SIR HUMPHREY DAVY.

THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and For. Mem. Geol. Soc., London; Mem. Roy. Min. Soc., Dresden; Imp. Agric. Soc., Moscow; Hon. Mem. Lin. Soc., Paris; Nat. Hist. Soc. Belfast, Ire.; Phil. and Lit. Soc. Bristol, Eng.; Mem. of various Lit. and Scien. Soc. in America.

VOL. XVII.—~~JANUARY~~, 1830. 1829

NEW HAVEN:

Published and Sold by HEZEKIAH HOWE and A. H. MALTBY. *Philadelphia*, E. LITTELL & BROTHER.—*New York*, G. & C. & H. CARVILL.—*Boston*, HILLIARD, GRAY, LITTLE & WILKINS.

PRINTED BY HEZEKIAH HOWE.

CONTENTS TO VOLUME XVII.

NUMBER I.

SCIENTIFIC INTELLIGENCE.†

MECHANICAL PHILOSOPHY.

---

* In a part of the edition, repeated through inadvertence.

† The arranged articles communicated by Prof. Griscom.

UNARRANGED MISCELLANIES, DOMESTIC AND FOREIGN.

APPENDIX.

NUMBER II.

SCIENTIFIC INTELLIGENCE.

CHEMISTRY.

MEDICAL CHEMISTRY.

NATURAL HISTORY.

MECHANICAL PHILOSOPHY.

STATISTICS.

MISCELLANIES.

NOTICES OF RECENT AND FORTH-COMING SCIENTIFIC WORKS.

Foreign.

Domestic.

ERRATA FOR VOL. XVII.

Page 70, line 6 and 13 from top, and in the rest of the article, for C', C'^2, &c. read c', c'^2, &c.

" " line 14 from bottom, for (*o*) read (O).

" 71, " 3 from bottom, for $\frac{PV}{PV}$ read $\frac{PV}{PT}$.

" 72, " 12 from top, for "whatever may be the time of describing C''," read whether $c'' = c'$ or not.

" 72 and 73, for *parameter* read *semiparameter*.

[In a part of the edition the above errata were corrected.]

" 142, 12th line from the top, for *over* read *at*.

Page 196, 5th line from the top, for 6.19, read .619.

" 211, line 8 from top, for *Oxy-chlorine*, read *Chloro-hydrogen*.

" 329, bottom line, and 2d from bottom, for

$$\frac{c'^2 \operatorname{cosec.}^2 \psi}{r^3} - \frac{c'^2}{r^2} d\frac{(\cot.^2 \psi)}{dr} = \mathrm{F}, \text{read} \frac{c'^2 \operatorname{cosec.}^2 \psi}{r^3} - \frac{c'^2}{r^2} \frac{d(\cot.^2 \psi)}{2dr} = \mathrm{F}.$$

Page 332, 18th line from the top, for xd^2z read xd^2x.

" 333, 5th and 2d line from bottom, and on bottom line, substitute small capitals for the italics x, y and z.

" 361, 16th line from the top, for *has* read *had*.

" " 19th do. do. *him* " *it*.

M. Swett delin.ᵗ on Stone.

[?]ARTFORD, CONNECTICUT.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Sketch of the Geology of the Arctic Regions, and the Steppes of Russia, with notices of Siberia, Kamschatka, and the Kurile Islands.*

Prepared and communicated for this Journal.

To scientific research, the Arctic regions have been, until within a few years, a *terra incognita*, seldom approached, except by a few persevering missionaries, or adventurous whalemen, who accomplished little for science, beyond pioneering the way for future investigators. To their diligence, and the observations of a few travellers, but still more to the exploring expeditions under Parry and Franklin, this age is indebted for whatever is known of the high northern latitudes in this hemisphere. These examinations were made under circumstances, little favorable to geological science. No mechanical facilities were at hand—no deep mines disclosed the secrets of their formation, or developed their mineral and metallic treasures—the frost bound rocks, and sterile earth, with here and there a ravine, or a rifted mountain, peering above the icy desolation, were the only indices of what lay shrouded beneath.

To give a comprehensive view of the rocky formations, and the minerals of the arctic regions, the materials furnished by McKenzie, Crantz, Egede, Von Troil, and other travellers, with the facts ascertained by the naturalists in the exploring expeditions, under Parry and Franklin, will be arranged in consecutive order, beginning on the North West with

I. *The Northern bluffs of the Rocky Mountains, and the McKenzie River, from Great Bear Lake, in 65° North lat. to the Northern Ocean.*

II. *From Slave Lake to the Arctic Ocean, by the Copper Mine River.*

Pendletons Lithography Boston. *M. Swett delin' on Stone*

JUNCTION OF TRAP & SAND-STONE, AT ROCKY HILL NEAR HARTFORD, CONNECTICUT.

III. *Melville Island, Port Bowen, and the Coasts of Prince Regent's Inlet.*
IV. *Islands and Countries bordering on Hudson's Bay.*
V. *Greenland.*
VI. *Iceland.*
VII. *The North of Europe, with the Steppes of Russia.*
VIII. *Notices of Siberia, Kamschatka, and the Kurile Islands.*

I. *The Rocky Mountains*, near their northern termination, do not form a continuous range, but separate into bluffs, and detached masses, running in various directions, some parallel with each other, and others diverging as they approach the Arctic Sea. A few barren hills, rising in a deep morass, from three to twelve miles in breadth, divide them from the frozen Ocean.

The formation of the mountains is of primitive rocks, over which a secondary covering, extending upwards, reposes upon their eastern sides many hundred feet from their bases. The sea coasts, from them, towards the McKenzie, are shallow, and skirted with islands, sometimes margined with a gravelly beach, and at others with high banks of sand, or limestone. Greenstone, sandstone, and limestone form the pebbles on the beach.

On the *Sea Coast West of the McKenzie*, Captain Franklin collected the following specimens. Greywacke slate in columnar concretions; globular, dark blackish grey splintery limestone; worn pebbles of quartz; lydian stone; splintery limestone; fine grained mountain green clay slate; potstone, and rock crystal. Brown coal; clay iron stone; pitch coal, and greenish grey limestone, were seen on the shores opposite the Rocky Mountains; and westward, towards Icy Cape, were found, greenish grey greywacke; fine grained greywacke slate; dark bluish greywacke slate, traversed by veins of quartz, and iron pyrites. On Flaxman's Island, N. lat. 70° 11′, W. long. 145° 50′, were seen fine grained greenish clay slate, "obviously of primitive rock, supposed to be brought down by the rivulets and torrents from the Rocky Mountains."

From the East end of Lake Superior, slightly converging towards the Rocky Mountains, to the east side of Great Bear Lake, exists a formation of primitive rocks, but little elevated above the general level of the country. For seven hundred miles, beginning in lat. 50°, between these two ranges, the space is occupied principally by horizontal strata of limestone, as far as 60° North.

The shores of *Great Bear Lake* are of primitive rocks, sometimes rising into elevations of eight hundred, or a thousand feet. Detached blocks and gravel, probably the debris of the hills, consisting of quartzose sandstone, fragments of granite, and granite running into gneiss, are found on the surface, and in the vallies. The north shore of Bear Lake is formed by bowlders of limestone. Fort Franklin stands on a bay of the West coast, and the bottom of the bay, and the beach, are strewed with bowlders of primitive and other rocks, of which the following are some of the varieties. Coarse crystalline granite ; felspar, flesh red ; granite, with felspar paler ; quartz in small quantity ; fine grained granite ; quartz and felspar, white, with garnets. Granite, felspar brick red ; quartz and augite, no mica. Porphyritic granite ; sienite ; porphyritic sienite ; reddish brown horn stone porphyry ; crystalline greenstone ; porphyritic greenstone ; pitchstone porphyry ; greenstone slate ; amygdaloidal claystone porphyry ; dolomite ; limestone with corallines ; chert ; white quartz ; coarse sandstone ; fine grained spotted sandstone ; striped sandstone ; and dark red claystone. Some of the granite bowlders were recognised as the same which occur at Fort Enterprize.

The soil in the vicinity of Fort Franklin is sandy, or gravelly, covering a bluish plastic, but not tenacious clay, of unknown depth, and during a greater part of the year firmly frozen. Narrow precipitous ridges of limestone rise in the country west and north of Fort Franklin, which is otherwise level as far as the eye can reach.

Bear Lake River.

Sandstone of a yellowish grey color, associated with beds of bluish clay, forms the solid strata on the banks of the river. Imbedded in them are concretions of various sizes and irregular shapes, of a purplish iron brown, studded with crystals of sulphate of lime, and small round grains of quartz. Salt springs yielding excellent common salt fall into the river a little below the rapid, at that point where the Rocky Mountains first appear in the distance. The walls of the rapid are a hundred and twenty feet high, and three miles long, consisting of horizontal strata of "earthy looking stone intermediate between clay and sandstone." Lignite with impressions of fern appears in the banks, also ammonites in a brown iron shot sandstone. The limestone ridge below the rapid stands on a narrow base, and its general direction is parallel with the Rocky Mountain chain. Between the cliffs of the rapid, and the limestone hills, a rivulet flows whose bed presents accumulations of bowlders, some of them very beautiful, consisting of varieties of granite, gneiss, mica slate with garnets, greenstone and porphyry; the latter much resembling some of the rocks in the gneiss district of Fort Enterprise. The Bear Lake River flows into the McKenzie through banks of blackish grey limestone with sparry veins. The superior beds are calcareous breccia, associated with limestone charged with bitumen, also bituminous shale. "Sulphureous springs, and streams of mineral pitch" are seen issuing from the lower limestone strata on the banks of the McKenzie when the waters are low.

McKenzie's River.

"Wood coal, in various states, alternating with pipe clay, potters' clay, bitumen, slate clay, and porcelain earth" forms the banks of the river at the junction of Bear Lake River. The lignite when recently detached is compact, but on exposure, soon splits into rhomboidal pieces. It burns with little smoke but an offensive odor, leaving brown red ashes, less than one tenth of the original bulk of the coal. The same bed presents brown coal that in different specimens is fibrous, conchoidal, trapezoidal, and earthy. Some of them have the appearance of compact bitumen, but exhibit the fibrous structure of wood. The beds of lignite take fire on being exposed to the atmosphere. The gravel, intermixed with it, consists of pebbles of lydian stone, flinty slate, white quartz, and conglomerate. Pipe clay, potters' clay, slate clay, and pink clay, are all found in the lignite deposits. The pipe clay is of a light yellowish cream color, and is used by the natives for food when provisions are scarce. It is not unpleasant to the taste and is said "to have sustained life for a considerable time. The traders use it for whitening their houses. It is associated with bituminous shale on the shores of the Frozen Sea." Lignite formations occur near the Rocky Mountains* "along their eastern edge, in a narrow strip of marshy, boggy, uneven ground," and again on a branch of Peace River, and on the Saskatchawan in latitude 52°, and on Garry's Island, near the mouth of the McKenzie. It lies over beds of bluish grey sandstone, and white clay.

* McKenzie.

On the banks of the McKenzie below Bear Lake River, are precipitous cliffs of bituminous shale, and near it, and in most instances underlying it, are horizontal strata of limestone. Salt springs are connected with this formation. The Rocky Mountains appear at no great distance from the McKenzie at the rapids in that river, where limestone ridges traverse the country. Pieces of chert and fragments of trap rock, connected by calc spar, and immediatly below, horizontal strata of sandstone, form the banks and bed of the river. Forty miles below the first rapid, the sides of the river rise into mural precipices of limestone, "weathered into columns," and castellated towers. Marly stones, containing corallines, accompany these rocks.

At this remarkable "Rapid" called by the traders "the Ramparts," according to McKenzie, the river is narrowed to three hundred yards, with fifty fathoms depth of water, and the defile is three miles in length. The banks rise on each side of this tremendous chasm, from eighty to a hundred feet above the level of the river. The ledges and cliffs of "the Ramparts," are of foliated granular limestone, stained with bitumen, and accompanying the river through this astonishing gorge, limestones of every variety appear, in some places associated with carbonaceous matters; in others with corallines and fossil shells, clay and marly deposits. Below "the Ramparts" the river expands to the breadth of two miles, and its banks slope away to a moderate elevation.

In latitude 66°, perpendicular hills of sandstone a hundred and sixty feet high, containing coarse grained quartz, repose in horizontal strata, upon horizontal limestone. The sandstone cliffs present many imbedded minerals, such as translucent quartz; black lydian stone; and disintegrated felspar. The underlying beds of limestone contain many shells and chain coral, traversed by veins of calc spar.

Forty miles below these sandstone walls and hills, marl slate breaking into shelving acclivities, and deep ravines, forms the banks of the river, which again contracting gives to this reach, for twenty miles, the name of "the Narrows." On emerging from "the Narrows," the McKenzie forms a number of deltas through which it falls into the sea. The Rocky Mountains form the western boundary of the lowlands of the deltas, and the Reindeer hills a parallel boundary on the eastern side. Limestone occurs in conical knolls, but a loose sandstone predominates. The sandstone contains black flinty slate, or lydian stone, and white quartz, accompanied by acclivities of sand. The summits of the hill are thinly coated with coarse pebbly gravel consisting of green felspar, white quartz, chert and limestone. These hills gradually diminish in altitude, and the eastern branch of the river runs round their northern limit in lat. 69°. White spruce grows as far as 68° where it disappears. The country thence becomes a frozen morass, onward, north of the hills, seldom thawing more than six or eight inches upon the surface.

Alluvial Islands.

The space occupied by the various reaches of the McKenzie between the Rocky Mountains and the Reindeer Hills, is ninety miles in length, and from forty to fifty wide. The river forms this tract into islands, by the numerous channels through which it winds its way to the sea. The islands are most of them flooded in the spring, but annual accumulations of drift wood and sand, have raised some parts above the reach of the annual inundations, and as far north as 68°, the highest parts are clothed in summer with dwarf willows, and white spruce. Sandy shoals skirt the coast, " and the whole line from Cape Bathurst, in W. long. 127° as far west as the Sacred Islands in W. long. 137°, presents a striking similarity of outline and structure."

The sea coasts east of the McKenzie for many miles, are low, with occasionally, gently swelling sand hills. The beaches and capes are thickly sown with fragments and pebbles of limestones, red and white sandstone, and sienite. Some of the promontories consist of bluish slaty clay, with a greasy feel, compact enough to be called stone, but crumbling readily in water. The cliffs are often variegated with beautiful colors. The shale is brown, interspersed with crystals of selenite, and between the leaves is filled with powdery alum mixed with sulphur. The wax colored variety of alum, called Rock Butter, occurs in layers, the shale is covered by " a bed of poor calcareous clay ironstone, which has a straight cleavage, and is coated by fibrous calc sinter, and chalcedony." The soil is clayey, and almost without vegetation. Further east in a high cliff of alum shale, alternating layers of Rock Butter occur again, with crystals of selenite on the surface of the shale. " Pebbles of granite, sienite, quartz, lydian stone, and compact limestone, all coated by white powdery marl" rest on the surface of the cliff.

Sea coast east of the McKenzie.

At Parry's peninusula, still on the margin of the sea, commences limestone. The beaches are covered with rolled pieces, and on the precipitous banks it appears in weather worn columns, while in other sections it spreads away into flat horizontal strata, and fragments of chert, dolomite, and green stone, are scattered over its surface. Vegetation is very scanty here, and through large tracts, there is not even the vestige of a lichen.

Sea coast. Cape Lyon to the Coppermine River.

The slaty clay occurs in thin bluish grey layers, interspersed with scales of mica. It rises into softly swelling hills, running *under* ridges of trap rock, which traverse the lower country and rise to the height of seven or eight hundred feet above the sea. On the coast, the trap ridges form lofty precipices,—and in many places, the clay strata are washed away and the greenstone columns overhang the beach. Eastward, the line of coast becomes lower, fine grained flesh colored quartzose sandstone occurs, and gothic arches of limestone in almost architectural proportions. Naked barren ridges of iron shot greenstone, cross the country at point De Witt Clinton, and the upper soil consists of white magnesian limestone gravel, and bluish clay.

From this district to the mouth of the Coppermine River, limestone is the prevailing rock, accompanied by varieties of sandstone, greenstone, trap rocks, and porphyry, with disseminated minerals of almost numberless species.

Vegetation ceases before reaching this line of coast, which is between 69° and 70° N. A patch of moss, or a clump of dwarf willows in the crevices, or under the shelter of decaying drift wood, occasionally surprises the eye of the explorer, but with these very rare exceptions, no trace of verdure or herbage is seen.

II. From Slave Lake to the Arctic Ocean by the Coppermine River.

Primitive rocks occur east of the Slave River where it joins Slave Lake: they consist chiefly of granite, containing flesh colored felspar and quartz, with but little mica. Coarse granite with mica, in large plates, forms the Reindeer Islands. The same formation continues to Carp Lake, in smooth round backed hills, with precipitous sides and narrow vallies between, producing spruce-pines, Banksiana and aspen. On Point Lake, in lat. 65°, the prevailing rocks are greywacke and greywacke slate; greywacke with small imbedded crystals of hornblende; dark greenish transition clay slate; compact earthy greenstone, containing disseminated iron pyrites. This rock is strongly magnetic, and its surface is variegated with streaks of iron brown. In the sheltered vallies spruce firs are seen, but farther east where gneiss crosses the river there is no wood. North west of Coppermine River, which passes through an arm of Point Lake, the strata belong to the transition series, alternating with primitive rocks. Reddish grey slate, greenish grey and clove brown slates, are among the varieties.

In lat. 66°, high peaks of red granite and sienite, large beds of greenstone, and purplish red felspar rock, rest upon old red sandstone. In the beds of torrents, intersecting the plains, are found fragments of reddish grey granular foliated limestone, of deep red sandstone, and of grey sandstone composed of grey quartz and felspar, members of the old red sandstone formation, which lies under coal, occasionally alternating with transition rocks. Fragments are seen of pale red sandstone, with circular concretions of quartz imbedded; also of dark green felspathose trap, colored by hornblende; of dark flesh red felspar in granular concretions, with imbedded patches of hornblende, and of red felspar associated with hornblende, containing amygdaloidal portions of prehnite. Masses occur of compact wine-yellow limestone, resembling conchoidal hornstone, alternating with thin layers of flinty slate. The plains are variegated with a few small conical sand hills, ornamented by clumps of spruce trees.

The famous Copper Mountains consist principally of trap rocks, imposed upon new red sandstone, or flœtz limestone. The rocks are sometimes of felspar, colored by hornblende, approaching to greenstone, but generally of a dark reddish brown amygdaloid. Scales of native copper are disseminated through this rock. The mountains are interrupted by narrow vallies traversed by small streams. In the vallies are found native copper, trap rock associated with copper, green malachite, copper glance, greenish grey prehnite, copper crystallized in rhomboidal dodecahedrons, and prehnite associated with calcareous spar and native copper. North of the Copper Mountains, trap hills occur. The intermediate country consists of a deep sandy soil, and some of the eminences are clothed with grass, but the ridges are destitute of vegetation. On the west banks of the river, red granite extends from the Copper Mountains to the sea, where it forms mural precipices on the coast. The main shore, for sixty miles east of the Coppermine River is a low shelving gravelly beach. Eastward of this beach trap rocks re-appear, and form an exceedingly sterile and rocky coast. The islands near this coast abound in cliffs of greenstone and dark brown claystone porphyry. The whole country is barren, one ridge of rocks rising above another, with stony vallies between, without a trace of vegetation. Red and grey granite rise occasionally into acute and craggy peaks fifteen hundred feet high, alternating with low naked ranges of gneiss. In one instance a vein of galena was found enclosed in the gneiss, which is often intersected by perpendicular precipices of trap rock, claystone porphyry, iron shot clinkstone, porphyry and earthy greenstone.

Continuing east, light red sandstone and bluish grey slate appear. Iron shot amygdaloid, and a reddish amygdaloid, enclosing beautiful pebbles of chalcedony and carnelian, with imbedded masses of jasper, are found on Barry's island. On the coast, gneiss re-appears at short distances, with occasional lofty pinnacles of granite, frequent beds of granite and hornblende gneiss, and hexagonal crystals of hornblende imbedded in the gneiss with scales of mica.

According to Dr. Richardson, the new red sandstone formation prevails on the Arctic sea coast, from the mouth of the Coppermine River in W. long. 116° eastward to Cape Turnagain, which is in W. long. 109°, N. lat. 69°. The gneiss formation is next in extent, and runs parallel and within the red sandstone, extending from the sea to Fort Enterprise in 65° N. lat. presenting the genuine "*Barren Ground*" with its dreary precipices and hills.

The average direction of the strata, just mentioned, is north west and south east always inclined towards the horizon, the mean angle exceeding 45°. Granite, sienite, gneiss, mica slate and clay slate occur throughout this tract, with their usual relations and positions, as in other parts of the globe. Gneiss is the most extensively distributed, *always attended with a scanty vegetation, and generally the most desolate sterility.* The bowlders which crown the summits of the hills on the "Barren Grounds" are generally a variety of granite.*

* Are not these "Barren Grounds" a continuation of the desert which ranges at the foot of the Rocky Mountains, south of Athabasca?

The resemblance of the loose blocks to those on which they rest, suggests the belief, that they are the more durable remains of the covering stratum, which has been destroyed by the long continued action of the atmosphere. Extensive alluvial formations occurred on the line of the first journey made by Capt. Franklin, such as lakes filled up by deposits from rivers, and the gradual waste of mountains, washed down by torrents, besides alluvial peninsulas formed by the action of the sea.

III. Melville Island, Port Bowen, and the coasts of Prince Regent's Inlet.

Winter Harbor, on Melville Island, is the most western point ever navigated in the polar sea from the eastern entrance. It is in N. lat. 74° 26′ and W. long. 113° 46′. The length of Melville Island is one hundred and thirty five miles from E. N. E. to S. S. W.: breadth forty or fifty miles. Sandstone in columnar precipices, and in some instances ranges of sandstone in their horizontal strata, were the only mineral substances noticed in Melville Island.

Port Bowen and the coasts of Prince Regent's Inlet.

Secondary limestone forms both sides of Prince Regent's Inlet. Its colors are ash grey and yellowish grey, more or less inclining to ochre yellow and yellowish brown. The external appearances intimate its magnesian character. It is every where distinctly stratified, and the strata are horizontal. Imbedded in them are found masses of chert and various organic remains. On the hills, and on the surface of a brick red limestone, were found masses of fibrous brown iron ore, also coal of a brown color.

Gypsum.

On the west side of Prince Regent's Inlet, deep beds of gypsum extend thirty miles through the country, associated with a limestone which, when near the gypsum, abounds in organic remains. All the varieties of this gypsum are of a snow white, and of these the granular foliated, the fibrous, and selenite were met with, but not the compact. The universal horizontality of its strata, its magnesian character, its brown hematite, and its fossil organic remains, indicate that it belongs to the first secondary limestone.*

---

* Jameson's notes on the geology of Port Bowen.

Alluvial Rocks.

Alluvial marly deposits from the snow waters passing through and over the limestone strata in the summer, occur on the shores and in the vallies; and fragments of limestone are scattered in different directions, by the same agency; but the limestone hills in many parts, and the country generally were more or less covered with bowlders of primitive rocks.* Some of them were of very large dimensions, weighing from three to fifty tons. Granite, gneiss, and sienite the largest—those of talc, quartz, iron glance, actynolite, and ores, smaller and less numerous.† They abound near the sea coast, gradually diminishing in size and number, and at the distance of fourteen or sixteen miles from the sea, they are comparatively rare and small, not more than three or four inches in diameter. "The nearest known fixed primitive rocks, were upwards of a hundred miles distant from these remarkable bowlders."

IV. Islands and Countries bordering on Hudson's Bay.

The lands bordering on Hudson's Bay, and the islands which it encloses are generally hilly, and are usually disposed in ranges, but are not very lofty, the average being about eight hundred feet, and the highest summits not exceeding fifteen hundred above the level of the sea. "The vallies are narrow and rugged," and the cliffs often display mural fronts of more than one hundred feet in height.—Wherever the shores are low, flats and shoals extend far out making a shallow sea, but where the coast is rocky and precipitous the sea is proportionally deep, and the shores bold. The country is covered with snow and ice the greater part of the year, often exhibiting the most beautiful colors and picturesque forms. The upper soil or loose surface varies from two or three inches to a foot in depth, beneath which the ground is frozen like the most solid rock. In the summer, a few plants obtain a brief existence in the chinks of the rocks, in favorable and sheltered places. The general aspect of the country indicates the primitive rock formation, and "no vestige of volcanic action has any where been seen."

The following classification of the rocks found in the islands, and countries bordering on Hudson's Bay, between 60° and 69° of N.

* Jameson's notes, &c. † App. to Parry's third voyage.

lat. and 65° and 125° W. long. has been arranged by Prof. Jameson, from the actual inspection, it is believed, of specimens brought from those countries by the expeditions under Capt. Parry.

Primitive Rocks.

Granite, gneiss, mica slate, eurite porphyry, hornblende, hornblende slate, primitive greenstone, and primitive limestone.

1. *Granite.*—Minerals imbedded in granite. Rose quartz, actynolite, epidote small yellowish green crystals, precious garnet of a columbine red color and transparent, chlorite, schorl, minute crystals of beryl, coccolite, zircon, graphite or black lead, specular iron ore, iron pyrites.

2. *Gneiss.*—Color red and grey, fracture sometimes coarse and granular, sometimes fine and slaty, most abundant of all the primitive rocks in the arctic countries. Minerals imbedded in gneiss.

Beautiful precious garnets, and hyacinth red garnets. Rich veins of red quartz traverse the gneiss, aud amorphous masses lie around.—Actynolite, graphite, magnetic and common iron pyrites.

3. *Mica Slate.*—This is a compound of mica and quartz, and forms beds subordinate to the gneiss. The minerals imbedded in this rock, are hornblende, actynolite, tremolite, precious garnet, rock crystal, common iron, and magnetic iron pyrites.

4. *Clay Slate.*—Less frequent than mica slate, contains imbedded iron pyrites.

5. *Chlorite Slate.*—Imbedded in this rock are found actynolite, hornblende, felspar of a red color, indurated talc, massive common chlorite, calcareous and rhomb spar, precious garnet, octohedral crystals of magnetic iron ore, red iron ore, iron pyrites.

6. *Hornblende.*—This mineral occurs in beds and also associated with felspar when it is called greenstone. The imbedded minerals in these rocks are felspar, mica, chlorite, actynolite, quartz, diallage, common iron, and magnetic iron pyrites.

7. *Serpentine.*—Colors dark leek green, and greenish black, the lustre glimmering, fracture splintery, or splintery conjoined with conchoidal, more or less translucent. The following imbedded minerals were found in these rocks. Brown diallage, glassy actynolite, fibrous greenish grey talc, flexible asbestus, rhomb and calcareous spar, chromate of iron, magnetic iron ore, and iron pyrites.

8. *Limestone.*—All the varieties of this rock are composed of granular concretions loosely aggregated, and the only colors observed were snow white, and greenish white. The minerals which occur in it are small crystals of mica, augite, augite with serpentine forming verd-antique, precious serpentine, sphene, and titanitic iron, graphite or black lead.

9. *Porphyry.*—But one specimen was observed, which was eurite porphyry, a variety of granite.

TRANSITION ROCKS.

1. Red and variegated sandstone, transition quartz rock, recent greywacke slate, drawing slate, flinty slate, and limestone. There are many varieties of red sandstone, and quartz rocks of which there are white, grey, purple, and red, in others the colors arranged in stripes. The white and grey hard varieties, may be considered, a transition quartz rock, the red and variegated, as transition red sandstone, or recent greywacke. The minerals occurring in them are felspar, mica, chlorite, pale rose quartz, epidote, rock crystal, schorl, crystals of iron glance, and red iron ore, scaly foliated iron glance, compact red iron ore, copper pyrites, quartz rock, quartz with magnetic iron ore.

2. Greywacke, and greywacke slate, with disseminated iron pyrites, are found in two or three instances. Transition clay slate was observed only in Bouverie Island.

3. Flinty slate, and drawing slate, with disseminated iron pyrites were seen, but were of rare occurrence.

SECONDARY ROCKS.

1. *Limestone*, bituminous shale, and secondary trap, flint and conchoidal hornstone imbedded in it. It contains various organic remains, among which, are corals, trilobites, and a species of orthoceræ, with many fossil shells.

2. *Specimens af bituminous shale* were met with, but no other trace of the coal formation.

3. *Secondary greenstone*, sometimes containing titanitic iron ore, sometimes iron shot and porphyritic, and at others crossed with veins of calcareous spar.

ALLUVIAL ROCKS.

Very few alluvial rocks were met with in those parts of the arctic regions, in the vicinity of Hudson's Bay. The most striking objects are the outliers or bowlders, spread over some of the islands.* Whole limestone islands are strewed over with blocks of gneiss, granite, and quartz, both in rolled masses, and angular fragments.

IV. Greenland.

Schist of a black color, enclosing garnets, agate, limestone, alabaster, mica in small plates or scales, flexible asbestus, soapstone, potstone, quartz, jasper, topaz, red garnets, by some lapidaries called ruby, and quartz crystals.

