin.*

(Communicated, in a letter, dated Philadelphia, Oct. 9, 1820, from Professor Hare to the Editor.)

I find, among the obvious qualities of chlorine, one which, I believe, has never been mentioned as such. The air around being at about 60, it produces a sensation of heat equal to 90 or 100, on immersing the hand in it, though the common thermometer should not be affected when immersed. The differential thermometer shewed the gas slightly warmer; but the effect thus indicated was too small to have affected the hand, and possibly may arise from chemical action on the atmospheric air, with which it communicates, or the moisture in it. Perhaps a sort of chemical action takes place, between the gas and the insensible perspiration of the skin, as the power of chlorine in decomposing animal effluvia is well known.

3. *Radiation of Heat through Glass.*

I neglected to mention to you, that I had, about two years ago, two large brass mirrors, sixteen inches diameter, one foot focus, accurately turned by a fixed radius of two feet. By these, an incandescent ball of iron, about three inches diameter, being placed in *one* focus, phosphorus was ignited, in that of the other, at the distance of sixty feet. But my object for introducing this topic now is, more particularly to state, that the phosphorus was ignited, on one occasion, at the distance of twenty-two feet, notwithstanding the interposition of a large pane of glass, twenty inches square. This shows, that glass is permeable by radiant heat from very hot bodies. I had my hand on a lever, to which the pane was attached in order to raise it; but I had not time to get it under way. For this experiment, the phosphorus was melted on cotton, at the bottom of a tube, and the cotton afterwards divided, under water, into pieces of a proper size. Being placed in a candle wick, the candle may be lighted by the mirrors, which is a very pretty result.

4. *Construction of Galvanic Apparatus.**

(See Professor Hare's Memoir in the present volume.)

I am constructing a galvanic apparatus, in a glass jar, two and a half inches in diameter, by eight inches in height, of coils of copper and zinc; the zinc plates are about nine inches by six, and are rolled up with the copper by means of a mandrel, and two pieces of soal leather interposed, one eighth of an inch thick, the copper beginning on the inside and ending on the outside; so that it takes fourteen inches of this metal. There will be eighty pairs only, at first. The soal leather is used merely to give them the proper spiral; and is, of course, withdrawn, when they are taken off the mandrel. Narrow pieces of wood are employed to keep them apart afterwards.

* Although the description of this apparatus has been published, we have thought it best to preserve this memorandum, because it contains some useful directions relative to the mechanical construction.—*Ed.*

Art. XV.—*Peculiar liability of Barns to be struck by lightning.*—Editor.

The fact, that barns are much more frequently struck by lightning than any other description of buildings, is notorious. Every summer presents a calamitous list of these buildings burnt in thunder storms; and it is no very uncommon occurrence, that several are consumed by the same thunder storm. Instances are at hand in sufficient numbers; but, as these occurrences are so frequent, it is not thought necessary to enter on the proof of the fact, which will therefore be taken for granted.—What then is the cause?

It will be observed, that these events more generally occur after harvest, or hay-time, when the barns are more or less filled with hay and grain;* which renders the calamity peculiarly distressing, as, in many instances, the farmers' hopes are blasted in an hour.

It is obvious, that the produce of the fields, when stored in a barn, must give rise to a copious evaporation. This is peculiarly the case with hay, which, especially when put up still damp, (and it always is so in a degree,) sweats (as it is termed) very powerfully; a hand thrust into the mow, is often rendered sensible of great heat and moisture, and a visible vapour is often abundantly exhaled, when a heap of such hay is moved. As the large barns of the farmers often contain many tons of hay and grain, it is obvious, that this cause is sufficient to produce the rise of a great column of vapour into the atmosphere, and that may be the fact for weeks together.

Vapour is a good conductor of the electric fluid; and thus the lightning may be determined, by the attraction of the vapour, to descend upon the barn, rather than to strike at random.

There is an additional fact, which is worthy of being mentioned. Evaporation, viz. the *very act* of forming vapour, produces electrical excitement; the vapour itself is differently electrified from the bodies around, and to produce a discharge of the electric fluid, it is necessary only that there be a decidedly different electrical state between two contiguous bodies; as, for instance, between the vapour arising from the barn and the neighbouring thunder cloud. It is immaterial which is positively, and which negatively electrified.†

Both these causes then,—that is, the conducting power of the vapour, and its different electrical state, may conspire to direct the lightning where to strike; and, from the combustible nature of the usual contents of barns, as well as of the buildings themselves, it is in no way surprising that, when struck, they are almost inevitably consumed. The most interesting question remains—What can be done to remedy the evil?

* *Corn*, in the language of the English farmers.

† The electrical excitement, produced by evaporation, is seen in the familiar experiment of putting a few live coals into a crucible; the crucible is placed on the cap of the gold leaf electrometer, and water is dropped upon the coals, when the gold leaves of the electrometer instantly diverge.

The answer is obvious. Let every man furnish his barn, as well as his house, with a lightning rod. In the case of such low buildings, a rod, which, without a curvature, may pass up at one end, would cause but a trifling expense, and, it is believed, would, in most cases, prove a perfect security. When the barn is very long, it may be better to let the rod pass over the middle of the roof, or else to have two rods—one at each end of the building.

Art. XVI.—*On the Compressibility of Water; by* Jacob Perkins, *Esq.—from the Philosophical Transactions of London; read before the Royal Society, June* 29, 1820, *and forwarded to the editor of this Journal, by the author.*

(With Notes, by a Correspondent.)

Having believed, for many years, that water was an elastic fluid, I was induced to make some experiments, to ascertain the fact. (*a*) This was done by constructing an instru-

(*a*) Although the experiments detailed in this paper present the subject of the compressibility of water in several new and interesting points of view, they cannot be regarded as the first by which this property has been ascertained to belong to liquids. So early as the year 1764, a series of experiments was instituted by Mr. Canton, (Phil. Trans. Vols. 11 and 12, Hutton's Abridgement,) from which it decidedly appears, that not only water, but liquids in general, sensibly expand by removing the pressure of the atmosphere, and contract under additional pressure. The method of Mr. Canton, for moderate differences of pressure, is susceptible of a high degree of accuracy, and seems to have been conducted with every necessary precaution. He found that, in the medium state of the thermometer and barometer, water expands one part in 21740 by the removal of the pressure of the air, and undergoes an equal diminution of bulk by subjecting it to the pressure of an additional atmosphere in a condenser. Similar results were obtained, from a series of experiments, directed to the same object, by M. Mongez, in France. Yet most of the continental writers on physics seem unacquainted with these results, and still appeal to the vague experiment of the Florentine academy for the proof that water is incompressible. Deluc found that, on breaking off the sealed end of the tube of a water or oil thermometer, and admitting the pressure of the air upon the column of the fluid, it instantly sunk. But, instead of ascribing it to the compressibility of the fluid, he resorts for an explanation to the hypothesis, that liquids, however carefully purified, still contain a portion of air, which, although chemically combined with the fluid, retains some part of its elastic force, and thus yields to an increase of pressure. It is somewhat singular, that this conclusion should be quoted with approbation by Biot, in his late elaborate treatise, (I. 195.) without expressing any suspicion that the phenomena may arise from the compressibility of the liquid. That most of the air which ordinarily exists in water tends, on removing the external pressure, to assume the gaseous form, and to rise in bubbles, is well known from experiment; but so long as no more air is ment, which I call a piezometer, and which is represented in Plate XXXII, (Pl. 3 of this No.) Fig. 1. The cylinder, A, was three inches diameter, and eighteen inches long. The end, B, was made water tight, by means of a plate, which was soldered firmly to it. At the other end, C, a cap was made to screw on and off at pleasure; being also made water-tight. The rod or plunger, D, which was five-sixteenths of an inch in diameter, was made to pass through a tight stuffing box, E. On the rod, immediately above the stuffing box, was fixed a flexible ring, *a*. A cannon, Fig. 2, of a sufficient size to contain the piezometer, was fixed vertically in the earth, the muzzle being left about eighteen inches above ground, and the touch-hole plugged tight. At the mouth, a strong cap, A, was firmly screwed on. In the center of this cap, a small forcing pump, B, was tightly screwed, the piston of which was five-eighths of an inch in diameter. There was an aperture, C, in the cap, to introduce a valve, for the purpose of ascertaining the degree of pressure. One pound pressure on this valve indicated an atmosphere. The piezometer, which was completely filled with water, was introduced into the cannon, which was previously filled with water, and additional water forced in until the cap showed signs of leakage; the valve, at the same time, indicating a pressure of one hundred atmospheres. The piezometer was then taken out of the cannon, and the flexible ring found to be eight inches up the rod, evidently proving the rod to have been forced into the cylinder that distance, showing, also, a compression of about one per cent. (*b*) We have seen, by repeated experiments, that, to be able to produce this degree of compression, three per cent. must be pumped into the

present than can exist in the liquid state, (as was the case in the experiments of Deluc,) there is every reason to suppose that it possesses the physical properties of a liquid, and has as little compressibility as the water with which it is united. Accordingly, Mr. Canton found that water was no more compressible when saturated with air, than when deprived of it by boiling. —M. Haüy, (Traité de Physique, I. 198.) although he denies that water is compressible in any appreciable degree, at the same time justly appeals to its power of conducting sound, as an evidence that it is in fact an elastic fluid.

(*b*) By calculating the solid contents of the piezometer, and of that part of the rod which was forced into it, the real compression will be found to have been only one-half per cent. There is reason to believe that the error lies here, rather than in the dimensions given at the beginning of the article, as the supposition that the compression was one-half per cent. harmonizes with the statement afterwards made, that the apparatus last employed gave the compression twice as great as the first.

gun. This fact proves, either that the gun expands, or that the water enters the pores of the cast iron; it is probable both these circumstances contribute to produce this effect.

This experiment was made in America, in the year 1819, and before I had time to strengthen my apparatus for the purpose of making farther experiments, I was obliged to embark for this country. On my passage, however, I had frequent opportunities of repeating those I had already made, and of making others, by a natural pressure. They were as follows. The piezometer, by the assistance of fifty-four pounds of lead attached to it, was sunk in the ocean to the depth of five hundred fathoms, which is about equal to the pressure of one hundred atmospheres. When drawn in, the gague or ring was found removed eight inches up the rod, indicating, as in the before-mentioned experiment, a compression of one per cent. This experiment was several times repeated, and with the same result.

The next experiment was that of sinking a strong empty porter bottle to the depth of an hundred and fifty fathoms, having first tightly corked and sealed it, in the following manner. Six coverings of cotton cloth, saturated with a composition of sealing wax and tar, were strongly fastened over the cork, by a cord wound round them, directly under the projection at the neck of the bottle. After the bottle had been suffered to remain at the depth mentioned a few minutes, it was drawn up. No water was found to have been forced into it, neither was there any visible change at the mouth.

The same bottle was again sunk, and at the increased depth of two hundred and twenty fathoms: when drawn in, it was found to contain about a gill of water; but not the slightest visible change had taken place in the sealing.

The same bottle was now sunk, for the third time, to the still greater depth of three hundred fathoms, and when drawn up, only a small part of the neck was found attached to the line. Its appearance was truly interesting. The bottle was not broken by external pressure, but evidently by the expansion of the condensed sea-water, which had found its way through the sealing. Upon examination, it was found that the cork had been compressed into half its length, making folds of about one-eighth of an inch; and that the coverings, consisting of six layers of cloth and cement, had been torn up on one side before the bottle burst. The effect produced upon the cork can, we imagine, be accounted for only in one way, viz. that the water, divided into very minute particles, must, by the surrounding pressure of water, have been forced through the coverings, and filled the bottle; that the water thus forced in, and condensed to a great degree, expanded as the pressure was removed by drawing it towards the surface, not only so as to press the cork back into the neck, and, owing to the resistance of the coverings, to compress it half its size, but to separate the neck from the body of the bottle.

Experiment 4. An empty porter bottle, the strongest that could be found, was stopped in the following manner. A cork, with a large head, was firmly driven into the neck; it was then covered with six layers of fine linen, saturated with a composition of tar and wax; over them was applied a covering of leather, and all perfectly secured by being well bound at the neck. The bottle, thus prepared, was sunk two hundred and seventy fathoms. When drawn in, it was found perfectly sound, and the sealing unchanged; but filled with water to within an inch of the cork. The coverings were taken off, layer after layer, but no signs of moisture were visible. Had the bottle remained down a sufficient length of time to have completely filled, it would undoubtedly have been broken by the expansion of the water upon being drawn towards the surface, as was the case in the former experiment. It is worthy of remark, that, when the water from this bottle was poured into a tumbler, it effervesced like mineral water. (*c*)

Experiment 5. In this experiment, two strong bottles were sunk to the depth of five hundred fathoms. One of them was stopped with a ground glass stopper, and well cemented, then placed in a strong canvass bag. When the bag was drawn in, it was found that the bottle had been crushed into many thousand pieces. The other bottle was very tightly corked, but, not having been left down a sufficient length of time, it came up whole, having filled to within one and a half inch. The cork had been driven in and re-

(*c*) This effervescence doubtless arose from the escape of the air which had been let down in the bottle, and was forced into combination with the water which made its way through the corking.

mained so; but the cementation was unaltered, excepting at the surface, where it had become a little concave.

Being satisfied that the piezometer, as first constructed, would not show all the compression, I determined to make one differently modified. The object was, to avoid the friction occasioned by the collapsing of the leather upon the rod, under such great pressure. The drawing in Plate XXXII, (Pl. 3,) Fig. 3, shows another modification of the piezometer, made since I have been in this country. This proves my suspicions to have been correct; since, under the same pressure, it indicated nearly double the compression shown by the former. (*d*)

This instrument is constructed as follows, Fig. 3 being a section of it. It is simply a small tube, A, closed at the end, B, and water-tight. At the upper end, C, the water is allowed to enter through a small aperture, E, closed by a very sensible valve, opening inwards. The tube is flattened at D, in order that it may yield to the expansion of the water, when taken out of the press.

(*d*) It seems scarcely credible, that the whole difference between the results of these two sets of experiments could be owing to the friction of the rod, employed in the first set, against its stuffing box. The friction, on this supposition, must have been sufficient to counteract an excess of pressure on the outer end, of fifty-seven pounds. Nor is it probable that any error, which may be supposed to have arisen from the neglect to ascertain the temperature of the compressed water in the first experiments, would be sufficient to account for the difference. The temperature of the water in the cannon was undoubtedly raised, by a diminution of specific heat, analogous to what takes place in other cases of compression; but, unless the experiment was completed in a very few moments, its sensible heat must have been reduced nearly to a level with that of the surrounding air. We are not informed what time was allowed for the equilibrium of temperature to be restored, nor what the temperature of the water was at the commencement of the experiment; both which circumstances are necessary to an accurate estimate of the error which might have arisen from the neglect to ascertain the temperature after compression. If, however, we suppose the previous temperature to have been 50°, and the rate of expansion for different temperatures to be the same under all degrees of pressure; the elevation of the water in the piezometer on compression, as is easily inferred from the investigations of Deluc, must have been no less than 26°, to produce an increase of $\frac{1}{200}$ in bulk. Is it not more probable than an error was committed in estimating the pressure? The valve, C, Fig. 1, is not particularly described; but it would require to be constructed with peculiar accuracy not to indicate too great a pressure, in consequence of the water insinuating itself between the top of the cap and the part of the valve which rests upon it, before it sensibly lifts the valve. The lever too, by which the valve is held down, unless made of great strength, would prove a source of deception, by its liability to spring.