According to Crantz, the potstone, of which the natives make their lamps and kettles, occurs but rarely, and is an article of trade among them. They carry utensils made of it, to districts where it is not found, and barter them for provisions, furs, &c. The Greenlanders sometimes send them as presents to persons of distinction in Denmark, where they are highly valued, as it is thought that articles of food prepared in them are finer than when done in metallic vessels. The stone is soft and compact, and more easily carved or turned than wood. It does not crack or scale off, but hardens after being wrought, and grows firmer by fire. When rubbed with oil, it acquires a beautiful porcelain smoothness. The cuttings are like fine flour, or viscous clay, and have a greasy feel. He adds, that he saw a few curious petrifactions of fishes, but could discover no pumice, or *basalt rocks*, or other volcanic appearances.† Coal and sulphur are of rare occurrence, but iron and lead ores are seen with indications of copper.

The mountains rise in sharp peaks and splinters, furrowed and scarred with deep weather stained fissures, so perpendicular on the south sides, as to be uncovered with snow. The lower elevations rise with broad backs, and are constantly enveloped with snow and ice. The surface of the vallies, generally, consists of white sand,

---

* Prof. Jameson's notes on the geology of the arctic regions.

† Basalt rocks are mentioned by O'Reilly, as of frequent occurrence.—See O'Reilly's voyages to Greenland, in 1817.

mixed with shining silvery specks, and full of transparent garnets—no salt, alum, or nitre. A fine bright glimmer sand, of a golden color, abounds in some of the vallies; and it is stated by Egede, that its appearance was so seducing, that two successive expeditions were sent from Denmark, in the early part of the eighteenth century,* for cargoes of it, in the expectation of finding gold. Not discouraged by the first failure, a second ship was laden with it, which after the most careful analysis, was found worthless, and the enterprize terminated in a total loss.

In fenny places, turf, or peat is found interspersed with roots, branches, decayed wood, and withered grass. Much of the peat contains sea shells, and fossil remains, from which it is suspected, that the sea washed over it, and retreated from it at some distant day. No wood grows, but drift wood is frequently obtained on the sea coasts, particularly in the southern and western parts. The east sea coast being inaccessible, by reason of the mountains of ice, is termed "Lost Greenland;" and although the inhabitants have many traditions concerning it, they cannot be quoted as authentic data, being little better than distorted legends. The west coast is indented with deep bays, which are believed by many to be straits, passing through to the Atlantic Ocean, dividing Greenland into a succession of islands; but the extent of the gulfs, and the northern boundaries of the land are unknown, although the N. E. coasts, from 72° to 80°, have been explored by Mr. Scoresby.

V. Iceland.

This island, if not originally thrown up by volcanic explosions, exhibits, over its whole surface, the results of such action, being every where marked by volcanic remains.

Iceland may be said to be planted with volcanos, in constant activity, every bristling peak, sooner or later, vomiting fire. The minerals mingled with the lavas, correspond with those found among volcanic substances, in other latitudes; and it may be inferred that the formation is analogous to that of those mountainous tracts which are agitated by volcanic agencies in other parts of the globe. The pumice, zeolites, enamels, jaspers, flints, and the scoriæ, seen by

* Kirquilen, in his voyage to the North, says it was in 1636.

Von Troil, and analyzed by Dr. Bergman, resemble, with wonderful exactness, those taken from the volcanos in the south of Europe, by Spallanzani. Suturbrand and limestone are found in small patches, in different parts of the island.

The phenomena of the boiling springs, or Geysers, are obviously produced by subterranean heat. Columns of boiling water, several feet in diameter, spout up many fathoms into the air, and around the orifices from which they issue, deposit a portion of silex, of which a large amount is held in solution, but released by the cooling of the water in its exposure to the atmosphere, forms a mineral basin, through which the waters return to the caverns below. Every substance near enough to receive a sprinkling from the spray of the Geyser, obtains a flinty covering, similar to ice on the twigs of a bush in a winter storm.

In this realm of fire and snow, some tracts of decomposed lava yield to the arts of agriculture, and are worked into farms: and amidst the terrors of earthquakes, volcanic eruptions, sulphurous vapor, and pestilential marshes, the inhabitants of Iceland obtain more of the comforts and necessaries of life, than are enjoyed in any other country of the arctic regions.

VII. Northern Europe.

The north of Europe presents an immense exhibition of primitive rocks.

Mr. Strangways* traces this formation from the mountains of Norwegian Lapland, through Russian Lapland, Finland, the north parts of Carelia, Nova Zembla, and the Islands of the Icy Sea to the northern extremity of the Ural Mountains. It also comprehends the whole tract of Sweden; and its southern boundary passing under the centre of the gulf of Bothnia, as may be seen in the isles of Aland, thence by the gulf of Finland, across the northern shore of Lake Ladoga to the north part of Lake Onega, continues in the same direction, until it terminates in the White Sea. Trap rocks are said to form the north part of this tract; gneiss and other schistose rocks compose the central, while the southern border consists exclusively of granite.

---

* The principal facts in this geological sketch of the North of Europe, have been obtained from the outline of the Geology of Russia, by the Hon. Wm. T. H. F. Strangways. Published in the 1st Vol. 2d series of the Geological Transactions.

In the mountains of Lapland, and at their bases, fine white sand in patches, and black and grey slate, quartz, and sandstone are found.*

On the Pargas islands in lat. 60° N. in the gulf of Bothnia are long steep ridges of gneiss, crowned with birch and fir trees. On one of the principal islands is found the mineral called pargasite, which occurs in large veins of milk white limestone, and traverses the island from side to side. The structure of this limestone is not sufficiently fine, to be called marble, but it is variegated with clouds of beautiful yellow, and waves of grey, and contains irregular veins of augite and hernblende rock. Bright purple spots supposed to be fluor, and moroxite, coccolite, and romantzovite, occur in some of its varieties. Tourmaline is sometimes, though not often seen. A remarkable mineral found in this rock, is chondrodite. It is so much harder than the limestone in which it is imbedded, that the latter washing and wearing away by the weather, leaves it in orange colored, and yellow knobs, and protuberances, on the surface, while it adheres in points, or clings in masses, to a limestone centre. It is also found in many parts of Finland, always in primitive limestone, passing through gneiss. Gneiss, more or less distinctly foliated, forms the common rock of the country, on the adjacent continent. The rock of Abo is an exception, being an example of stratified fine grained granite, very hard, studded with garnets. North and east are granitic slates; rose quartz; felspar; copper ore; garnets; and primitive limestone.

Primitive granitic slates continue northeasterly, and form the rapids or falls of Imatra, "one of the grandest spectacles of the north." A fine deep black slate is quarried near Lake Ladoga, "where is found a *garnet rock*," and further north is a species of potstone from which are made bowls and various utensils.

South of this tract, the primitive rocks lose their lamellar structure, and a true granite prevails. Felspar, spotted with small grains and crystals of hornblende, and black mica, predominates in the granite opposite Borgo, and rolled masses occur near Petersburg. Between Borgo and Louisa, are found bowlders of jet black mica slate, with and without garnets, and a red and yellow hornstone. As far as the granite is found *in situ*, it is particularly marked by oval and round masses of reddish felspar. Hornblende is plentiful, and mixed with

---

* Ehrenmalm's Travels.

quartz between the felspar, and sometimes disseminated through it in black spots. The felspar is variously colored; dark red, pale pink, flesh colored, and white, and ash colored. This granite is extremely liable to decomposition, and holes are seen in the rocks, of twelve and fifteen feet in diameter. In the bottom of some of the vallies, in this vicinity, a purplish clay is found, formed probably, by the decomposition of the felspar, so abundant in this granite. Towards the south the granite recedes beneath the surface, and is lost beneath its own rubbish, "and its ending is unknown."

Red and grey veined marble, form the deeply indented northern shores of Lake Ladoga. Veins of sulphuret of copper, and iron ore have been wrought near its northern boundary, and magnetic sand is obtained from one of its islands.

Lake Onega is bounded on the northwest by rocks of dark green jasper breccia; on the north by a green-veined marble full of tremolite. It is crystalline and probably a primitive limestone. The west coast consists of a red sandstone of great hardness. Bowlders of this sandstone are found far south, distributed over a large tract of country. The resemblance of the shores of the two lakes, and of the gulf of Finland, is peculiarly striking. The northern shores are of the older rocks, much broken, the waters deep, and many islands skirt the coasts. "Sand or sandstone forms the east and west sides, and the southern boundary of each is a marsh, behind which at a short distance, is a range of secondary limestone hills, of one and the same formation." In the north east part of Lake Onega is the celebrated isle of Wolves, famous for its beautiful minerals. Masses of dark brown argillaceous iron stone, lie loose upon the surface, which being broken, discover cavities lined with the most brilliant quartz crystals, and oxyd of iron. "Sometimes the quartz becomes amethyst penetrated with tufts and pencils of oxyd of iron in radiating capillary crystals. At others the quartz is coated with red and yellow oxyd of iron, and resembles the hyacinth of Compostella.—Some of the blocks present cavities, each lined with a separate variety, others contain all the varieties in one group."

The traces of diluvian action, and the course of the currents from north to south, throughout the whole of Finland are astonishing. Without stopping to notice "the stupendous size, and extensive distribution of primitive bowlders, it is impossible not to perceive that the top of every rock *in situ*, every tor, every hill and knoll of granite, or primitive rock, from Carelia to the Gulf of Bothnia, presents a surface as distinctly rounded and water worn, as the bowlders or colossal pebbles that lie around their bases." In some places the detached masses of rock are so thickly scattered, as to prevent the culture of the earth. Another fact, illustrative of the diluvian action from north to south in this quarter, is, that the parent rocks of the bowlders in the vicinity of Petersburg, are recognised *in situ* in Finland, while new varieties of rolled masses are there found, brought from rocks existing still farther north.

Immense quantities of iron are smelted at Petrozavodsk from bog iron ore, obtained by dragging the lakes. Plumbago is found, but of inferior quality.

South of this primitive district, follows a distinct secondary formation, the lowest of which is a pale blue clay, probably resting on the older rocks just described. Upon this are found sand, and sandstone, shale, and limestone, containing organic remains. These three strata run in a continuous formation from Sweden through the Baltic Isles, Esthonia, and Ingria, in an east north east direction to the isle of Wolves.

Northern salt district.

Red marl and sand are the peculiar features of the salt formation in every part of the globe, containing subordinate beds of sulphate of lime. Rock salt, and salt springs are of frequent occurrence in the central and south parts of Russia. The northern salt district extends in a line parallel with the limestone of Petersburg for one thousand versts. Gypsum, resembling oriental alabaster, is quarried in many parts of this district, and is extremly beautiful.

Valday Hills.

The elevation of the hills is not more than eight or nine hundred feet, but they are the most considerable chain between the Baltic and Black Sea, and form the ridge from whence the waters descend north and south through a vast extent of country. The Duna flows from their western extremity into the Baltic, and the Dneiper into the Black Sea,—east at a small distance, rises the mighty Volga, which, receiving as tributaries the waters of eastern and central Russia, traverses in its various windings, a distance of four thousand miles, bearing on its bosom the commerce of Russia, China, Siberia, Persia and central Asia, and finally falls into the Caspian. Many inferior rivers on the northern descent, after passing through a series of lakes, discharge their waters through the Neva into the gulf of Finland. The Dina or Dwina collects the waters from the north east, and is lost in the White Sea at Archangel.

The hills bordering the plain of Novogorod, are of red and grey marbled clay, resembling the red marl of central Russia. Limestone and sandstone form the bed of the river Msta. Opposite, and east of the river, the sand appears in horizontal strata, containing "an agglomerate of charred wood and every sort of geode." Some of its concretions resemble Egyptian pebbles, and are of a siliceous character; above this are beds of red and yellow sand; the next beds are blue limestone containing madrepores. Impressions of large tufts of pentacrinite cover the surface of the limestone strata, bending in every direction. The blue limestone also contains minute corallines, and other fossils.

Central salt district.

Near the most northern bend of the Volga, which, for a short distance, runs east from its source in the Valday Hills, the face of the country is of loose red sand, in many places blown into waves, and ridges by the winds, and destitute of herbage. When cultivated it yields flax, rye, and wheat in abundance. Bowlders of primitive and siliceous rocks are strewed over the bed of the river which is shallow, but soon receives such accessions from the Tvertza, Mologa, and Shexna, as to become a mighty stream. Its banks acquire new features rising into lofty precipices, and falling into deep ravines—the red rocks loose their sandy character for the argillaceous, which commonly distinguishes the salt formations. The sandy surface appears at intervals, and marl is discovered at the depth of a few feet, of a deep red color, though sometimes of a greenish gray or white, producing the richest pastures, and the deepest verdure in Russia. The soil is peculiarly favorable to flax, and it is worthy of remark, that a *similar soil* yields the finest quality produced in the northern districts.

The same formation continues to Kostroma, in lat 57° N. 41° E. long. where both the riches and the scenery of the country are of surpassing value and beauty. In the neighborhood of Kostroma, noble oaks border the margin of the Volga, and the scene is varied with towns and villages. "Red marl and sand are here found *in situ*;" and salt springs are of frequent occurrence, throughout the government of Kostroma.

On the precipitous banks of the Oca, ten miles above its junction with the Volga, stands the town of Nishney Novogorod, the grand centre of the internal commerce of Russia. The chasms in the banks of the Oca, show nothing but horizontal strata of red and white marl; but above the town, its beautiful valley exhibits smiling landscapes, adorned with tufts of oak and ash, with occasional glimpses of the winding river, " studded with sails," and bordered with brilliant verdure, and rich vegetation. Villages adorn the lofty and broken banks of the Volga, below the town, as it pursues its way south-east, through fine orchards, and pastures, and noble woodlands. The abrupt chasms which intersect the banks, discover beds of pale red sandstone, alternating with marl. The color sometimes varies from pale red to dusky green, containing globular concretions. At the bottom of the cliff, and near the river, is a thick bed of compact tuff, the cavities of which are filled with stalactites of sulphate of lime, sometimes resembling those found among solid alabaster. Fresh water shells are found in this tuff, but are of rare occurrence.

" Among the greatest curiosities of the salt district," says Mr. Strangways, " are the cavern and rocks of Barnacouva. They are situated near the western extremity of a ridge of hills, on the north bank of the Piana, which makes a circuitous course around these hills, and then running east falls into the Volga. A round hill, covered with oaks to the summit, is at this place hollowed on one side into a natural amphitheatre, accessible only by a rugged path, which follows a little stream issuing from a narrow opening between the hills. On pursuing this stream into the recess from which it flows, lofty perpendicular rocks appear above the wood, on the right hand, and on turning a sudden corner, the dell widens a little, and is barred across its upper end with a precipitous cliff of snowy whiteness. A small lake lies in the hollow, fringed with oaks. The white cliff rises abruptly behind it, and a woody eminence above terminates the scene. The beauty and repose of this sequestered spot are not the only features which distinguish it. On reaching the cliff, it is found to be of *the purest alabaster*; and on passing the tangled brushwood that conceals it, is seen the mouth of a cavern, of which it is no exaggeration to say that it resembles the driven snow. At several feet distance from the cave, a remarkable sensation of chill is experienced, and it seems as if this appearance of snow, had also its coldness. The interior of the cave contracts suddenly, and is intensely cold. On the right hand the tops of the larger masses rise above the trees, and glitter in the sun like drifts of snow, while the purity of their colors, their powdery texture, and furrowed surfaces, channeled and waved, as if by the action of the wind, contribute to deceive the observer, and produce the most perfect resemblance." Starry crystallizations of selenite are found in the rocks. Red rock marl forms the neighboring district, and alabaster exists in subordinate beds. The red marl found along the Volga, produces the finest corn, grass, and oaks. The black earth makes the finest corn land, but is less favorable to oaks, being overrun with wormwood, but subdued by cultivation, yields abundant crops.

On the bank of the Volga, opposite Tetusky, stand the ruins of Bolgary, the ancient capital of the Tartars. Remains of minarets, baths, arabesque figures, and chair patterns carved in stone, indicate its former magnificence; while coins, inscribed with the names of Mongol princes, dug up from the gardens and fields, leave no doubt of its origin. These ruins are on a hill, composed of a loose sandy rock, covered with a black soil of extraordinary fertility. The ground is covered with the yellow flowers of the Scabiosa Tatarica —the hop climbs upon the ancient minaret, and the peasant swings his sickle among the most luxuriant harvests, where the Tartar Czar wielded his sceptre.

The same sand rock extends north east to Cazan, where a greyish yellow limestone appears, distinctly oolitic, full of organic remains; containing also concretions of radiated quartz. A ridge of hills opposite Cazan, skirts the whole eastern part of the "High Steppe of Pallas," and the right bank of the Volga. Beds of limestone alternating with red and white marl, are also seen.

In the central parts of Russia, a black clay containing green sand and pyrites, and full of organic remains, is deposited in patches, and occasional large slabs containing ammonites, beautifully iridescent, are found lying on the surface of the ground.

The central *mining district* is in general a poor sandy country belonging to the red marl formation. Several extensive iron works supply the interior of Russia with that metal. In the gloomy forest of Mouram at the depth of sixty feet, below a sandy surface, are found beds of ironstone of many varieties, of which the pale yellow brown ore is principally worked. In the vicinity are chalybeate and sulphureous springs. This district embraces parts of several governments beginning with Novogorod and extending west to Calouga.

At the foot of the *Ural Mountains* a broad tract of red marl, salt and gypsum, follows the course of the Kama, and probably is connected with the salt district of Vologda in the south. The alabaster grottos of Perm, in this neighborhood, are said to exceed that of Barnacouva. On both sides of this salt country, is an immense tract of copper sand, which borders the south west sides of the Ural Mountains. It is of a dull reddish green, and contains fossil wood, "resembling the fossil vegetables of the English coal formations."

A salt district, full of lakes, occurs at the south east corner of the Urals, connecting Siberia with European Russia and the steppe of the Kirghis.

Secondary rocks extend across the whole country of southern Russia as far south as the primitive steppe. Coal has been found near Toula, but cannot be obtained on account of the quicksands beneath it.

STEPPES.

Steppe denotes a tract of waste country destitute of forests. It may be desert, or covered with herbage, like the pampas and prairies of South and North America. In Russia, a variety of tracts are denominated steppes, as the high, the low, the salt, the sandy, the stony, the icy, and other steppes, differing, each from the other, in every feature except the absence of wood.

The *primitive steppe* reaches S. S. E. from the upper part of the Bug to the Birda, crosses the Dnieper, and passing south terminates near the Black Sea. The rocks in this tract are granite with garnets disseminated, running at times into trap or sienite. A fine earthy felspar occurs near Gallicia, fit for making porcelain.

Calcareous steppe.—A series of calcareous rocks occurs on the margin of the primitive steppe, by the line of the Dniester and the shores of the Black Sea. Limestone containing shells and large grained oolites, occupies large tracts between the Bug and the Dnieper. Bitumen appears at the sea of Asoph, and at the end of the Caucasian chain. Secondary limestone forms a high intermediate steppe, around the northern edge of Caucasus. The bituminous formation, in a ridge of argillaceous shale, composes the level country of Shirvan: the hills of Shirvan and Daghestan, are of shelly limestone. Bitumen again appears in the Isles of Naphtha, on the eastern shores of the Caspian.

The *salt steppe* is a remarkable region lying at an extremely low and uniform level, occasioned it is believed, by a change in the level of the Black Sea. Pallas, and others who have examined the geology of this tract, conjecture that the waters of the Black Sea, at some remote period, burst a passage through the straits of Constantinople, and receding from this shallow tract, left it dry, from its present margin to the shores of the Caspian. This supposition is rendered highly probable, from the extreme want of fresh water through the whole extent of the steppe, and the fact of its being covered with sand, and and recent shells like those now found in the neighboring seas, with no other herbage upon its whole surface, than an occasional tuft of such plants as grow only on the sea shore. Lakes and pools are found in its different sections and an efflorescence of salt, resembling hoar frost is said to cover some parts of the dry ground. The rock under the sandy superficies is a hard black clay slate, sometimes bare and totally sterile. The whole steppe is a tract of barren desert without inhabitants.

In the centre of this steppe, alabaster, which is said to belong to the salt formation, rises in the insulated hills of limestone, accompanied with gypsum and salt.

The Caucasian chain consists chiefly of primitive rocks, but in many parts of columnar trap. The secondary rocks resting on its northern border, are a continuation of the mountains of the Crimea, and consist principally of slates and limestone, with chalk and flints. On the south part of this secondary tract is a soft shelly yellowish limestone, extending along the shores of the Black Sea, through a rich and productive, although woodless, country. The secondary strata, being probably a continuation of these limestones, form the high steppe of Pallas, between the lower Volga and the Don.

VIII. Miscellaneous Notices of Siberia.

Geological inquiry has made but little progress in the northern regions of Asia, but a miscellaneous notice of Siberia, is subjoined, enumerating such mineral and metallic substances, as are known to occur, although their positions *in situ* are not ascertained, nor in every instance their localities. This immense territory extending from the Ural Mountains on the west, to the Pacific Ocean on the east, and from the borders of China and Kalmuck Tartary on the south, to the Frozen Ocean, presents a scene of great interest to the scientific, the humane, and the political inquirer. The late expeditions from Russia and Germany, upon "Icy Sea discoveries," might probably supply these deficiencies, but the accounts are not to be obtained in this country. The information which is the basis of the following remarks, has been derived principally from the journey of the Count De Lesseps (interpreter to La Perouse,) overland, from Kamschatka to Paris, and from the narrative of Capt. J. D. Cochrane, of the R. B. Navy.

The four grand divisions of Siberia will be noticed in their order, beginning on the west. They are Tobolsk, Irkutsk, Yakutsk, and Okotsk, within which, it is subdivided into provinces, governments, and commissariats, all subject to Russia.

TOBOLSK.

The government of Tobolsk commences on the east side of the Uralian chain, which divides Asia from Europe. This magnificent range of mountains consists of primitive rocks, and is rich in the treasures of the mineral kingdom. The mines of gold appear to be inexhaustible, and the minerals and precious metals of this region, are said to surpass those of South America in variety and beauty.—It extends from the Icy Sea to the steppe north of the Caspian.—Primitive marble is found in many parts, and "ornamental jasper occurs in large rock masses."* At Catharinebourg, the first town in Siberia, at the foot of the mountains, are large iron and copper founderies. The copper is brought three hundred miles to the city, and worked up into ingots. The river Iset, which runs near the city, is dammed up to form a sort of lake for washing the gold sands, some of which are found in beds six or eight feet deep, but the greater part are brought twelve miles from the mines of Berezoffsky, which have been penetrated, perpendicularly, one hundred and sixty feet. Immense iron establishments are also situated in this vicinity, one of which employs six thousand peasants. Proceeding east, but little is known, of the mineral, or geological character of the country. It frowns in dark and lofty forests, preserving its wild and ancient magnificence. Occasionally fine districts of cultivation, are seen, with immense herds of cattle, luxuriant cornfields, and a civil and hospit-

* Strangways' Geology of Russia.

able population. Approaching Tobolsk from the west, the country becomes marshy, and for fifty miles is almost a morass, occasioned by the inundations of the Toura and Irtish, with several of their tributaries. A few miserable huts, on this line of country, denote the wretched condition of the inhabitants.

Tobolsk is a large and ancient city, formerly the capital of all Siberia. It stands at the confluence of the Irtish and Tobol, two noble streams which fall into the Oby, where they take its name, and are lost in the Frozen Ocean. A governor general resides in the city, whose jurisdiction extends to Irkutsk, excepting the mines of Kolyvan, whose director is amenable only to the cabinet at St. Petersburg.—It contains twenty thousand inhabitants, and carries on a considerable trade with China, with which it supplies western and central Siberia. Provisions are cheap and abundant, and society good, for malefactors are not allowed to remain in Tobolsk, but are sent to the mines of Nertchinsk and Kolyvan, or to the distant provinces. The exiles who remain in Tobolsk are officers or others who are banished for political opinion, and the governor is at liberty to permit their appearance in society, and to give them such privileges and immunities as he sees fit to grant, upon his own responsibility. This province extends from the latitude of 50° north, to the Frozen Ocean, and is one thousand miles in breadth. The upper soil in the vicinity of the city, is marl and chalk, but north of it are immense tracts of sand. The country from the Ural chain, far east of Tomsk, and from Tobolsk to the Frozen Sea, is one unproductive level steppe, but little known, except that it is thinly peopled by hordes of savages, who bear a striking resemblance to those inhabiting similar parallels on the western continent. The extreme north is the country of the Samoieds and Ostiaks. Sand hills of comparatively small elevation, with occasional limited tracts covered with black soil, supporting corn and forest trees, are the principal objects which interrupt the endless monotony of these lonely deserts.

The lands on the Irtish south of Tobolsk, are some of the most beautiful and rich in the world, but lie waste for want of inhabitants and cultivation. Towards the Chinese frontier are lofty mountains of granite, and luxuriant vallies, forming the most picturesque scenery, but deserted from being held as neutral territory. On the river Kolyvan, and near the confines of Calmuck Tartary are important silver mines. "The silver contains three per cent of gold, which is separated in the imperial laboratory at St. Petersburg. The mines and

and founderies of Kolyvan employ forty thousand laborers, besides the peasants of Tomsk and Kusnetz, who cut wood, transport ore, and make charcoal for the founderies."* Twelve thousand horses and oxen are also employed in the various processes relating to the produce of the mines. This province is abundantly supplied with provisions and wood—the scenery is picturesque and the soil fertile.

Tomsk, north east from Kolyvan, is the capital of the province which bears that name. The fertility, plenty and industry of Kolyvan, ceases at its borders--the intervening country gradually becomes cold and desolate, as you approach the capital, wood and cultivation disappear, and the country wears the aspect of a desert. Tomsk is half way from Tobolsk to Irkutsk, contains five thousand inhabitants, and is distinguished for hospitality to strangers. In the dreary wilds between Tomsk and the river Jenesei, caravans of traders are met laden with teas, silks, and nankeens from China for Moscow. The Jenesei rolls its course over a picturesque district, well cultivated to a considerable extent. The little river Katcha winds at the foot of the north western hills forming a peninsula of sandy alluvion at its junction with the Jenesei, upon which stands the town of Krasnojark, distinguished for the beautiful scenery which surrounds it, but unpopular as a residence, from being subject to fevers, and the epidemics incident to flat river countries. Mines of the precious metals again occur in these hills, the vallies abound in timber—and villages scattered every ten or fifteen miles indicate the approach to the government of Irkutsk, where the increased attention to regularity and good order, reflects the highest credit upon the governor of that province. The progress of improvement within the last forty years is surprising, as since that period it has risen to a government and a capital.†

IRKUTSK.

Irkutsk is one hundred and fifty miles west of the Lena. Civilization has made considerable advances throughout the province. The Russian inhabitants are numerous—the country lies over hill and dale, and "except a few cornfields is one uninterrupted pasture." Post houses and roads are good, and little villages frequent. The inhabitants of the villages are principally exiles who have been banished

* See Coxe's account of the mines of Russia.
† Cochrane, p. 136.

for minor offences, and who, bringing with them some of the knowledge of European customs, impart an air of thrift and neatness to all about them. Near the city is a cloth manufactory, and within it a military, and a Lancasterian school, with other humane and useful institutions. These convicts if they attempt to desert, are considered and treated as outlaws, so that once passing the frontier of the province fixes their fate for life.

YAKUTSK.

For several hundred miles north east towards Yakutsk on the Lena, the country is in a state of barbarism, inhabited principally by wandering tribes, occupied in the chase, or in raising reindeer, for whose subsistence they roam from pasture to pasture with their herds and tents. Yakutsk is much resorted to by the Russian American Company, and is a great mart for furs, the choicest kinds being bought and sold there. It is on the left bank of the Lena, which in summer is four miles wide. This is a majestic river, the longest in Siberia, pursuing a course of nearly four thousand miles from its source to the frozen ocean.*

From Yakutsh north east to Nishney Kolyma is a distance of eighteen hundred miles. Yakutsh is the last limit of civilization; the country becomes mountainous north east from the Lena to the Aldan and the Jana, and perpetual snow marks the near approach to the arctic regions. Parallel ranges of mountains occur in these latitudes composed of granite, with accompanying strata of slate. On the banks of the Kamer de Maslo is a fossil or earthy substance, of a yellowish cream color, called by the Russians kammenoye-maslo, or stone butter, which is eaten in various ways, and is not disagreeable to the taste. It is probably similar to the mineral found in corresponding latitudes, on the banks of the McKenzie; which Capt. Franklin states is used by the natives for food in periods of famine. It oozes out of the rocks in many parts of Siberia, and when exposed to the air it hardens, but in wet weather becomes soft and even liquid. That found on the McKenzie resembled a kneaded paste, and was used by the traders as is stated by Capt. Franklin, for whitening their apartments.

---

* Cochrane.

"These regions are traversed, rather than peopled, by men who belong to no nation," for between the Jana and the Kolyma the country is one vast desert.

The commissariat of Kolyma has for its capital Nishney Kolymsk, an island in the Kolyma, opposite its junction with the river Annuiy, and almost the most easterly part of Asia, in 70° N. lat. Capt. Cochrane states that, both from his own observation, and as appears from registers kept by others, the cold is many degrees greater here than in corresponding parallels in the Western hemisphere: and that even at Irkutsk, the cold was as intense as was at any time remarked on Bear Lake, or Melville Island. Nishney Kolymsk is famous for the high rank of its convicts, and contains the tombs of some illustrious exiles. Slate hills occur on the right bank of the Annuiy, thirty-five miles east of the Kolyma, while the left is a vast alluvial deposit. At Ostroonaga, a fortress on the Annuiy, in about 68° N. lat. and one hundred and fifty miles east of Kolymsk, an annual fair is held, for the sale of furs. A commissary presides, who instals two savage chiefs, decorating them with medals and swords, and receiving at the same time a tribute. The following morning, these persons, arrayed in their gayest attire, in sledges drawn by reindeer, precede a long cavalcade of followers, when, after some religious ceremonies, the commissary declares that the fair cannot proceed without a tribute in advance for the Emperor; on which the principal traders come forward and lay each a red fox skin at the feet of the commissary. The fair then proceeds; the natives are astute and exact in their dealings, and barter their furs for knives, swords, a few implements and utensils, and some trinkets; but the main object of desire with them is tobacco, for which they exchange their fiery fox skins, and their best sea-horse teeth, which make the finest ivory in the world. Savages from the American continent attend this fair, and bring a great variety of furs, which the vicinity of the fortress could not supply. The Asiatic tribes are each headed by their chiefs, and are from Shelatskoi Noss—from the east sea coast—and from the borders of the river Anadyr, south-east, towards Kamschatka. There are wandering hordes, who live by hunting, fishing, and trafficking in ivory and furs, and they strongly resemble the American savages in their language, superstitions, dress, and many of their customs. They are honest and hospitable, but bold, irascible, suspicious, and far more spirited and sagacious, and more rude and wild than the Esquimaux, but yet bear a greater resemblance to them, than to any tribe of Asiatics. They have a tradition that some of their people have been driven beyond seas by prevailing sickness or persecution; and it seems highly probable, that the Esquimaux are their descendants, tamed into apathy and cowardice, perhaps, by sustaining greater privations. They have no tradition of a northern land, but say that the sea on their northern frontier is frozen ten months in the year, and that nothing but ice-mountains are visible; that the sea breaks up in August and September, but not so as to admit the passage of vessels; and that the intermediate lands between themselves and the sea, are mountainous, barren, and deeply covered with snow. These representations, corresponding with ascertained facts relating to the Arctic regions on other meridians, and the additional fact, that the Baron Wrangle found a continuous coast around Shelátskoi Noss, strengthen the probability that an undivided ocean stretches across the Pole, and that the north coasts of Europe and Asia, form a land shore upon its margin, within the Arctic circle, from North Cape, in Lapland, eastward to Bhering's straits.

OKOTSK.

This grand division of Siberia includes Kamschatka within its government, and has its capital on the sea of Okotsk, in 60° N. lat. 140° E. long. From the river Kolyma, S. S. W. to Okotsk, is nearly two thousand miles. The country is diversified with snow clad mountains, overflowed morasses, decayed forests, frozen lakes, and rapid and dangerous rivers. The town has been erected principally by the Russian American Company, the head officer of which resides there. Meat and fish are plentiful, but bread is dear, and vegetables scarce and inferior. Forests of timber in the vicinity of Okotsk, make it an advantageous place for a dock yard, and substantial vessels are built and fitted out to transport goods and provisions to Idgiga, and Kamschatka. Ships arriving from America, bring most valuable cargoes of furs to Okotsk, but the province may be termed a dreary waste, from the border of its principal city, to the river Anadyr, on the north east confines of Asia.

KAMSCHATKA.

The stormy sea of Okotsk is navigated with difficulty, owing, in some measure, to deficient surveys. It divides the city and the south part of the government of Okotsk from the peninsular of Kamschatka, which is a mountainous sterile region, with bold coasts, and various, and sometimes grand and romantic scenery. It extends from lat. 52° to 64°, and is not more than eighty or one hundred miles wide in the broadest part. A magnificent range of mountains stretches through the whole length of the peninsula, equidistant from the east and west coasts. The river Kamschatka, navigable for vessels of one hundred tons for one hundred and fifty miles, passes from south to north until it reaches the 57° N. lat. when it turns suddenly east, and falls into the sea of Kamschatka, which is that part of the Pacific Ocean between the N. E. shores of Asia, and the N. W. coasts of America. A broad steppe of Arctic desert separates it on the north from the Anadyr, and the Asiatic coast tends north east from the mouth of that river, beyond which a field remains for the examination of future explorers. On that part of the peninsula north of the mouth of the Kamschatka river, commences the country of the Koriaks, a fierce and barbarous race, differing materially from the servile and cowardly Kamschatdales. The country is thinly inhabited, and civilization has not improved their condition much beyond that of their arctic neighbors. The riches of the whole peninsula consist in furs, which exist in immense quantities; so prodigious is the number of animals, that there are not inhabitants sufficient to take them. Foxes and Sables are the most valuable, particularly the fiery red fox, the finest of the species. Bears, wolves, reindeer, argali or mountain sheep, otters, beavers, lynxes, and foxes of every variety, are found in the greatest plenty, and aquatic birds are hunted for their feathers, flesh, and eggs. The mode of travelling in Kamschatka and Koriaka, is with sledges drawn by dogs, and next in importance to the furs, are the dogs, who perform the labor of horses, and who almost outnumber the people. The winters are milder than in Siberia, but the climate is unfriendly to corn and vegetables, though timber arrives at perfection in the southern part. The summer is extremely disagreeable, owing to the heavy rains and fogs, and the torrents which descend from the mountains. On the east side of the river Kamschatka are four active volcanos,* rising from the level surface in insulated peaks, many miles apart.

Pedlars roam over the peninsula, bartering Chinese cottons, teas, tobacco, spirits, and trinkets, for furs, which are first carried to

* De Lesseps.

Okotsk, and thence distributed as markets invite the various proprietors. One skin out of every forty is paid, as a tribute to the Emperor. St. Peters and St. Pauls is the chief town of Kamschatka, a miserable place consisting of fifty seven dwellings, on the east side of the peninsula, one degree of latitude from its southern cape. Of rocks and minerals, it can scarcely be said, that any thing is known. De Lesseps saw talc in large plates or leaves, and it is said there are hot springs at Natchikin, in the south, near which are iron, copper, sulphur, calcareous earth, and rocks of limestone; but of their relative position, or of the mountain formations, nothing is known.

KURILE ISLANDS.

These islands south of Kamschatka, are doubtless a continuation of the hills of the peninsula, which have been separated from it or which have been raised by volcanic convulsions, as volcanic remains are found on those which have been visited; and the opinion is supported by the fact, that they are on the same meridian with the volcanoes on the east side of Kamschatka, and that earthquakes are of frequent occurrence. The islands are without rivers, and but few of them inhabited. Their number is not well ascertained, but probably from fourteen to twenty five, part subject to Russia, and the remainder to Japan. They abound in fine pastures and some cattle, with great multitudes of water fowl, from whose skins and feathers, the inhabitants make their warm clothing, which is extremely beautiful. Foxes are said to be the only animals of the chase, found there, and they are very numerous and of all colors. From these a small revenue is derived for the Emperor.

Chinese Frontier.

For forty or fifty miles between Irkutsk and the Baikal Lake, hundreds of traders with carts and horses, laden with furs and ivory from the north, and with silks, teas, and nankeens from the south, going to, and coming from the great fair of Kiakhta, within the Chinese border, declare the vicinity of the celestial empire.

Immense mountains of porphyry shooting into spires and pinnacles, overhang the Chinese river Selenga, while villages and fertile valleys occupy some of its banks between the ranges, until it ultimately loses itself in the Baikal. Verchney Udinsk, a populous city on the banks of the transparent Selenga, is on the frontier line, and is the great mart between Irkutsk and Kiakhta, by way of Selenginsk, which is seventy miles distant from Verchney Udinsk, on the frontier. Kiakhta is a regular built town, placed in the centre of a stony, sterile basin, but the surrounding hills rising in an imposing manner, spread away, and almost redeem the desolation of the vallies, by the gracefulness of their outline. The little brook Kiakhta runs in front of the fortress, and is, at this place, the boundary line between these mighty empires. A little beyond, is what is called Old Kiakhta or the town of Commerce—the residence of the merchants only—no officers, or strangers, or women, being permitted to remain in it. It contains a great number of rich stores, surrounding an oblong hollow square, in the centre of which the Chinese reside, and around the sides display their goods in the most fantastical manner. These men are courteous and affable, but maintain with scrupulous jealousy the antiquity of the great empire, and its superiority, and that of its descendants, over all other lands and tribes; guarding their borders from the profane curiosity of foreigners, with the same suspicious policy which is exercised in Canton. In this little district, by common consent, they dismiss ceremony in entering the Russian and Chinese villages; the best understanding prevails, and the business of the Fair, is transacted with liberality and good faith. The Chinese give no credit, but credit is given by the Russians. This is the grand place of exchange between Russia and China, where the former send their furs, woollens, and Walrus ivory, and receive in return, the teas, muslins, nankeens, silks, porcelain, pictures, and carved trinkets of China. The distance from Kiakhta to Pekin, is one thousand five hundred miles, one thousand of which is through Mongolian Tartary, a well peopled territory, nominally subject to China. The consumption of tea almost surpasses belief; it is used not only by the refined and polite, but throughout Siberia, the wildest savages receive it for their furs, and seem not to hold it second in value even to spirits and tobacco. Three millions of pounds have been imported by Russia in one year, and the annual amount, it is presumed, does not vary materially. The choicest furs are not sold in China, but the precious ermines of Yakutsk—the best sables—and the finest fiery red foxes, are sent to Moscow, and Novogorod, for the use of the Russians, Turks and Persians.

NERTCHINSK.

Five hundred miles east of Verchney Udinsk, on the south east confines of Siberia, over a rich country abounding in timber and pastures, is Nertchinsk, on a small river which flows into the Selenga, through the Bunat steppe. This city is famous for its metallic and mineral treasures. There are within its jurisdiction, thirteen silver mines and six founderies, beside an iron foundery, and a considerable amount of gold and copper. The silver mines are wrought by convicts, and such is the severity of the discipline and requirements, as fully to verify the pathetic details concerning the horrors of banishment to Siberia. There are, in these mines, two thousand four hundred and fifty eight convicts, confined for life. If they desert, they are liable to be shot by the wanderers on the Bratskey steppe, if they take the high road they can obtain subsistence only at the post houses, where they are immediately arrested, returned to their prisons, and subjected to additional inflictions. They are guarded by five or six hundred officers, to prevent their purloining gold and gems.

In the hills, on the river Argoon, east of Nertchinsk, are found some of the most splendid minerals and gems. Among them are amethyst, topaz, aqua marine, onyx, quartz crystals, and Scotch pebbles of the largest size and of singular beauty.

In reviewing the discoveries which have been made within and near the Arctic circle, it appears that primitive rocks compose the shores of the Frozen Ocean, probably forming, in high northern latitudes, an entire belt around the globe. This circuit has been, in part, accurately surveyed, and reasoning from well ascertained geological facts, there can scarcely be a doubt that those intervals which have not been examined, are continuations of ranges known to exist in the same parallels, and in corresponding meridians.

Art. II.—*On the influence of certain substances on the Peroxide of Hydrogen.*

Columbia, S. C. June 24th, 1829.

TO THE EDITOR.

Dear Sir,—I take the liberty of sending you the following remarks on a subject, which I presume will not be uninteresting to you.

Should I not have been anticipated, and should you deem it worthy of a place in your Journal, the present paper may be acceptable to some of your readers. Yours with respect,

EDWIN D. FAUST, M. D.

In the first American edition of Turner's Chemistry, pages 121 and 122, we find the following interesting details, respecting the influence of some substances, on the peroxide of hydrogen.

"The most remarkable property of the peroxide of hydrogen is the facility with which it is decomposed. The diffused day light does not seem to exert any influence over it, and even the direct solar rays act upon it tardily. It effervesces from the escape of oxygen at 59° F., and the sudden application of a higher temperature, as of 212° F., gives rise to such a rapid evolution of gas as to cause an explosion. Water, apparently by combining with the peroxide, renders it more permanent; but no degree of dilution can enable it to bear the heat of boiling water, at which temperature it is decomposed entirely. All the metals except iron, tin, antimony, and tellurium, have a tendency to decompose the peroxide of hydrogen, converting it into oxygen and water. A state of minute mechanical division is essential for producing rapid decomposition. If the metal is in mass, and the peroxide diluted with water, the action is slow. The metals which have a strong affinity for oxygen are oxidized at the same time, such as potassium, sodium, arsenic, molybdenum, manganese, zinc, tungsten, and chromium; while others, such as gold, silver, platinum, iridium, osmium, rhodium, palladium, and mercury, retain the metallic state.

"The peroxide of hydrogen is decomposed at common temperatures by many of the metallic oxides. That some of the protoxides should have this effect, would be anticipated in consequence of their tendency to pass into a higher state of oxidation. The protoxides of iron, manganese, tin, cobalt, and others, act on this principle, and are really converted into peroxides. The peroxides of barium, strontium and calcium may likewise be formed by the action of the peroxide of hydrogen on baryta, strontia, and lime. But it is a singular fact, and I am not aware that any satisfactory explanation of it has been given, that some oxides decompose the peroxide of hydrogen without passing into a higher degree of oxidation. The peroxides of silver, lead, mercury, gold, platinum, manganese, and cobalt, possess this property in the greatest perfection, acting on the peroxide of hydrogen, when concentrated, with surprising energy. The decomposition is complete and instantaneous; oxygen gas is evolved so rapidly as to produce a kind of explosion, and such an intense temperature is excited, that the glass tube in which the experiment is conducted becomes red hot. The reaction is very great even when the peroxide of hydrogen is diluted with water. The oxide of silver occasions a very perceptible effervescence when put into water which contains only one fiftieth its bulk of oxygen. All the metallic oxides, which are decomposed by a red heat, such as those of gold, platinum, silver, and mercury, are reduced to the metallic state when they act upon the peroxide of hydrogen. This effect cannot be altogether ascribed to the caloric disengaged during the action; for the oxide of silver suffers reduction when put into a very dilute solution of the peroxide, although the decomposition is not then attended by an appreciable rise of temperature."

In the works to which the author refers, more extensive papers may be found; but we have preferred referring to the above work, as more accessible to readers. Having seen no explanation of the phenomena above stated, and being induced, by the statements of our author, to believe that no satisfactory theory has been proposed, we have thought proper to offer the following considerations on the subject. That a metal or a protoxide, when presented to a substance containing a large quantity of oxygen loosely combined, should receive a portion of oxygen, at the expense of the other substance, will not excite the surprise of any chemist; but when we find one substance decomposing another, without uniting with any of the constituents of the latter, we recognise a wide departure from the ordinary phenomena of decomposition. Our invention is fairly put to the test, when, on placing the oxide of silver in the peroxide of hydrogen, we see oxygen evolved, not by the fluid only, but by the solid oxide; and find that this last is reduced to the metallic state. These, and other phenomena, are at variance with all our observations, and are explicable we think, on no other principles, than those which we shall apply. Our rationale is founded on the doctrine of Sir H. Davy and Berzelius, that chemical affinity is the result of electrical agency; a theory opposed but not refuted.

When any metal is placed in the peroxide of hydrogen, a galvanic effect is produced. The hydrogen having less affinity for the *excess* of oxygen, than the metal has, the liquid becomes negative, thus acting the part of the copper plate of a battery, while the metal becomes positive, supplying the place of the zinc plate. The liquid is thus resolved into water and oxygen. If the metal be very oxydable, it retains the oxygen, which is evolved if gold, platina, &c. be used. We need scarcely refer to the wires of a battery, for a parallel case.

When the peroxide of hydrogen comes in contact with the oxide of silver, the oxygen escapes from both, and the latter is reduced to the metallic state. To comprehend this most singular fact, it must be remembered, that metals combine, under certain circumstances, with more oxygen than under other circumstances; and it must be especially recollected, that when the peroxide of potassium is placed in water, it gives off oxygen, and becomes a protoxide. It is not going too far then, to suppose that a peroxide may result from the action of the peroxide of hydrogen on the oxide of silver, that this peroxide exists under no other circumstances, and is, like the peroxide of potassium, decomposed by water. The conclusion will, perhaps, warrant this assumption. The oxide of silver, then, being put into the peroxide of hydrogen, the latter having no affinity for oxygen, becomes negative, while the former, becoming positive, receives oxygen, and becomes a peroxide, to which the excess of oxygen must adhere very slightly. But the fluid in *immediate contact* with this peroxide has, by yielding its oxygen, been converted to water; and we have, now, in contact, not peroxide of hydrogen and protoxide of silver, but protoxide of hydrogen and peroxide of silver. The effect is, a total change in the electrical phenomena. The peroxide of silver becomes negative, and the protoxide of hydrogen positive. This galvanic influence forces the silver to reject the whole of the oxygen, returning to the metallic state; hence results the incorrect opinion, that the oxide of silver has decomposed the liquid, without receiving oxygen; while, in reality, it has only received oxygen at one moment, to change its electricity, and reject it in the next instant. The same effect is produced by other oxides reducible by heat alone; the oxide being reduced to a metallic state.

Those protoxides which are not reduced by heat alone, become peroxides; and these peroxides are not reduced to a metallic form, as in the above cases, because the galvanic effect produced by their contact with water, is too slight. In this respect, they differ from the peroxide of potassium, and the (supposed) peroxides of silver, gold, &c. which cannot exist in water.

A very singular and inexplicable fact is, that iron, tin, antimony and tellurium, will not, like other metals, decompose the peroxide of hydrogen. The act appears still more obscure, when we consider, that the decomposition is effected by the protoxides of iron and tin. Perhaps those of antimony and tellurium would produce the same effect.

The phenomena quoted above, are not explicable on any other known principles, than those which we have here adopted. Whether our readers will consider the rationale sufficiently free from hypothesis we cannot determine. To us, it has appeared more probable, at each revisal.

ART. III.—*Compression of the Air.—An account of a remarkable accident which occurred in a mine of Bovey coal, in consequence of the compression of the Air; by the Inspector, Dr. Professor Nöggerath. (Jahrbuch der Chem. und Phys.)*

(Translated and communicated for this Journal.)

IN order to understand correctly, the following account of the accident which occurred at the pit of Turnick in the territory of Cologne, it is necessary to premise a few words concerning the subterraneous position of the coal pits, and the manner of working them, which for some time has prevailed in this region. The coal business is of great importance in this district, and several hundred workmen are employed in it.

Some pretty high ridges of hills, which arise in the basaltic Godesberg, extend more than half a league from Bonn on the Rhine, to the region of Bergheim on the road from Cologne towards Aachen, where they end in a plain, constituting the main locality of the ternary formation of Bovey coal. This coal is commonly covered with layers of clay not very compact; and over the clay to the surface of the ground, is a deposit of coarse sand and rubbish washed from the hills. Where this covering is thick and strong, in order to obtain the coal to advantage, the mining is performed by a process, or rather a particular kind of excavation, which in our region is termed *tummelbau.** The parts of the tummelbau are shafts, passages, and

* *Tummel* is a corruption of the Latin word *tumulus; bau* here signifies *mine*, though it may mean any work or building. *Tummelbau* is an excavation in the form of an obtuse cone. In the *Jahrbuch* there is a plate, conveying a very clear idea of the manner of excavating these mines.

arched cavities. The whole mine is commonly sunk to one base, namely, just above the level where water would naturally stand. But, when by its natural situation, or by artificial draining, the mine is carried very deep, and the stratum of coal is thick and extensive, a second tummelbau is made under the other, after the former has become exhausted.

In the mine there are two apertures, one of them for the passage to and from it, and the other, called the wind shaft, for ventilation. These two shafts at the bottom are united by a passage, connecting them at right angles. Upon this passage the mining is begun by forming a *tummel*, which is arched above like a bee hive, and its bottom is continued on the level of the passage between the two shafts. A tummel is commonly from three to six fathoms in diameter, and from two to five in height. The coal itself serves to support the highest part of the tummel, because, by the pressure of its sides it settles of itself to a certain extent, the excavation still preserving its arched form. When the tummel is carried so high as to reach the top of the layer of coal, or the level of the tummel is itself reached by a second mine that has been sunk under it, by degrees, it commonly breaks and becomes filled, by which means, the walls or parts subject to the pressure, are again brought together and consolidated. By the filling up of the tummel, many funnel shaped apertures on the surface are formed. A second or third tummel can at any time be formed upon a passage by removing the surrounding coal, or by making a new excavation; and in the present instance, upon the right and left of the main excavation, and at the shafts, new passages had been formed, and new tummels had appeared, so that the mine was continually enlarging, and receding farther backwards. Finally, near the wind shaft, and likewise by the main tummel, pillars were erected to make the works as strong as possible. A new tummel had been sunk below the passage between the two shafts, and the shafts themselves were continued down to the level of its base, and a passage formed for connecting them. The old tummel did not fill again as is common after a new one is formed below, because from one third to one fifth of the superincumbent coal had been left for support, in consequence of the extreme caution of the workmen. But it was difficult to secure it altogether, as the coal was very light in some places, and the timber was small as a matter of economy, in consesequence of the moderate profits of the mine.

The accident occurred in the tummelbau of Botterbroicher, Therchengrube, near Turnich, Feb. 7, 1826. There were in the mine, 1st, John Weber, contractor, who was killed; 2d, Martin Pohl, coal cutter, who had his sight slightly injured, besides a superficial bruise of the thigh; 3d, Jacob Brewer, coal porter, who had a shoulder dislocated, and a severe contusion of the left thigh. Without the mine, though near a shaft, were in waiting two windlass turners, John Bieck and Hilger Zimmermann.

At 7 o'clock, A. M. as the workmen were going into the mine where they had worked the day before, a pressure was perceived, and in apprehension of the falling in of the tummel, they took the precaution of employing themselves upon the coal near its entrance. About 9 o'clock, the pressure had sensibly increased, and some large pieces of the clayey stratum of the arch fell in. Weber the contractor, heard the crash, and ran to those who were in the pit. He had the tummel searched externally and internally, and thought it not proper for the workmen to go immediately to their business, but that they should first eat their breakfast, and if in the mean time, there should be another break, they might quit their work. Upon this, Weber set out to brace the pit, the workmen remaining seated at their breakfast in the wind shaft, near the passage to the tummel. Weber had been gone but a few moments, and had not probably reached the middle of the ascent of the shaft, when the tummel suddenly fell in, and the rush of the air was so terrible that Pohl, who was five fathoms within the windshaft, and Brewer, who was in another passage, were thrown down. Pohl recovered himself as he was lying upon the windshaft; and upon regaining his senses, looked after his companion, whom he found senseless in the main passage. After Brewer had recovered so as to come to his reason, they found Weber the contractor near them, apparently lifeless. Upon calling, Bieck came to their assistance. Brewer was drawn out by means of a rope, and the body of Weber was brought out in the same manner. Pohl was able to climb out, without assistance.

Bieck and Zimmermann state, that after Weber had left them, Bieck called and enquired, whether they should take their breakfast within the shaft? After receiving an answer, they went about ten paces from the mouth of the shaft to the hut, to eat their breakfast. In less than a quarter of an hour, an alarming noise was heard. The brick roof of the hut, that was built over the entrance of the mine, was blown into atoms, and an entire ladder was thrown out of the shaft, which fell upon the hut of the other shaft, that still remained standing. The hats of those who were within the mine, were found at the distance of twenty paces without, from the mouth of the shaft, as also two iron hooks with which the ladder had been fastened, were picked up near the shaft, one of them broken short, the other torn out of the timber and twisted. Upon examining the shaft, it was found that by the powerful dislodgement of the ladder, the timber of the shaft had been much damaged.

This is a very strange and singular accident of its kind, which could arise only from the violent compression of the air in the cavity of the tummel, at the moment when it was filled by the simultaneous fall of the materials of the arch. The great strength of the strata, combined with the circumstances, that there was, directly over the pit, a very firm clayey roof, was the cause of there being given to the tummel (though it was very ill judged,) uncommonly large dimensions; for by the report of the coal cutters, it was twelve fathoms in diameter, and four and a half in height. To increase the force of the rush of air, another circumstance greatly contributed. In lately fitting up the mine, two apertures only were retained, the wind shaft and the passage for conveyance. As the tummel fell, the whole mass of air was forced out of one passage only, the pressure being directed to this, because during the cold weather, the wind shaft had been stopped at its mouth.

When we consider the amazing force with which the ladder was carried out of the shaft, and the other circumstances testified by the workmen, it is most probable that Weber, who was on the ladder as the tummel fell in, and wore a long linen frock, was lifted up by it so high, that the distance of the fall caused his death.

The medical examination of the corpse of Weber, discovered numerous fractures. The fourth, fifth, and sixth ribs of the left side, and the heads of others were broken, and driven into the cavity of the chest. The pericardium on the left side from above downwards was ruptured, as was also the right cavity of the breast. The left lobe of the lungs exhibited several lacerations, and was crushed into a confused mass.

Art. IV.—*Assay and Analysis of an Iron Ore, (fer titanné,) from the environs of Baltimore,* received through Mr. Warden; by* T. G. Clemson.†

From the specimens received, this mineral appears to be associated with a schiste granitoïde. It is in amorphous masses, possessing a parallel division. The exterior surface is of a reddish brown, like the peroxide of iron. The interior is of a bright gray, having the texture of iron, occasionally presenting indices of crystallization. It feebly attracts small particles of iron, and possesses polarity in a slight degree. Specific gravity =4.9.

The following assay was made upon a specimen that appeared to be void of gangue. The powder was black, with a tinge of red, which indicates the presence of the peroxide of iron.

Calcined in close vessels, it does not sensibly diminish in weight. Twenty grains of this mineral were mixed with ten grains of kaolin, (silicate of alumine,) and seven grains of carbonate of lime. The mixture was submitted, in a crucible, to the strongest heat of a wind furnace. The result of the assay was a culot and scoriæ, weighing in sum, 29.62. The scoriæ were covered with a thin metallic layer, of a copper red, which characterises the presence of the oxide of titanium. The interior of the scoriæ was nitrous, black and opake. The iron was white, possessing good properties. It weighed, 12.

Weight of the culot and scoriæ, - - -		29.62
Ten grains of kaolin, calcined, equals, -	10.	
Seven grains of carbonate of lime, -	3.94	
Twenty grains of mineral, - - -	20.	=33.94
Oxygen, - - - - - - - -		4.32

13.94 equals the quantity of kaolin and lime added. Now the scoriæ weigh 17.62. Consequently the kaolin and lime have augmented in weight equal to 3.68.

---

* Land of Mr. Patterson.

† *Extract of a letter from Mr. T. G. Clemson to the Editor, dated Paris, May* 27, 1829.

I embrace this opportunity of sending you an extract of a process verbal, made by myself, at the School of Mines, May 1st, 1829. Considering it of sufficient interest, will you have the goodness to give it a place in the next number of your excellent Journal of Science and Arts.

Considering this augmentation as oxide of titanium, its composition for 100. would be

Iron, - - - - - - -	60.
Oxygen, - - - - - - -	21.60
Protoxide of titanium, - - - -	18.40
	100.

Analysis.—Five grains of the same mineral, reduced to an impalpable powder, were treated by sulphuric acid, concentrated and boiling. The solution was evaporated to dryness, taken by water, and filtered, the residue, insoluble, weighed 0.1. This residue gave no indications of the oxide of titanium before the blowpipe. To the filtered solution, tartaric acid and ammonia were added by turns, until the latter produced no precipitate. A small excess of hydro sulphate of ammonia was then added, and the hydro-sulphuret of iron separated by filtration, the solution evaporated to dryness, and the residue calcined, gave 0.95 of the protoxide of titanium.

This mineral may be considered as having the following composition for 100.

Iron, - - - - - - -	60.
Oxide of titanium, - - - - -	19.
Silex, - - - - - - -	2.
Oxygen, - - - - - - -	19.

This quantity of oxygen is not exact, the iron containing an indefinite quantity of carbon.

Art. V.—*Sketch of the rich mine of Pasco; by* M. de Rivero, *received from the author in his Journal of Natural Science, and National and Foreign Industry, Jan.* 1828, *Vol. I. No.* 2. *published at Lima, and translated for this Journal by a Scholar of the New Haven Gymnasium.*

Introductory notice of specimens of silver from Peru and Chili.—Ed.

Mr. Rivero's account of the mineral riches of Pasco has excited the more interest in my mind, because some of those riches, and of those of the contiguous country of Chili, have been recently deposited in my hands, by the kindness of Mr. Daniel W. Coit. This gentleman, for many years a traveller and resident in various countries in Europe and both Americas; and for the last six or seven years, established as a merchant at Lima, has availed himself of his opportunities, to make various collections, interesting to the fine and useful arts, particularly of numerous and valuable pictures, and also of noble native specimens of silver, which he has brought home. The box containing them, being left in trust with me, during the absence of its owner in Europe; I have, with permission, examined its contents with some attention, and a brief notice of them seems not an inappropriate introduction to the Memoir of Mr. Rivero.

1. Among the numerous pieces of native silver, there is one pure and solid piece, without pores or intermixture. It is seven inches long, five and a half broad, and from three to two and a quarter thick. Its weight exceeds fourteen pounds avoirdupois, and its value, *as silver merely*, is over two hundred and thirty dollars. It is from the mines of Pasco, and appears to be a fine exhibition of the full dimensions of a rich vein or cavity of virgin silver, as it has the natural faces by which it was joined to the rock or vein stone, (a calcareous one as appears by very small adhering portions.) On one side only, does it bear marks of having been cut and forced by instruments from the rest of the vein. It exhibits the appearance of having been a knob or protuberance.

2. There are other pieces of native silver, from the size of a hand to that of a walnut, in many accidental and imitative forms; protuberant, dendritic, cellular, pectinated, reticular, &c.