The experiment with this instrument was made at Mr. KIER's manufactory, in the presence of many scientific gentlemen. The piezometer, being perfectly filled with water, (the weight of which was accurately known,) was put into an hydraulic press, and subjected to a pressure of about three hundred and twenty-six atmospheres. When it was taken out and weighed, there was found an increase of water amounting to three and a half per cent. This water had been previously boiled, and cooled down to a temperature of forty-eight degrees, and kept at the same temperature during the experiment.

A machine, calculated to avoid loss of pressure from destruction of the materials of which it is composed, will be made with all convenient speed. This machine, being constructed with metallic stuffings and flexible metallic pistons, will effect a much greater pressure than the hydraulic press, the power of which is limited by the animal stuffing now used. It is probable, a pressure of from two to three thousand atmospheres may be obtained, before the metallic piston is destroyed.

It is expected that this machine will be sufficiently accurate to give the exact ratio of the compressibility of water with much greater precision than has hitherto been obtained; but the results of farther experiments must be the subject of a future communication. (*e*)

29, *Austin Friars, June* 6, 1820.

(*e*) The experiments described in this paper establish the important conclusion, that water continues to yield to a compressing force, after it has been rendered vastly greater than has been hitherto employed; but much remains to be done, in order to give our views on this subject the extent and precision which it would be desirable to attain. The exact *degree* of condensation by a given pressure, and the *law* of variation in the density for different pressures, both remain in uncertainty. The experiments of Mr. Canton, which seem entitled to much confidence, from the mode in which they were conducted, and which have the singular confirmation of explaining the known velocity of sound in water, make the compression, by a single atmosphere, $\frac{1}{22000}$. Mr. Perkins's last experiments give to each atmosphere an average compression of $\frac{1}{9300}$. M. Oersted, (Journal de Physique, October, 1818,) makes it $\frac{1}{7700}$. Which of these deserves the most reliance? To reconcile the results of Mr. Canton with those of Mr. Perkins, we must suppose the compressibility to increase as the pressure increases; a supposition contrary to the laws of all other elastic substances.—Should our ingenious countryman continue to prosecute his researches on this subject, and extend them to much higher pressures, as is promised in his concluding paragraph, it would be peculiarly desirable that the *law* of condensation by different

Art. XVII.—*Notice of Mr. Jacob Perkins's Invention of Engraving upon Steel.*—Editor.

The American public are already informed that Mr. Perkins, has given to the, before, comparatively perishable labours of the engraver, a degree of perpetuity which may well vie with that of bronze or marble. We allude to his well known discovery of a method of engraving upon steel. In an interview with Mr. Perkins, some years since, we were informed by him, that his steel plates, after being duly prepared, were, by a particular process, carried on by the aid of fire, *decarbonized*, as (if we do not misremember) he termed the operation. The result, at any rate, was to soften the steel, so that it would admit of the easy application of the graver. The design being made, the plate goes through another fire process, by which it is hardened to a high degree; and then the work becomes so permanent, that the plate may be passed through the rolling press to an almost indefinite extent, without undergoing any material wear.

We have just received, from Mr. Perkins, (now in London,) a *planisphere* of the " solar system ; shewing the orbits of the primary planets,* transferred to the plane of the ecliptic, with the place of aphelion; and exhibiting, also, the satellites, the ring of Saturn, some of the comets and their orbits, the ecliptic and its constellations, &c. This plate, executed on steel, and published by Perkins, Fairman and Heath, is nine inches and three-fourths, by eight and three-fourths; it was drawn and engraved by Lowry, whose reputation is well known in this country, and is a beautiful, and—for its particular object—a perfect thing. It is a fine engraving; and the lines and shades are sufficiently delicate to evince that this mode of engraving is susceptible of great precision. Upon the margin of the plate, there is written,

degress of pressure should be examined. For small pressures, the usual law of elastic bodies, when made to undergo slight variations of form, viz. that the variation of bulk is proportional to the compressing force, may be regarded as sufficiently established by the experiments of Canton and Oersted. But farther experiments are wanting, to ascertain whether it continues to hold true for pressures of several hundred atmospheres.

* Including those of the new discovered ones, Vesta, Juno, Ceres and Pallas, whose orbits are all included between those of Mars and Jupiter.

in pencil—"From the number of impressions taken from a similar plate to this, we have no doubt of obtaining two hundred thousand *proof* impressions from this plate."

When it is recollected that the common number of proof impressions is two thousand, and that one plate scarcely affords more than four or five thousand prints, Mr. Perkins's invention may well be regarded as one of great value, and as enhancing, in a high degree, the importance of the productions of the pencil and the graver, so that statuary has scarcely any superiority in this respect, while it has no means of multiplying copies, except the slow and tedious ones by which the originals are produced, or the substitution of plaster casts.

Art. XVIII.—*Tests for Arsenic.*—Editor.

It is a question very interesting to medical jurisprudence, whether there is any test for arsenic, which can be implicitly relied on, to such an extent as to justify, on that ground alone, the condemnation of an accused person. Some experience, in such cases, has produced in us an increasing impression, that nothing short of the actual production of the metallic arsenic can be safely relied on for the above purpose, although various tests may serve, more or less perfectly, to guide the inquiries, and to influence the opinion of the practical chemist.

A pupil, Dr. T. D. Porter, now a member of the faculty of the University of South Carolina, in his inaugural dissertation states, that he finds, on repeating some of the popular experiments, with onion juice, which were some time since published in the newspapers;—that the onion juice, with the solution of sulphate of copper, (blue vitriol,) but *without* the carbonate of potash, produces, in a weak arsenical solution, "a shade like Scheele's green;" but, if carbonate of potash be added, the effect is completely different. Considering Scheele's green as a test that has been much relied on for the discovery of arsenic, Dr. Porter formed it in the usual way, with sulphate of copper and subcarbonate of potash; in one experiment, a decided precipitate was produced from a *stronger*, and, in another, a scarcely perceptible one, from a *weaker*, arsenical solution. Coffee was then added to the solution of copper and of carbonate of potash, but *without arsenic*, and the effect resembled that of the stronger arsenical solution, more than this last was resembled by that of the weaker.

But the most important facts mentioned by Dr. Porter remain still to be stated. He found, that,—in the production of Scheele's green, by arsenic, sulphate of copper and carbonate of potash,—*chromate of potash* might be substituted for the arsenic; and that it produced a precipitate not to be distinguished, by the eye, from Scheele's green. He ascertained, also, that even Mr. Hume's celebrated test, nitrate of silver, (as modified in its application by Dr. Marcet,) gave, with chromate of potash, a yellow precipitate; which, when placed side by side with one produced by arsenic, could not be distinguished by their colour and appearance. Dr. Porter's experiments appear, then, to throw still greater suspicion on the infallibility of tests for arsenic, and are worthy of being repeated.* His results were exhibited to us.

* The nitrate of silver used by Dr. Porter, was the lunar caustic dissolved, and the chromate of potash contained an excess of alkali, having been formed by heating potash on chromate of iron.

AGRICULTURE.

Art. XIX.—*On Spring Pasture; by Professor* Eli Ives.

A plant which will grow in the autumn, of a size sufficient to make it an article of food for cattle, and which will not be destroyed by our severe winters, is much needed by the farmers in the northern and eastern states. The severity of the weather in January, and the sudden transitions of the temperature in March and April, are equally unfavourable to vegetation. All the grasses occasionally, and at least the foliage and the roots of many, are destroyed by the severity of the winter and spring.

The burnet (poterium sanguisorba) has been recommended to be cultivated for early spring pasture. Objections exist against cultivating the burnet for this purpose. In the first place, it requires the whole of the previous summer for its growth, and it is, to a considerable extent, killed by the frost; according to the experiments made in England with this plant, as related in Miller's Gardiners' Dictionary, it appears that, even in Great Britain, the crop is so scanty, as to render it an object unworthy of the attention of the farmer.

A species of *vetch* was recommended for a spring feed; but, by an experiment which was made, every plant was destroyed by the severity of the winter, or the sudden change from winter to the occasional summer heat of March.

Excepting the winter grains, wheat and rye, I know of no plant that promises so much to the farmer, for the purpose of supplying his cattle with green food in the spring, as the *woad* (isatis tinctoria.) This plant is less affected by the temperature of the winter and spring months, than any other plant, unless it be those appropriately called evergreens. It is cultivated, so far as I have been able to learn, only for the purpose of dying.

The woad is a biennial, very little, if at all, affected by the winter. It affords an abundant foliage; which, together with the upper part of the root, is readily eaten by cows, in March, April and May. The woad might be sown in July or August, after plowing in the stubble, and would make fine green feed for cattle in March and April. After the leaves and a part of the root are eaten by cattle, it will sprout again; and, probably, if eaten off in April, would be sufficiently grown, by the last of May, to be valuable to plow in as a green dressing for potatoes. This plant is extremely tenacious of life, and will flourish in a meagre, sandy soil.

A small piece of ground was sown, in June, with the seeds of the woad, which was fed by cows in April. They ate it very readily, and no unpleasant taste was given to the milk. The experiment was made on a small scale; the cows subsisting on the woad but part of the time.

It will require more experiments to determine the real value of the plant as food for cattle. From the experiment above related, it is abundantly proved, that it does not suffer from the severest frost, its foliage not being injured,—that its growth is merely suspended by severe freezing weather, —that its life is readily extended, and that it is nutritious to cattle.

The above article is offered to agriculturists, as worthy of their attention, for the purposes above specified.

INTELLIGENCE AND MISCELLANIES.

I. Domestic.

1. *Archæologia Americana. Transactions and collections of the American Antiquarian Society.* Vol. I. 1820.

The American Antiquarian Society, as appears from the act of incorporation, was instituted at Worcester, Massachusetts in the year eighteen hundred and twelve. The immediate design of the association, in the language of their petition to the legislature of Massachusetts, is "to discover the antiquities of our own continent; and, by providing a fixed and permanent place of deposit, to preserve such relics of American antiquity as are portable, as well as to collect and preserve those of other parts of the globe." From the time of their incorporation to January 1820, the Society had collected a library of more than six thousand volumes of rare and valuable books, some of which, it is believed, cannot be found elsewhere in the country. The cabinet is stated to be likewise respectable. The national government has ordered its laws, &c to be sent to the society; and the legislature of Massachusetts has directed the Secretary of the state to furnish the institution with two copies of all their laws and other publications, which they now have or may hereafter have. The society has experienced like indulgence from the legislatures of most of the other states. For the preservation and proper arrangement of the library and cabinet, a commodious and substantial building has been erected at the expense of the president of the society, Isaiah Thomas, Esq. of Worcester; whose munificence in this instance, as well as in his valuable donations to the library of the society, and in the aid he has afforded towards completing the examination and surveys of the antiquities in the western country, justly entitle him to an honorable rank among the benefactors of the literature of the union.

The volume mentioned above, is the first in the series of the proposed publications of the society. After a historical account of the origin and progress of the society, the volume commences with Father Hennepin's narrative of the discovery of the river Mississippi and the adjacent country, by the lakes; and of La Salle's undertaking to discover the same river, by the gulf of Mexico. Then follow several highly interesting communications from Caleb Atwater, Esq. of Circleville, Ohio, respecting the ancient fortifications and tumuli, which exist in that and the adjacent states. We have next, a full account of the Indian tribes inhabiting Ohio, by John Johnson, Esq. conjectures respecting the ancient inhabitants of North America, by Moses Fiske, Esq. and a communication on the antiquities and curiosities of western Pennsylvania, by President Alden. After these, follow several highly valuable papers written and published at different times, by S. L. Mitchell, LL. D. "showing the progress of his mind in coming to the conclusion, that the three races of Malays, Tartars, and Scandinavians contribute to make up the American population." To these are subjoined, a description of a cave in Kentucky, by J. H. Farnham;—of a mummy found in the same cave, by Charles Wilkins, Esq.; of the Caraibs who inhabited the Antilles, by William Sheldon, Esq.; and of a great and very extraordinary cave in Indiana.

It is not our object to give a review, or an abstract of this volume:—the latter would, indeed, be scarcely practicable without the accompanying engravings to illustrate the descriptions. We would merely invite the attention of the public to the work, which we think highly creditable to the individuals who have contributed to its pages, and to the society in whose name it appears. It is a point of no small consequence gained, when a man of the intelligence, zeal and activity of Mr. Atwater can be brought heartily to engage in an undertaking so extensive and arduous, as a complete examination and survey of the numerous vestiges of the ancient population, which, there is little reason to doubt, once extended from the straits of Bhering to Mexico; and perhaps through the whole of the American continent. It is much to be hoped that this gentleman will be encouraged to proceed, and to give to the public as ample descriptions of the antiquities in the country west of the Mississippi and on the gulf of Mexico, as he has now done of those in his own state and neighborhood. There is undoubtedly a general similarity in all these ancient works, in whatever part of the continent they are situated; yet the examination of the whole will be useful; as the few weapons, ornaments, and instruments of labor, which may still be found, will afford new varieties, and furnish important aid, in any comparison between these and similar remains in the northern regions of Asia and Europe.

The Asiatic tumuli scattered over the whole tract from the borders of the Wolga and its western branches, to the lake Baikal, and perhaps to the straits which separate Asia from America, according to Mr. Tooke, are found only in plains and extensive deserts, which seem to have been the abode of a nation which subsisted by pasturage and the produce of the chase. There is in this respect, a striking resemblance between the ancient mounds of Asia and America: as none, it is believed, have yet been found in America in the mountainous regions. It is true Mr. Tooke supposes these Asiatic monuments to be of comparatively modern date, and refers them to the Tartars of Jenghis Khan and their immediate successors, and it is certain that the Kalmucs are still in the habit of burying horses, arms, &c. with their chiefs. The truth probably is, that these monuments are of very different ages; and that there are among them those of the ancient Scythians, as well as those of the modern Tartars who have succeeded them. It is by a careful discrimination of the different ages of these tumuli; their several peculiarities, and especially the utensils which may be discovered in them; and by an exact comparison of these with similar remains on our own continent, that we can hope to approximate towards the time when these latter works were erected. Whatever may be thought of this, all will admit, that the subject of these antiquities is one of rational curiosity.

We consider this publication as adding much to our former stock of materials for deciding the question which has so long perplexed historians and antiquaries, and which has led to so much vague speculation,—we mean, the original peopling of America. While we acknowledge our obligations to the Antiquarian Society for what they have already done, we would express a hope they will not relinquish the inquiries which they have so successfully commenced. It is an object which falls directly within the design of their association and what they have already accomplished will facilitate their future operations.

2. *American Geological Society.*

A stated meeting of this society was held at the house of Professor Ives, on the evening of the first Monday in December.

Reports were made to the society of the receipt ;—

I. Of a box of specimens from Professor Dewey ; they are chiefly primitive and transition rocks, and are illustrative principally of the geology of the vicinity of Williams College, and of the region between it and the Hudson river.

II. Of two boxes from the president of the society, William Maclure, Esq. ; these contain geological specimens, " collected and ticketed" by Mr. Maclure during his different travels* in Europe, and are therefore a contribution towards a cabinet of foreign geology.

III. Of two boxes from Col. George Gibbs, first vice-president; one of these was mentioned in the last report, and consists of foreign specimens, chiefly in mineralogy; the pieces are select and fine. The other box is composed of domestic specimens.

IV. A collection of books from the president of the society: they are,

1. The Transactions of the Geological Society of London, as far as published, in 5 vols. quarto, with 150 plates, chiefly coloured.

2. The Transactions of the Wernerian Society of Edinburgh, as far as published, in 2 thick vols. 8vo. with between 40 and 50 plates, principally coloured.

3. Journal de Physique, or Journal of Natural Science, (Paris,) 54 vols. quarto, with numerous plates†.

4. Chemical and Economical Memoir on the production of Saltpetre, quarto.

5. Mineralogy of France, by Rozzin, 1 vol. 8vo.

6. Meidinger's work on Fishes, royal folio, with fifty superb coloured plates.

* This gentleman has, in person, examined the geology of almost every portion of Europe, as well as of the civilized portions of North America. He has visited several countries repeatedly, and has inspected most of the interesting localities of minerals in Europe and America.

† With the promise of thirty-four more volumes, as soon as they can be obtained.

7. Batsch's Elements of the History of the Fungous Plants, 1 vol. quarto, with 42 beautiful coloured plates.

8. Botany of J. J. Rosseau, 1 vol. 8vo.

9. Colvet's complete treatise on Nurseries, 1 vol.

10. Jaquin's descriptions and representations of the rarer plants of the Cæsarian Garden, at Schoenbrunn, Vienna, in 4 vols. royal folio, with 500 elegant coloured plates—a magnificent work.

11. The able Gardener's Almanack for 1808, 1 vol.

12. The Gardener's Calender for 1816, 1 vol.

Besides the above works, relating to the physical sciences and arts, there are several works in the fine arts.

13. Designs of Leonardi de Vinci, 1 vol. folio, with 66 plates chiefly in outline.

14. Collection of designs engraved from the famous masters—drawn from the collection of the electoral Palatine academy of the fine arts, at Dusseldorf, 1 vol. folio, with 67 plates in outline.

15. Description of the bas reliefs and figures, &c. found among the ruins of the baths of Titus, and of Livy, engraved for the Cabinet of the Count D'Artois, 1 vol. royal folio, with 74 fine plates.

16. Pictures, statues, bas reliefs and cameos of the Florence gallery and the Pitt palace, 2 vols. royal folio, with 117 plates in the most finished style of Parisian engraving; as each plate contains (in a great proportion of instances) two or three distinct pictures—the work comprehends from two to three hundred separate designs, executed in the most exquisite manner and as the subjects are from the pencils of the first artists of Italy and other countries, the entire work with the accompanying descriptions is unrivalled.

The following works are of a Miscellaneous nature.

17. Life of Frederic the second, 7 vols. 8vo.

18. Atlas of the Prussian monarchy with statistical tables and numerous designs illustrative of tactics and the art of war, in the whole 103 maps and designs in 1 vol. folio.

19. Statistical annals of France in 33 vols.

20. Statistical archives of France in 6 vols.

21. Extracts from the deliberations of the council of

state—these and a number of other small works put in to fill the trunk.*

In Mr. Maclure's donation, there are more than 1100 fine plates without reckoning those in the Journal de Physique, and in the smaller works, which would probably amount to two or three hundred more.

This gentleman's liberality to purposes of science and humanity, has been too often, and too munificently experienced in this country to demand any eulogium from us. It is rare that affluence, liberality, and the possession and the love of science, unite so signally in the same individual.†

V. Count Bournon's Treatise on Mineralogy or rather, that part of it which relates to the Carbonat of lime, in 3 vols. large quarto with 72 plates, presented by Mr. William C. Woolsey of New-York.

The society directed a committee to procure cases with glass fronts for the reception of the above books and of such as may hereafter be presented to the society. They also ordered that the name of the society and that of the donors of the books should be stamped upon them in gold letters.

Since the meeting of the society, Horace H. Hayden, Esq. of Baltimore has presented to the society a copy of his geological essays. [See p. 47 of this volume.]

P. S.—A box of specimens for the society has been received from James Pierce, Esq.—this box has not yet been opened.

A box is announced as being on its way from Professor Dewey. This is the second from this gentleman.

* Mr. Maclure, in a letter to one of the officers of the Geological Society, remarks that the reason why the collection of books is of so *mixed* a nature, is, that being packed at Paris along with the whole of his library, they were not assorted, but were put up indiscriminately, and forwarded to Havre, whence this trunk was ordered to be sent to the American Geological Society. Its members will consider themselves fortunate that they are thus *fortuitously* put into possession of such interesting and rare volumes.

† This remark as respects the present case, will be well understood in Philadelphia, and especially in the academy of Natural Sciences.

3. *Remarks on the study of Geology.*

In a recent letter to the editor, from William Maclure, Esq. President of the American Geological Society, dated at Paris, are the following remarks: "It has always appeared to me that the science of geology was one of the simplest and easiest to acquire of any: the number of names to be learned is small, and the present nomenclature although rather generic than specific, is not difficult. In teaching geology I would have a cabinet of specimens containing all the rocks divided into four classes, or as many of them as I could procure, keeping always in mind, that the most common are the most useful. I would begin by giving the student an exact idea of all the rocks of transition, at one end of which he will find the primitive, and at the other the secondary, which two classes are so different in their structure as not to be easily mistaken. The alluvial rocks encroach on the secondary, as soon as they have remained in contact long enough to adhere, and take the consistence of rocks, for the whole secondary, was at one time, alluvial, when they were first deposited by the waters, excepting always the volcanic."

We are not willing to withhold an additional remark:—when speaking of this Journal, he observes: "In some of the memoirs of geology there it *a little inaccuracy* in the names of the rocks which should be as strictly scientific as possible; the Wernerian nomenclature is still the best understood."

Every such hint, coming from such an authority as Mr. Maclure than whom no man (with the single exception of Col. Gibbs,) has so good a right to give advice on the subject of *American* geology, is worthy of attention and will have its full weight in this country.

4. *Sulphat of Strontian.*

Extract of a letter to the editor from Professor Douglass of the Military Academy at West-Point, dated Black Rock, (N. Y.) May 5th, 1820.

My Dear Sir,

The mineral which I had announced to you upon a slight examination of it as sulphate of barytes, (see Vol. II. p. 241)

proves to be sulphate of strontian. Its specific gravity, I find to be 3.85 to 3.90. The crystal a flattened prism of six angles, formed as it were by the bevilment of two opposite lateral edges of a four sided prism, thus producing four obtuse angles of 140° each, and leaving the other two of 76° each. I have no crystal which will lead me to the form of its termination.

This mineral is found in a small island, called in *our* maps of last summer, Mouse Island; it lies about a mile west Bass, or Put-in Bay Island. The crystals intersect and cross each other in every possible direction, as will appear to you by some of the largest specimens. They easily separate however, or rather break to pieces by a slight stroke of the hammer. The gangue is a compact grey lime stone.

5. *Map of Mountains.*

Cummings and Hilliard of Boston, have just published* an engraving presenting at one view, the comparative heights of the principal mountains in the world, with corrections, and upwards of one hundred additions of the principal American mountains. We have a copy of this map and think it well worthy of being possessed, both for geographical and geological purposes, as it produces, at a *coup d' œil*, an impression, for which no description can be an adequate substitute. The annexed heights, latitudes and names, give the most important particular information, and the map neatly mounted, coloured and varnished, forms a handsome parlour picture.

ED.

6. *Epidote.*

Dr. Webster informs us, that very beautiful epidote and fibrous prehnite have been lately found in the trap rocks of Nahant, nine miles north east of Boston.

* Price coloured and mounted on rollers $5,25, plain $4,00—coloured and not varnished $4,25.

7. *Western Minerva, or American Annals of Knowledge and Literature; a Quarterly Journal to be published in Lexington, Kentucky.*

The motto is *un peu de tout* and corresponds with the sketch drawn in the prospectus. This literary and scientific journal will be published quarterly, in Lexington, Kentucky, in numbers of eighty pages, forming every year a volume of three hundred and twenty pages or more. The first number was promised for January, 1821, and the other numbers to appear successively in April, July and October following.

8. *Annals of Nature.*

Professor Rafinesque has published the first number of an annual or occasional Journal, which he denominates Annals of Nature, or Annual Synopsis of new Genera, and species of animals, plants, &c. discovered in North America. This work is established principally for his own discoveries and for those of his friends. His first number contains sixteen pages, and is occupied upon animals under the classes sucklers, birds, reptiles, fishes, crustacea, insects, worms, mollusca, polyps, and porostomes; and upon plants under the classes eltrogynes, mesogynes, endogynes, symphogynes, aniogynes, gymnogynes, phanerians, cryptians, fungians, and algians. Under these respective classes both of animals and plants many species are embraced.

9. *Fossil Fish.*

On page 222 of this volume mention is made of the fossil fish, found at Sunderland, Mass. by Mr. Edward Hitchcock. This gentleman at our request, has caused this place to be more thoroughly explored, and we have now the pleasure to state, on the authority of a letter from him, dated April 9, 1821, that fifty or sixty specimens of fossil fish have been discovered at Whitmore's Ferry, Sunderland, by those whom he has employed. We are informed, that there are two distinct species of fish, and as we have not yet obtained the box of specimens, put up for us by the kindness of Mr. Hitchcock, we subjoin the catalogue received with the letter, as this will impart some valuable information.—Ed.

List of organic remains and accompanying rocks, contained in a box forwarded to Professor Silliman by Edward Hitchcock.

No. 1. *Pudding stone* perhaps *grauwacke slate*, obtained from the bottom of Connecticut river, Whitmore's Ferry, Sunderland, Mass.

2. Slate lying immediately above No. 1, commencing at the surface of the river and extending upwards of ten feet, *containing one species of fish.*

3. Same rock containing *another species of fish.*

4. Same rock, *fish impressions, two fish lying across each other.*

5. *Fish impressions*, same slate rock.

6. *Fish impressions.*

7. Organic remains in same slate.

8. do. do. do.

9. Specimen of a reddish slate two hundred feet above the fish.

10. do. brown slate three hundred feet above the fish.

11. do. do. do. do. with a vegetable or animal relic penetrating the specimens.

12. Vegetable remains on the same general formation.

13. Slate three hundred feet above the fish containing a *clam shell.*

More particular information will be found in the labels.

10. *Severity of cold at Plattsburgh* on Lake Champlain.*

Extract of a letter to the Editor, dated March 17, 1821, from Dr. Lyman Foot, surgeon in the United States Army.

It is now snowing violently and has been snowing for thirty six hours; the inhabitants here call it the "equinoxial storm." The weather has been very cold at this place, during the last winter. The lake Champlain is now passable on the ice in every direction; I have seen ice cut out of the lake this winter, which I should judge to be three feet thick. The thermometer on the 25th of January last, at Reveilleè stood 23° below 0. Notwithstanding the intense cold here, we do not suffer so much as you would naturally

* Lat. 44° 42′ N.

suppose. Every one prepares for it, and no one ventures out without being properly guarded. On that extremely cold day, Jan. 25th, wrapped in buffaloe skins, furs, &c. I drove six miles in a sleigh without any inconvenience.

11. *Crystals of Snow.*

Professor Dewey, in a letter to the editor, mentions, tions, that in a late fall of snow, he observed *double crystals,* formed by a junction of two of the stars of six rays and of two others of the same form, but with bifurcated points; they were, in each instance, united by the ends of the three contiguous rays, on each crystal, and of course, the middle ray of the three, formed, in each instance, a continued right line passing through both crystals. The single crystals we suppose to be correctly represented in Figs. 1 and 4 of that plate of Vol. II. which illustrates Professor Green's piece on snow crystals,—see page 338.

12. *Fluor Spar of Genesee.*

We have just received (May 1, 1821) from Mr. H. R. Fenn, of Rochesterville, Ontario County, N. Y. some specimens of well crystalized fluor spar, which were discovered by him, half a mile from Rochester on the Genesee river in the bed of the great canal. They are scattered in cavities of secondary lime-stone rocks. The discoverer remarks that this mineral is found there in considerable quantities, and that some crystals are an inch and a half square.

N. B. We presume that if this locality be not *exactly* the same as that mentioned page 235 of this volume, it must at least be in the same formation; the specimens received from Mr. Boyd and from Mr. Fenn, cannot be distinguished from each other.—Ed.

13. *Fluor Spar of Illinois.*

At page 52 Vol. I. we mentioned this locality of fluor spar, and again at page 243 of the present volume. We have this day (May 2, 1821) received through the kindness of Capt. Abm. Hawkins of Shawneetown, some superb specimens, which we mention for the sake of drawing the attention of mineralogists to this locality, the most remarkable that has been observed in North America and probably one of the most interesting in the world. A specimen now lies before us more than six inches square, on which are deposited between three and four hundred distinct cubes and parallelopipeds some of which are an inch in diameter, and others so minute as to be almost microscopic; they are of a deep violet and purple colour, and the whole group (except that it has not quite the freshness of specimens which have been recently taken from the cavities of mines) is scarcely inferior to the finest pieces of Derbyshire and France.

II. FOREIGN LITERARURE AND SCIENCE.

1. *Slide from Mount Pilatus to the Lake of Lucerne.**

Communicated by Professor Griscom.

A slide was erected in 1812, by Mr. Rupp, for the purpose of bringing down to the lake of Lucerne the fine pine trees which grow upon Mount Pilatus. The wood was purchased by a company for 3,000*l* and 9,000*l* were expended in forming the slide. The length of the slide is about 44,000 English feet, or about 8¼ miles, and the difference of level of its two extremities is about 2,600 feet.