3. Two specimens are worthy of being mentioned, on account of the beauty of their crystallization; especially as good crystals are much more frequent among the ores, properly so called, than among the native metals.

In these pieces, which are from two and a quarter to three and a half inches in length, the silver is of the most perfect whiteness, without tarnish, and with the lustre of the polished metal; and the numerous crystals, both adhering in rich groups of many hundreds, and being also interspersed through brilliant white calc spar, make a very splendid appearance. The figures are between the cube and octohedron,—usually the cubo octohedron. The forms of the crystals are not readily distinguished, without a magnifier.

4. An elliptical ovoidal mass, four and a half inches long by three and a half wide, and two and a half deep, nearly flat on one side. It is porous in every part, and has the appearance of having been produced by amalgamation, and of having been moulded, while in a

pasty state; the quicksilver being afterwards expelled by heat. It corresponds with no natural form that I have ever seen.

5. Specimens that are softer and more sectile than the native silver; apparently composed of little plates, that seem by compression to slide over each other, like amalgam.

6. Numerous specimens of sulphuret of silver, which, from the proportion they bear to the whole collection, would seem to be the most common product of the mines. The color of this ore is dark gray; structure granular, or perfectly foliated; streak brilliant; sectile, cutting with a knife, almost like lead, and more like plumbago, to the brilliant specimens of which, it often bears a strong resemblance, but it does not mark paper. It is in some pieces mixed with finely divided native silver, so that when cut, the peculiar color of both is displayed. The tarnished, dull specimens are brilliant, if cut.

By the blow pipe, it is reduced to the condition of metallic silver, the sulphur being exhaled in fumes, and escaping with ebullition, which throws the silver about in jets, and on cooling, it appears on the charcoal, in brilliant white points. If the process be stopped before the reduction is thoroughly accomplished, the globule, on cooling, exhibits a beautifully mottled appearance, not unlike that of the variegated soap balls. It is produced by the congealed silver, being interspersed, with its characteristic whiteness, in lines, clouds, and spots, in the dark base, of that part of the sulphuret, which is still unreduced.

7. There is one mass of sulphuret of silver, which is distinguished from all the others by its beauty; it is in large brilliant plates, having almost the lustre of polished steel, but the color of the darkest plumbago. Its size is four inches long, two and a half wide, and two deep. This also gave metallic silver by the blow pipe.

8. There are large masses of what appears to be muriate of silver, soiled by and mixed with an ochreous powdery earth. Still, the masses are tolerably firm, and it is only by breaking them that the muriate is discovered, in laminated veins of a light gray color, brittle, and giving points* of reduced silver, by the blow pipe.

9. Most of the foreign substances observed with these specimens are calcareous; sometimes the native silver was interspersed in quartz, but more frequently in calc spar.

---

* *Points*, because there is earthy matter mixed with it, which gives only a slag.

10. Some specimens from Chili, furnished by the lady of Commodore Hull, accord very well with some of the pieces of native silver already described; one piece, which is nearly pure, weighs two pounds avoirdupois, and another which consists principally of silver, interspersed through calc spar, weighs one pound and three quarters.

11. Among the specimens of Mr. Coit, are several silver images, said to be dug from the graves of the aboriginal Peruvians. They are generally from two to three inches in length, and are rude and sometimes ludicrous resemblances of the human form; they have generally crowns or helmets on their heads; one figure clasps an infant; another a harp, or other instrument of music; and another, (the largest of this kind,) has a kind of a *Chapeau bras*, ornamented with a crescent, on his head, a sceptre or spear in one hand, and something, swinging like a basket, in the other. The images, mentioned above, appear to be cast. There is still another image, carved rudely out of silver ore, but consisting principally of native silver. It is much larger than either of the others. This appears to represent a large baboon, or some animal of that family, riding on a ferocious beast, and holding his upper jaw with his hand. These images prove, if proof were wanting, that the ancient Peruvians were familiar with silver; and that they regarded it as among the most precious of their possessions, is obvious from their depositing these silver *Penates*, with the remains of their departed friends.

With the specimens of Mrs. Hull, is an image of a large dog, or perhaps a lion, cast in silver, but this appears to be modern, and not to have had any connexion with the rites of sepulture.*

Sketch of the Mine of Pasco, &c.

Among the great resources which Peru enjoys, the mountainous chain of Yauricocha, or Pasco, ranks first; famous in the history of mineralogy, not only for the treasures it yields, but also for the vast mass of metallic ore which it contains, and for a variety of other circumstances which render it worthy of note in the eyes of a naturalist. It is unquestionably difficult to give a complete account of the in-

* Yale College is indebted to Commodore Hull, for a beautiful series of naval historical paintings, and for various minerals and articles of curiosity from Peru, Chili, Africa, and other countries.

teresting particulars relating to this subject, with which all wish to become acquainted, unless the writer is accurately, or at least in some degree a mineralogist, philosopher and merchant. My efforts are not adequate to so great an undertaking; but the desire I feel of giving the literary world some idea of the wealth of Yuricocha, and the manner of working its mines, enables me to conquer the innumerable obstacles which present themselves; at the same time, I hope my readers will be liberal enough to pardon the faults I may commit in so complicated a task. For the sake of clearness, we will divide this subject into five parts.

1st. Physical appearances, and geographical description.

2d. Geognostic description.

3d. Manner of working the mines, and extracting the metals.

4th. The profit and wealth arising from them.

5th. Number of mines, and their produce for a certain period.

Physical Aspect.

The Cordillera of the Andes, united in Cuzco, between the parallels of 14° and 15° S. lat. divides into two branches; the eastern runs to the east of Huanta, Ocopa, Jauja, and Yarma; the western diverges to the west of Castrovireyna, Yauli, Huaypacha and Pasco. Near Huanuco these unite, and continue in this manner some distance. Three branches then rise; the eastern commences between Puzuzu and Muña, the central passes between the river Hualla and Marañon, and the *coasts* of Trujillo and Payta; these again join in Loja. The two branches which proceed from Cuzco, stretching out, surround the pampa of Bombon, the lake of Chinchaycocha, or Reyes, and the range of Pasco. Various colossal summits are seen in both, covered with perpetual snow, as those of Vinda, Potosi, Yaguahuanca, those of Huarochiri, of Oyon, and many others not designated by name. One of these is seen from the ranges of Pasco, which is in the branch of eastern, or royal mountain, dividing the LLANOS of the ridge in which the richest mines are found. The western branch, or, as it is called, the Cordillera of Oyon, inclines to a juncture more rapidly than the other, from the quicksilver mine of Cuypard, forming a regular semicircle; the breadth of the Cordillera from Lima to the termination of the road to Chanchamayo, is between eighty and ninety leagues in a direct line, according to an approximate calculation. Between these branches, as we have said, lies the plain of Bombon, fifteen leagues in length, and differs in breadth from two to four leagues; but it extends along the west, (not under the same name, however,) as far as the mine of Cuypard, which distance is about eight leagues, but is not so level as that of Bombon. It is situated four thousand and sixty metres above the level of the sea, and the lake of Chinchaycocha is seven leagues long, and three broad. The river, called Oroya, runs from it, and joins the Raucas, which has its source in lake Alcacocha, these being tributaries of the Jauja. This plain is similar in its form, situation, and other geological circumstances, to that of Bogota, Lampa, and Mexico. A causeway was constructed by the ancients, about two yards wide, and three and a half long, paved with *limestone*, and is very serviceable in winter, when the pampas are full of bogs. It is between the village of Carhuamayo and the town of Junin. There is also a subterranean aqueduct from the *pasture grounds* of Raeracancha, to Dambo Inga, the pallace of the ancient Incas, the remains of which are found upon a hill which runs through the pampa; this served to conduct the water when the Incas visited the different towns. At the extremity of the pampa, in Bombon, towards the north, you meet with the famous silver mine, called *Colquijirca*, which means a "*mine of silver;* this is about three quarters of a league long, and half a league broad. It is the principal ridge running through this pampa, belonging to the Pasco mine. There are many villages in this plain; also the ancient city of Pasco, situated in the north east, near the skirts of some ridges; the celebrated town of Junin is in the southern extremity, half a league from the lake, totally in ruins, on account of the war of Independence, and of the battle which took place on the sixth of August, about three miles from the city, marking with *positive signs*, the restoration of our rights, and the complete overthrow of the Spanish army. In time of slavery, these plains, which are extremely fertile, were strewed with thousands of animals, as numerous as the palm trees in the deserts of Egypt, and serving as food and clothing for man.

All has been destroyed by the sword and the barbarity of the defenders of tyranny, who burnt many towns. The *mine* of Pasco is surrounded by many chains, which form a circumference; in its centre are the rich mines of Yauricocher, Santa Rosa, and Yauracancha. The range of mountains, which properly speaking, form a central branch with an elevation much less than the other two, encloses different mines, as of silver, copper, iron, lead and combustibles, which cause the wealth of the department of Junin. It continues uninterrupted, until united again a little beyond Huanuco. The chains which form the circle of Pasco, are broken by the *uneven ground* of Quinlacocher, Tulluranco, and Pucayacu; (see the map,) that of Quinlacocha, which opens towards the S. E. serves as a drain for the lake of the same name, the waters of which are employed for grinding with different machines. The others to the N. and E. lead to various engines established in them, and grind with the waters which flow from the contiguous chains; these springs form the source of the river Maranon *formerly* passing by the city of Huacho, in order to form the river Guallagen; but others affirm that the true source of this river is in Lake Lauricocha near Cayatambo. In this *basin* are three lakes, two of them, those of Partacocha, communicate, and that of Quinlacocha which is the largest, serves as a drain to the excavations; there are also some plains in the northern part, called pampas de St. Andres. Whithersoever you recede, towards the north, east and west, you are obliged to descend considerably; so, that in less than an hour, you find a milder climate, and a vegetation no where seen in Yauricocha or Pasco. The aspect of the mines is more gloomy than can be readily imagined. Naked rocks, the sight of which at once indicates the barrenness of the metallic mountains, the people torpid with cold, the want of respiration on account of the tenuity of the air, their clothes, countenances, plainly show the labors which they endure, and the dangerous, disagreeable life they lead in the caverns.—The range of Pasco, is situated in 10° 55′ S. lat. and 75° 40′ W. long. counting from the meridian of Greenwich. Its height is five thousand, two hundred and six yards* above the level of the sea; it is sixty leagues from Lima, and contains about five or six thousand souls, three fourths of whom are employed in working the mines. The houses are irregular, all made of unburnt brick, covered with *papa*, and situated on a declivity at the mining works.—Its climate is very disagreeable, as well on account of the excessive cold, as its height. Its temperature in the months of June, August and September, is on an average through the day 44° Fah.—at night 35°. In these months I observed several falls of snow, and hail in abundance, which made the thermometer descend considera-

* Fifteen thousand, six hundred and eighteen feet; about the height of Mount Blanc, the highest point of Europe.—*Ed.*

bly; and even without this, in the months of August and September, it descended to 28° and 30° below freezing point. The water begins to freeze when the sky is clear, at six in the evening; and even that in the rooms freezes very often; it begins to boil at 180° Fah*. From the middle of October to the end of April, this climate is insupportable, because of snow, hail, and storms which benumb the spirits of the inhabitants, and hinder them from going out of their houses; the lightning also does almost every year, a good deal of damage. No branch of agriculture is pursued here, notwithstanding potatoes, *ocas*, *relloeas*, mocas and barley are of a rigid temperament, and if the last be sown in the rough ground, it does not *produce grain;* but still, good fruits, pulse, and other eatables *are to be found in market*, which they bring from Huanuco, about twenty leagues distant, and from the neighboring villages. The temperature is so severe that the fowls cannot hatch, nor the lamas breed. The women that labor, are obliged to go into a milder temperature, if they do not wish their children to die; but for some time past, those who enjoy any conveniences, are spared this trouble by means of chimneys, which were introduced by the English about two years ago, for although they use the *brasier*, it does not warm them sufficiently. It is observed, that those who have just arrived, and those who are not accustomed to the climate and have weak lungs, suffer from the breast, respiration failing when they stir; here it is called *veta*, since it is believed the veins they dig in mining, produce this complaint; the want of breath (also called borochus,) arises to a considerable degree from the tenuity of the air, owing to the great height; so that even animals fall dead, when *exhausted* by *dragging up* heavy burdens. The disease which attacks the workmen, is the palsy, occasioned by the sudden transition from a high temperature to a colder, and also by the continued use they make of quicksilver.

Those who suffer from this, are called *azogados*. I have seen some, who, in consequence of breathing mercurial vapors for a few moments, were rendered incapable, by palsy, of raising their fingers to the mouth. But the most common disease is the pleurisy or pain in the side, and putrid fever or tabardillo. The first is cured by taking an infusion of *mullara*, a very small herb which grows thereabouts, or with that called "*dead man's bone*." The first plant has very small

---

* This would indicate a greater height than that stated on the last page, since Saussure found water to boil, on the top of Mount Blanc, at 187°.—*Ed.*

leaves, and bears a round red fruit. The second grows in the pasture ground, and has short white leaves.

The employment of the population, as might naturally be supposed, consists entirely in mining. They are divided into two classes. The first includes the proprietors; and the second those who refine that portion of metal obtained by the miners and which they work by shares, called *huachacas*, and also that which some others get by fraud. The immorality observed in every mine of Peru, is owing to the indifferent education our ancestors have given us; in consequence of the facility with which we obtain the necessaries of life, there is very little regard for silver.

Jealousy, intoxication, assassinations, &c. are the vices most common in mines; this is the reason why the vast estates of the proprietors, and the emoluments which they acquire from time to time, are consumed; they often throwing the blame upon the miners, of whose faults they are themselves, for the most part, the cause, and not charging it to their own bad management; losing in this manner, the credit and confidence of those who could be useful to them. Nevertheless, there are persons to be found, worthy, as respects their conduct and untiring perseverance.

Geological Description.

Geology, which has for its object, the knowledge of the different terrestrial strata of which our globe is composed, is of the greatest importance to the mineralogist, since in proportion to the knowledge he has of this subject, he can with more facility carry on a work with advantage, and with more or less certainty.

The layers of which our planet is composed, are divided by geologists into four classes; the primitive, secondary, transition and alluvial. The first is distinguished by their not containing remains of organical series, and because they are composed of crystals deposited confusedly, and they occupy the most interior part of the globe as far as we know. The transition lies upon the primitive, and contains the earliest vestiges of animals and plants, and consequently belongs to a previous creation. The secondary contains vast quantities of the remains of animals and vegetables, and lies almost always upon the transition, and generally in horizontal strata. The alluvial is composed of the ruins of the primitive, transition and secondary soils, and contains frequently remains of amphibious animals and fish; they lie upon the secondary, and sometimes upon the primitive.

There is another class of formations, which is abundant in some countries, namely, the volcanic, formed by a cause, opposed to the preceding; provided we are authorized to attribute the former to water in which its particles have been dissolved or suspended, and the second we must of course attribute to subterranean fire. The formations which compose the mineral chains of Pasco and its environs, are worth studying; they furnish interesting data for geological investigation, confirm the observations made in different countries upon the position of the strata, and render more clear the invariable law, that only in the *gres* or sandstone of the secondary is found the combustible called *stone coal.* As for myself, I have always observed it in Colombia and Peru, in forms like those of St. Stephen, Wetin, Sarbruck, Newcastle, Liege, &c. It nevertheless confirms the important observation of Humboldt, that in America the primitive soils do not contain the metallic repositories, but they are contained in the transition and secondary. This is the case with the greater part of the mineral districts of both republics with which I am acquainted. But I will not confine myself to a delineation of the relative existence of the strata, nor to a comparison of them with others, but will only give a description of them, that more learned geologists may draw the conclusions, which these observations enable them to do. The predominant rocks which compose the ledge of Yauricocha, and extend many leagues both north and south, are granite, blackish *esquito*,* sandstone, red porphyry, blue limestone and conglomerate. The black *esquito* occupies the lower part of the geological centre, which is, to appearance, in all the space comprehended between Lake Quinlacocha and the mine of Ayapota and the foundery, extending to the north and east. I have traced it to the foot of the Pargas ledge: passing by the mines and *vent holes of the machine*, it is seen again in the north, in the mines near the church of Yauricocha; and a proof that it passes it, is, that it is found in the thirteenth *lumbrera*, made in the gravel of Ayapota. The direction of this formation is from north to south, inclining to the east; and from what I have observed in the excavation of Quinlacocha, perforated in this rock, it undulates as much on the surface as in the interior, and divides into strata. The grain of

* We are not certain what rock is intended by the *esquito*, but from its associations, contents and characters, have concluded that it is *argillaceous slate.*

this *esquito* is fine, of a darkish color, and very hard: it contains particles of mica, and small veins of iron pyrites and white quartz, run indistinctly through it. The miners, on account of the yellow pyrites, and of the hardness of the rock, which does not permit the four men who work in the excavation to advance more than two yards, call it bronze. The stratum in the mass, bears the same name, and in the extension of it, pyrites are found in mass, in almost all the mines, and especially in those of St. Catalina, St. Rita, the excavation of Yauacancha, and the mines north of the church of the same name, since all those in this line are perforated with this substance. The pyrites are decomposed as much in the interior as the exterior of the mines, and produce sulphate of iron, or a whitish sort of copperas; this salt is found in abundance, chiefly in the excavations of Yauacancha. The *magustral* is made of these pyrites, by first calcining it, in order to reduce it to an oxide; it also contains a considerable quantity of silver, and would defray the expense of working it, if they knew how to extract the precious metal from this kind of ore.

The *esquitoso* soil mentioned, which, from all the qualities and circumstances attending it, belongs to the transition class, ought to contain the *pyritose* strata, and with them the silver, since those which Trinidad, St. Catalina, St. Rita, St. Philip, &c. afford, prove, that from the decomposition of this, proceeds the silver now extracted; and although the miners do not think so, this supposition is confirmed, by observing that in the deep mines the metals are always accompanied by this stratum, and very often they unite and form a mass. Upon this soil rests the *gres*, as in the neighborhood of Lake Quinlacocha, in Uliachin, Pargas, Suco, and in the whole circumference comprehending the formations known to be metallic. The horizontal strata have a direction from north to south, inclining to the east, and are plainly seen in the hills of Uliachin and St. Juan, in which is observed a certain correspondence in the opposite strata, which are interrupted only by the mineral bed, in the cavity of which the diluvian waters remained a longer time; for this conclusion is naturally founded upon what remains in the lakes existing in this cavity, and the many which are scattered about at a short distance from the place. This formation extends many leagues, being the same which I have observed in Punco, Lampa, Chucuito, Huaypacha, Yauli, and the neighborhood of Tarine. It contains every where stone coal in considerable beds, as in the exploded mine in Raucas, in Curaopuero, road to Vinchos, heights of Tulluranca, in the chain of Alconoculpan, lake of Huisque and Huarochiri. In all the rugged land which surrounds the ledge, as in the pampas of Bombou, the highlands of Pargas, Vinchos, Cuypan, Vruda, &c. this formation is visible and extensive; the *gres* is red, with yellow and white spots; its grain is fine, rough to the touch, and passes insensibly to the white, and argillaceous earth alternating with strata of compact, white and blue limestone, and red and green porphyry. In this sandstone or red *gres*, has been found in small quantities, the *cinnabar*, near the tenements of St. Lovergo, which is not strange, because the soil is just like that of Cuypan, and lies in the same direction. This *gres* is varied by a darkish *esquito*, in the strata, of small bulk, with limestone full of shells, (height of la Vinda,) and with a *cuarzolidio* or touchstone, (chain of Colquijuca.) From the center of the mine, some promontories of a quartzose rock, full of cavities, rise up, of a yellowish color, like the ochre of iron; within it is of a dirty white, with a conchoidal fracture; it passes in some pieces to flint, but its qualities indicate it to be a quartzose porphyry, (hornstein.) Many fragments, and other pieces extracted from one of the sky lights of the excavation, show the *pudinga*, (puddingstone or conglomerate,) distinguished by iron pyrites and white quartz. This composes all the hill of St. Catalina, hills of Yauachancha, Chaupimarca, Caya, St. Rosa, Fraguarmachay, and extends to Ayapota, &c. In the interior of the mines, it passes to a decomposed *gres*, as in the mines of St. Augustin, Descubridora, the great mine of the Ijarras, of Tingo, &c. the grain of which is loose, is not as hard as that of the former, and is more mixed with the oxide of iron. This rock is the gangue of metals known by the name of *pacos*, which compose all the soil of St. Rosa. Here no stratification is perceptible on the surface, nor in the interior; it is nothing more than a shapeless mass of metals extracted in abundance, without the necessity of gunpowder. Thousands of loads are here found, about five or six marks in value, which do not defray the expenses, when the quicksilver is dear. The metals exploded in the mines which have been mentioned, are extracted from a very distinct stratum, which is found decomposed in this rock, and another of pyrites. There is a dispute whether it is really a stratum or a vein; the miners commonly call it a vein, and Trevithich, a miner and engineer of Cornwall, who was some years in the mine, has fallen into the same mistake. No quality or sign favors this supposition.

Upon the gres, rests the white *Alpine limestone,* (so called from being the same in form with that of the Alps,) as in the acclivity of Uliachin, Yanamente, chain and pampas of St. Juan, shores of Quinlacocha, Colquyurca, *Vinchos* and *Pargas.* The conglomerate is well distinguished, as in the rocks of Suco, and Chaquïlguanca, where it makes a grand fortification, of more than three hundred yards high. The calcareous formation is the most extensive, since it may be said to be the most common matrix of metals of silver in this place; all to the east of Yauricocha, the contiguous rough grounds and hills of the plain of Bourbon, are composed of this rock, which forms horizontal strata, inclining to the east, and in some parts, as in the broken land of Quinlacocha, and shores of the River Ranca, it is frequently observed in the zigzag form; and in the broken land of Uliachin and St. Juan, the strata appear perpendicular, from the excavation which the taza of Yauricocha forms. This limestone is blue, and semi-compact, and contains veins of calcareous white spar; the shells are scarce, and in it are some metallic strata, principally lead, and sulphureous pyrites, which produce silver. In the hill of Vinchos, this formation is more extensive, and lies more distinct, as is seen in the road from Pasco to this point, and principally in the height of Chaguanaco, and rocks contiguous to Chaquilguanca; but descending to the deep uneven ground of Janio, the gres insensibly disappears, and passes to an argillaceous esquito. Vinchos is rather valuable, owing to its strata being composed of lead and pyritous minerals; it has three peaks which are called Maman Vinchos, Guaquan Vinchos, and Riuam Vinchos. All three are composed of blue limestone, half decomposed on the surface; presenting inequalities and roughness, which prevent the traveller from ascending to its summit; the calcareous strata are almost horizontal, and those of the lead veins have the same direction; and are in the mine from a half a yard, to a yard wide. In that of Descubudora, which is the most celebrated, the stratum is about twelve inches broad, and one is composed of pyrites, which are ferruginous and very compact; this prevents the mine from being worked to advantage; almost all this ledge is traversed by metallic strata, the minerals of which, yield at least from eight to thirty marks the cajon; but there is a great inconvenience arising from the want of instruments and combustibles, for the foundery. On the north, the soil continues forming slopes, and contains many strata of pacos in the gres, extending almost as far as the village of Mosca, in the neighborhood of which, are found the labaderos of gold. Very near the village of Pallanchacu, there is a considerable stratum of stone coal, which is worked from time to time. In Cuypan, the limestone lies also upon the sandstone, and in other parts upon the conglomerate; the strata are very white, less compact, and contain small shells; the metallic stratum is argillaceous and calcareous, it contains the cinnabar, and balsonadas of cinnabar, more or less spacious, are found in these mines, with remains of lignite. In general, the gangue of this metal, is calcareous, or argillaceous, of the color of ashes, and in both, it is scattered in small quantities, since they do not yield more than one *arroba* the *cajon.* In Colquijarca is observed a whitish limestone; in some layers it is compact, in others, crossed in every direction, by the crystallized calcareous spar, which prevents the extraction of large masses for lithography; it alternates with a green argil of some yards in bulk, as is plainly seen in the excavation Don Miguel Otero is making, which commences at the plain, and cuts, perpendicularly, the metallic strata which run from north to south. In this calcareous rock, are found three narrow strata of stone coal; the *gres* and quartz rest upon it, the aspect and characters of which are very similar to the flint, which forms the gangue of the metals of silver, in this chain. When many strata unite in the centre, they form masses which are extremely rich, and many yards broad, and they are all composed of minerals, which produce from twenty five to thirty marks, as has been the case in the mines of Leonera, St. Frances, and others. On the surface of this chain, is the quartz, in appearance, half decomposed, and full of cavities, forming a distinct line, known to be the metallic strata, actually explored.

Huaypacha.

This mine is situated in a narrow inequality of ground, and along the shores of a river of the same name. On the west side, near the estate of St. Domingo, the granite is found very well marked, which serves for the engines; its color approaches a red, the crystals of felspar and mica are visible; it passes, in some pieces, to the fine granite and gneiss, and forms a small pointed island in the sea; which is sloping and of some extent; on the east, you find the micaceous and argillaceous slate, of a greenish color, which is easily decomposed, owing to the many veins of iron pyrites. Upon this is observed a green compact rock, very hard, tenacious and like *greenstone*, with veins of white quartz; in others it has the appearance of serpentine.

The *grès* lies distinctly upon this in horizontal strata, from north to south, inclining to the east and varying with the limestone just like that of the *Pasco Ridge*.

A stratum of green porphyry with crystals of felspar, presents itself at the entrance of the break through the road of Junin; it is about a yard wide, and varies more or less in its inflections. In this calcareous and sandy formation, are the mines of our Senora de la O, Chiriquiquira, Descubridora, Copacabana, Trinidad, &c. In the first, the stratum has for covering a loose grès; for a wall, a dark calcareous sandstone, half a yard wide, and extremely vitreous; the metal is an argentiferous oxide of iron, with copper pyrites, with pavonine spots. The summits of these ridges are all of limestone, and in it is found the notable stratum of *lignite*, a league and a half from the place, and which has been wrought by the miner *Loli*, after having at first extracted large pieces of this fossil, which plainly indicate its origin. Also the limestone varies with a stratum of white compact yeso, in the road to Tarma, half a league from Huaypacha, along the shores of the river. This yeso is like that which exists at the foot of the ridge of Chiacha, near Hualley; from which a brackish water issues. In all the breaks which surround the ledge of Pasco, the limestone is seen changing with the sandstone, in strata, sometimes horizontal, sometimes perpendicular, according to the directions the breaks assume; in the ridges of Sacra-familia, and shore of Quinlachocha, sinuosities plainly appear. In the breaks of Pucayau and Tulluranca, a limestone is found which appears of more recent formation than that of the chain; it is a mass which contains separate pieces of black limestone, semicompact, united by a dirty black cement, similar, on the whole, to the puddingstone. With this rock they make the grindstones of the engines, which last two or three months; descending by these breaks on the north, you go as far as the gold mine of Quinau, distant two leagues from Pasco. In the bottom of the valley, you meet with a very interesting formation, seen only here and there, because the sandstone covers it. On entering the valley, (even in the break itself,) you find a white semisaccharoidal rock, in which are distinctly perceived shining plates, which reflect the light. It contains fragments of the white conchoidal, hyaline quartz, spangles of green talc, and small pieces of pyrites; it appears to be of felspar. It serves for the stones of the engines which grind the gold metal. Inclining towards the rivulet, it meets a rock, which at first sight appears to be a porphyry, but upon examimation, it is found to be a decomposed granite, in which the quartz, the mica and felspar which compose the green cement, are discovered. It contains a vitreous substance, yellowish green, like the peridot, but in the other pieces it is found to be rather a garnet: on the other side of the rivulet, there is an elevated chain, called Chuquitaniba, in which are found gold mines; this is composed of sandstone, quartz, and hornstone porphyry, and forms a stratum of considerable extent and bulk; in this lie the auriferous cubic pyrites, and the green carbonate of copper. These pyrites have been exploded for a long time back; it varies with the argillaceous slate, which also encloses the same cubic pyrites. The cajou of this metal yields from four to five ounces, the gold is of the best quality; and the metal is so abundant in this, and the ridges of la Quina, Chiquirin, and Huanacuanca, that there is enough for many years. It is stated that there are found in the neighborhood, ores of quicksilver, of rather good quality. An interesting formation of granite, well characterized, but of little extent, is found in the heights of Pargas, (see the map,) and appears similar to that of St. Gothard, of Hogblin, in Norway; and to that of the heights of Tucto, Cordillera of Yauli. It forms in both parts strata distinctly disposed, reposing upon a black, leafy slate, in Pargas, and upon the sandstone, in Yauli. The quartz is transparent, with conchoidal fracture; the felspar is white, in large and well formed crystals, and also in small ones, constituting the base of the rock; the mica is in very black hexahedral prisms. The granite is not very fine, but that of Tucto is more so, and does not contain the felspar, so well formed. This formation is to all appearance modern, and always found in the summits of the Cordillera, as the learned geologist, Humboldt, has observed, serving as a base to the traquito, as in Hually, although this appears to be a granite, entirely decomposed, since it has all the substances which characterize it. In Pargas, this formation is accompanied by a whitish compact limestone, towards the North; towards the South, by a black slate; and towards the East and West, by the sandstone; but pursuing its direction, it extends to the pampas of St. Andrews, in which is found the black slate, upon which it probably lies. This granite decomposes, and changes to a white granular rock, in which the quartz abounds, and in other pieces is the felspar, without any signs of mica or quartz. The miners use this rock for the grinders of the engines, and then it bears the name of *fly's wing*. On the West of the mine, at the distance of three leagues, is the insulated chain of Raco, in the form of a cylinder mutilated at the top; it is composed of a fine grunstein, with crystals of amphibole: it is very hard, and of a bluish color, with black spots. This rock is the same with that found in a considerable stratum in the grès, at the ascent of Pigchaca, on the road Pinchos, and Chalaya, road to Tussy. The mill-stones of the engines, on the river of Quinlachoca, are of this stone.