It is a wooden trough about five feet broad and four deep, the bottom of which consists of three trees, the middle one being a little hollowed, and small rills of water are conducted into it to diminish friction.

The declivity at its commencement is about 22½°, and it was calculated by Professor Playfair that a heavy body, not retarded by friction, would describe the whole length of the trough in 66″.

The large pines with their branches and bows cut off, are placed in the slide, and descending by their own gravity they acquire such an impetus by their descent through the first part of the slide, that they perform their journey of

* Although these facts have been already published in our newspapers we are willing to present them in a more permanent form. Indeed it often happens that articles of scientific and literary intelligence go the round of our principal newspapers, before it is possible that they should appear in our more permanent journals. When the articles are interesting and important we shall not think this a sufficient reason for omitting to insert them.—Ed.

eight and a quarter miles in the short space of six minutes. Only one or two descend at a time, but by means of signals placed along the slide, another tree is launched as soon as its predecessor has plunged into the lake. Sometimes the moving trees spring or bolt out of the trough, and when this happens they have been known to cut through trees in the neighborhood as if it had been done by an axe. When the trees reach the lake, they are formed into rafts, and floated down the Reuf into the Rhine.

The very singular phenomena described by Mr. Playfair's paper, arise from the diminution of friction, in consequence of an increase of velocity, and may be regarded as an experimental confirmation, on a large scale, of the ingenious views of Coulomb who had the merit of discovering this remarkable property of friction.—Ed. Phil. Journal.

2. *Oxigenized Water.*

Oxigenized water as prepared by Thenard is a real combination of water with oxigen, and not a simple solution of oxigen gas in water. It is not analagous to any compound at present known in chemistry. Its density is 1.452 and when poured into common water it flows upon it like syrup.

The phenomena presented by its contact with other substances differ entirely from those ordinarily observed. Thus platina, gold, silver, and oxide of manganese decompose it immediately ; separating the whole of the combined oxigen gas, and without appropriating to themselves any part of it. This cannot be explained by affinity, at least as the term has generally been used. This is certainly one of the most remarkable discoveries of modern times, and opens to chemists a new career, which can hardly fail to extend their views of chemical combinations. The oxigenized water has been employed in restoring ancient pictures for designs, which have been spoiled by the gradual combination of sulphur or sulphuretted hydrogen with the white lead used by the painters. It is only necessary to wash the dark spots with water feebly oxigenated, i. e. with five or six times its volume of oxigen. The dark hue immediately disappears. The sulphuret of lead is converted into sulphate, which is white.

3. *Lithographic Paper.*

Count Lasteryrie has reported to the Society D'Encouragement of Paris (under date of June 28th, 1820) in favour of the Lithographic paper or cards, invented by Senefelder. The card is covered on one or both of its faces, with an argillo-calcareous mixture, which has the property of receiving the ink or the crayon and of undergoing the ordinary preparation and furnishing proofs as neat and perfect as those obtained from designs traced on stone. Common writing is easily transferred to the lithographic or papyrographic plate and copies of it taken. The Persian ambassador being present with the commissioners at their examination of the press, wrote in Arabic a note, of which copies were taken. The translation is as follows :

Mirza Aboul Hassan Kham, ambassador extraordinary from the illustrious court of Persia, residing in the delightful city of Paris, the 24th May, 1820 of the christian era came to see the papyrographic press which has been invented in France, and which offers greater facilities than any other. All that I have seen in Paris, either with respect to the climate or to objects of art, surpasses all that I have seen in other countries."

4. *Ivory Paper.*

A Mr. Einsle of London has invented what he calls *Ivory Paper* which is found in regard to hardness, smoothness and whiteness, to answer as well as ivory in the hands of miniature painters. A premium of thirty guineas has been assigned to the inventor by the Adelphi Society in London.

5. *Manufacture of Glass.*

M. Westrumb has found that the salts of potash and soda deprived of their water of crystalization answer as well as the pure alkali itself in the fabrication of glass. Muriate of soda, sulphate of potash, and particularly sulphate of soda, contain much water. The latter loses fifty eight per cent by drying. Twenty four parts of sulphate of soda are thoroughly dried and mixed with eight parts of powdered charcoal and sixteen of good white sand. The mixture is to be calcined in the drying oven until the sulphur is dissipated and then transported into the pots for fusion. It gives a superb glass.—*Annals General de Sciences de Physique Brussels, May*, 1820.

6. *Portable Gas Lamps.*

These have been contrived by David Gordon of Edinburgh, and it is probable they will become quite common in private families.

They and made of strong copper, either spherical or cylindrical, with hemispherical ends. The gas from coal or oil is forced into them by a condensing pump, and is discharged through a stop cock to the burner. A reservoir of six inches diameter and nine inches high, filled with gas, condensed by twenty-five atmospheres will burn six hours, and afford a light equal to five candles of six to the pound. If the gas be obtained from oil, such a lamp will burn twelve hours. A sphere twelve inches in diameter will contain sufficient gas for two argand lamps, equal to twelve candles, burning six hours with coal gas or twelve hours with gas from oil. Such lamps can be filled with very little expense or trouble, in every town where there is a public manufactory of coal gas.—*Edin. Journal.*

7. *Potash in Sea Water.*

Dr. Wollaston has ascertained the existence of potash in sea water. It is in the state of sulphate and constitutes rather less than $\frac{1}{2000}$ part of the water.—*Idem.*

8. *Salt.*

The European salt mines and salt springs produce annually, as nearly as the estimate can be made, from twenty-five to thirty millions of hundred weight of salt.—*Idem.*

9. *Iron Boat.*

The iron passage boat on the Forth of Clyde canal, constructed under the direction of Henry Creighton, Esq. formerly of Soho, has an extreme length of sixty feet, beam thirteen feet and depth five feet. With two hundred passengers it draws forty eight inches of water. The weight of iron is twelve and a half tons, rather less than that of a wooden vessel of less internal dimensions. It is found to be more easily tacked than a wooden boat.—*Idem.*

10. *Supply of Water to Glasgow.*

The city of Glasgow is supplied with water from the Clyde. This stream is commonly very turbid, but the water filters through a body of sand into a well on the left bank of the river. Into this well dips a flexible iron tube which passes across the river, lying on its bottom. Three engines are employed on the other side to raise the water, two of thirty-six inch cylinders and seven feet stroke, and one of fifty-four inch cylinder and eight feet stroke. The flexible tube is the invention of the late celebrated J. Watt. He derived his first idea of it from observing a lobsters tail.

Idem.

11. *Air and Water support Vegetation.*

A fig tree, seven and a half feet high, with a stem five and a half inches in circumference, is growing luxuriantly in the hot house of the botanic garden of Edinburg, completely suspended from the ground, and without a particle of earth to nourish it. Water is thrown over it every day.

Idem.

12. *Electrometers.*

The Abbe Haüy has contrived two very delicate and useful electrometers. 1st. A fine crystal of Iceland spar attached to the end of a lever, and suspended by a silken string, is electrified vitreously by simply pressing it between two fingers. It retains its excitement two hours; and is not much altered by dipping in water.

2d. A support is made of sealing wax in which is stuck a needle that serves as a support and centre of vibration of a small bar of silver or copper terminating in balls.

This retains its excitement much longer that when suspended by silk.—*French Journal.*

13. *Extraordinary Surgical Operation.*

The most surprising and most honorable operation of surgery is, without any contradiction, that executed by M. Richerand, by taking away a part of the ribs and of the pleura. The patient was himself a medical man, and not ignorant of the danger he ran in the operation he had recourse to, but he also knew, that his disorder was otherwise incurable. He was attacked with a cancer on the internal surface of the ribs and of the pleura, which continually produced enormous fungosities, that had been in vain attempted to be suppressed by the actual cautery. M. Richerand was obliged to lay the ribs bare, to saw away two, to detach them from the pleura, and to cut away all the cancerous part of that membrane. As soon as he had made the opening, the air rushing into the chest, occasioned for the first day, great suffering, and distressing shortness of breath; the surgeon could touch and see the heart through the pericardium, which was as transparent as glass, and could assure himself of the total insensibility of both; much serous fluid flowed from the wound, as long as it remained open, but it filled up slowly by means of the adhesion of the lungs with the pericardium, and the fleshy granulations that were formed in it. At length the patient got so well that on the twenty-seventh day after the operation he could not resist the desire of going to the medical school to see the fragments of the ribs, that had been taken from him, and in three or four days after, he returned home and went about his ordinary business.—*Thomson's An.*

14. *Royal Society of London.*

Dr. Wollaston has been chosen *ad interim* President* of the Royal Society of London. It would be difficult to name any philosopher of the present day, who excels him in acuteness of perception, as well as depth of attainment. A paper by him was read before the Royal Society in June last, on sounds inaudible to human ears. On observing that the ears of a person were insensible to the sound of a small organ pipe which was far within the limits of his own hearing,

* Sir Humphrey Davy has since been chosen president.

he found upon examination that this person's hearing terminated at a note four octaves above the middle E of the piano-forte. Other instances were then referred to, of the insensibility of certain persons to various acute sounds, such as the chirping of the grasshopper, crickets, and sparrows, and especially the squeaking of the bat, the existence of which is unknown in many individuals from its being inaudible to them. The pitch of the sound was stated to be about five octaves above the middle E. The author fixed the limits of his own hearing at six octaves above the same note. The range of human hearing includes upwards of nine octaves, the whole of which are distinctly audible to most ears, although the vibration of the acuter sounds is six or seven hundred times more frequent than that of the lower. The author concluded by observing that it is very probable that other animals are so organized as to be able to distinguish sounds still more acute and of course more inaudible by human ears, and thus to possess what may be considered a new sense.—*Thomson's An.*

15. *Prisons.*

A Society for the Amelioration of Prisons has been established at St. Petersburg; Prince Galitzin is the president.—*Rev. Ency.*

16. *Pompeia.*

A shower of ashes having fallen recently on the ruins of Pompeia, M. De Gimbernat, a Spanish naturalist, compared its composition with that of the substance under which the city was anciently buried. He did not find the least resemblance between them; whence it appears doubtful whether the ruin of that city was occasioned by a shower of ashes. The same philosopher observed that some days after the eruption, the crater of Vesuvius was covered with crystaline marine salt.—*Ibid.*

17. *Antidote to Corrosive Sublimate.*

M. Taddei professor of Pharmacy in the hospital of *Santa Marie Nuova*, of Florence has ascertained that the *glu-*

ten of wheat dissolved in water with soap, destroys the terrible effect produced in the animal economy by *corrosive sublimate.* He has published a memoir on this subject which is highly praised in the Italian Journals.—*Ibid.*

18. *Schools.*

Schools for the instrustion of the poor on the system of mutual instruction are making rapid progress in Italy. The duchess of Parma has established three, two at Parma and one at St. Donino.—*Ibid.*

19. *Manufactory of Thimbles.*

A thimble manufactory has been established in France by Rouy and Berthier, in which the mechanism is so ingenious and perfect that they can afford to make steel thimbles lined with gold and of elegant workmanship, at the rate of eighteen or twenty francs per dozen. The same kind of thimbles lined with silver, can be afforded at six or seven, per dozen. Common iron thimbles, closed at the end, can be sold for one franc per dozen.

In this single branch of manufactory, France has been tributary, it is said, to other countries, to the amount of 875,000 francs. At present it is supposed that French thimbles will be sought after in other countries—*Bul. Soc. d'encouragement.*

20. *Auscultation.*

This singular method of discovering the various disorders of the chest by percussion, was, we believe, first suggested by Avenbruggen, a physician in Venice, who published a work on the subject, since translated by M. Corvisart. A memoir has lately been presented to the French Academy, by M. Lacunec, detailing the various modes of employing this discovery.

Among others, Mr. L. recommends using a tube with thick sides, or a cylinder, pierced along its axis with a narrow aperture. This, on being applied to the chest of a person in good health, who is speaking or singing, produces a sort of trembling noise more or less distinct; but if an ulcer exists in the lungs a very singular phenomenon happens.

The voice of the sick person can no longer be heard by the ear at liberty, the whole of the sound passing along the aperture of the cylinder to the observer. Commissioners appointed by the French Academy, have verified the experiment in various cases of consumption.

21. *Languages.*

M. Frederick Aldeling counsellor of state to the emperor of Russia, has lately published in one hundred and fifty three pages. "A view of all the known languages and their dialects."

In this view, we find in all 937 Asiatic, 587 European, 276 African, and 1264 American languages and dialects enumerated and classed, a total of 3064.

22. *Evaporation of Spirits.*

The rapidity of evaporation and the cold produced by it have been applied by Mr. Ritchie of Perth, to the determination of the strength of spirits.

"Having made three very delicate hydrometers, according to Leslie's construction, I inserted the bulb of one of them with strong whiskey, the bulb of another with a mixture of equal quantities of the same spirits and water, and the bulb of the third with water. I watched the descent of the fluids in the stem till each had gained its maximum of cold and marked the cold induced by the water 40, by the diluted spirits 64, and by the strong spirits 88. Now the difference 40 and 64 is 24, and between 40 and 88 is 48. Hence the following proportion 24 : 48 : : the strength of the dilute to the strength of the strong spirits.

This I have tried with different proportions of spirits and water, in different states of the atmosphere, and found the same property uniformly obtain. The experiment requires to be performed with great delicacy and care, as the spirits soon acquire their maximum, after which the fluid in the tube begins to ascend—*An. of Phil.*

23. *A newly discovered flower of extraordinary dimensions.*

Mr. Brown read before the Linnean Society of London a memoir on a new species of plants, discovered in Sumatra in 1818, by the late Dr. Jos. Arnold. It has been named Rafflesia, from Sir Thomas Stamford Raffles under whose auspices Dr. Arnold travelled.

This flower springs immediately from a horizontal root. The stem is covered with round imbricated floral leaves, of a darkish brown colour, and not very unlike a cabbage. The size of this flower is surprisingly great, when fully expanded its diameter is three feet, and its weight is fifteen pounds. Its tube holds twelve pints.

Mr. Brown in treating of the affinities of this singular plant, compares it principally to the aristolochias and passifloras. He has not undertaken to decide however, to which of these two species it approaches the nearest. He suspects that it is parasitic upon the root which supports it; but to decide this question more fully, further observation appears to be necessary.

The largest flower that has hitherto been found is the purple flower of the *aristolochia cordifolia.* According to the measurement of Humbolt its diameter is sometimes sixteen inches. Upon the borders of the river Magdalena children amuse themselves in covering their heads with it.

An. de chimie, Aug. 1820.

24. *Chinese Dictionary.*

Mr. Morrison is advancing with his Chinese Dictionary. The second part of this important work was begun in April 1811. It will contain one thousand pages in 4to and more than twelve thousand chinese characters explained by numerous examples. In the month of April 1817, they had finished six hundred pages, comprising nearly eight thousand characters. The impression of all the volumes will require at least ten years.

25. *Van Diemen's Land.*

A printing office was established in 1818 at Hobart's town in Van Diemen's land, to which convicts are sent from England. The first book published there was the history of Michael Howe, a convict, who, at the head of twenty eight brigands, disturbed the peace of the colony during six years.

26. *Egypt.*

The grand canal at Ramainah, which extends from Cairo to Alexandria, was completed in the month of January 1820. The Pacha made a voyage upon it to assure himself that the whole of it has been executed agreeably to his instructions.—*Rev. Ency.*

Egypt under the intelligent and active government of the present Pacha is opening commercial relations with different parts of the world, by means of agents sent by his orders. Specimens of refined sugar have been received at Trieste from Egyptian manufacture. Cotton, silk, and cloth are also manufactured in that country.—*Idem.*

27. *Temple of Jupiter Ammon.*

After sixteen days of great fatigue employed in traversing the desarts of Lybia and Marmorica, M. Frediani an Italian traveller, has at length succeeded in discovering the famous edifice called the great temple of Jupiter Ammon, which it is supposed has not been visited since the time of Alexander the great. M. Frediani was accompanied by an escort of two thousand men, and was obliged to open his way by force to this celebrated monument of superstition.

Idem.

28. *Comforts of travelling in Finland.*

In the course of last winter, the Russian government established, for the comfort of travellers, along the gulf of Finland, from St. Petersburg to Cronstadt, guard houses, at the distance of three Verstes, or half a league from each other. They are well warmed by stoves, and offer to strangers a comfortable retreat during the night. The top of each house is lighted by a reflector which can be seen at a great distance, and during a thick fog, a bell is frequently rung as a call to those who may wander from their track. Large posts are also erected surmounted by a pavilion to serve as a guide during a deep snow. At mid distance an inn is kept, well provided with needful refreshments.

Idem.

29. *Monument of Pultowa.*

A monument of cast iron has been erected at Pultowa by the emperor Alexander, in memory of the victory obtained by Peter the great over Charles the 12th of Sweden.

Idem.

30. *Biography of Linneus.*

Chaver has recently brought to light at the house of a Florist, a biography of Linneus, in the Swedish language, written by himself and continued to his death.

The manuscript has been sent to Upral and will soon be published in an 8vo. of five hundred pages. It will be ornamented with six engravings, presenting two portraits of the celebrated naturalist, a *fac simile* of his writing, his monument in the cathedral church and the arms of his family.—*Idem.*

31. *Jurisprudence in Switzerland.*

A premium of fifty louis has been granted to M. Hangard by a convention of inhabitants of the Canton de Vaud, in Switzerland, for the best dissertation on the question, "would the institution of juries in criminal cases prove advantageous in the Canton de Vaud." The memoir will be printed at the expense of the Canton and spread throughout Switzerland. The author has decided against the establishment of juries in Switzerland though an admirer in general of that excellent institution. But in the Canton the judges are appointed by the people at determinate periods; they receive nothing from government, and have neither grace, favours, nor fortune to hope for. Their independence is established by good laws, and they enjoy besides the entire confidence of the nation. These reasons with many others, not less plausible, are developed in the memoir with great precision.—*Idem.*

32. *Education of the Poor.*

If the school for poor children at Hosfevyl demonstrates the happy influence of a moral education upon a large scale, it is a fact that similar results may be obtained in smaller establishments. There exists a poor woman who has devoted herself to the education of unhappy orphans without any other resource than public and private charity. She has eight of these orphans, and supports them as well as herself with twenty nine francs per month. Her dwelling costs her four francs per month, so that there remains only a *batz* per day for the maintenance of each individual. The children are, nevertheless, in good condition, and nothing in their exterior indicates misery. This wonder of economy is still surpassed by the ability with which this respectable woman supports her authority and instils into her children habits of order and neatness and the love of labour. She has been led instinctively to adopt the Lancasterian mode of education by assigning to the elder the instruction of the younger children. Would it be difficult to find in each district females thus qualified, who might serve for two or three villages, and who might be furnished with lodging, fuel, and a small lot of ground which the pupils would cultivate? Government might encourage such establishments by granting a premium to the communes which formed them. The following is an instance similar to the above.

The widow Rumph, aged 70 years, residing near Betheny, supports, with less than thirty francs a month, five boys and three little girls. These children are remarkable for their lively and happy countenances, their good condition and polite behaviour. The widow Rumph has been the mother of fifteen children and has nursed thirty two at her own breast.—*Idem.*

33. *Medicine.*

M. Re, Professor of Materia Medica in the veterinary school of Turin, has discovered that the lycopus europœus of Linneus, called the herb of China by the inhabitants of Piedmont, where it grows abundantly, especially in marshy places, possesses the same properties as the *quinquina* and may be conveniently used as a substitute.—*Idem.*

34. *Bible Society of Athens.*

A Bible Society has been formed at Athens in Greece, the direction of which is committed to twelve respectable inhabitants, all native Greeks.

35. *Dictionary of Ancient and Modern Greek.*

A *Dictionary* of the Greek Language, *Ancient* and *Modern,* is now in the course of publication at the patriarchal press at Constantinople. It will form more than six large folio volumes, the first of which has already appeared. This important work is under the auspices of the present patriarch Gregorios, a native of Peloponnesus, a prelate as virtuous as he is enlightened.

36. *College of Chios.*

The grand College of Chios, has already become a kind of European University. Ambrosios Argentis, one of its pupils aged 17 years, has just published a discourse on Navigation, in which he exhorts with much ardour, his countrymen to engage in commercial navigation, as an imperishable source of riches and prosperity.—*Idem.*

37. *Fruitfulness of the Potatoe.*

Marseilles.—There has been brought here from London, a kind of potatoe which is a prodigy of vegetation. A single tubercule has produced 1,058 kilogrammes (2,160 pounds) of potatoes, the quality of which is excellent.—*Dieppe.*

38. *Distillation of Sea Water.*

P. Nicole an apothecary of Dieppe has succeeded in distilling sea water so as to deprive it of the disagreeable odour which it is so apt to retain. This he has effected by causing the vapour to ascend through a stratum of charcoal.—*Idem.*

39. *New Hydraulic Ram.*

M. Godin, Rue de Poliveau, No. 21 Paris, has invented a new hydraulic Ram of such simplicity as to be easily executed by any village ploughman. It is adapted to the raising of water for agricultural and economical purposes. M. Godin furnishes those who desire it with engraved representations of his machine, accompanied with instructions, for its fabrication, and if desired a model in relief.—*Idem.*

40. *Sea Signals.*

Experiments have been made in the neighbourhood of Paris upon a new kind of nautical telegraph, intended to furnish by day and by night the means of enabling seamen to communicate with each other, and with a neighbouring coast, in all languages at the distance of three or four leagues. This improvement may be the means of diminishing the number of shipwrecks.—*Idem.*

41. *Remarkable Petrifaction.*

A tree about twenty six inches in diameter has been found in the actual erect condition in which it grew, but in a state of complete pretrifaction, in a sand stone quarry near Glasgow in Scotland. The body of the tree itself is composed of sandstone similar to the rest of the quarry. But the bark has been converted into a perfect coal, which adheres firmly to the tree and renders it easy to remove the rock with which the tree is incrusted. About three feet of the bottom part has been uncovered. This portion is situated about forty feet below the surface of the earth, in a solid quarry of sand stone. The roots may be seen dipping into the earth precisely as the roots of living trees do. Four large roots may be seen issuing from the trunk and extending about a foot before they are lost in the quarry. The upper part of the trunk and branches has not been traced. This petrifaction demonstrates that the sand stone has been formed at a period posterior to the existence of large trees, and that the water-worn appearance of the quarry pebbles of which the sand stone is composed is not a deceitful indication, as some Geologists would persuade us, but quite correct. But if the sand stone which constitutes so great a proportion of the coal beds, be a formation posterior to the earth's being covered with wood, we can entertain no doubt that this was the case also with the slate clay, and the coal which alternate with this sand stone. If the coal formation, exists as a portion of the old red sand stone, we can entertain no reasonable doubt that the old red sand stone itself was formed after the earth was covered with wood, and if it turn out to be true, as there is some reason for believing that the transition and some of the primitive rocks, alternate with the old red sandstone, we must conclude that these rocks also have been formed after the earth was covered with wood.—*Thomson's Annals, Nov.* 1821.

42. *Spontaneous Combustion.*

A barrel of oat-meal which had been left in a recess of the chimney of a house in Glasgow, took fire while the family were absent at bathing quarters last summer. Nothing remained but the iron hoops of the barrel and a few pieces of charcoal. The meal was probably a little moist.—*Idem.*

43. *Magnetism produced by Voltaic Electricity.*

A new and interesting discovery has been made in relation to the connexion between Voltaic electricity and Galvanism. It has been ascertained that the Voltaic (Galvanic) fluid, directed in a proper manner, is capable of communicating magnetic properties to bars of steel. If steel bars or rods be exposed to the Galvanic current, placed in the direction of the magnetic axis, no effect follows ; but if they be placed parallel with the magnetic equator, they become magnetic, the end placed to the west becoming the north pole of the new magnet, and that toward the east the south pole. The galvanic influence is so great in this respect as to exert its power at a distance of some inches (even ten or twelve) so that if the steel bar be moved in a circle round the course of the galvanic current, but always kept parallel to the magnetic equator it becomes magnetic.

When an electrical or a voltaic battery of considerable quantity is charged, the compensating or discharging wire becomes magnetic upon the completion of the discharge. Common needles or bars of steel placed *transversely* on the wire, or under it, or on its sides, become permanent magnets on the discharge.

If the quantity of electric fluid be very great, contact with the wire is not requisite. In one instance magnetism was communicated at fourteen inches distance from the conducting wire. It was also communicated through plates of glass and even when the bars or needles were immersed in water. These experiments were made both at the Royal and London Institutions. At the latter, the electrical batteries used, were from eighteen to seventy cubic (square) feet. The voltaic troughs of four inch plates, mounted with double copper agreeably to Dr. Wolloston's plan.

Phil. Mag. for Nov.

44. *French Translations from the Arabic.*

The French *literati* are occupied at this time in a work of some importance, preparing translations of Plutarch, Salust, Tacitus, Aristotle, Hippocrates, &c. from the Arabic MSS. into which languages many or all the best Greek and Roman authors are known to have been translated.

The French Ambassador at Constantinople, M. Giardin, has lately sent to Paris fifteen valuable MSS. in Arabic, from the Imperial Library there, among which are the complete works of Plutarch and Heroditus.—*Ibid.*

45. *New Alkali.*

Pelletier and Caventon have, it appears detected another alkali in the seeds of the *veratrum sabadilla*, or meadow saffron. It has been named *veratrine*. It is white, pulverulent, without smell, but excites violent sneezing; it is very acrid, but not bitter, producing violent vomiting in so small doses, that according to some experiments, a few grains may cause death. It is but little soluble in cold water, boiling water dissolves about $\frac{1}{1000}$ part, and acquires an acrid taste. It is very soluble in alcohol. The super sulphate alone appears to form crystals.—*Ibid.*

46. *Population of Greenland.*

The whole population of Greenland, according to the last report of the missionary board, consists of three thousand five hundred and eighty-six individuals, spread through seventeen colonies on the western coast. The interior is not habitable owing to accumulations of ice. The population has increased seven hundred and fourteen since the year 1789.—*Ibid.*

47. *Mildew.*

Dr. Cartwright has ascertained that a solution of common salt, sprinkled on wheat infected with mildew, completely removes the disease. Six or eight bushels of salt will serve an acre, the expence will be more than repaid from the improvement of the manure, arising from the salted straw. The efficacy of this remedy has been completely verified. Its operation is so quick, that in forty eight hours, the vestiges of the disease are hardly discernible.
Ibid.

48. *Theory of Electricity.*

A paper was read by Dr. Van Marum, at the Royal Institution of the Sciences at Amsterdam in 1819, the reasoning of which goes far to prove that the Franklinian hypothesis of a single electrical fluid is the true one; and that the theory of Du Fay, of vitreous and resinous fluids principally supported by the French philosophers, does not so well explain the phenomena. The paper of Van Marum is published in Thomson's Annals, December 1820.

49. *Gas illumination,*

Has been introduced into one of the districts of Paris with the best effects, under the judicious direction of M. Darcet. The hospital of St. Louis which contains seven hundred patients is finely lighted by it, as also the hospital for incurables in Rue des Recollets, and the Maison de Santi, Rue St. Denis and the prison de St. Lazare. Three hundred lights are sufficient for the hospital St. Louis. The gas is obtained by *the distillation of coal.*

50. *Iodine.*

This substance has been found to be an excellent remedy in the cure of Goitre. An able memoir upon it by Dr. Coindet in the Bib. Univ. of Geneva contains the following. Iode is a stimulant, it gives tone to the stomach, and excites appetite; it acts neither as a cathartic, nor diuretic, nor does it excite sweating; but its action is directed to the reproductive system, and especially to the uterus. If given in a certain quantity and continued for some time, it is one of the most active emmenagogues that I know. It is perhaps by the sympathetic action that, in the greater number of cases it cures Goitre. This substance deserves, under this new point of view, the attention of physicians, and I doubt not, that it will become in skilful hands one of the most powerful remedies with which modern chemistry has enriched the materia medica. It has been discovered in sponge and in peat.

51. *Mercurial Atmosphere.*

Mr. Faraday chemical operator at the Royal Institution, London, has found that when a thin stratum of mercury rests in the bottom of a clean vial, a piece of gold leaf carefully suspended from the stopper, becomes in the course of a few weeks, whitened by a quantity of mercury through every part of the bottle, the mercury remains just as before.

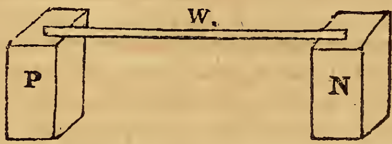
Brande's Journal.

52. *Connexion between Magnetism and Electricity.*

The discoveries of Professor Oersted of Copenhagen which so clearly establish the connexion between Magnetism and Voltaic electricity have been considered so important as to induce the Royal Society of London to vote him the Copley medal. We insert from the Journal of the Royal Institution, a summary of these highly interesting results.

"No discovery has, for a long time, so strongly excited the attention of the philosophic world, as that of the magnetic phenomena belonging to the voltaic apparatus; we shall, therefore, endeavour to give our readers a short statement of what has been done in this department of scientific inquiry.