Manner of working the Mines, and extracting the Metals.

The mines of Yaurichocher, (the proper name is ridge of St. Stephen, of Lauricocha,) were discovered about the year 1630, by an Indian, called Huari Capacha, a shepherd of the estate of Paria, to which this tract of land belongs. As he was one evening feeding his flocks, in Santa Rosa, he made a fire to warm himself, and at the same time to prepare his scanty meal; the stones he collected for the hearth, and those at the bottom, melted, and he discovered threads of silver. Being pleased with this phenomenon, he went immediately to the town of Pasco, two leagues distant, which at that time was the seat of the mine, and all its inhabitants worked in the chain of Colquijirca, celebrated for its numerous and rich metals. The discoverer spoke to D. Joseph Ugarte, showing him the stones he had picked up; this man set out for the place, and convinced of the truth of the accounts of the native, began to work in St. Rosa, and was exploding with the greatest success. On hearing of his mines, many resorted thither, and among them, D. Martin Retuerto, who worked the mine of Lauricocha, making the first excavation in it. D. Joseph Miguel Maiz, in 1740, bought of the heirs of Retuerto, this same mine, and directed an excavation to the same part, concluding it in 1760. Maiz, who undertook it, obtained the favor of styling himself "Marquis of the Royal Confidence," and by virtue of a great quantity of quicksilver, he extracted the precious metal from the Cajas, and faithfully fulfilled his engagements. When it was known that the metals were rich and productive, the Salcedos came from Puno, to work in Yaurichoca and Pariajurca; this property afterwards fell to the family of the Arrietas. All the mines produced thousands and thousands of marks, extracted solely from the Pacos. But when the steam engines were introduced, in the year 1816, by a famous contract between the Messrs. Abadia, Arismandi y el gremio òr, and the corporation of miners, they began to make deeper excavations, and find the rich pavonine ores, the polvorillas, and native silver, and while they were making the three machines of Yaurichoca, St. Rosa, and Caya, there was considerable profit, although they did not dig more than fifteen yards below the excavation of St. Judas, where there ought to have been forty, according to the contract. The drain of the mines of the ridge was made by an excavation, and a machine now totally in ruins. The excavation begins from the Lake of St. Judas; it has an opening of about four hundred yards, and afterwards continues under ground; in Portachuelo, it divides into two branches, one of which goes to Champianca, towards the East, and the other from Yaunancanca to the North. The eastern branch runs along near the mines of Trinidad, Descubridora, St. Augustin, &c. as far as the church of Champemarca; the northern range, passes by St. Philip, Caya, and goes very near the church of Yanachanca; but in reality, the greater part precipitates into Chucarillo. The excavation is about two yards wide, and two and a half high, its length is from twelve hundred to fourteen hundred yards, to the portachuvelo; this work has cost the miners more than one hundred thousand dollars; Don Viente, Amivisea y Don Bernado Cardenas, were promoters of it, in 1780, and it was finished in 1800; but its branches continued to be worked until the year 1807, by the Messrs. Maiz, Alverez, and Cordero. Upon the excavation of St. Judas, is the sky-light of St. Rosa, which has about forty yards to the excavation; this has been dug by the company, twenty yards below the surface of the excavation; but on account of the excessive hardness of the soil, in which twelve men could only dig half a yard a month, they could not finish the forty yards of contract, and were obliged to fill up six yards, and at twelve they drew a *rasgo* for the mines near the Cumbrœra, of Yauricocha. This rasgo is about a yard and a half wide in some places, in others less, and about a yard and a quarter high. Owing to bad management they lost four or five yards of its level, and for this reason the waters do not reach the mine Descubridoria, or St. Augustin, &c. for some days. With this rasgo the rich mines of St. Catalina were drained, but in proportion. The company of miners observing that the excavation of the mineral was expensive, and that the excavation was not sufficient, they took in hand that of Quinlachoca, which has its origin in the lake of the same name. This all important work, which will make the Peruvians happy, has met with a thousand accidents, both on account of the numberless disputes among the miners, and the errors made in the excavation of it. The companies of speculators have greatly contributed to paralyze it. The work was begun in Quinlachoca, in the month of September, 1825, but the perforation had reached only about forty yards, in the month of January, 1827, and the expenses amounted to from thirty five to forty thousand dollars, and probably the latter sum is not beyond the truth.

The general directors of the mine being informed of the suspension of the working of the excavation; they attempted to prosecute it farther; soliciting at the same time, aid of the government, and inviting the return of the miners. In fact, they obtained from the government two thousand dollars every month, and from the miners their consent. I removed to the chain and set to work in the excavation on the 1st of June, 1827. We have now three *fioutones*, and shall soon have two more, unless they drain the waters of the thirteenth vent hole, perforated in the *cascajo* of Ayapoto, which is very near the plains of the excavation. The machine will then have no effect, because the plains being lower than the vent hole in which the machine is, its waters must tend towards the general drain. Two other excavations are begun; that of Rumillana begins in the break of the same name. That of Avellafuerte having its origin in the lake of St. Judas, inclines towards the church of Yanacancha; it was begun but not continued, because the capital failed. By this the rich mines in the pampa of St. Andres and Matajente might be drained. The two excavations worked by the company, received an assignment of twelve thousand dollars and two reals from the bribunæ. At first, twenty four thousand dollars were given by the court; afterwards abated to twelve thousand. In the excavation of Quinlacocha alone, until the year 1820, they expended two hundred and forty seven thousand dollars. The drain by means of the steam engine, is very defective, because it is not permanent. The workmen have endeavored to remedy this evil, by placing a box upon the piston, but to no purpose. The cylinder is twenty five inches in diameter; the play of the piston is five feet, and it makes three strokes a minute. The caldron is seven yards, twenty three inches long, and two yards, sixteen inches in diameter. This machine is on the high pressure principle, and constructed after the invention of the engineer Trevithick; at present, it raises the water from thirty six to thirty eight feet above the plains of the lumbrera to the excavation of St. Judas. The water of the mines, by means of the sulphuric acid and sulphates it contains in solution, destroys the body of the iron pumps and the caldron; it has been observed that those of the copper are not so easily attacked, and it would be more convenient for the future, if other machines were used, to have the pieces which come in contact with the acid, of the same metal. The iron mines are situated about Yaurichoca, St. Rosa, Caya, Yanacancha, and Matajente, extending a league in length, and a quarter in breadth. About five hundred and fifty eight mines are found here, and all are more or less productive. In Caya, are many rich mines belonging to Vivas and others; in Yanachanca, are found those of Rosarios, Aninus, Jesus Nazarene, San Judas, &c. belonging to the miners Vivas and Maturna. It is affirmed, and not without foundation either, notwithstanding the short time the machine was at work there, that this place is richer than all the others put together, but now there is not a particle of metal extracted, because it must be worked under water. Matajente was once the richest point of the chain, and the excavation as well as many other points exposed to view, confirms it. It was ruined by an accident, by which three hundred workmen were buried. If the excavation of Yanachanca, as well as that of Avellafuerte, were brought to this point, very rich returns of metals would be obtained, which would repay all labor and expense. All the mines of Yaricoche are very badly wrought; no art or economy is observed in the caverns; the lives of the men are exposed, the moment they set their feet on the threshold of an aperture in one of these mines; the method they have observed and still pursue, is to open upon an eastern exposure, some air holes of various dimensions, all inclined according to circumstances. Then they pursue the stratum, making tubes of the space; in others they make spacious arches, without leaving buttresses or bridges, as in the mine of St. Catalina and Trinidad. The system of galleries in a series, and the communication from one to another by the circulation of the air, and facility of the transportation of the minerals is not carried on in perfection, and they only make wells with the same irregularity which they practice in making the air holes. They set the laborers to work without any distinction, not pursuing the more easy and economical method practised in Huaypacha, and in the mine of Victorias, in the department of Puno. The air holes are so badly made, that there are dangerous intervals for want of steps to place the foot, and also for being ill secured by planks. As the wood is very dear, they make continual use of the limestone found near, to fortify the spaces which need it; when there is a proportion of enmaderar, they do this, and then the pieces cut off are called *tincas*, which last in proportion to the quality of the wood, and to the weight they have to sustain. The excavations of St. Judas and Yanacantha, are lined with tincas. The tree of *queñua*, which grows in the Cordilleras, lasts longest, and I have seen pieces pulled out of old mines perfectly entire.* The mines of St. Cataline, Great Mine, Trinidad, St. Augustin and St. Rite, which are below the line, have pumps, worked by the Indians, twelve inches in diameter, settled in square *calderas*, well lined, from eight to ten yards deep; in each one of them are two pumps, but in the first three mines are three stocks which throw from the first *caldera*, to the second, and this to the line; from the bottom of this *caldera* to the second, and this to the line; from the bottom of these *calderas*, they construct pipes, to the north and south, with a certain inclination, to extract the metals; and the space they leave is filled with stones and rubbish. The workmen enter the mines by *puntas*, and are ten or twelve hours, some pumping and others extracting the metal and sending it to the place of deposit, which is nearer the entrance; those in the interior, rest three times in the space of half an hour, and this they call *acullio*.

* * * * * * *

The sequel of the memoir, may be given in the next number.

Art. VI.—*Geological Prodromus; by* Prof. A. Eaton.

It having been announced in public journals, that Mr. Van Rensselaer had ordered an extension of his geological surveys, and Mr. Cortlandt Van Rensselaer and myself having already travelled between two and three thousand miles, the present summer, in pursuit of geological facts to fill up the chasms of former surveys, public curiosity may be in some measure gratified with the following:—

---

* There is in the cabinet of Yale College, a piece of perfectly sound wood taken from an old Roman work in a mine which was wrought more than fourteen hundred years ago, and the wood is supposed to be of that age.

I intend to demonstrate, by references to localities of easy access, that,

All geologial strata are arranged in five analagous series; and that each series consists of three formations; *viz.* the Carboniferous, Quartzose, and Calcareous.

APPLICATIONS.

FIRST SERIES.

1st. *Carboniferous formation.*—Primitive slate rocks, as gneiss, mica-slate, &c. contain plumbago; often in large quantities; as in Sturbridge, Mass.; on Lake Champlain, &c.

2nd. *Quartzose formation.*—Granular quartz; as in the west part of Massachusetts.

3d. *Calcareous formation.*—Granular limerock; as in the west part of Massachusetts.

SECOND SERIES.

1st. *Carboniferous formation.*—Argillite contains anthracite, passing into plumbago; as in Worcester, Mass., Providence and Newport, Rhode Island; Troy, New York.

2nd. *Quartzose formation.*—First graywacke, including the rubblestone or conglomerate; as in Rensselaer county; Shawingunk Mt. in New York, &c.

3d. *Calcareous formation.*—Sparry limerock, calciferous sandrock, and metalliferous limerock; as in Rensselaer, Albany, Columbia, Herkimer, and Oneida counties; near the base of Catskill Mountain, &c. This underlies the slate containing the Lehigh, or Lackawannock coal in Pennsylvania. It is called the lower carboniferous limerock by Conybeare, Bakewell, and others.

THIRD SERIES.

1st. *Carboniferous formation.*—Calciferous argillaceous slate; being the lower division of second graywacke. It embraces the Lehigh, or Lackawannock, coal range in Pennsylvania, and underlies the conglomerate or millstone grit near Utica, is at the basis of Catskill Mountain, &c.—Note. Bakewell quotes Farey's name, *limestone shale*, for this rock, because it always reposes on limestone.—Note 2. Second graywacke contains tropical vegetable petrifactions, which entitle it to a place in the secondary class; a fact not known to me until this summer, (1829.)*

* In the lower secondary strata, the organic remains belong almost exclusively to the vegetable kingdom, and are analogous to the native plants of warm tropical climates. See Silliman's Bakewell, p. 109.

2nd. *Quartzose formation.*—Millstone grit, red sandstone or saliferous rock, rubblestone, common graywacke; as near Utica, in Catskill mountains, in the mountains of Pennsylvania over the Lehigh range of coal, &c.

3d. *Calcareous formation.*—Geodiferous and cornitiferous limerock, as in Lockport, Black Rock, Seneca and Cayuga Lakes, under the Tioga or Lycoming coal, top of the Helderberg Mountain in Albany county, &c.—Note. Bakewell calls this the upper *carboniferous limestone.*

FOURTH SERIES.

1st. *Carboniferous formation.*—Pyritiferous slate. It embraces the Tioga, or Lycoming coal, in Pennsylvania. It forms the south shore of Lake Erie, chief of the banks of Seneca and Cayuga Lakes, the banks and bed, at the upper falls, on Genesee River, &c. It is the pyritous shale of Whitby in England, or it might be called the upper *limestone shale* of Farey.

2nd. *Quartzose formation.*—Pyritiferous grit, conglomerate or rubblestone, ferruginous sandstone, and coarse graywacke; as on the Genesee River, near the line between New York and Pennsylvania, &c.

3d. *Calcareous formation.*—The oolite lately discovered in large fields in Ohio.—Note. The chalk of Europe belongs to this formation.

FIFTH SERIES.

1st. *Carboniferous formation.*—Plastic clay and marly clay, (London clay.) They embrace the lignite, or wood coal of New Jersey, in a regular stratum of great extent; as may be seen in the south bank of the bay of Amboy, from Middletown Point to the Cheesequake Creek.

2nd. *Quartzose formation.*—Marine sand, (or Bagshot sand,) which overlays the marly clay in almost every part of North American.

3d. *Calcareous formation.*—Shell-marl. This is justly entitled to a place among the general strata; for it is almost universally deposited in the bottom grounds of both continents. We find it in the elevated bottom grounds of the primitive Green Mountains, as well as in the vast low grounds and swamps of the western secondary class.

SUBORDINATE SERIES.

Some of the general series embrace subordinate ones, which are of an extent more or less limited. The formations of subordinate series are always analogous to the general series, excepting that they do not embrace carboniferous minerals.

Example 1st. The third series embraces a subordinate series, about two hundred and forty miles long, and twenty miles wide; which runs along the south side of Lake Ontario, commencing near Little Falls. It is interposed between the divisions of the quartzose formations of the series; to wit, the saliferous rock and shell grit.

1. Carboniferous formation. Ferriferous slate.
2. Quartzose formation. Ferriferous sandrock.
3. Calcareous formation. Lias, embracing the gypsum.

Example 2nd. The first series embraces a subordinate series near the west line of Massachusetts. It is interposed between the calcareous formation of the first, and the carboniferous formation of the second, series.

1. *Carboniferous formation.*—Gneiss, and talcose slate; as all the eastern part of Saddle Mountain near Williams College.
2. *Quartzose formation.*—Granular quartz; as the west part of Saddle Mountain, &c.
3. *Calcareous formation.*—Granular limerock; as all the valley near the west line of Massachusetts.

CARBONIFEROUS ASSOCIATES.

Ores of iron and manganese are generally associated with the carboniferous formations.

First Series.

Protoxide of iron, and peroxide of manganese are found in and near the Green Mountain and Champlain range. Hematitic iron ore, and peroxide of manganese are found in the subordinates of the first series; as in Salisbury, Con. and Bennington, Vt.

Second Series.

Hematitic iron ore of the Elba variety, and argillaceous manganese, are found in carboniferous slate of this series, in Rensselaer and Columbia counties, New York.

Third Series.

Lenticular iron ore is found in the subordinates of this series, and argillaceous manganese in the carboniferous slate; as the iron in all the subordinate range, and the manganese in Blenheim, New York.

Fourth Series.

Reniform argillaceous iron ore is found accompanying all the Tioga or Lycoming coal; and small quantities of argillaceous manganese.

Fifth Series.

Bog ore and iron stone are found with the lignite coal of New Jersey—also in the same geological association from Fort Ann to Coxsackie, a distance of eighty miles on the west side of Hudson River.

I intend to demonstrate, that THE DETRITUS OF NEW JERSEY, EMBRACING THE MARLE, WHICH CONTAINS THOSE REMARKABLE FOSSIL RELICS, IS ANTEDILUVIAL, OR THE GENUINE TERTIARY FORMATION.

Between South Amboy and the Neversink River, a distance of about twenty miles, the marine sand (Bagshot sand) reposing on the marly clay (London clay) is continuous, excepting some narrow channels and very limited denudations. The plastic clay appears beneath, the marly above and near the level of the bay, for a distance of about three miles from South Amboy. It there seems to sink beneath the bay, leaving the bank of marly clay and marine sand in view.

Ferruginous conglomerate and ironstone, are embraced in the marly clay, in one continuous stratum, varying in thickness, throughout the whole distance from South Amboy to the Neversink. Between the Cheesequake and Matavan rivers, a stratum of lignite or wood-coal, consisting of charred *cauline* plants, above and in connection with the ferruginous conglomerate and ironstone, is entitled to a visit from every American geologist. It consists, mostly, of charred wood of a large size, every where mineralized with iron pyrites. It may be seen in one uninterrupted stratum, three or four miles in extent. Trunks of trees, more than twelve inches in diameter, may be obtained here, most perfectly charred, and mineralized with the pyrites.

Between the Matavan River (called Middletown Point River) and the Neversink, very interesting beds of marle are embraced in the marly clay. Perhaps it is more correct to say, that the marly clay passes into this marle. As these beds have been described under the title of marl pits, in several public journals, I will merely state, that they are rich in fossil mineralized relics, perhaps without a parallel. The bones, shells, &c. embraced in them, are well preserved, by being mineralized with hydrate of iron, &c.

I intend to shew, that THE LEHIGH OR LACKAWANNOCK COAL, OF THE STATE OF PENNSYLVANIA, IS EMBRACED IN THE SECOND GRAYWACKE, AND BELONGS TO THE SECONDARY CLASS.

I placed this rock in the transition class, but it must be removed to the lower secondary; because petrifactions, peculiar to the secondary class, are found in it. See note, page 64. I think that the vegetable origin of this coal is very manifest. If we suppose a vast coal pit, consisting of an immense broken down forest of palm trees, with an undergrowth of reeds, ferns and coarse grass, deeply covered with earth, and highly, but unequally, heated with under flues, so that some parts would be slightly charred, leaving the entire forms of the vegetables charred, other parts heated to fusion, we should have exact prototypes for these coal beds.

The thin layers of coal in Catskill Mountain, are in the same continued stratum with the Lackawannock coal.

I think I have facts sufficient to prove, that THE TIOGA COAL IS EMBRACED IN THE THIRD GRAYWACKE, OR UPPER SECONDARY of Bakewell and others. It consists chiefly of charred palms, and reeds also, where the charring process has been imperfect; but ferns seem to be considerably abundant also. Would it be extravagant to say, that this district was once covered with vegetables of the *culmiferous and stiped* kinds, before a *cauline* plant was created? Also that they were swept from the high grounds into the valley and covered deeply with earth? That great and long continued heat was applied, by which these vegetables were charred?

The thin layers of coal at Ithaca, Seneca Lake and Lake Erie. are in this same stratum.

NOTICES.

I have now personally examined and compared the geological strata of New York, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New Jersey and Pennsylvania, under the direction and at the expense of Mr. Van Rensselaer. I have received complete suites of specimens, from Dr. Z. Pitcher, Mr. R. Peter, and others, exhibiting the entire geology of the circuits of Lakes Superior, Michigan, Huron, and of the states of Ohio and Illinois. The territory which I have personally examined and reviewed, mostly several times, is more than double that of all Great Britain. And I have before me specimens illustrative of more American territory, than all Great Britain, Ireland, France and Switzerland. I have free access also to specimens illustrative of the general geology of Europe, and the minute geology of some of the most important localities.

As soon as time will permit, I shall endeavor to discharge my duty to Mr. Van Rensselaer, and to the public, by condensing, in as small a compass as possible, every thing of importance which has fallen under my notice, relating to the mineralogical resources of this district, accompanied by a geological map of the state of New York.

A. E.

Rensselaer School, Troy, July 28, 1829.

N. B. Any statement of facts, calculated to explain the geology of any part of North America, addressed to Mr. Cortlandt Van Rensselaer, of Albany, will be thankfully received. But it must be understood, that we may take the liberty to express the subject matters of such communications in our own condensed manner; and that we introduce and leave out, according to the plan of the proposed geological report and map.

Art. VII.—*Solution of a Problem in Fluxions; by* Prof. Theodore Strong.

(Continued from Vol. XVI. p. 283.)

TO PROFESSOR SILLIMAN.

New Brunswick, July 29, 1829.

Dear Sir—You will oblige me by inserting the following continuation of my last paper in the next Journal. Yours respectfully,

T. Strong.

The same notation being retained; I assume $\frac{d^2x}{dt^2}=-\frac{xF}{r}$, $\frac{d^2y}{dt^2}=-\frac{yF}{r}$, $\frac{d^2z}{dt^2}=-\frac{zF}{r}$, (g); $\therefore F=\frac{\sqrt{(d^2x)^2+(d^2y)^2+(d^2z)^2}}{dt^2}$, (h); (b) becomes identically $F=F$, and $d\left(\frac{xdy-ydx}{dt}\right)=0$, $d\left(\frac{zdx-xdz}{dt}\right)=0$, $d\left(\frac{zdy-ydz}{dt}\right)=0$, (i); $\therefore F'=0$, $F''=0$.

Equations (i) show that the particle is not acted on by any force except F, in the direction r. Indeed (g) are the equations that would result from the decomposition of a centripetal force, F, (acting in the direction r,) in the directions of x, y, z, respectively. The integrals of (i) are $\frac{xdy-ydx}{dt}=A$, $\frac{zdx-xdz}{dt}=B$, $\frac{zdy-ydz}{dt}=C$, (k); (A, B, C, being arbitrary constants;) $\therefore Az+By-Cx=0$, (l); the equation of a plane passing through the centre of force; in which s is wholly situated; (since x, y, z, are common to s and (l).) By assuming (l) for the plane of x, y, I have $z=0 \therefore \vartheta=0$, and $\frac{d\vartheta}{dt}=0$, and (C) does not exist: also (A), (B), become the same as in the last Journal, (on the suppositions there made,) as they evidently ought to be. Put $r\sin.\psi=p$ the perpendicular from the centre of force to the tangent to s at the place of the particle; $\frac{C'}{p}=V=\frac{ds}{dt}$ the velocity; $V'=$ the velocity of a particle describing a circle, about the same centre of force, at the distance r; $D=$ the distance fallen through to acquire V from rest, by a particle, when continually acted on by a constant force, equal to F, (at the distance r;) $\frac{pdr}{dp}=R$, half the chord of the equicurve circle, with s at the place of the particle, estimated on r. It is evident that (I) can be changed to

$$-\frac{C'^2}{2}\frac{d\left(\frac{1}{r^2\sin.^2\psi}\right)}{dr}=-\frac{C'^2}{2}\frac{d\left(\frac{1}{p^2}\right)}{dr}=\frac{C'^2dp}{p^3dr}=\frac{V^2dp}{pdr}=\frac{V^2}{R}=$$

$$=\frac{C'^2}{p^2R}=\frac{C'^2}{r^2R\sin.^2\psi}=F=\frac{V'^2}{r}=\frac{V^2}{2D}\ \text{(L)};$$ and that (H) can be changed to $$-\frac{C'^2}{2}\frac{d\left(\frac{r^2dv^2+dr^2}{r^4dv^2}\right)}{dr}=-\frac{d\left(\frac{ds^2}{dt^2}\right)}{2dr}=-\frac{VdV}{dr}=F\ \text{(M)};$$

$\therefore VdV+Fdr=0$ (N).

If Fdr is integrable, I may change d into δ, and (N) becomes $V\delta V+F\delta r=0$ (o); (δ being the characteristic of variations.) I shall suppose that Fdr is integrable; that is, that F is constant, or a function of r only; and shall put its integral $SFdr=\varphi r$. Then the integral of (N) is $V^2=D-2\varphi r$ (1); (D= const.), (1) corrected is $V^2=V''^2+2(\varphi' r-\varphi r)$ (2); V'', $\varphi' r$, being the values of V, φr, at some given point of s.

From (2) it appears that V depends on V'', $\varphi' r$, φr; suppose then two spherical surfaces to be described from the centre of force (as centre) through the distances corresponding to $\varphi' r$, φr; then it is evident that if the particle passes through the first of these surfaces (in any point whatever) with the velocity V'', it will always arrive at the second with the same velocity, V, and that in whatever point it may meet it, and whether it moves in a straight line, a curve, or curved surface; provided the curvature be continued, so that the direction of the motion changes by insensible degrees, and that there is no friction; also the law of force is supposed to be the same in all these cases. (Prin. b. I. sec. viii. prop. 40.) I will now show the use of the different forms of F, as given in (L), by a few examples. By the form $F=\frac{C'^2 dp}{p^3 dr}$ it appears that F is as $\frac{dp}{p^3 dr}$ at different points of the described curve. (Vince's Fluxions, art. 206.) Also by $F=\frac{C'^2}{p^2 R}=\frac{V^2}{R}$, F is as $\frac{1}{p^2 R}$ or as $\frac{V^2}{R}$. (Prin. b. I. sec. ii. prop. 6. cor's 2, 3.) The form $F=\frac{V^2 dp}{pdr}=\frac{V'^2}{r}$ gives $V : V' :: \sqrt{\frac{dr}{r}} : \sqrt{\frac{dp}{p}}$ (3); (Vince's Fluxions, art. 208) and $F=\frac{V^2}{R}=\frac{V^2}{2D}$ gives $D=\frac{R}{2}$ (4); (Vince's do. art. 209.) The form $F=\frac{C'^2}{r^2 R \sin.^2 \psi}$ furnishes a very simple solution of prob. 2. prop. 7. sec. ii. b. I. Prin. (See Newton's figure.) For $R=\frac{VP}{2}$, $r=SP$, $\sin. \psi = \sin. SPY =$ $= \sin. PAV$ (Euc. 3. 32.) $=\frac{VP}{AV}$, substitute these values and reject the invariable quantities $2C^2$, AV^2, and there results F as $\frac{1}{SP^2 \times PV^3}$, the same that Newton has found. The same form does also enable me to demonstrate very easily the second and third corollaries to the same proposition. (See Newton's fig.) I shall suppose F to denote the force to the centre S; F′ the force to the centre R. Then I have the equations $F=\frac{C'^2}{r^2 R \sin.^2 \psi}$, $F'=\frac{C''^2}{r'^2 R' \sin.^2 \psi'}$, ($C''$, r', R', ψ' being the same for R, as C', r, R, ψ respectively for S.) Hence I have $F : F' :: \frac{C'^2}{r^2 R \sin.^2 \psi} : \frac{C''^2}{r'^2 R' \sin.^2 \psi'} :: C'^2 r'^2 r : \frac{C''^2 r^3 R}{R'} \times \frac{\sin.^2 \psi}{\sin.^2 \psi'}$; but $R=\frac{PV}{2}$, $R'=\frac{PT}{2}$, $r=SP$, $r'=RP$, $\psi=SPG=T$ (Euc. 3. 32.); and $\psi'=$ the supplement of V (Euc. 3. 32); $\therefore \sin. \psi = \sin. T$ and $\sin. \psi' = \sin. V$ $\therefore \frac{\sin. \psi}{\sin. \psi'}=\frac{\sin. T}{\sin. V}=\frac{PV}{PV}$ (by trig.); substitute these values and there results $F : F' :: C'^2 \times RP^2 \times SP : C''^2 \times SG^3$ (5) (since $\frac{SP^3 \times PV^3}{PT^3}=SG^3$ by the sim. tri's TPV, SPG;) hence if

$C'=C''$ or the areas described in equal times by the radii vectores are equal, (which is virtually Newton's supposition,) I have $F : F' :: RP^2 \times SP : SG^3$ (6) the same as Newton has found. Hence I have $F' = \frac{F \times SG^3}{RP^2 \times SP}$ or F' is as $\frac{F \times SG^3}{RP^2 \times SP}$; if then the law of variation of F is known that of F' is found. If C' is not equal to C'' I have by (5) $F' = \frac{C''^2}{C'^2} \times \frac{F \times SG^3}{RP^2 \times SP}$ or F' is as $\frac{F \times SG^3}{RP^2 \times SP}$ (rejecting the invariable quantities C'', C': they being the same at every point of the described curve,) the same result as by Newton's supposition, that $C'=C''$ as it evidently ought to be. For it is not the absolute value of F' that we seek, but its law of variation at different points of the described curve; which will evidently be the same whatever may be the time of describing C'': but by supposing $C''=C'$ (as Newton does) we determine the law of variation of F' in a very simple and elegant manner. Again the form $F = -\frac{C'^2}{2} \frac{d\left(\frac{1}{r^2 \sin.^2 \psi}\right)}{dr}$ applies very readily to the case of the particle describing an ellipse about a centre of force at the focus. For let a, b, respectively denote the greater and lesser semiaxes; $\frac{b^2}{a} = p'$ the semiparameter; $\therefore b^2 = ap'$. Then since $r =$ the distance of the particle to the centre of force, $2a-r$ equals its distance to the other focus, (Vince's Conic Sections, Ellipse, prop. 1.); also r, $2a-r$, make equal angles with the tangent at the place of the particle (Vince's Conic Sections, prop. 3. cor. 2.) $\therefore (2a-r)\sin.\psi = p''$ the perpendicular from the other focus to the tangent; but $r \sin.\psi = p$ that from the centre of force to the tangent; $\therefore (2ar - r^2)\sin.^2\psi = pp'' = b^2$ (Vince's Con. Sec. prop. 6.) $= ap'$. Hence I have $\frac{1}{r^2 \sin.^2\psi} = \frac{2}{rp'} - \frac{1}{ap'}$ (7); if in (7) I omit $\frac{1}{ap'}$, it becomes $\frac{1}{r^2 \sin.^2\psi} = \frac{2}{rp'}$ (8); which is the case of the particle moving in a parabola; the centre of force being at the focus, p' being the parameter of its axis; if I change the sign of $\frac{1}{ap'}$ in (7) it becomes $\frac{1}{r^2 \sin.^2\psi} = \frac{2}{rp'} + \frac{1}{ap'}$ (9); this applies to the case of the particle describing an hyperbola; the centre of force being at its focus, and $p'=$ the parameter of its axis. Now as in (7) and (9) $\frac{1}{ap'}$, is constant, and $=0$ in (8), it is evident that I shall have $F=-\frac{C'^2}{2}d\frac{\frac{1}{r^2 \sin.^2\psi}}{dr}=-\frac{C'^2}{2}\frac{d\left(\frac{2}{rp'}\right)}{dr}=\frac{C'^2}{r^2p'}$ for the form of F in each of these cases; ∴ in each of these curves the law of force to the focus is F is as $\frac{1}{r^2}$ (since C', p' are invariable in each of them); if in (9) I change the sign of $\frac{2}{rp'}$, I have the case of the particle moving in an hyperbola, and acted on by a central force in the focus of the opposite hyperbola, and I have $F=-\frac{C'^2}{r^2p'}$ ∴ F is as $-\frac{1}{r^2}$, the sign minus shows the force to be repulsive. (See Prin. b. I. sec. iii. prop.'s 11, 12, 13.) The same results may be found after the manner of La Place, (Mec. Cel. Vol. I. p. 114,) by using the polar equation of the ellipse and transforming it into the equations of the parabola and hyperbola as he has done. As the polar equation of the ellipse is not usually given in treatises on the conic sections; I will conclude this communication by the following investigation of it. Put $2C=$ the distance of the foci; $2a=$ the sum of the lines from the foci to any point in the curve $=$ the transverse axis; $r=$ one of these lines; then $2a-r=$ the other; $v-\varpi=$ the supplement of the angle contained by r and $2C$. Then by a known theorem (which is easily derived from Euc. 2. 13.) in trigonometry, I have $(2a-r)^2=$ $=r^2+4C^2+4Cr\cos.(v-\varpi)$ (10); or by reduction $a^2-C^2=ar+$ $+Cr\cos.(v-\varpi)$; ∴ $r=\frac{a^2-C^2}{a+C\cos.(v-\varpi)}=\frac{a\left(1-\frac{C^2}{a^2}\right)}{1+\frac{C}{a}\cos.(v-\varpi)}=$ $=\frac{a(1-e^2)}{1+e\cos.(v-\varpi)}$ (11) $(e=\frac{C}{a})$; (11) is the same equation that La Place has given at the place cited above; $\frac{C}{a}=e$ being the eccentricity divided by half the greater axis; also $a(1-e^2)=$ the semiparameter.