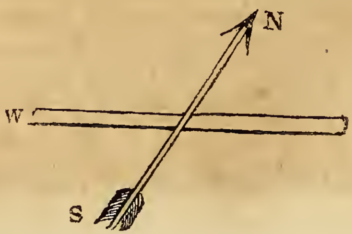
1. If the extremes of a voltaic battery (we will suppose it to consist of 20 pairs of 8 inch plates,) be connected by a *platinum* wire, it becomes heated, and, if of sufficiently small diameter, it suffers ignition. Let us suppose such a wire W, lying upon the supports P and N, which represent



the positive and negative conductors of the active Voltaic apparatus, P being connected with the first zinc plate, and N with the last copper plate ; upon bringing the north pole of a common magnetic needle *below* and at a right angle to the platinum wire, it will be repelled or driven downwards ; if we now remove the needle keeping it in the same position, so that its north pole may be *above* the platinum wire, it will then be attracted towards it. If the electric poles be reversed, these phenomena will also be reversed.

If we suppose the conjunctive platinum wire to be vertical, instead of horizontal, and in that position approach it with either end of the magnetic needle, the needle will *oscillate*, but will not be permanently attracted or repelled by any part of the conjunctive wire.—Professor Oersted.

2. If a small steel bar be attached to the conjunctive wire, and parallel to it, it does not become a polar magnet ; but if it be attached transversely, it does become polar, and it becomes north and south, or south and north, according to the direction of the supposed electric current traversing the conjunctive wire, according as one or the other end of it is positive or negative. Thus supposing W to represent the platinum conjunctive wire of the Voltaic apparatus, and



N S a wire of iron attached transversely to it, the latter becomes permanently magnetic.—Sir H. Davy.

3. If we suppose a second conjunctive wire parallel to, and similarly situated with, the first, as in this figure, those

wires will *attract* each other; but if one conjunctive wire be traversed by the electric fluid in one direction, and another in an opposite direction, as in the following wood-cut, those

wires will *repel* each other. In this circumstance, the dissimilarity of the electro-magnetic and of simple electric phenomena is observed: for bodies similarly electrified repel each other, and, dissimilarly electrified, attract each other; but here the horizontal wires, similarly electro-magnetized, attract; and, dissimilarly electro-magnetized, repel each other.—M. Ampere.

4. The shock of a Leyden jar, or battery, passed through a wire, confers upon it, at the moment of its passage, properties precisely similar to those of the Voltaic apparatus.

To render a steel bar magnetic, it is not necessary that it should *touch* the conjunctive wire, to which it is attached at right angles, for the electro-magnetic influence is conveyed to some distance, and is not excluded by the interposition of a plate of glass, of metal, or of water.—Sir H. Davy.

5. The phenomena, exhibited by the electro-magnetic or conjunctive wire, may be explained upon the supposition of an electro-magnetic current passing round the axis of the conjunctive wire, its direction depending upon that of the electric current, or upon the poles of the battery with which it is connected.—Dr. Wollaston.

In the above figure, such a current is represented in two sections at right angles to the axis of the wires, when similarly electrified, from which it will be apparent that the north and south powers meeting, will attract each other.

In the following figure, the sections of the wire are shown

dissimilarly electrified, by which similar magnetic powers meet, and consequently occasion a repulsion.

53. *Notices of Vegetable Remains in Coal Strata.*

TO THE EDITOR.

SIR—The very close resemblance the figures in your last Journal marked C 3—C 4—, bear to a remarkable sandstone which occurs abundantly in the coal fields of Scotland, must strike every one acquainted with the latter.

On the shores of the Frith of Forth are vast quantities of this sandstone in various imitative forms, more commonly resembling branches of trees. These are seldom less than an inch in diameter, and often exceed four inches. Branches of smaller size are sent off from the larger, and the exterior of all is covered with the impressions so well delineated in Mr. Granger's paper. Although they have been examined by many distinguished naturalists in Great Britain, no satisfactory explanation of them has been published. The following notice of similar appearances is from Tilloch's Magazine for December, 1820.

Your's, &c.

J. W. WEBSTER.

"*Large Organic Remains.*

"In some of the sandstone rocks which alternate with the seams of coal, in a great many if not in all the coal-fields of England, the remains of very large, thin, hollow or *reed-like vegetables* have been found, sometimes lying along in the stone, and sometimes standing erect therein ; the inside hollow of the vegetable being now completely filled with sandstone, in all respects like that which surrounds it, and the vegetable case or sheath is found converted into perfect coal ;* on the outside of which coaly case or sheath, the papilia or places where very numerous large leaves were once attached to the vegetable, are in general visible ; and not uncommonly, particularly in the medium and smaller sizes of these reed-like remains, the leaves are yet attached and in a coaly state, and spread out into the sandstone on every side : it is seldom that these remains are quite round, but mostly somewhat oval ; particularly towards the bottom, where they usually swell out into an irregular club-like form, much more resembling the lower parts of coralline and other aquatic stems, than the commencement of the roots of a tree, or of any land plant ; no branches have ever been observed, proceeding from the sides or the tops of these remains ; but it is very common to observe the smaller and medium sizes of them, to terminate at top in a large bud, very closely resembling the top of an asparagus shoot in the state the same are brought to market. In a free sandstone quarry on the western side of Glasgow, a large organic remain has lately been found, which in every essential particular seems to agree with the description above mentioned."

54. *Ancient Sarcophagus.* (*J. W. W.*)

Dr. E. D. Clarke has communicated to the Cambridge Philosophical Society a discovery which he had made respecting the supposed alabaster soros, brought by Mr. Belzoni from Upper Egypt ; and which he had found to consist of one integral mass of arragonite.—*Ibid.*

* "It seems more than probable, that hollow *vegetable pipes* contributed greatly to supply the masses of which the coal-seams are now composed ; because, on the tops of many coal-seams of inferior quality, and where much earthy matter is found mixed with the bad coal, such pipy vegetables, nearly or quite collapsed, and converted into coal, very much abound ; the papilia, and sometimes the leaves also, being visible on the outsides of such collapsed pipes, or flattened *reeds* as they are very commonly called. In the process of forming good or perfect coal, a crystalization of the vegetable mass has taken place, by which all traces of organization are obliterated."

55. *Siliceous Sinter of the Azores.*

Mr. Silliman,

In examining some varieties of siliceous sinter from the Azores, I have met with one which differs from any hitherto found in Iceland or other countries, where the substance occurs under those forms usually seen in our cabinets. From the island where this variety occurs (St. Michaels) it might perhaps be distinguished by the term Michaelite. From the specimens before me I send you the following description. Your's, &c.

J. W. WEBSTER.

External Characters.

Color snow white, reddish and yellowish white, passing in some specimens to yellowish grey.

It occurs in long slender (capillary) filaments, from one to four inches in length.

The filaments cross each other in every direction.

On the cross fracture, viewed with a microscope, a lustre between vitreous and pearly is observed.

It is translucent. Brittle and light.

When reduced to powder and rubbed on glass it scratches it.

Specific gravity 1.866.

Chemical Characters.

Infusible without addition before Brooke's blowpipe.

Constituent Parts.

Silex, - -	97.0
Alumina, - -	1.5
Iron a trace, -	—
Water, - - -	1.5
	100

Six grains in fine powder, intensely ignited in a platina crucible for fifteen minutes, lost 0.98125 grains, equal to 16.35 per cent.; it is an hydrate of silex and is composed of

Silex, -	83.65
Water, - -	16.35

This approaches very nearly 2 proportionals of water = 18 — five proportionals of Silex = 80.

Geological and Geographical Situation.

It occurs in cavities in massive and other varieties of sinter, and upon conglomerated masses of altered lava and pumice, in the vicinity of the hot springs of the island of Saint Michaels, (Azores) and has probably been deposited from the waters which held it in solution by their elevated temperature, aided by an alkali.

56. *Swainson's Zoological Miscellany.*

Notice communicated by Professor Rafinesque, in a letter dated Lexington, 10th October, 1820.

I am requested *by the author* to have the following notice inserted in your Journal.

" Mr. William Swainson of Liverpool, a gentleman who has travelled in Brazils, Greece, Italy, Sicily, &c. was to commence publishing in London, in October, 1820, a Zoological Miscellany, with coloured plates. He is an able naturalist and painter, two qualities which will render his work very valuable. It is to be on the plan of the Zoological Miscellany of Dr. Leach, where so many new objects have been elucidated, and to contain the figures and descriptions of the new animals which he has discovered in his travels. It will be published in monthly numbers, in 8vo, each number will contain four highly finished coloured plates of new and unfigured or imperfectly known birds, fish, shells and insects, all from original drawings by the author, who has likewise engraved the plates. The price will be two shillings and six pence per number. He has also a monography of the genus of humming birds, with coloured engravings of each species, nearly ready for the press."

57. *Notice of the Revue Encyclopedique, published in Paris under the direction of Mr. Julien.*

This Monthly Journal has but recently begun to be known in this country. Indeed, its publication began only two years since, but this period has been sufficient to shew that it is one of the ablest and most interesting publications of the kind extant.

It embraces within its plan

1. " Analysis of and extracts from choice works.

2. "Memoirs, notices and miscellanies, upon objects of general interest.

3. "Literary and scientific news from all countries.

4. "A Bibliographical Bulletin, or annunciation of new works both French and foreign, the substance of all the most remarkable productions in literature, the sciences and the arts."

It is remarked of it in one of the Paris Journals,* that a numerous and select band of literary, scientific and learned men; of authors, and distinguished writers of all descriptions labour in this work, and seem honourably to represent in it, universal literature and the extent of human knowledge. This new "Recueil literaire" has already obtained honourable mention and copious extracts are made from it in many of the literary and scientific Journals of Germany, England and Italy.† The effect of this Review is to open a central channel of communication to the friends of science and humanity, whatever part of the globe they inhabit, and in whatever department of the sciences and arts they exert their efforts. It offers and already promises a valuable and continued abstract of all the works useful to man in society. It presents by degrees the annals of comparative civilization.

It is remarked that the six numbers published in the six first months of the year 1819, contained analyses or extracts or simple annunciations of more than three hundred choice works; a collection of more than thirty memoirs or notices of a general interest upon literature and the sciences; and lastly, many pictures of the movements of human genius, manifested in different countries, by the labours of learned societies or by those of public utility, by inventions and discoveries, by the measures of government in support of education and of industry, and by marks of honour rendered to distinguished and useful men.

* L'Independant, Journal general, politique, literaire et militaire.

† It is beginning to be quoted in the American Journals.

In another Parisian Journal* there is a very minute and animated picture of this Review, and an analysis of the last number in detail: our limits will allow us to cite only some passages. The work is spoken of as being highly meritorious on account of the extent and importance of the plan, the merit of the execution, the reputation and talents of its editors, the noble end which they have in view and the spirit of moderation and of true philanthropy by which they are actuated. The United States and with them our own humble labours and those of our collaborators are honoured with a good degree of attention in this Journal. It is remarked, in the notice before us, that the United States appear to cultivate particularly the physical sciences and statistics, and that we are a rising nation (une nation naissante) still occupied in making out the inventory of the riches of our vast territory and of the means of exploring them. Speaking of the notice of all nations in the Revue Encyclopedique the Journalist goes on to remark—" thus, in their turn, many different countries have been passed in review, brought together and compared, and the noble examples, the public works, the important facts, the pregnant observations collected with discernment and presented with perspicuity, have contributed to manifest and still to excite the movement of human intellect, embraced in the peaceful sphere of the sciences, of letters and the arts. With respect to that division of the work which relates to scientific and literary intelligence, it is remarked that the review presents a true *panorama* of the civilized world, and that we there see appear, in succession, in the course of more than sixty articles, all the nations known; the summaries of their journals of science and of the labours of their literary and scientific societies; the designations of prizes proposed and of prizes distributed; the particular objects of the researches of skilful men in every country; the actual condition of national schools and their progress, especially among communities recently organized; extracts of letters respecting scientific travels or which have reference to some useful public object, with respect to antiquities, arts, sciences or the progress of civilization; inventions and discoveries, the immediate publication of works, the organiza-

* Le Moniteur Universal, for August 10, 1820.

tion of public establishments, universities, museums, hospitals, savings banks, &c.; national remunerations, accorded by governments or by societies to learned men and to benefactors of the human race; monuments consecrated to celebrated men; the phenomena of natural history or of meteorology, processes of domestic economy, statistical extracts, discoveries of objects of art or of ancient manuscripts, the finest recent productions of architecture, sculpture or painting, the progress of mutual instruction adopted by all governments that interest themselves in the well being of their people, the state of lithography; the new dramatic productions which obtain a degree of celebrity, and the direction given to the influence of the theatres which may become schools of public feeling; lastly, obituary notices of men whose lives have been illustrated by good actions or by good productions; such are the infinitely varied subjects which are created and multiplied in this gallery of nations.

It is added, "The Revue Encyclopedique is not then merely a *scientific* work destined for the savans; or, *literary*, for mere *scholars*, or *national*, designed for one nation only. It is a methodical collection of interesting facts, which evince the activity of the genius and industry of man, upon all parts of the globe. It is a philanthropic enterprize in which all elevated minds ought to be interested, and all generous hearts summoned to form a kind of electric and mysterious chain infinitely extended, embracing the destinies of man and which from age to age, from country to country, unites all the thoughts, all the works having reference to the great end of the preservation, amelioration and alleviation of the condition of man, as well as to the more free and complete developement of the human faculties and of the social institutions which constitute true *civilization.*"

Such are the views entertained in Paris of this periodical work. As far as we have had opportunity to peruse it, they are (abating perhaps a degree of enthusiasm which is certainly pardonable on such a subject) justified by the execution which evidently involves an amount and variety of knowledge and labour unprecedented, we believe, in the execution of any periodical work.

58. *Atomic Weights of Bodies.*

Extract of a letter dated Glasgow, November 2, 1820, *from Dr. Thomas Thomson Regius, Professor of Chemistry in the University of Glasgow, &c. &c. to the Editor.*

I have but little scientific news to communicate to you. Little is doing at present in chemistry, either in this country, or on the continent of Europe. I am at present engaged in a set of experiments, to determine the true atomic weights of bodies with mathematical accuracy, and I have already made considerable progress. A first paper on the subject has just appeared in the annals for November, a second will appear in the January number. Having this winter a course of clinical lectures to deliver, and being anxious to take the opportunity of investigating more exactly than has been done, the state of the urine in various diseases, I shall be obliged to interrupt my experiments for the winter, but I shall resume them next May. As soon as I have completed this investigation I shall have it in my power to apply mathematics to chemistry.

59. *Palermo.*

Extract of a letter to the Editor from Mr. William C. Woodbridge, of the American Asylum for the Deaf and Dumb, dated February 25, 1821, *Palermo.*

"The University (of Palermo) has a noble unfinished building, a small philosophical apparatus and scarcely any chemical. There are thirty schools, where lectures are delivered on every branch of science, and about five hundred students who attend gratis. The professors are supported by the funds now much reduced, and by government. At the Royal Palace is the observatory, under the direction of Professor Cacciatore, a scholar of Piazzi. It contains several very fine instruments, particularly a circle for the observation of altitudes, which is said to be unique. It was made by Ramsden and presented by him to the University when Piazzi was the Professor. It is said to have cost him two years labour. It seems to be about three feet in diameter and revolves horizontally in an iron frame, fixed on a foundation of stone, at the height of at least sixty or seventy feet from the ground.

"Palermo offers little that is interesting in mineralogy. The able Ferrara tells me that the whole region is transition limestone, and calcareous tufa, and that the only interesting minerals are jasper and agate. It is situated much like New-Haven, on a plain, surrounded by mountains. The country is beautiful.

"The weather has been as mild as September is with us. In two instances only have we had a little snow, which melted immediately. Green peas and other vegetables are abundant. Oranges are just ripening."

APPENDIX.

Communicated (in MS.) for this Journal.

Read before the New-York Lyceum of Natural History, April 30, 1821.—(This communication came too late for insertion in its proper place.—*Editor.*)

The Coca of Peru; a plant whose leaves are employed most extensively by the native Americans for a masticatory, as the Asiatics chew Betel.

Abstract from a communication of Hippolite Unanue, Proto-medico of Peru, Secretary of the Philosophical Society at Lima, &c. &c. to Samuel L. Mitchill, dated at Lima, 1st Feb. 1821.

The internal commerce in the leaves of the Coca is immense throughout the provinces of this viceroy, although it is in extensive and constant use, both in Upper and Lower Peru. The aboriginal natives are the principal consumers.

The native Indians believe the use of the Coca to be indispensable. They must chew it, or cease to live. The Spaniards employ it merely as a remedy; or whenever the inclemency of the season induces them to adopt the Indian custom. Its operation is similar in almost every particular, to that which the East-Indians experience from Betel. The leaves are the parts gathered for the mouth. They excite a flow of spittle, which is not rejected as by tobacco-chewers, but swallowed together with the substance extracted from the plant. Employed in this way, the *Coca* enables the people, whose principal articles of substance are *maize* and *potatoes* to undergo the toil of cultivating the land, the labour of working the mines, the fatigue of tending herds of cattle in the mountains, and other severe exercises. In short they find the coca capable of repairing lost vigour, of withstanding the assaults of time, of opposing the inroads of the elements, and of performing in short, the function of a true ———* elevating the spirits on occasions of trouble and inducing a forgetfulness of the ills of life, as is observed in the Odyssey, on the drink prepared by Helen to refresh her guests:

> Charmed by that virtuous draught, th' exalted mind,
> All sense of woe delivers to the wind.
>
> Lib. iv.

From analysis it appears, that the Coca contains much gum and no resin. The gum has a bitter and stimulant taste; and the leaves exhale an agreeable smell. When chewed, the coca is warm to the tongue and palate, stimulates the glands, and provokes a copious flow of saliva. This, with the abundance of gum expressed and swallowed, produces a most comfortable operation on the stomach, which is nourished and supported by the gum. In some weakly persons who are not accustomed to its action, the nerves are sometimes affected, and an agreable sleepiness induced. If an alkali, (such as quick lime, for example) is mixed with coca in chewing, the virtues are much increased. Its virtues are considered as tonic, nutritive and calming. Hence are explained the remarkable benefits derived from it by the well Indians. They who are sick, may be thrown into a sweat by drinking a hot tea of it. It is excellent against the humid asthma. In the same preparation it strengthens the stomach, removes obstructions, loosens the bowels, and relieves colics. It is an admirable remedy for hypochondriacs, and dyspeptics. They who are addicted to chewing it, have fine and sound teeth.

* A word in the MS. was here rendered illegible by the seal; the idea is however, fully exhibited by what follows.—[*Editor.*]

Its extraordinary restorative and prophylactic qualities recommend it to be used by seamen who are exposed to the hardships of all climates, and by soldiers who are obliged to hazard themselves in all sorts of expeditions.

The Coca is a shrub of middling size, growing on the Andes. It belongs to the class DECANDRIA, and order DIGYNIA. Its botanical name is *Erythroxylon Peruvianum*, or Peruvian red-wood. The leaves are eliptical with short footstalks, alternate, entire, smooth and shining, three-nerved, with the two lateral nerves less observable than the middle one.

The Coca is cultivated in many tracts adjoining the mountains, and blossoms in May and June. It grows best in the strong, moist soils of hot climates. Therefore it is most congenial to the valleys. The seeds are planted during the moist and rainy season, to wit, in December and January. When grown to the height of a foot and a half, they are transplanted into the grounds prepared to receive them. The shrub lives many years, and in favourable situations, the leaves may be picked, three times in twelve months.

This plant had acquired great celebrity in the time of the Incas, before the invasion of the Spaniards. The smoke of the leaves was the holy incense offered to the sun, on the most solemn occasions.

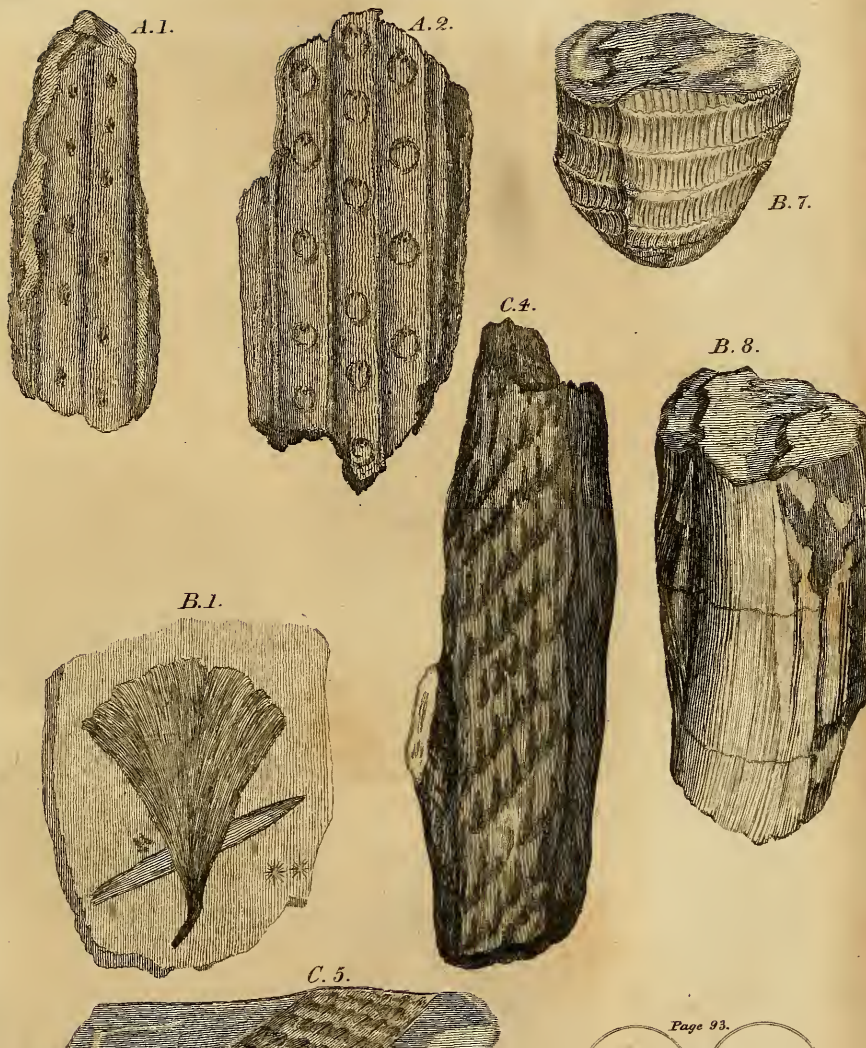
A more complete and detailed history of the Coca, was published in that highly respectable work, the *Peruvian Mercury*, embracing its botanical description, culture, commerce, use and virtues, with agricultural and economical remarks. From that performance, the present is but a concise abstract.

TO CORRESPONDENTS.

Several communications came too late for this number, and will be noticed in our next. Some memoranda of errata forwarded to us have been mislaid; they are, however, either obvious or unimportant.—[*Editor.*]

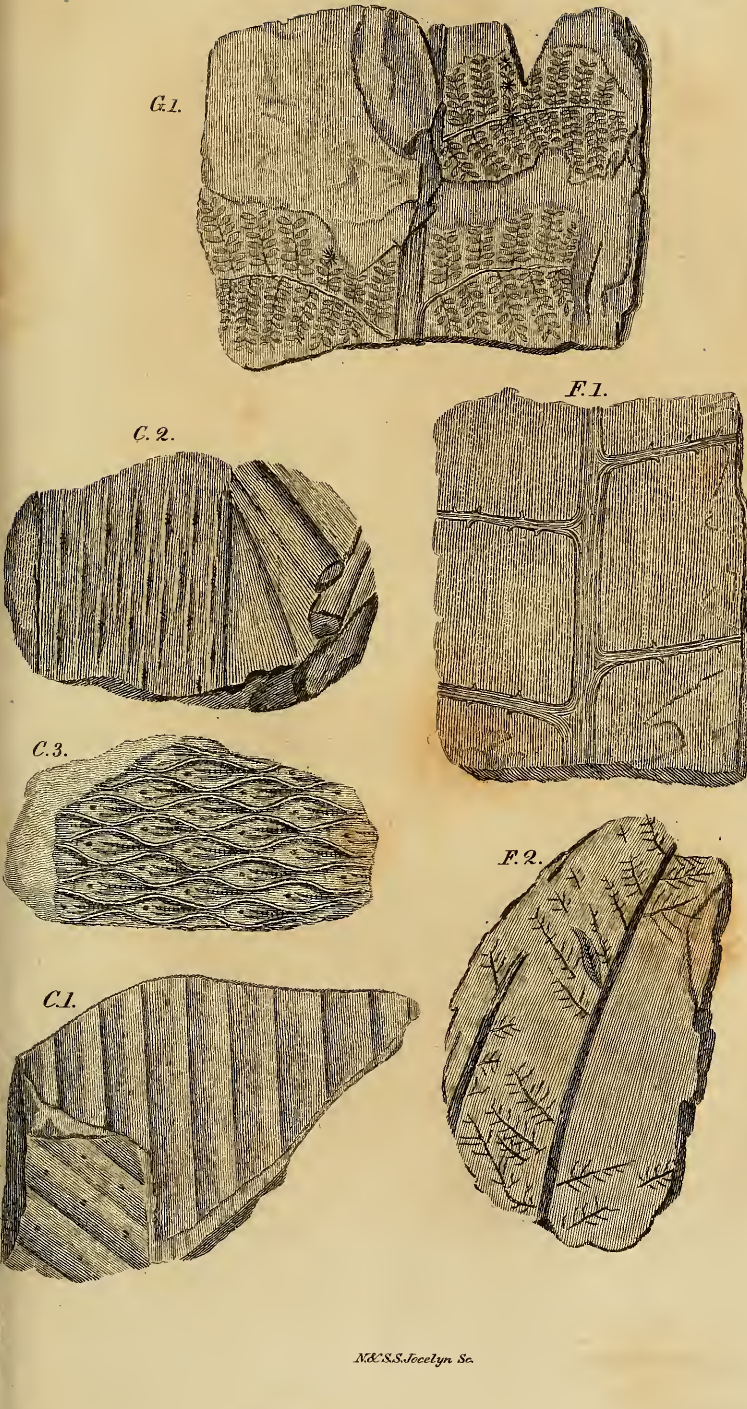
INDEX.

PLATE I.



N.&S.S. Jocelyn Sc.

Plate II.



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GALVANIC DEFLAGRATOR.

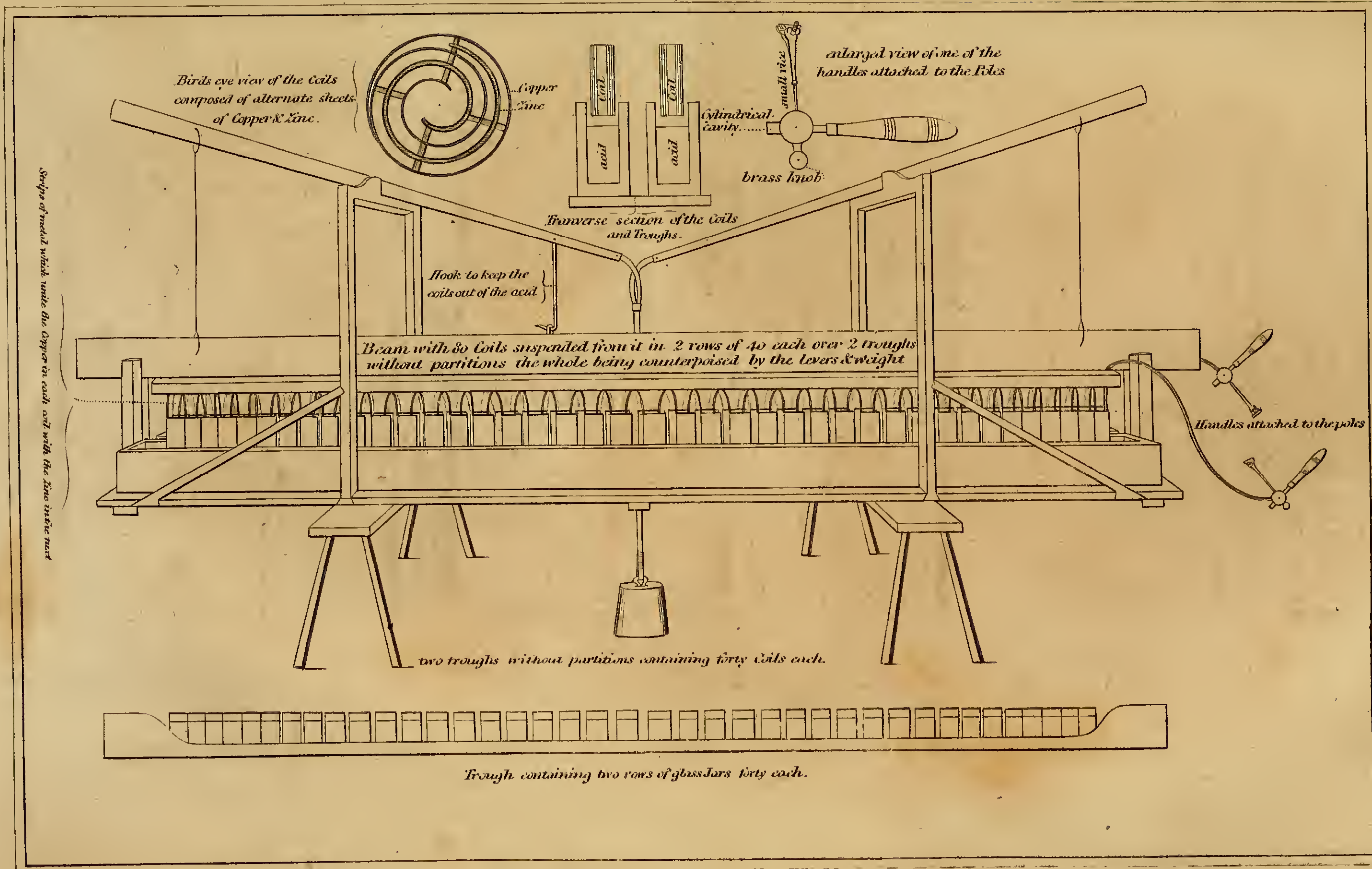
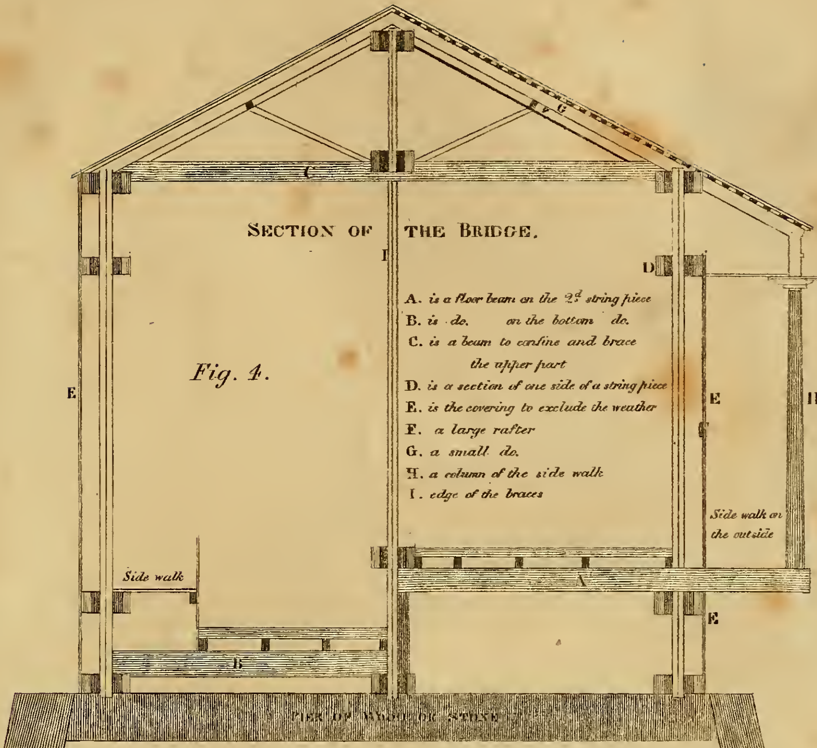