Art. VIII.—*The Fundamental Principle of the Higher Calculus demonstrated by the method of Indeterminates.*

(Communicated by Mr. Stiles French.)

The following extracts from a recent commentary on Newton's Principia,* contain a view of the principle presented in Lemma I. Book I., which may interest mathematical readers.

"The first section of the Principia," the commentator remarks, "comprehends the substance of the method of Exhaustions of the Ancients, and also of the Modern Theories, variously denominated Fluxions, Differential Calculus, Calculus of Derivations, Functions, &c. &c. Like them it treats of the relations which indefinite quantities bear to one another, and conducts in general by a nearer route to precisely the same results."

On the 55th page of the commentary, he gives an account of the steps, by which he was led to a theory of these quantities, which he considers as "divested of all the metaphysical obscurities and inconsistencies, which render the methods above enumerated so objectionable as to their logic."

"Having engaged," says he, "to write a Commentary upon the Principia, we naturally sought to be satisfied as to the correctness of the method of Prime and Ultimate Ratios. The more we endeavored to remove objections, the more they continually presented themselves; so that after spending many months in the fruitless attempt, we had nearly abandoned the work altogether; when suddenly, in examining the method of *Indeterminate Coefficients* in Dr. Wood's Algebra, it occurred that the aggregates of the coefficients of the like powers of the indefinite variable, must be separately equal to zero, not because the variable might be assumed equal to zero, (which it never is, although it is capable of indefinite diminution,) but because of the different powers being essentially different from, and forming no part of one another.

"From this a train of reflections followed, relative to the treatment of homogeneous *definite* quantities in other branches of Alge-

---

* "A Commentary on Newton's Principia, with a supplementary volume. Designed for the use of students at the Universities. By J. M. F. Wright, A. B. late scholar of Trinity College Cambridge, author of Solutions of the Cambridge Problems, &c. &c. In two volumes, pp. 458 and 415. London, 1828."

bra. It was soon perceptible that any equation put = 0, consisting of an aggregate of different quantities incapable of amalgamation by the opposition of *plus* and *minus*, must give each of these quantities equal to zero. Reverting to indefinites, it then appeared that their whole theory might be developed on the same principles, and making trial, we have satisfied ourselves most fully of having thus hit upon a method of clearing up all the difficulties of what we shall entitle

THE CALCULUS OF INDEFINITE DIFFERENCES.

"A *constant quantity* is such, that from its very nature it cannot be made less or greater.

"*Constants*, as such quantities may be briefly called, are denoted generally by the first letters of the alphabet,

a, b, c, d, &c.

"*A definite quantity is a* GIVEN VALUE *of a quantity essentially variable.*

"*Definite* quantities are denoted by the last letters of the alphabet, as

z, y, x, w, &c.

"*An* INDEFINITE *quantity is a quantity essentially variable through all degrees of diminution or of augmentation short of absolute* NOTHINGNESS *or* INFINITUDE.

"Thus the ordinate of a curve, considered generally, is an *indefinite*, being capable of every degree of diminution. But if any particular value, as that which belongs to a given abscissa, for instance, be fixed upon, this value is *definite*. All abstract numbers, as 1, 2, 3, &c. and quantities absolutely fixed, are *constants*.

"The difference between two definite values of the same quantity (y) is a *definite* quantity, and may be represented by

$$\triangle\, y$$

adopting the notation of the Calculus of Finite (or *definite*) Differences.

"In the same manner the difference between two definite values of $\triangle\, y$ is a definite quantity, and is denoted by

$$\triangle\, (\triangle\, y)$$

or more simply by

$$\triangle^{2} y$$

and so on to

$$\triangle^{n} y.$$

"The difference between a *Definite* value and the *Indefinite* value of any quantity y is *Indefinite*, and we call it the *Indefinite Difference* of y, and denote it, agreeably to the received algorithm, by

$$dy$$

"In the same manner

$$d(dy)$$

or

$$d^2y$$

the *Indefinite Difference* of the *Indefinite Difference* of y, or the second indefinite difference of y.

"Proceeding thus we arrive at

$$d^ny$$

which means the n^{th} indefinite difference of y."

"The reader will henceforth know the distinction between *Definite* and *Indefinite Differences.* We now proceed to establish, of *Indefinite Differences*, the

FUNDAMENTAL PRINCIPLE.

"It is evidently a truth perfectly axiomatic, that *no aggregate of* INDEFINITE *quantities can be a definite quantity, or aggregate of definite quantities, unless these aggregates are equal to zero.*

"It may be said that $(a-x)+(a+x)=2a$, in which (x) is indefinite, and (a) constant or definite, is an instance to the contrary; but then the reply is, $a-x$ and $a+x$ are not *indefinites* in the sense of our definition.

"*Hence if in any equation*

$$A+Bx+Cx^2+Dx^3+\&c.=0$$

A, B, C, &c. be *definite quantities* and x an *indefinite quantity;* then we have

$$A=0,\ B=0,\ C=0,\ \&c.$$

"For $Bx+Cx^2+Dx^3+\&c.$ cannot equal $-A$ unless $A=0$. But by transposing A to the other side of the equation, it does $=-A$. Therefore $A=0$ and consequently

$$Bx+Cx^2+Dx^3+\&c.=0$$

or

$$x(B+Cx+Dx^2+\&c.)=0$$

But x being *indefinite* cannot be equal to 0; ∴

$$B+Cx+Dx^2+\&c.=0$$

Hence, as before, it may be shown that $B=0$, and therefore

$$x(C+Dx+\&c.)+0$$

Hence $C=0$, and so on throughout.

"Again, *if in the equation*

$$A + Bx + B'y + Cx^2 + C'xy + C''y^2 + Dx^3 + D'x^2y + D''xy^2 + D'''y^3 + \&c. = 0$$

A, B, B′, C, C′, C″, D, &c. *be definite quantities*, and x, y INDEFINITES; *then*

$$\left.\begin{array}{r} A = 0 \\ Bx + B'y = 0 \\ Cx^2 + C'xy + C''y^2 = 0 \end{array}\right\} \textit{when } y \textit{ is a function of } x.$$
$$\&c. = 0$$

For, let $y = zx$, then substituting

$$A + x(B + B'z) + x^2(C + C'z + C''z^2) + x^3(D + D'z + D''z^2 + D'''z^3) + \&c. = 0$$

Hence,

$$A = 0,\ B + B'z = 0,\ C + C'z + C''z^2 = 0,\ \&c.$$

and substituting $\frac{y}{x}$ for z and reducing we get

$$A = 0,\ Bx + B'y = 0,\ \&c.$$

"In the same manner, if we have an equation involving three or more indefinites, it may be shown that the aggregates of the homogeneous terms must each equal zero."

Some of the more obvious applications of this principle will be seen in the following extracts.

Lemma I.

"Quantities and the Ratios of Quantities.—The truth of the Lemma does not depend upon the *species* of quantities, but upon their conformity with the following conditions, viz.

"That they *tend continually to equality, and approach nearer to each other than by any given difference.*

"Finite Time.—Newton obviously introduces the idea of time in this enunciation, to show illustratively that he supposes the quantities to converge continually to equality, without ever actually *reaching or passing* that state; and since to fix such an idea, he says, "before the end of that time," it was moreover necessary to consider the time *Finite*. Hence our author would avoid the charge of "*Fallacia Suppositionis*," or of "*shifting the hypothesis*." For it is contended that if you frame certain relations between actual quantities, and afterwards deduce conclusions from such relations on the supposition of the quantities having vanished, such conclusions are illogically deduced, and ought no more to subsist than the quantities themselves.

"In the Scholium at the end of this Section he is more explicit. He says, *The ultimate Ratios, in which quantities vanish, are not in reality the Ratios of Ultimate quantities; but the Limits to which the Ratios of quantities continually decreasing always approach; which they never can pass beyond or arrive at, unless the quantities are continually and indefinitely diminished.* After all, however, neither our author nor any of his commentators, though much has been advanced upon the subject, has obviated this objection. Bishop Berkeley's ingenious criticisms in the Analyst remain to this day unanswered. He therein facetiously denominates the results, obtained from the supposition that the quantities, before considered finite and real, have vanished, the "*Ghosts of Departed Quantities;*" and it must be admitted there is reason as well as wit in the appellation. The fact is, Newton himself, if we may judge from his own words in the above cited Scholium, where he says, "If two quantities, whose DIFFERENCE IS GIVEN are augmented continually, their Ultimate Ratio will be a Ratio of Equality," had no knowledge of the *true nature* of his Method of Prime and Ultimate Ratios. If there be meaning in words, he plainly supposes in this passage, a mere approximation to be the same with an Ultimate Ratio. He loses sight of the condition expressed in Lemma I. namely, *that the quantities tend to equality nearer than by any assignable difference*, by supposing the difference of the quantities continually augmented to be *given*, or always the same. In this sense the whole earth, compared with the whole earth minus a grain of sand, would constitute an Ultimate Ratio of equality; whereas so long as any, the minutest difference exists between two quantities, they cannot be said to be more than *nearly* equal. But it is now to be shown, that

"*If two quantities tend continually to equality, and approach to one another nearer than by any assignable difference, their Ratio is* ULTIMATELY *a Ratio of* ABSOLUTE *equality.* Let L, L′ denote the Limits, whatever they are, towards which the quantities L+l, L′+l′ continually converge, and suppose their difference, in any state of the convergence, to be D. Then

$$L + l - L' - l' = D,$$

$$\text{or } L - L' + l - l' - D = 0,$$

and since L, L′ are fixed and definite, and l, l′, D always variable, the former are independent of the latter, and we have by the fundamental principle

$$L - L' = 0, \text{ or } \frac{L}{L'} = 1, \text{ accurately.} \quad \text{Q. e. d.}$$

"This way of considering the question, it is presumed, will be deemed free from every objection. The principle upon which it rests depending upon the *nature* of the variable quantities, and not upon their evanescence, (as it is equally true even for constant quantities provided they be of different natures,) it is hoped we have at length hit upon the true and logical method of expounding the doctrine of *Prime and Ultimate Ratios*, or of *Fluxions*, or of the *Differential Calculus*, &c."

"This general principle, which is that of *Indeterminate Coefficients* legitimately established and generalized, conducts us by a near route to the *Indefinite Differences of functions of one or* MORE *variables*.

"*To find the Indefinite Difference of any function of* x.

"Let $u = f x$ denote the function.

"Then $d u$ and $d x$ being the indefinite differences of the function and of x itself, we have

$$u + d u = f(x + d x)$$

Assume

$$f(x + d x) = A + B d x + C d x^2 + \&c.$$

A, B, &c. being independent of $d x$ or definite quantities involving x and constants; then

$$u + d u = A + B d x + C d x^2 + \&c.$$

and by the fundamental principle we have

$$u = A, \; d u = B . d x$$

Hence then this general rule,

"*The* INDEFINITE DIFFERENCE *of any function of* x, f x, *is the second term in the development of* $f(x + d x)$ *according to the increasing powers of* d x.

Ex. Let $u = x^n$. Then it may easily be shown independently of the Binomial Theorem that

$$(x + d x)^n = x^n + n . x^{n-1} d x + P d x^2$$

$$\therefore d(x^n) = n . x^{n-1} d x$$

"*To find the indefinite difference of the product of two variables.*

"Let $u = x y$. Then

$$u + d u = (x + d x) . (y + d y) = x y + x d y + y d x + d x d y$$

$$\therefore d u = x d y + y d x + d x d y$$

and by the principle, or directly from the homogeneity of the quantities, we have

$$d u = x d y + y d x."$$

The limits of this article will not permit us to exhibit the manner in which this principle of *homogeneity*, is applied to finding the Indefinite Differences or Differentials of Complex Algebraic, or of Transcendental Functions. The reader, we think, will easily perceive the great clearness which must result from its use in every process involving the consideration of the limiting ratios of quantities.

How far the praise of being the original discoverer of the relations of this principle to the purposes of the Higher Calculus, is due to Mr. Wright, we shall not attempt to decide. We would, however, remark that the views of Carnot in his notice of the method of Indeterminates of Descartes,* though not fully developed or given in the appropriate notation, seem in some measure to have anticipated those above expressed. After establishing the fundamental principle of that method by the same considerations as are employed by Mr. Wright, Carnot says "let there be an equation of only two terms $A + Bx = 0$, in which the first term is constant and the second susceptible of being rendered as small as we please: this equation cannot subsist unless the terms A and Bx are each, separately, equal to zero. We may lay it down then as a general principle, and as an immediate corollary of the method of Indeterminates, that *if the sum or difference of two pretended quantities is equal to zero, and if one of the two may be supposed as small as we please, while the other contains nothing arbitrary, these two pretended quantities will be each separately equal to zero.*

"This principle alone is sufficient to resolve by common algebra all questions within the province of the infinitesimal analysis. The respective processes of the two methods, simplified as they may be, are absolutely the same." And again, in conclusion, after applying it to some examples, "We thus see that the method of Indeterminates furnishes a rigorous demonstration of the infinitesimal calculus. It were to be desired, perhaps, that this course had been pursued in arriving at the differential and integral calculus; it would have been as natural as that which was taken and would have prevented all difficulties."

---

* "Réflexions sur la métaphysique du calcul infinitésimal." Seconde édition, page 150.

Art. IX.—*Notice of the Mineral Fusible Cement of H. Fitz Löwitz.*

We have received from a respected correspondent, the following account of a composition whose properties appear, from the statement, to be sufficiently important to entitle it to a place in this Journal. The account of the properties has been already printed; but that of the use, tools, &c. has been communicated for this Journal in a lithographic copy.

In announcing the Mineral *Fusible* Cement for sale in England, it is right to state that it has been for some years in use on the Continent; particularly in *Sweden* and *Denmark*, whose engineers, after repeated trials, recommended it to their respective governments.

The Honorable *Board of Ordnance* in England, directed various trials of it to be made at the King's Mews, Pall Mall East, in August last; in the presence of several officers of the Royal Engineers, and other scientific gentlemen. The experiments were conducted under Captain Smith of the Royal Engineers; who was of opinion after repeated trials, that it was *impervious to water*, and that its *adhesive* qualities were greater than any cement he had ever known.

We shall only cite a few of the numerous trials made at the *King's Mews*, to shew its resistance to water and damp, and its powers of adhesion. 1st. A case of *wood* was *united* with the cement only, and *lined* with it; and in *less* than half an hour filled with water; it was perfectly tight. 2d. To shew its adhesive qualities, two plates of *iron*, four inches square, with a hook in each, were united with the cement by a seam or joint of one eighth of an inch; on being suspended, it bore a weight of upwards of eight hundred pounds before they separated. 3d. The flat side of a *brick* was united to an upright board by this cement, another to that, and so on, until the *twentieth* brick was attached; when one of the bricks split, but none of the joints gave way. This experiment was repeated frequently, but in every instance the cement proved stronger than the bricks. 4th. A piece of *iron*, with a hook at the upper end and shank three inches long, was *inserted in a hole in a block of granite*, and there fixed with this cement instead of lead; the block of granite was attached *by the cement to another* of the same size, weighing *together* about three hundred pounds; the two were suspended by the hook, and *weights* to the extent of three hundred pounds were placed on the upper stone, but nothing gave way: the iron was not dovetailed at the bottom, and this weight (of *upwards* of six hundred pounds) was supported entirely by the adhesion of the cement to the iron plug and the granite.

Some further experiments were made at the *Tower* in December last, under the direction of Mr. Wright, the clerk of the works; when one bushel of dry sand was found to weigh one hundred and thirty pounds, and one bushel of Mineral Cement in a solid body one hundred and fourteen pounds. These experiments were made with a composition of two hundred and twenty eight pounds of sand and one hundred and fourteen pounds of cement, mixed together by melting; and 1st. Two *bricks* were united by a joint of one fourth of an inch with this gauged cement, and suspended by a chain which bore a weight of one thousand three hundred and forty four pounds, when one of the bricks split; but the joint, with about one fourth of an inch of the brick attached to it, remained perfect. 2d. *Bricks were united* with this gauged cement, in the same manner as described in experiment No. 3 at the King's Mews, and extended to *eighteen* joints, when the second brick broke.

The cement being thus properly guaged, will unite *bricks* so firmly, that when coated with a mixture of three fourths sand and one fourth cement, they will form a solid body superior in strength and quality to sandstone; and applicable to similar purposes. From these experiments it is evident that the Mineral Fusible Cement possesses two invaluable properties, viz. *resistance to water and damp*, and powerful *adhesiveness*. Of the latter property we may observe, that wood may be united to wood, iron, stone, brick, tiles or slate; and any of these bodies to each other, indiscriminately; by means of this cement. [It may be added that it is very rare for one cement to suit so many objects.]

It is difficult to point out all the uses to which this valuable cement may be applied. Among the most prominent may be named, the formation and lining of tanks or cisterns, the lining of damp rooms or cellars, coating the outside of houses, which would effectually keep out damp—for *gutters* on the roofs of houses, instead of that expensive article, lead—for building turrets or minarets of churches—light-houses, where the firmest union of parts is required—the abutments of a series of arches—*fastening iron railings in stone copings*—preserving wood in damp foundations, by coating it with cement—in jointing stone copings, rendering the use of lead or iron cramps *unnecessary*—lining the inside of churches, to preserve them from damp—and the inside of boxes for packing merchandize which requires to be preserved from sea damp—and *uniting iron pipes* either for water or gas, more effectually than by lead or any other substance; and for which purposes a mixture composed of two *parts* of dry sand with one part of Mineral Cement, may be applied with great advantage and economy. It is also applicable in its *pure* state for coating the bottoms of *canal boats instead of copper.*

The Mineral Fusible Cement is prepared and *sold in casks or packages* of various sizes, accompanied by proper directions for its use.

London, January 1, 1829.

N. B. When a parcel of this cement is sent for, an account of the mode of using it, is added; and a set of the implements necessary (which are cheap,) may be got as patterns for making more.

It is known, that the Duke of Wellington, who has been at the head of the English Board of Ordnance, and Mr. Nash, the architect of the king of England, are in favor of this cement.

Directions for its use; tools, &c. requisite.

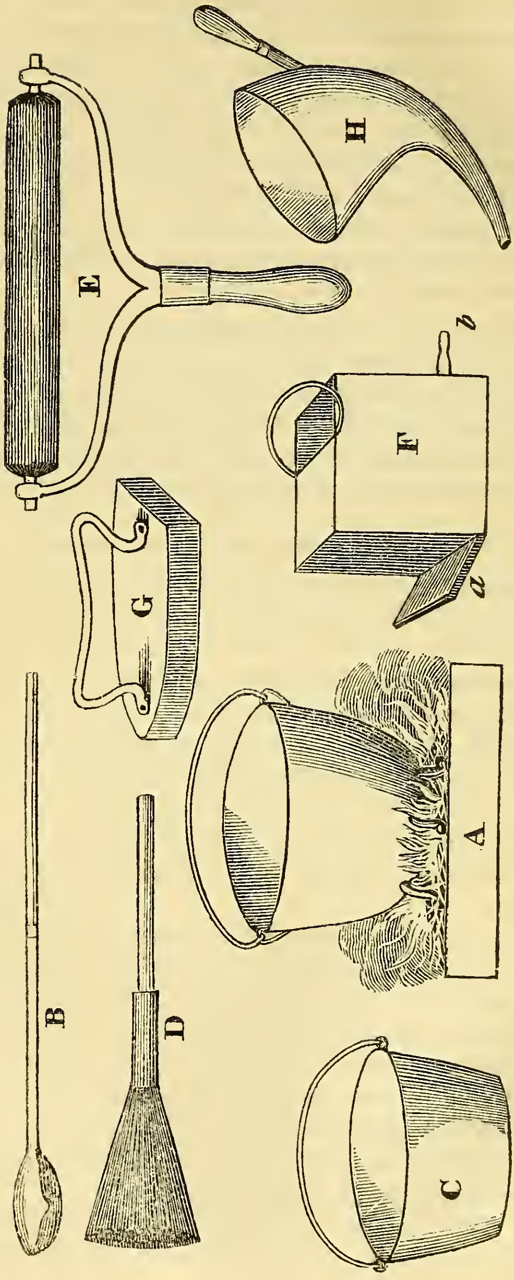
To be heated in an iron kettle or pot, on either a coal or coke fire, to the temperature for *melting lead*, when used either in its pure state or gauged.

This cement may be *gauged* with dry sharp sand, in any proportion as required, *not exceeding three fourths sand to one fourth of cement*, under any circumstance; such gauging being by weight, and not in bulk or measurement; taking care to well mix the same while heating.

Such materials and parts as are intended to be used with, or worked upon by this cement, must be quite dry, or no adhesion thereto will take place.

When the cement in the small kettle becomes too cold for use, it may be remelted, without its strength or virtue being deteriorated.

The inside of tanks or cisterns may be rendered or lined with this cement, and made perfectly water proof, *with a thickness of one fourth of an inch*, (instead of three fourths as with other cements,) when gauged with an *equal* proportion of *sand;* such tanks or cisterns if made of *brickwork* being built with or set in this cement; thereby making close joints; but if of wood, slate, iron, or other substances, they will *only* require jointing therewith.



No dimensions are given here, but it is easy to get a set of these articles from England with the cement, which may serve as patterns.

A. Iron kettle or pot, for melting, on either a coal or coke fire.

B. Ladle for taking out the cement, and other purposes.

C. Small kettle to contain so much cement from the large kettle A, as may be used in twelve minutes.

D. Fine wire brush for using the cement in a pure state, when coating or lining tanks, bottoms of boats, &c.

E. Roller to be used for making fair surfaces.

F. Machine used when doing horizontal work, (such as floors, &c.) and followed by the roller E, to make the fair surface.*

G. An iron for remedying irregularities of surface of new work or filling in and making good to settlements straight joints and other similar purposes.

H. A vessel to be used for filling in joints, and difficult parts.

N. B.—The common bricklayer's trowel, can be used when the cement is *guaged* with sand; but when used in its *pure* state for building brickwork, the best mode is to dip† the bricks into the kettle; as by so doing, the whole surface will be covered, and yet nothing wasted.

Orders to be given to the agents.—Mr. J. B. Shepherd, surveyor, 28 Prince's St. Bank, London; Mr. H. Gardiner, at Messrs. G. Barclay, & Co. 17 Goree Piazzas, Liverpool, where specimens may be seen.

---

* It is supposed that the part of F marked (*a*) is hollow; and receiving the cement in a melted state, lets it pass out at a slit at its upper termination in so thin a body, as to spread it well to the depth of one fourth of an inch. The vessel is to be tilted in this case, by means of the projection below at (*b*). If stiffened by cooling, the cement is easily warmed again.

† The dipping, it is presumed, need be applied only to the *sides* of the bricks, or at least not to their faces, unless the bricks be porous.

Art. X.—*Inquiries into the Principles of Liquid Attraction; by* Dr. Horatio G. Hough, of Martinsburgh, N. Y.

TO PROFESSOR SILLIMAN.

Sir—If you think the following worthy of a place in the American Journal of Science and Arts, by giving it an insertion, you will oblige your obedient servant, Horatio G. Hough.

New Haven, August 31, 1829.

Having never seen on record, any account that explains in a satisfactory manner, the true principles of attraction by which liquids are governed, I have thought it proper to communicate some experiments and observations on the subject.

My attention was first directed to this subject from some unsuccessful attempts to cause a small piece of light wood of a cylindrical form, to rest on water at the centre of a small cup, where each end of the wood extended within about an inch of the sides of the cup. The wood, when left to rest at the centre, constantly avoided it, and was stationary only at the sides of the cup. (See Fig. 3.)

My inquiry was next directed to the cause that produced this unexpected movement of the wood. I soon perceived an elevation of the liquid at the sides, both of the cup and wood, and these elevations of the liquid appeared to be, in some mysterious manner, the cause that produced this effect.

Soon after this experiment, another, of quite a different character, was presented to my view. A thin scale of slatestone was carefully laid on water and it floated; I soon noticed a depression of water around the stone, and concluded that as much water above the stone was displaced, as was equal to the difference of their specific gravities, and that by this means it floated.

Not long after witnessing this experiment, I made another observation of a similar kind, but still more remarkable. On presenting a pin to a small globule of mercury, it adhered to it, and I soon afterwards applied a globule of this metal to water in a small cup. The globule, when laid on the water, separated from the pin and disappeared; but after repeating the experiment two or three times, with similar results, I was surprized to find the globules floating on the water. I then presented a pin to one of these globules, and as soon as the pin touched the water, the globule suddenly darted from it, with a velocity that seemed the effect of a strong impulse. (See

Fig. 4.) Two of these globules, when brought within the distance of about an inch of each other, rushed together with a force which was constantly increased as they approached. (See Fig. 5.) These globules produce a very sensible depression of the liquid, and equally avoid the pin and the sides of the cup.

These experiments were all made about twenty years since, and from that period, my inquiries have been occasionally directed to the discovery of those substances which are attended with an elevation of the liquid around them, and to those which have a depression. In my first experiments, vegetable leaves seemed to depress liquids, and glass and metals to elevate them; but by giving them different positions, and consequently different angles of inclination to the surface, I discovered that all substances, when their angles of inclination are sufficiently acute, are attended with an elevation of the liquid; and when sufficiently obtuse, with a depression. A green vegetable leaf, placed perpendicularly in water, has on both sides a depression, but give the leaf a suitable inclination to the surface, and the liquid is elevated on the side of the *acute* angle, and depressed on the side of the obtuse angle.