Fig. 1.

Fig. 2.

Fig. 3.

N.&C.S.S.Jocelyn Sc.



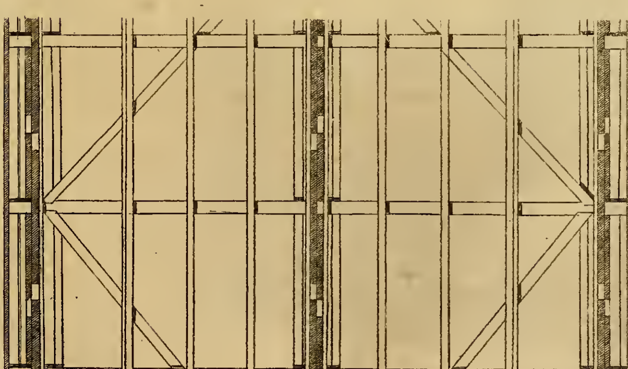


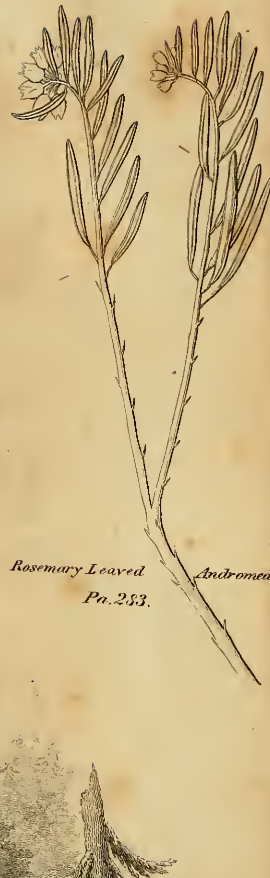
Fig. 5.

Fig. 6.

N. & S.S. Jocelyn Sc.

Pl. I.

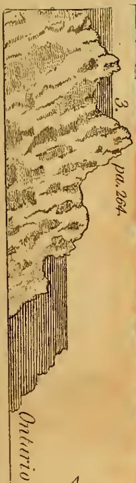
Fossil Medusa. Pa. 285.



Rosemary Leaved Andromeda. Pa. 283.

Native Copper Rock of Lake Superior. Pa. 204.

1. pa. 258



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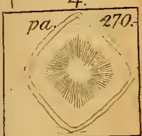
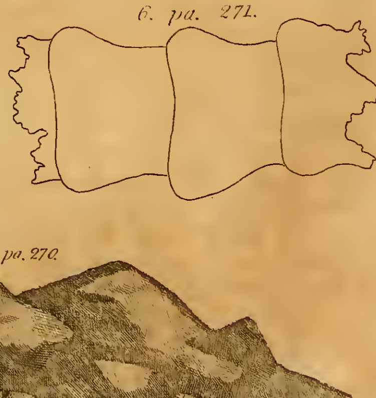
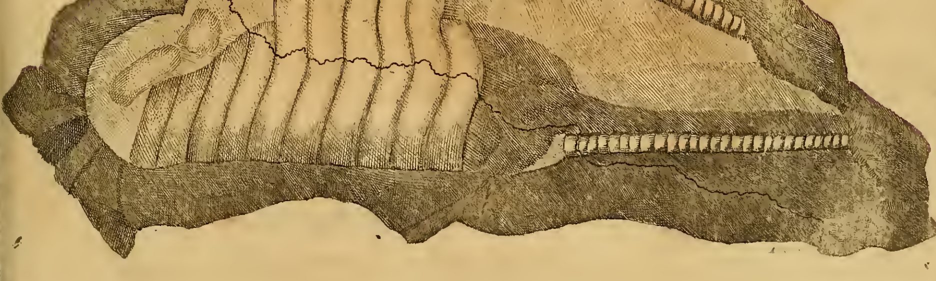


7. pa. 271.

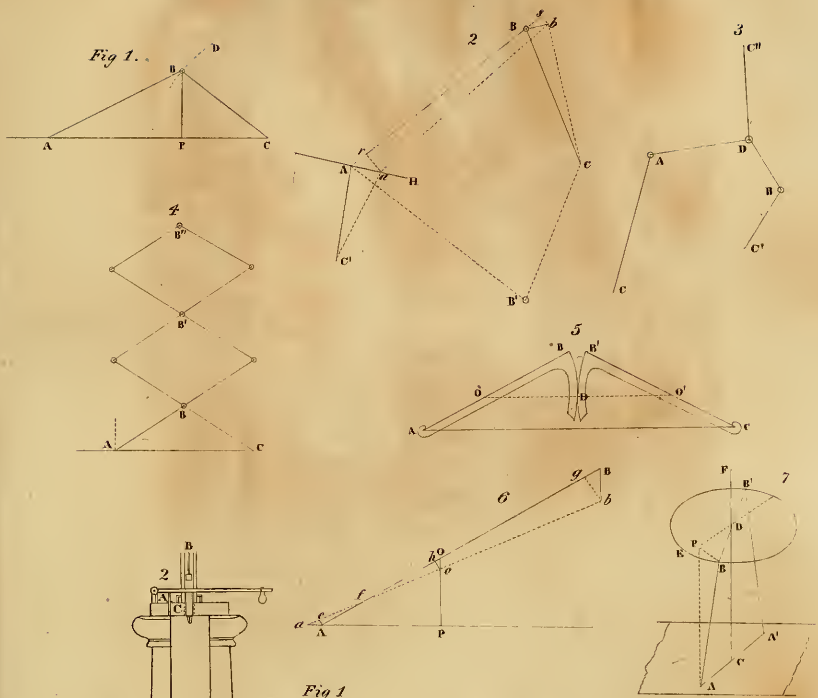
6. pa. 271.

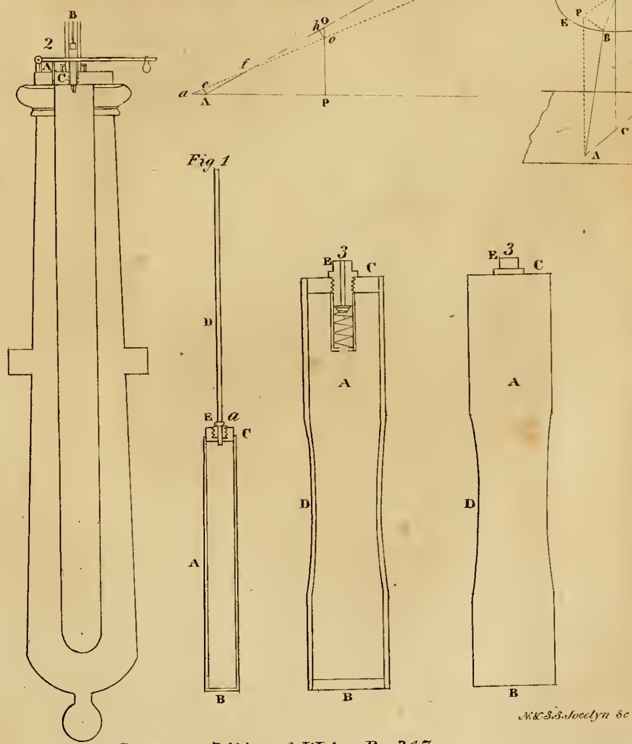


5. pa. 270.



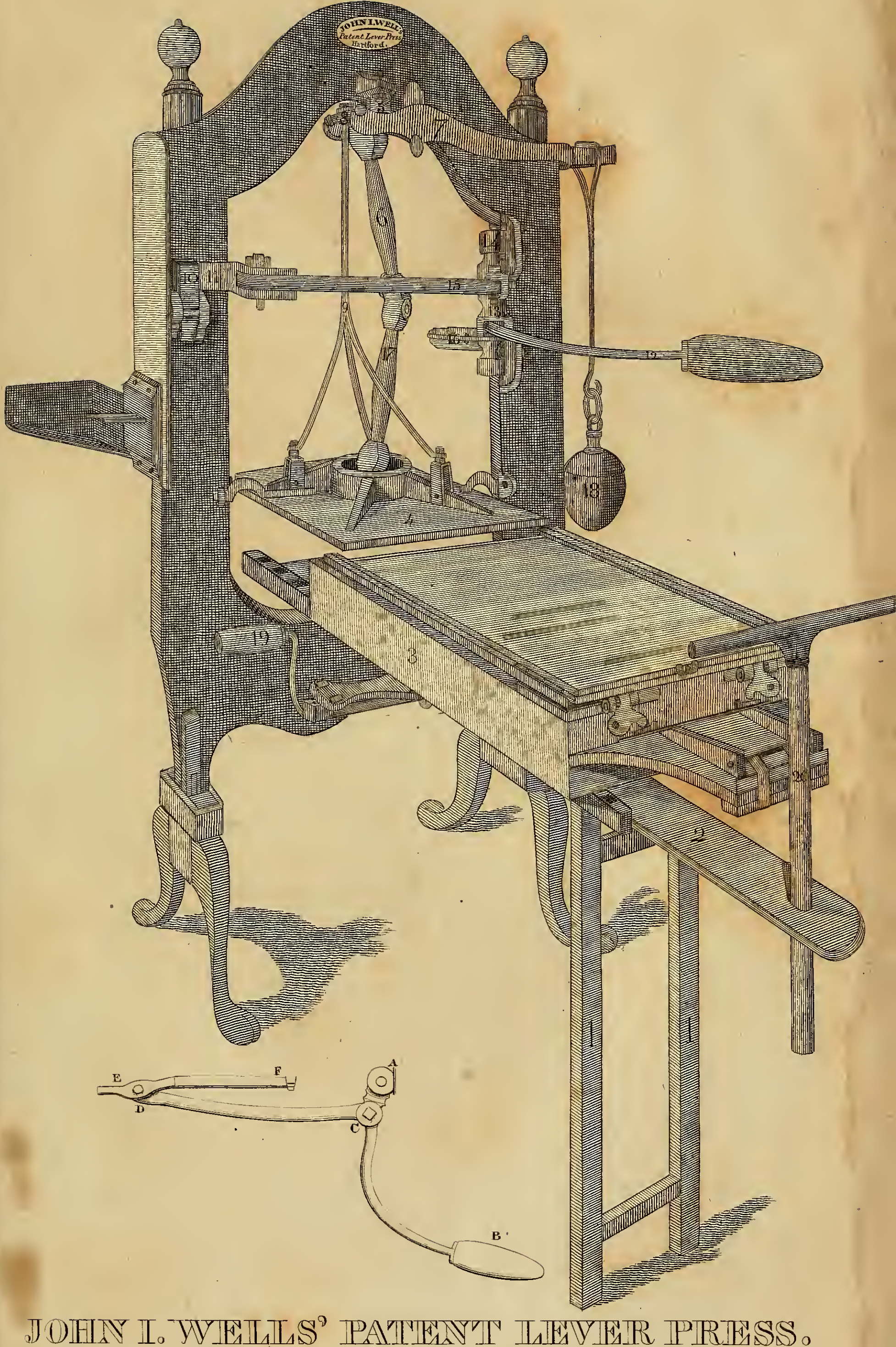
Theory of Printing Presses. Pa. 320.





N. & S. S. Jocelyn Sc

Compressibility of Water. Pa. 347.



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VOL. III.....No. 1.....FEBRUARY, 1821.

ENTIRE NUMBER, VII.

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CONTENTS.

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VOL. III.....No. 2.....May, 1821.

ENTIRE NUMBER, VIII.

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Page.

II. FOREIGN LITERATURE & SCIENCE.

ERRATA.

2, page 240—line 21 from top, for *we* believe, read *I* believe.
351—last line, for *waters*, read *craters*.
352—line 17 from top, for Dr. *Boru*, read *Borrè*.

Vol. 3. 184—line 17 from top, for *Medicarninum*, read *Medicaminum*.
do.—line 27 from top, for *Langrist*, read *Langrish*.
190—line 30 from top, for *windy*, read *wiry*.

Page 372—read 372 for 237 and 3 for 2 on pages 381, 2 and 3.

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