A fine needle, also, carefully placed on water, is known to swim. Now the convex surface of the needle, (the needle being considered a cylinder,) presents no difference of angles to the surface of the liquid, on its revolving. By the *angles* which the convex surface makes with the surface of the liquid, is meant, the angles which are made with the surface, by the tangents, drawn to all the different points in a circular ring, taken about the needle, and produced to meet the surface of the liquid. For it is well known that a line from any point in this circular ring, makes the same angle with the surface of the liquid, which the tangent of that point makes with the same surface. The same explanation is also applicable to the convex surfaces of the globules of mercury. But when these globules, or the needle, descend into the liquid, the tangents of these convex surfaces, and consequently the convex surfaces themselves, make all the varieties of angles with the surface of the liquid, first the acute, and then the obtuse; and, as it has already been remarked, when any substance makes angles with the surface sufficiently acute, it is always attended with an elevation of the liquid; and whenever sufficiently obtuse, with a depression. This is the case in the descending of the needle; and it is proved to be the case, by inserting the point of a needle in a small piece of wood, of equal length with the needle, and three or four times its *weight*, and balancing it over the edge of a tumbler full of water. (See Fig. 15.) The acute angles which the convex surface of the needle makes with the surface of the liquid, elevate the liquid, and support the piece of wood over the outside of the glass; and when the needle only is placed on water, it descends into the water till the angles are sufficiently obtuse, and then the liquid is depressed, and the needle swims. (See Fig. 16.)

The cause why these different angles elevate the surface of the liquid, is this. The more *acute* the angles of inclination are, the greater will be the extent of surface which the attracting substance presents to the surface of the liquid; and the consequence is, that the *extent* and *force* of the *focal seat* of attraction, from which the elevating power acts, is increased. By "focal seat of attraction," is meant, the line where the surface of the liquid comes in contact with the surface of the attracting substance; and it is called *focal seat* because the mutual attraction which exists between the two surfaces, and which causes the elevation, is concentrated in this place.

A careful observation of the above experiments, and many more of a similar kind, has, in my view, established the following laws.

1st. The common surface of a liquid never rests in a horizontal position when it comes in contact with any substance; but is always either elevated or depressed. It may be observed that there is a striking analogy between the angles of these opposite curves of elevation and depression. They seem to bear some resemblance to those of a parabola.

2d. Different substances have different degrees of attraction for liquids; and their greatest degree of attraction may be known by the angle which will, in given circumstances, sustain an elevation of any liquid, except some liquids that, by attraction spread on the surface of other liquids, as oils on water, and are not elevated.

3d. All substances attract liquids more readily when moistened with the same liquid, than when dry, for those bodies that have a weak attracting surface, are by this means furnished with a strong attracting surface. But when grains of wheat, and globules of mercury are moistened, they will, notwithstanding, float; for after they have been shaken to the bottom of a liquid, they will again float, when raised to the surface.

4th. Two bodies floating on a liquid, both of which are attended by an elevation of the liquid, will, when near, approach each other with a column of liquid rising between them.

5th. Two floating bodies, both having a depression of the liquid, will, when near, approach each other, with the liquid descending between them.

6th. Two floating bodies, one having an elevation and the other a depression of the liquid, will, when placed contiguous to each other, recede.

Of the seat and properties of Liquid Attraction.

Having noticed some of the laws and phenomena of liquid attraction, it now remains to point out the seat and properties of this attraction. It may, however, in the first place, be proper to take some notice of the opinions of philosophers on this subject. As far as my information extends, but little difference of opinion exists in relation to the attraction of the particles of liquids for each other; but in relation to the attraction which takes place between liquids and other bodies, some little difference of opinion exists on the subject, while at the same time, some affirm, and others deny the existence of a repelling power. According to Enfield, Book I, Prop. 3d. Ex. 1. " the drop is spherical because, each particle exerts an equal power in every direction, drawing other particles towards it on every side, as far as its power extends." Doct. Good, in his " Book of Nature," says, " that there being an equal tendency in every particle of homogeneous bodies to press together, they must press equally towards one common centre." "Hence, then, the cause of the globular figure of drops of quicksilver, drops of water, drops of rain, and drops of dew."

The doctrine of an equal attraction, or mutual cohesion between the particles of a liquid, without discriminating in the least, the situation and circumstances of those particles, is, indeed, ancient; and it appears to have been adopted as a *self evident* proposition, sufficiently obvious without proof; and we see that philosophers have, for more than a century, supported it with the constancy of an " Aristæus," amidst all the " Proteus" forms in which liquids have appeared. But has this doctrine of a mutual cohesion of liquid particles yet disclosed to them, the true method of explaining the various phenomena of liquids?

Water is a liquid, the most abundant in nature, and when pure, perhaps a perfect one; but its properties are very different from what its appearance would lead one to expect. Until lately, it was considered an element; but Chemists, by subjecting it to the test of a rigid analysis, have ascertained its composition; and it is by the help of some appropriate experiments, that we must acquire a knowledge of its attracting powers.

The practice of washing wheat, to free it from smut, has presented, on this subject, some facts, worthy of attention. In the process of washing, when the tub containing the wheat and water is inclined for the purpose of pouring off the water, many of those grains which are just above the water, float out and cover the surface, and require to be constantly beaten down to make them sink, and to prevent them from running off with the water. These grains of wheat, compared with the water, are specifically heavier, and yet they float, as in the case of the globules of mercury, abovementioned; not because, as some have supposed, they are specifically lighter than water, but because the obtuse angles, which their convex surfaces make with the surface of the water, cause a depression around them.

Again, when the wheat is emptied by inverting the tub, some of the grains usually adhere to the sides of the tub, by means of the aqueous surface which surrounds them; and thus they are suspended by an attracting force, much greater than their own weight. But if we again fill the tub with water, these grains of wheat sink as soon as the water rises above them. This fact proves that the attracting force which suspended them is destroyed, when the grains are submerged. The needle, also, when wet, will adhere to the side of a tumbler, above the water; but only raise the water above the needle, by inclining the tumbler, and the needle sinks. These facts evince that the *surface* of the liquid is the seat of the attracting power.

For the properties of the attracting power, we must look to the *soap bubble* as it stands on a liquid, the bubble of pure water being too evanescent for inspection. This soap bubble presents to us a thin coat of particles, apparently very uniform in thickness, impervious to air, of uniform strength, and equally *contractile* in all its parts.*

---

* By "contractile," is meant that constantly uniform strain, which may be observed between the particles of the surface, and by which the surface has a tendency to shorten itself.

Thus, by way of illustration, when globules of mercury have been flattened by pressure, and have thus had their surfaces enlarged, their globular form is again restored by the contracting power of the surface, as soon as the pressure is removed; and when drops of water, on cabbage leaves, have had their surfaces enlarged in the same way, they will again resume their spherical form, for the same reason that the globles of mercury did, on removing the pressure.

It partakes of all substances which are mixed or dissolved in the liquid; but it differs essentially both in its mechanical properties, and in its appearance, from the liquid state in which it previously existed. This coat of particles, of which the bubble is constituted, is sustained by the enclosed air; and it has an elevation of the liquid at its base, where it unites with the surface of the liquid; and it may be considered a mere continuation of this surface. Like other attracting bodies, it approaches those which have an elevation of the liquid, and avoids those which have a depression; but unlike muscular fibre, it has no corrugation, but its particles at all times exert the same steady contracting force. Such, I conceive, is the nature of the surface of all liquids; and it is this contractile power which it has, that causes the drops of a liquid to assume a spherical form.

Again, those particles beneath the contractile surface are, emphatically, *liquid.* They move over each other without cohesion, or sensible resistance, and may be considered passive, except so far as they are subject to the law of gravitation.

The reason of this remarkable difference between particles of the same liquid, without supposing any chemical change to have taken place in any of them, must be attributed to the different situations and circumstances in which they are placed, one class of them constituting the *surface*, and the other the *liquid* beneath it. The particles of the surface have no external particles of the same kind to balance them, or to counteract their attraction for each other; whereas, those beneath the surface, being entirely surrounded by particles of the same kind, have their attractive forces equally balanced in every direction, and by this means are kept in equilibrium, and possess hydraulic properties. And this I conceive to be the great cause of difference between the particles of the surface, and the particles beneath it.

Some estimate may be made of the strength of the surface of different liquids, by observing the magnitude of the largest drops which their contractile power will enable them to retain in a spherical form, when resting on substances which have for them the least attraction, or when suspended under bodies which have for them the greatest attraction. (See Figs. 6, and 7.)

Having pointed out the seat and properties of liquid attraction, some attention will now be directed to its various applications.

1st. To its application in explaining the phenomena connected with the first law, above mentioned. viz.: "that the common surface of a liquid never rests in a horizontal position, when it comes in contact with any substance; but is always either elevated or depressed."

If water be carefully poured into a vessel whose bottom is dry, it rises nearly to the height to which drops attain, and then spreads laterally, as the quantity of water increases, having its edges curved downward through the influence of the contractile surface; so that when it meets the sides of the vessel it has the appearance of depression. (See Fig. 8.) Now as it comes in contact with the sides of the vessel, the surface of the liquid makes new angles with the vessel, and, if the surface of the vessel has a sufficiently strong attraction for the surface of the liquid, an elevation of the liquid suddenly takes place, which is usually so rapid as to render its progress difficult to be observed. When the elevation commences, the depressed curve begins to shorten, and does not stop shortening till it vanishes, and then it is succeeded by an upward curve, which continues to rise contiguous to the sides of the vessel, till it attains its maximum height; and this is when it has risen as much above the common surface as it was at first depressed below it; (See Fig. 9.) and in which situation, it has the apparently uniform curve of the parabola.

Now as the curve of the surface moves upward, at the sides of the vessel, it necessarily acts against the pressure of the atmosphere, and performs an office similar to that which the piston of a common pump performs, diminishing the pressure on the liquid under the curved surface, contiguous to the sides of the vessel; but because the uniform pressure of the atmosphere is not sensibly diminished on the liquid under the surface, at a distance from the sides of the vessel, it forces the liquid up under the elevated surface, where it is sustained by the pressure of the atmosphere.

2nd. Let us observe how these principles account for the phenomena connected with the fourth law, viz: "two bodies floating on a liquid, both of which have an elevation of the liquid, will, when near, approach each other with a column of liquid rising between them."

It is a well known fact, that the lateral pressure of a column of water under the piston of a common pump, diminishes in the same ratio as the point pressed rises above the base of the column; and if we suppose the piston of a pump to take off the pressure of the atmosphere thirty two feet, the lateral pressure will diminish from a pressure represented by 32 at the base of the column, till the point pressed arrives at the top, where the lateral pressure may be represented by 0; because the water will rise no higher than about thirty two feet. But the lateral pressure of the atmosphere at the same height suffers no sensible diminution; consequently the lateral pressure of a column of water, which can rise but about thirty two feet by the pressure of the atmosphere, is unable to resist the lateral pressure of the atmosphere at an equal height. From these facts, it will be very readily understood *why* two floating bodies, which have an elevation of the liquid around them, approach each other. For when the remote extremities of their curves of elevation meet, these two curved surfaces, which in respect to the common level are becoming concave, now act as an upward moving piston diminishing the pressure of the atmosphere, and consequently allowing the preponderating lateral pressure of the atmosphere, to force the floating bodies toward each other. (See Fig. 10.) Now as these bodies approach, the column of liquid between them rises, and the contractile surface constantly taking off the atmospheric pressure, leaves the column of liquid, whose lateral pressure diminishes with its height, constantly less able to resist the lateral pressure of the atmosphere; and on this account the bodies should come together with an increasing velocity, which experiment abundantly proves.

3rd. Let us notice the application of these principles to the fifth law, viz: "two floating bodies, both having a depression of the liquid, will, when near, approach each other with the liquid descending between them." When the surface of the liquid curves downward, the same contracting force which, in elevated curves gave an upward motion, now acts with an equal force downwards, and the surface in this case may be considered a piston, not of a lifting but of a forcing pump. Accordingly, when two floating bodies, both of which have a depression, are placed within about an inch of each other, the *curves* which they make, meet, and in respect to the common level of the liquid, are becoming convex. The small column of liquid between the bodies is now depressed below the common level, by the contractile power of the surface, (See Fig. 5,) and the lateral pressure of the atmosphere, which supplies the place of the depression, is now unable to resist the lateral pressure of the surrounding water, and the bodies are consequently made to approach each other, with a velocity which is increased as the distance between the bodies is diminished.

4th. As the principles respect the sixth law, viz: "two floating bodies, one having an elevation and the other a depression of the liquid, will, when placed contiguous to each other, recede." When two floating bodies which make opposite curves in the surface, the one upward and the other downward, are placed contiguous on water, these opposite curves have nearly a perpendicular position, and consequently the contractile force of their curved surfaces acts in the same direction, and in consequence of the direction in which this force acts, it is unable to resist the force of the surrounding surface; and hence, the bodies recede from each other, one or two inches, to stations where the remote extremities of their opposite curves coincide with the common surface; and here the bodies remain at rest, unless the momentum with which they were at first propelled, carries them beyond these limits. (See Fig. 4.)

The ascent of liquids in capillary tubes, and between two parallel plates of glass, takes place on precisely the same principle as in the lifting pump. When two parallel plates of glass are partly immersed in water, and are placed perpendicularly to the common surface, if they have an elevation of the liquid around them, they will, when brought sufficiently near together to have the remote extremities of their elevated curves meet, have a column of water rising between them, and the height to which it will rise increases in the same ratio as the distance between the plates diminishes; and for this reason; their focal seat of attraction has the same extent, and acts with the same uniform force at all the different distances of the plates, and the contractile force of the surface *also* continues the same, but it has the pressure of a less column of atmosphere to resist, and this column of pressure diminishes as the area of the surface between the plates diminishes. (See Fig. 12.)

In capillary tubes of different bores, the focal seat of attraction diminishes as the diameters of their bores, but the pressure of the atmosphere which it resists, diminishes as the *squares* of these diameters; hence, as the diameters of capillary tubes diminish, the force of the contractile surface which acts from the focal seat of attraction, has a ratio to the force of the atmosphere constantly increasing, and therefore as the bores diminish, the liquids ascend with this increasing ratio. Now if a capillary tube be immersed in water, and then be raised from the water in an inclined position, so as to take up a greater quantity than it otherwise would, it will then sustain a column about twice the perpendicular height that it will when the lower extremity of the tube rests in water; for when the tube is taken from the water, the pressure of the atmosphere is diminished by the upper surface of the column of liquid, which acts as a lifting piston, as before described; to which there is also added the force of another surface at the bottom of the column which acts as a forcing piston, and in concert with which the atmosphere acts, which, when the tube rested on the water, acted indirectly, but now directly, to sustain the column; but this elevation will be the case in a less degree, except when the sides of the tube, at the bottom, are extremely thin. (See Fig. 11.)

Having considered the various laws and properties of liquid attraction, as they occur in the open atmosphere, it now remains to examine them as they may be observed in a rarer medium, particularly when under the exhausting influence of the air pump. Now if we suppose the common atmosphere entirely removed, and a new one formed, by the evaporation of some liquid placed under the receiver of an air pump, the pressure of this new atmosphere, which for the sake of distinction may be called *artificial*, will depend on the degree of temperature, and on the different degrees of volatility which the different liquids used possess; whether they be ether, alcohol, or any other. If for example, we take the atmosphere formed from *water* at a medium temperature, and suppose the pressure of this to be equal to the pressure of a column of water of six inches, and if we suppose the upper and elevating surface in a capillary tube of sufficiently fine bore, to take off the whole pressure of the artificial atmosphere from the column of liquid in the tube, the pressure of the atmosphere which rests on the surface of the liquid *without* the tube, must force up the liquid the whole height to which this pressure can sustain, viz. six inches. But if the bores of the tubes are larger, the height to which it will rise will be proportionally less. If the column of liquid in the capillary tube, in the open atmosphere, be broken by a portion of common air; the upper portion of the column of liquid will have both its upper and under surfaces concave, the former acting as a lifting piston upwards and the latter downwards, and the separation will remain permanent. (See Fig. 13.) But if a separation of the column of liquid should happen in the tube, under the receiver of an air pump, by unequal degrees of temperature in the evaporating process; the artificial atmosphere will be condensed by the equalization of the temperature, and will allow the column to reunite.

Bodies floating on liquids where the common atmosphere is removed, obey the same laws as when in the open air; that is, when both have an elevation, or both a depression of the liquid, they approach; but when one has an elevation, and the other a depression, they recede.

We have seen the action of the contractile surface in resisting the pressure of both the common and artificial atmospheres; let us now notice its action in compressing the common atmosphere.

First, take air bubbles, as they rest on a liquid; they are bodies of a spherical, or rather of a hemispherical form; therefore, according to the principles of geometry, as their diameters diminish, their volume, and their superficial contents diminish, the former in the ratio of the *cubes* of their diameters, and the latter in the ratio of the *squares* of these diameters; consequently, as the diameters of air bubbles diminish, their superficial contents have to their volume, a ratio constantly increasing; but the compressing force of the surface is directly as the superficial contents; and these contents having to the volume, a ratio constantly increasing as the bubbles diminish, the force with which they are compressed increases in the same ratio. It is manifest from this, that as the bubbles may be diminished to an almost unlimited extent, the pressure to which the enclosed air shall be subjected by the continually increasing force of the contractile surface, may at length become equal to the pressure of the atmosphere; and when it has arrived at this degree of pressure, every new diminution of their diameters gives a renewed accession to the compressing force of the surface, till at length they will be made to sustain the pressure of several atmospheres. Now water contains air in invisible globules, which are doubtless under this amazing pressure. For we can come to a definite result on this point, by transferring to the globule of air in water, the calculation of the pressure which the contractile surface, in diminishing capillary tubes, is found to sustain. For it is found by experiment, that in a capillary tube, the diameter of whose bore is the $\frac{1}{100}$ of an inch, water will be elevated 5.3 inches, and since it is the upper spherical surface of the column which causes the elevation, this surface will consequently sustain a pressure equal to that of a column of water of the same height. Now as this surface is equal to the hemispherical surface of a bubble of air of the same diameter as the tube, the pressure which the air bubble will sustain will be equal to that of a column of water of the same height; and since the pressure on diminishing globules of air increases in the ratio of the differences between the square and the cube of the diminishing diameters, the pressure which a globule of air will sustain whose diameter is diminished to the $\frac{1}{400}$ of an inch, will be equal to that of a column of water seven feet $\frac{8}{10}$ of an inch in height, and when the diameter is diminished to the $\frac{1}{800}$ of an inch, the pressure will be equal to that of a column of water twenty eight feet three inches in height, and so on in the same inverse ratio.

Now it is known that the atmosphere may be compressed in proportion to the weight or force to which it is subjected; and if we take a minute portion of air of the medium density, and subject it to the pressure of a column of water of thirty two feet, its magnitude will be diminished one half; and for every similar column which may be added, the magnitude of the portion of air will be proportionably diminished; and if we add to the pressure which a minute portion of air sustains from the contractile surface, the pressure which it must sustain at the various depths in water where we find it, it is easy to conceive, in strict conformity to the results which have been presented, that it sustains the pressure of several atmospheres.

If we may be allowed to reason from analogy, it will appear, by comparing the magnitude of drops of water and of mercury, that the contractile force of the surface of mercury exceeds that of the surface of water, nearly in the ratio of their specific gravities.

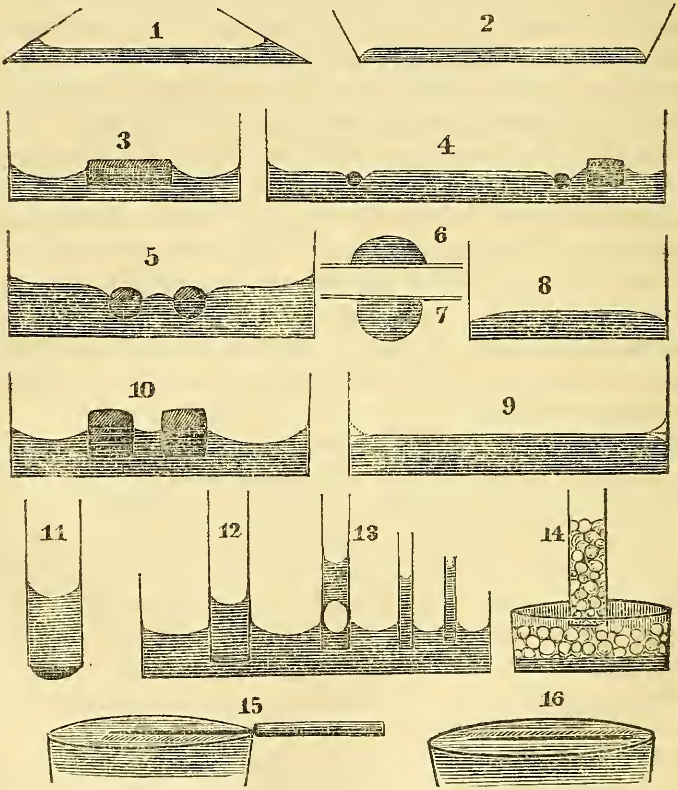
Lastly; the attraction of different substances for the surfaces of liquids, has a strong resemblance to chemical affinities; where the smallest particles have an attraction for each other, which attraction, when compared with the force of their gravitation, exceeds all expression by numbers.

Remarks.—In reviewing the above explanation of the laws of liquid attraction, it appears necessary, in order to avoid misconception, to observe, that the term *capillary* has been applied to tubes which are not strictly so. By "capillary tubes," I understand those whose bores are so exceedingly minute, that the water, or other liquid, which is in them, may be said to have lost its peculiar character as a liquid, and to have assumed active properties. The tubes which have been considered are either artificial, as glass, or natural, as quills and straws, and such as were not intended to contain circulating active fluids, but to contain air.

The two states of a liquid, viz. the contractile state of the particles of the surface, and the passive state of the particles beneath the surface, are both of them to be considered as the effects of attraction, modified by circumstances.

By inspecting Fig. 1, which represents a vessel whose sides make, internally with the bottom, acute angles, it will be seen how a greater focal seat of attraction, and an apparently less degree of atmospheric pressure at the acute angles, contributes to elevate the surface; and by inspecting Fig. 2, which represents a vessel of a different description, it will be seen how a less focal seat of attraction, and a greater degree of atmospheric pressure at the obtuse angles, contribute to depress the surface.

Soap bubbles will rise in tubes of a sufficiently large bore, in the same manner as liquids rise, but to a much greater height; but the experiment requires some care in preventing the air from interposing, which will retard the operation. (See Fig. 14.)



Dr. Ure makes the elastic force of the vapor of water, at the temperature of 55°, equal to the pressure of a column of water about six inches in height; and consequently this pressure will sustain in capillary tubes, columns of liquid proportioned to the diameters of their bores, at any height below this pressure; and the reason to be assigned is, that the contractile surfaces of the liquid columns not only permit of evaporation, but act against the elastic force which this evaporation produces.

In the following experiment, when water is contained in an inverted vessel, and connected with a small column of water in a capillary tube inserted above it, it is sustained in the open atmosphere; but if the inverted vessel with its capillary tube, be placed under the receiver of an air pump, the diminished pressure will cause the column of liquid in the inverted vessel to break off from the column in the capillary tube above it, leaving it still in the tube, and will descend till it meets the common level, not because it wants a pressure sufficiently elastic to support it, but on account of the evaporation which takes place more readily on that section of a liquid which is under the *least pressure*, which in this case is at the top of the column under the inverted vessel. This has been called, "a perplexing experiment," but it admits of the above very obvious explanation; and it may be illustrated by means of a glass tube, having one end immersed in a vessel of water, and placed under the receiver of an air pump. This tube must contain a piston, with its rod passing through at the top of the receiver, secured by means of a collar of leather; and when the air is sufficiently exhausted, let the piston be quickly raised, and the water will follow the piston to a given height, but the evaporation will produce an elastic air, and soon force it down to the common level.

Art. XI.—*Architecture in the United States.*

The fine arts have hitherto received little cultivation or encouragement in our country—a fact usually attributed to its infancy.—But this is not the only cause. There is in most minds among us, even among persons of enlightened understanding and liberal views, a secret recoil when they are mentioned, a kind of vague feeling that they would be dangerous to that simplicity of manners, and purity of morals, which must form both the basis and bulwark of a republic. The feeling is a natural one, but does great injustice to the subject.—The fine arts are perfectly consonant with good morals, and, so far from being the handmaid of luxury and licentiousness, have always operated as a check on their extravagance. True it is, they have always been found associated with corruption of morals, and the companionship has been a most unfortunate one, since luxury has first abused their powers, and then dragged them with it in its fall.—But this union, though heretofore constant, is not a necessary one, as I will endeavor briefly to shew.

Most of the fine arts, by which I mean, painting, sculpture, music, architecture, engraving, poetry and eloquence, require a rich and well cultivated soil for their growth. Let any one take up a criticism, say on a piece of statuary, and he will be astonished at the extent, variety and difficult nature of the subjects it comprehends. History, antiquities, anatomy, proportion, costume, adaptation of parts, taste, form but a small portion of them, while taste itself embraces a circle of most difficult objects. The same is the case with painting. Architecture requiring, in addition to most of these, a deep knowledge of the mathematics and involving more important interests, is still more difficult. Indeed what Cicero has said of eloquence, may be applied most forcibly to all the sister arts :—*ex illis rebus universis constat quibus in singulis elaborare permagnum est.* But this is required not only in the artist, but also to a considerable degree in the public ; for to the public belongs the severe duty of being arbiter on the subject ; of drawing the nice distinction between true worth and its counterfeit ; of rewarding merit and frowning pretention back into obscurity. It was the Grecian public that formed the orators, poets, historians, sculptors and architects of that country, whatever nature may have done towards furnishing the *materiel:* and the public alone could do it. Had this not been keen-sighted and *classical;* had it, in short, been contented with less than it received, it would have received less ; and in this respect, at least, the world is still the same. Now this state of things requires a combination of circumstances hitherto seldom found, except in a certain stage of the career of nations. That career has been through rudeness, vigor, prosperity, luxury and decay ; and so constant and regular has been their succession that it has come to be considered a fixed and unalterable law of nature. With the first of these the fine arts are utterly incompatible ; in the second they appear ; the third carries them to maturity ; luxury follows, and then comes decay. Luxury would have followed without them, and they would have flourished better without luxury. We do not usually separate them, however, as we ought to do, and transfer to the fine arts themselves our dislike for the accompanying licentiousness, into which they are unavoidably drawn, and as I have said, in this, do them injustice.

Our own country, I believe, is destined to shew that the usual course of nations does not arise from any fixed law of nature. Its commencement certainly was at variance with this law. Like the famed goddess of old, it came into existence in full panoply, in full size and proportion, and with at least a sufficiency of mental as well as bodily power. Our progress too, has been like that of no other nation—and this brings me to the main object of my remarks—the advantages of our country in regard to architecture.

By architecture, I mean not only the principles of science and taste, as applied to public and private edifices, but also to the ornamenting of towns or cities with columns, arches, porticoes, bridges and fountains, and generally, in the way of building, to whatever can be of utility or ornament to them or their precincts. My remarks will also take a wider range, and embrace a science, for which I cannot find a name, for the good reason, that among the nations from which we draw our language, no such science could be known. I mean the choice of position, and the planning of towns, with the grounds and appurtenances connected with them.

We are a calculating people, sufficiently attentive to present interests; too much so, perhaps; but to these interests I wish first to address myself. He who observes the common language of men around him, will be struck, in our country, with the strong susceptibility to objects of mental pleasure. It is natural that it should be so. We are a reading community: and though our reading is generally loose and of a light character, still it brings with it a good degree of information, and more or less of mental culture; it leads to a desire for more, and our enjoyments consequently flow more from the mind than is usual among nations. We are also a travelling people, and from this, pick up a considerable degree of intelligence. Thus prepared for mental pleasure, and ever on the wing, with abundant opportunity for comparing places and scenes one with another, we are gradually forming a pretty correct judgment, as to the beauties of a landscape or a town; and our taste is beginning to set strongly towards them.—This is shown in the crowds that gather to the deck of a steam or canal boat, as a fine point of view, or a handsome village, is approached and is heard in the murmur of approbation among little groups of such travellers, on more ordinary occasions. One of the first questions too, about a town, usually respects its beauty of situation, and of internal character; and no question is answered sooner, and generally, with more correctness. Indeed I do not hesitate to say, that in no country is a striking object sooner analyzed or its worth more correctly estimated. This feeling of the public is going to increase and improve, and, before many years, he who will wish a town to flourish, in choosing its position and forming its plan, will have to consult not only health and convenience, but also beauty and good taste. The former will in most cases allow a range of a few miles for the latter, and the sooner these are consulted the better will it be for the interests even of those whom no other considerations affect.

But I wish to touch another string, and one to which every patriotic bosom will respond. We have a happy country: it may be made as beautiful as it is happy. But there is some danger that this will not be. Our forefathers set the example of looking to Europe, and particularly to England, for every thing; and in most cases we follow the example. We draw even the plans of our towns and cities from them. By this I do not mean that we form them street by street, according to the model of any English city, but that we are pleased or satisfied if their general character corresponds with those abroad. Now there is not one of them, not even Rome, that would not be glad to remodel itself, and change from the clumsiness of its present form, into something of more symmetry and taste. And they always do it, as far as possible, whenever there is opportunity. Witness London, after the great fire, and Rome, after the sack by Brennus and his Gauls. Both events have been a blessing to these cities, though regarded as calamities at the time. We will confine our remarks to England for the present. Her origin was in darkness: her morning gloomy and obscure. The sites for her towns were chosen, and their character determined, by men of rude habits and unenlightened minds, governed in their judgment of such things by the harsh dictates of necessity and nothing more: their successors, for centuries, were but little better, and thus have their cities taken shape and form. Palaces it is true have been substituted for the huts of the first inhabitants; but, after all, it is only a savage in brocade. I use harsh language about places we have been taught to respect, and do justly respect: but still it is true, and they feel it; for London is almost every day tearing down costly houses to widen streets, or form new ones, or open public squares, for the health or proper convenience of her inhabitants. And so will our posterity have to do, if we go on as we have commenced: indeed we are doing it already. We have a vast advantage on this subject, and it is surprising how little we have felt it. We have yet to choose the sites of what are to be large towns and cities, in a generation or two: we have to plan them, with full choice as to convenience or beauty; we have most of our public buildings to erect; we build from one to three hundred private edifices yearly, in each of our large cities; we have a population enlightened, and capable of appreciating beauty in these things; and we have the whole world to choose our models from—or what in some of them is better still—to travel over, and from which to collect beauties, and form a model for ourselves.

Let no one urge that we are not prepared for these things; that they require wealth and leisure, which we have not for them; and that business, not taste, must engross the attention of a young nation. We *are* prepared for them. It is as easy in planning a town to consult good taste and beauty as not to do it, and unless this is done now, the odds are greatly against its ever being done. It is as easy to build in good taste as not, if good models were only before us. And here let me express my regret that we have so few of them, and my hope that the deficiency will soon be supplied. I can conceive no greater benefit than would be conferred on his country by him who would go abroad, and collect there the best specimens of architectural beauty, whether in public or cheap private edifices, and place the whole before our community in a form that would be accessible to all and easily understood. For this the public certainly are prepared. We are prepared also in pecuniary resources. Taste is perfectly consistent with simplicity, indeed, cannot exist without it. The best specimens of architecture which we have, I mean the Greek temples, are characterized by simplicity in every part. Many of them are of costly substances it is true; but many of them also are of the plainest materials; and yet by these last the traveller pauses with the warmest admiration, his feelings kindle, and he finds a powerful effort necessary to tear himself away. The material indeed is always of secondary consequence: it is the "mens divina," the chastened and powerful intellect diffused through the labors of the true architect, that gives the force to their charm. It is nobleness of design, vastness and grandeur of conception, proportion and harmony of parts, that are, or ought to be, the aim of an artist, and the object of our attention in his works. Stone, and mortar, and wood, are to him only subsidiaries, and ought to be by us little regarded. True his materials should be adapted to his object, but they should never *be* his object. When there is any thing about them, in richness or brilliancy, to call off the attention from the *design*, from the mental character of his labors, it is a fault; and the fault is in proportion to such an effect. In this point Italian artists fail the most. Perhaps it is a feeling that their powers are not equal to their task; more probably it is a perversion of taste:—but be the cause what it will, they crowd together jasper, and porphyry, and alabaster, and verd antique, till the senses are dazzled and bewildered by the finery; and then we come from their edifices, with a confused sensation that we have seen some splendid object—and nothing more. This is the effect at first: this richness soon palls on the taste, and then we give them no further attention. This effect is felt by all who visit that country, and is evident in the books of travels some of them give, and also in the guide book through their cities. The talk is all about jasper, and verd antique, and *rosso antico*, till the patience of the reader is exhausted. Travellers there all tell us that their attention soon becomes languid: but how different is it in Greece. In Greece the curiosity is always awake; the feelings always under powerful action; the admiration ever excited; each visit to the Parthenon makes us love it the more. "But the Parthenon is of marble"—true, but this circumstance is always felt to be an inferior consideration: it is not brought out glaring and bold; it strikes us only in its character of adaptation to the grandeur and majesty of the edifice, that mighty effort of mighty minds. There is a little temple in Greece, in which we can suspect no such effect: it is of the rudest material; and yet that temple has a charm about it scarcely inferior to that of the Parthenon. I speak of the temple of Jupiter Panhellenius in Egina. It has received little notice from travellers, for it is in an island seldom visited. The modern Romans however in substituting ornament for taste are doing little more than following their ancestors. There was more wealth at Rome than at Athens; they had far more in their power, as far as materials were concerned, than the Athenians; and perhaps it was this very fact that led to a degenerate taste. In taste Athens was the admiration of the world: they could excel her only in the size and costliness of their edifices; and so they erected mountains of brick work, and loaded them with ornaments; but Athens, standing as it did in simple grandeur, still bore the palm. In the one case, taste was formed on the principles of nature, every where simple, chaste and beautiful in its forms; the artist studied these, till they became a part of his being, his thoughts, his very soul; he then surrendered himself to the subject and he could not go wrong: in the other, taste was sacrificed for effect, and profusion of ornament must supply what was wanting in design. Indeed, so far is great wealth from being necessary to a flourishing state of architecture, that from its temptation to excess of ornament, it is rather an injury than a benefit. Simplicity, not splendor, must be the governing principle; and for this we have abundant means. At the time when Athens erected most of her celebrated temples, she had not half the population, or half the resources, and, probably, not half the wealth now possessed by New York.

Athens! our feelings kindle at the name. Much of this is no doubt owing to the "men of renown" whom she has produced. Demosthenes, and Plato, and Socrates would have given imperishable interest to any place. But take away the Acropolis, and the temples at its base, and what a chilling influence would it have on our feelings; transfer them to any other spot, and that spot will be an Athens to us. If the effect on our feelings after this lapse of time, and at this distance,—if the effect of ruins is so great, what must have been the influence upon the ancient Athenians themselves. The ancients understood these feelings well, and in the days of calamity and danger, each country looked to them as its strongest safeguard. The magnificence and grandeur of their temples attached the hearts of the people no less than the august character of their gods: to each citizen they were the objects of wonder in childhood, of deep veneration in after years; his just pride and boast: he gazed upon them, the monuments of his country's piety, and her honor; he felt himself a sharer in their glory; his feelings became warmed, expanded, refined and ennobled; his attachment to his nation grew strong, and pure, and active; and he, who would otherwise have been a being of selfish and contracted views, was now a devoted and unwavering patriot. It was to these feelings their orators appealed, when they wished to rouse them to action, and no other appeals were so effectual. These were a bond of union, unseen, but powerful: they nerved the arm, and steeled the heart: they were the last to fail; they followed the captive to other lands, and clung to him till death.

Some of these feelings we need, perhaps more than we suspect. I should like to see the character of our nation analyzed by some able hand, for it has already begun to form; I believe that such an analysis, one that would give us credit for our merits, and encourage us in them, and would at the same time, boldly, yet kindly, exhibit our faults, would be of service; for the character is not yet formed beyond repair, and every moment now is of vast consequence in its bearing on the future; of more consequence, probably, than can ever be possible again. In this character would be found, as a striking feature, a fondness for change. It is noticed by all foreigners, and is a natural result of our circumstances. Enterprize is free; the means of support are easy; the roads to honor, or emolument, or fame numerous and open; the stimulants to industry abundant; each individual has the whole country before him, where to choose. Ohio offers allurements to the citizen of Pennsylvania, Indiana to the farmer of Ohio, and so on, West and South. The consequence is a restlessness, both in old and young, approximating strongly to the wandering habits of the Tartar, and felt in all parts of our country. To a certain extent, such a feeling among us is a benefit; but in the extent to which it exists, there is no doubt that it is an evil. It prevents strong local prejudices, it is true; and by mingling together people from different portions of the country, makes our national character more uniform; but at the same time it relaxes the bonds of society; it makes us restless and discontented; dissatisfied with present good—with the best possible good, and disposed to look anxiously and feverishly forward to something imagined to be better. On such loose fluctuating materials can be built no grand national fabric; or if built, it will fall when "the floods come, and the winds blow." Who would look for verdure and beauty on the moving sands of the desert? It is a fact that no people have so much the means of happiness within their power, as our own; but perhaps there are no people who know so little when they are happy, or are so little contented with being so. The assertion is a strong one, but I believe it is true. I landed, not long since, in one of our large cities, after an absence from home, long enough to make me familiar with the countenances of people in other countries. It was a national holy-day, and of course people might be expected to wear their happiest looks: the first thing that struck me was the verdure of the trees and grass; the next, the comfort visible in the appearance of every thing around; the next, the deep sobriety, approaching to sadness, on the countenance of every one I met. I have got accustomed once more to this sombre expression, but it was several days before it ceased to affect me. I have since often thought there is a danger that our character may err on this point; that the powerful and inspiring motives every where presented to our citizens, may take too strong hold on our feelings, and make us, it is true, a thriving and prosperous; but at the same time, a selfish people; that in the eager pursuit of wealth and station, and the disposition it brings to "lay aside every weight," we may throw from us some things more honorable than even wealth, or popular applause; that in the strong and constant pressure of business, patriotism and generous feelings, and piety may be stifled and disappear. The decline of these is already an object of frequent remark. That we mourn over more than we have cause for, is probable; but still they are in danger; and the danger is most to be dreaded, because it is insidious, slow, secret, and in every person's breast. One effect of our circumstances certainly is, to produce greater individuality of feeling among us than is to be found in any other country. It is a singular trait in our character, and I think by no means a favorable one. Our general government itself, instead of drawing us closer to one another, and making us feel like one vast nation, separates us into parts, and places this individuality strongly and distinctly before us. And so with nearly all our institutions: indeed, every object of pursuit, thought, and feeling, will be found, more or less, conformed to this character, and calculated to make each individual stand out effective, it is true, but isolated and alone. The fact is, we need greatly, something to break down this individuality, and form a common bond of union among us; something to make us feel that we are members of one great community; something that, by being a common subject of thought, action, and strong interest, will make our feelings flow into one another, and attach us more powerfully to our fellows, and to the country. Other nations are provided for this, in their king, their national religion, their national universities, their national monuments, in a hundred things to which the term national is applied. The republics of old times provided for it, chiefly in giving their cities objects of deep and common interest. We have no provision for it, except in our Army and Navy, and a few other institutions. We have, I believe, but one *state* university, in the nation; all is loose, solitary and distinct. There is no cement to integral parts, an article deemed necessary, even in the well based pyramids of Egypt: we have no strong bond of union; no object which, disgraced, would bring disgrace on the community; nothing around which we should rally in case of danger, with perhaps the single exception of our liberties. Something, as I have said, to turn the mighty energies of our nation, or portions of it, into one channel; to give us some common objects of pursuit and pleasure, of regret and praise; something to make us more a people of one heart and one mind, is needed. I do not say that objects of architectural beauty, would do every thing towards correcting the evil; but I believe they would be found of vast benefit in that way. They would be public, objects of sense as well as study, constantly before us, and, of necessity, matters of thought and remark. Place in a village a handsome public monument, or pillar, or church, and I do not hesitate to say that, all other things being equal, those villagers will be bound more to one another, and to their village, than those of another. Place by another a group of trees, with a fountain playing in their midst: have beneath them tasteful seats, and make it a place to which experienced age and prattling infancy will go for company or amusement; a spot where the villagers will assemble in the evening for cheerful conversation, and I venture to say that these people will love their homes more, and thinking less of changing, will improve them more; that they will be wiser; that their taverns will be less frequented; and that every good feeling will prevail more among them, than would have been the case without. Place in a town or city, a spot with spreading trees, and pleasant walks between, a spot which would serve as an agreeable promenade, and the feelings of that people will flow in a kinder and smoother channel; there will be more cheerfulness and more happiness than there would otherwise have been. It is a delightful amusement to saunter along the French *promenades* about sunset, and observe the happy groups, of all ages, that throng them; to watch the rapid sale of bouquets, at the platforms which line their sides (flowers only are admitted there); and as an American looks at the cheerful scene, he must think with pain of his own cities, where every thing seems calculated for dull labor, or lynx-eyed gain. It is doubtless owing, in some degree, to the provision of such places, in foreign countries, that their natives resort less to taverns for amusement than with us; and that intoxication consequently is less frequently seen. The French have their Boulevards; the Spaniards their Prado; the Italians their Corso; all of these have their public gardens; and we—we have our tippling shops, the bane and disgrace of our land, and shall have them, I fear, till we provide more innocent places of resort. All attempts to check this current of human feeling are vain; the stream must flow; and if we give it a channel, will refresh and beautify the land. it would otherwise have desolated and destroyed.

So much for the effect on the morals of a people. The reaction on the mind is also of very great consequence. A flourishing state of architecture, it is true, implies a good degree of previous mental culture; but no cause perhaps, operates with more quickness, certainty and power, in refining the mind, thus prepared, than this. It is placing objects of taste before the public, which they cannot help seeing, about which they must converse, whose beauties they must analyse, on which, in short, all will turn critics, and the sure consequence will be, a refinement of taste, an elevation of mental character, which will carry itself into all the concerns of life. The principle of accommodation is one of the most powerful and useful in our nature. Place a civilized man among savages, and his thoughts, feelings and habits, will, before many years, be strongly assimilated to those of the savage: place a savage in refined society, and his character will in a short time undergo a change. Place a number of tasteful public edifices in a town, and the private buildings of that town will become classic and tasteful: build private edifices on the principles of good taste, and I do not hesitate to say, that their interior will correspond,—that in cleanliness, good order and regularity of the system within, there will be a sure and rapid improvement, reacting strongly on the mind, as well as on the moral character of the occupants.

The subject is one sufficiently important, to be a matter of governmental patronage. This we can scarcely expect, but I hope much from honorable rivalship between our cities and towns. The character of a place depends more on this, than would seem probable, at first sight; and, as I have already said, will depend on it still more in future years. Most of the Italian cities owe their reputation, and some of them, through the crowds of foreigners thus allured, a considerable part of their support, to the attention architecture formerly received. Milan would gain but little attention from the multitudes hurrying yearly to Rome, were it not for her cathedral. Genoa would draw but slight notice, were it not for her beautiful palaces. The Duomo and Logia of Florence divide with its gallery, the admiration of all travellers: even Rome owes much of her present celebrity to her architectural remains, and Greece without hers would be but a winter's shadow. I recollect the first time I heard a native of Leghorn speak of his city. He wished to make a favorable impression about it, and spoke, not of its sudden rise, its harbor, or commerce, or canals, but of its *burying ground.*

Leghorn is a comparatively small city, low in its situation, not very clean, and in its best days marked, in every part, with the dull common-place character of a business people. The scenery around is not interesting; and the traveller for pleasure, with Florence, Pisa, and Lucca so near at hand, would think of Leghorn as an odious place, were it not for the protestant cemetery. This is a spot just without the city, of only a few acres in extent, its only ornaments an iron railing, cypresses, weeping willows, and marble tombs; and yet so strong is its redeeming character, that Leghorn never comes to my mind except in bright and cheerful colors.

I will now come nearer home. New Haven was going the way of all our other towns, when, in 1798 or thereabout, she was fortunate enough to have for a resident an English architect of the name of Banner. His name is now almost forgotten, but a time will come, when it will rank well among those of her worthies. He erected a house, still to be seen, on one side of the public square, which though not a model of good taste, was yet sufficient to draw public attention to the subject. New Haven has now taken a character through the land, that draws to it crowds of visitors, a character above all price, since it attaches its inhabitants to their homes, and makes them satisfied and contented. I have met its natives almost every where, and as I have witnessed the glow of feeling, with which they talked of its greens, its elms, and avenues, and its burying ground, I have wished earnestly, that the cause of such feeling were universal in our land. It is true there are other subjects that contribute to the reputation of the place; but when it is spoken of, it is always as the "beautiful city," shewing at once, the idea first suggested by its name, and uppermost in the estimate of its character. All this has been effected at the most trifling expense. The elms have cost simply the labor of planting them; the houses, if there is any difference, are cheaper than in other cities; the burying ground is but little more expensive than such places usually are, and might be made, with advantage, less expensive than it is. There is nothing in New Haven beyond the power of every town in our country. I would not however, propose it as a model :—but the subject has already expanded itself more than I intended it should. If the public think it sufficiently important, I shall perhaps resume it in a future number of the Journal.

Art. XII.—*Manufacture of Steel.*

In a letter from Mr. O. L. Clarke, dated New York, August 9th, we are informed that he is vigorously pursuing the very important manufacture of steel; that for two years past, his whole attention has been applied to this subject, and that last autumn he erected a furnace of the capacity of about five tons and in which, at two operations, he made ten tons of steel. This steel is stated to be equal in every respect to good English blister or (L) steel, and that it has been so pronounced, by a large number of the most eminent and respectable mechanics and artizans in New York and elsewhere; its capacity for hardening it is said, far exceeds any thing they have ever seen, and consequently, it is necessary to reduce the temper proportionably low for edge tools, &c.—it appears that it has been severely tried, and with uncommon success. It is manufactured from iron found and prepared in the state of New York, and from actual experiment, this iron proves to possess all the qualities necessary for making steel, equal to the best English (L). Its qualities are uniform, and the quantity of the iron is presumed to be sufficient for ages to come. Such is his confidence in this undertaking, that Mr. Clarke is determined to push the manufacture as fast as the necessary means can be obtained. His ambition is to complete the manufacture of steel in this country, by making cast steel, which is produced from the best blister that can be obtained. As yet he has not been able to obtain a crucible to stand the trial, but he has every prospect of speedy success. No efforts have yet been made to give publicity to his manufacture, any farther than by his own personal applications to have it proved.

* * * * *

Actuated by a desire to promote so important a manufacture, and wishing to have the specimen of steel which Mr. Clarke transmitted with his letter, brought to a trial, by persons who possess both science and skill; we committed the subject to the care of Mr. Eli W. Blake of Whitneyville, near this place, who with his brother Mr. Philos Blake, ably and successfully superintends the excellent establishment for the manufacture of small arms, erected and for many years sustained by the late Eli Whitney, Esq. In the note to Mr. Blake, a question was proposed respecting the scintillations from steel, which is answered in the subjoined letter in connexion with the main subject.

Letter on steel and other subjects, from Mr. Eli W. Blake, *addressed to the Editor, and dated Whitneyville, Aug. 24th,* 1829.

INTRODUCTORY REMARKS.

My dear sir—In compliance with your request of the 13th inst. we have subjected the piece of American steel, manufactured by Mr. O. L. Clarke, to such tests as our experience suggested, and our means afforded, for comparing its quality with that of the English (L) steel.

Before I proceed to state the results of these trials, it will be proper to remark that for different purposes, steel may possess different properties; or in other words, properties which make it inapplicable to one purpose, may not injure it for another. We do not profess to be judges of the English steel, except for the purposes to which we have been accustomed to apply it, in the manufacture of muskets. We have consequently tested the specimen for those purposes only. The results of our trials, therefore, cannot be considered as testing the qualities of the steel, except for those purposes in the application to which, it must undergo similar processes, and be subjected to similar trials.

A large proportion of the English steel that is imported into the United States, is used for the coarser articles of cutlery. We do not consider our trials of the specimen as testing its qualities for such purposes, for we have tried parcels of steel which had a high reputation among axe makers, &c. and found them unfit for musket-work. We use the English steel for ramrods, and for the main springs of the locks. Any good steel will answer this purpose, provided it may be drawn under a tilt hammer to the size of $\frac{3}{16}$ of an inch square, without becoming *flawy*, and provided it may be hardened without *fire-cracking*. We formerly used the best qualities of German steel for this work, but have latterly had difficulty in finding such as would answer. Since we began to use the English steel, we have experienced comparatively little difficulty from those defects. We have however had one parcel which fire-cracked so much in hardening, that we abandoned the use of it, and yet the same steel was considered of a very superior quality by other artizans. We have thought it necessary to state these facts, thus minutely, in order that the result of our trials of this steel may not disparage the sale of it to those engaged in other branches of manufactures. The domestic manufacture of steel is a subject of great importance to the United States. Whoever labors to improve it, deserves well of his country, and we heartily wish him success.

Trials of Mr. Clarke's Steel.

The results of our examination and trials of this steel are as follows :—

The steel looks well in the bar. The fracture presents in a high degree, that appearance which we have been accustomed to consider as indicating a superior quality of steel.

It is often the case with steel as *high* as this, that it will not "*bear the fire well*," as the workmen term it; that is, before the heat is sufficiently raised, it will begin, (perhaps by the extrication of gas,) to exfoliate or puff up and become spongy, which so much affects its power of conducting heat, that combustion will commence on the surface before the interior parts are sufficiently heated. Mr. Clarke's steel is remarkably free from this difficulty.

A *cold chisel* was made of it, which stood severe usage, as well as those made of English steel.

In attempting to draw a piece of it for a ramrod, three distinct flaws were formed before the drawing was completed. The attempt therefore failed. In making rods from the English steel, we do not ordinarily find more than that number of flaws in drawing a hundred rods.

After making several trials for the purpose of ascertaining the proper temper to be given to it, we made a main-spring of it, which was tempered as nearly as possible, according to the result of those trials. This spring, on being put into a lock, broke at about one third of the ordinary degree of tension. The fracture indicated that it had fire-cracked in hardening. From this cause we usually lose from two to five per cent. of the springs made of the English steel.

From these experiments our conclusion is, that this steel would not answer for rods; but we are not certain that it would not answer for main springs, if the best method of tempering it were more perfectly ascertained by further experience.

In the course of the last four years, we have made trials of several specimens of American steel at the request of different persons who have attempted the manufacture of it, and to a greater or less extent, have uniformly found the same difficulties with it. We however, on the whole, give the preference to Mr. Clarke's steel, over any we have seen.

Defects in the applications of chemical science to the subject of steel and iron.

The various textures and qualities of iron and steel, probably in most cases, owe their differences to their combination with different foreign substances, or with the same foreign substances in different proportions. How happens it, sir, that this subject is so little understood? Can it for a moment be believed that the powers of modern chemistry are inadequate to discover the nature of these combinations, and the means by which they may be effected, varied, modified, or prevented at pleasure? When we see the chemist, almost without hope of reward, seizing with avidity on some new body just brought down from the skies, or up from the inmost recesses of nature, summoning to his aid all his powers of *analysis* and *synthesis*; (I had almost said, of *annihilation* and *reproduction*,) dividing and subdividing it into all its chemical constituents; ultimately detecting in it as the cause of its novelty, some thousandth of a grain of a substance hitherto unknown; then operating upon this until he has determined its specific gravity, its chemical affinities, the ratio of its chemical combinations, and even measured the angles of its primitive particles, —I say, when we see all this refinement of investigation, so freely bestowed on bodies unknown in the arts, is it not surprising that the causes, which so essentially modify the properties of *iron* and *steel*, should still remain almost unknown; and that the art of manufacturing them, which, of all others, should be based on chemical science. should still continue almost in the state of mere empyricism.

Scintillation of steel—inflammation of gunpowder.

You inquire, sir, if we have ever tried whether gunpowder will fire in the sparks from our polishing wheels.* We have tried the experiment, and find that when coarse emery is used on the wheels, it will be fired at any distance to which the sparks extend; but when very fine emery is used, a stream of innumerable sparks may be poured upon coarse gunpowder without inflaming it. The same powder, however, on being finely pulverized, will be readily inflamed

---

* The polishing wheels referred to, are of various sizes and kinds, from large grindstones on which the gun barrels are ground, to small wheels, covered with oiled leather and armed with emery powder; all these wheels are moved with great rapidity by strong water power, and when the steel articles are held upon them, there is a splendid corruscation of innumerable sparks flying off in tangent lines, which follow one another with such rapidity, that the wheel is constantly surrounded *with a glory.—Ed.*

by the sparks from the fine wheel. In both cases the sparks are particles of ignited iron, and there can be no difference in the two cases except in the magnitude of the particles. It would seem, therefore, that within certain limits, gunpowder will not be inflamed by particles of ignited iron, unless they have at least a certain magnitude in relation to the magnitude of the grains of the powder. Your question was probably suggested by the fact well known to you, that on putting the hand into the stream of sparks, the sensation experienced is rather that of *cold* than of *heat*. This is a fact which not a little surprises those of our numerous visitors who have the courage to present their hands to a stream of fire, so dense as to have the appearance of one continuous flame. The paradox, I apprehend, may be explained in the following manner :—

The particles which make up the stream are much smaller in dimensions and fewer in number than they appear to be, each particle, from the extreme rapidity of its motion, appearing to extend several inches, when in fact it is little more than a mere point. These particles, being thus minute, do not impart a sufficient quantity of heat to penetrate through the insensible external membrane of the skin, called the cuticle or epidermis, so as to reach the adjacent membrane, which alone is the organ of sensation, before it is again withdrawn, and more than withdrawn, by the increase of evaporation, produced by the current of air, which the wheel puts in motion. If the hand is held steadily in the stream, until the evaporation is diminished by the gradual desiccation of the skin, we shall perceive a mild sensation of heat. These sensations, first of cold only and afterwards of mild heat, take place only when we present to the stream the *inside* of the hand or fingers, where the cuticle is thick. If the *back* of the hand be presented, a very pungent and pricking sensation of heat is produced at every point where a particle impinges, highly contrasted at the same time with a general sensation of cold produced by the increased evaporation. In the first case, the heat in passing through the thick cuticle of the inside of the hand, extends laterally and loses its intensity before it reaches the sensible membrane ; but the cuticle on the back of the hand, being extremely thin, is immediately penetrated.

Acid in Tomatos.

I would suggest to you sir, or to Mr. Shepard, if he has more leisure to attend to it,, the idea of examining the acid contained in Tomatos. I have observed that it acts powerfully on tin, which I believe is not common with the vegetable acids. I have also observed that this fruit has the remarkable property of imparting a beautiful orange color to animal oils. Very respectfully yours,

ELI W. BLAKE.

ART. XIII.—*Notice of Peruvian Antiquities.*

Translated for this Journal, from the Spanish of the Lima Journal of Prof. Rivero, of January, 1828 ; with a print of ancient images.

THE history of the American nations, which offers so much interest to modern literature, is yet involved in a darkness which with difficulty can be illustrated by some important documents, so as to give us even an imperfect idea of it. Who were the first inhabitants of this great hemisphere? According to ideas that have been transmitted to us by historians, respecting Quetzalcoatl, Bochica, and Manco-Capac, holy and mysterious men, we know that they were the first who appeared in different places, to give laws, and to introduce the customs of the conquerors. These persons, adorned with virtues and talents, are represented to us with sacerdotal robes. The first who was legislator of the Aztecas, came from Panuco, a stream of the Gulf of Mexico. Bochica, a white person, with a long white beard, appeared in the Cordilleras of Bogota, from the plains of Casanare, as legislator of the Muscas. Manco-Capac, celebrated for his laws, and for the empire which he formed, was the one who was chosen to unite the worthy Peruvians into society.

The history of these illustrious men is lost in obscurity, and only their names, which were respected by their vassals, have deserved to be preserved in the archives of their documents, as just and wise men, to whom they owed so many benefits. We are ignorant of the time, as well as the place, whence these extraordinary persons came, and the imagination overreaches its limits, when it attempts to investigate the manner in which this continent was populated. The theories formed by sagacious persons, respecting this subject, discover no other desire but that of following the false traditions of the first conquerors, who, with very covetous ideas, and intoxicated with the gold which they found, forgot the investigations respecting so interesting a subject, and sought only to gratify their cupidity; in their monuments, (which might have revealed to us some truth,) they only took notice of the hidden treasures, without considering that they were more precious, and more interesting than the magnificence which they contained. Unhappy nation! whose greatness and power consist in destruction!

If we believe modern historians, who have described in novels, hymns, and histories, the greatness, the extent of territory, and the laws of the Peruvian people; and if we examine with some minuteness the remains of their monuments, we shall be easily persuaded that the empire of the Incas contained many millions of people; and that its civilization, tolerably advanced, compared with the neighboring kingdoms, was owing to a system of government, made firm and respected by the laws which ruled it. The monuments of Siahunaco, at Cuzco, its great roads and aqueducts, its arts, and its beneficial laws, give some foundation to the thought respecting the existence of a kingdom anterior to the documents of chronologies; besides, all the writers on this subject have devoted their pens to paint to us, in exaggerated colors, their greatness and magnanimity: but no one has wished to undertake the task of describing the rank of civilization to which they had arrived, by arts and sciences, a subject of great interest to human researches. If we judge by the remains which we see, and by what we find in their *huacas*,* they were not barbarous and ignorant; as is evinced by their architecture, and by the fact that they were acquainted with the fusion and soldering of metals, with the manufacture of earthen ware, and the cutting of stones, and also with the construction of roads and aqueducts, and the labors of agriculture. A proof of this is seen in their sumptuous edifices, obelisks, bridges, statues, &c. whose remains are admired for the enormous masses, which without machines are raised to a great elevation. The copper and stone tools which they used, their permanent colors, their earthen vases, and finally their instruments, such as hatchets, pinchers, copper and stone chisels, &c. prove evidently, the knowledge which they possessed in these branches, which we are disposed to boast of at the present time; and it is also apparent that they possessed in perfection, the art of soldering, which is so permanent in some figures of gold and silver, that the solid part would break before it separated. We observe also, in the many figures which we possess, of gold, silver, copper, stone, and clay, the resemblance which they have to those of the Egyptians, from whom, some have said, that the Peruvian people are descended.

The figures engraved on the adjoining plate, are in our possession. The three first are of gold, made it appears with the hammer; they

* *Huacas:* houses of prayer, which are constructed in caverns.

are hollow, and without any visible soldering. The first and the third represent a naked woman, with her hair plaited, seen both with a full and side face; it is two inches seven lines long, seven lines wide, and it weighs a castellano, five and a half tomines.*

The figure No. 2, is also of gold; it represents an Indian, seated, with a head dress, which covers his shoulders, and he has a girdle about his head; it is about five inches eight lines in length, three inches six lines in width, and it weighs about an ounce, (a doubloon.) It belongs to Señor D. Pio Tristan, who found it in a *huaca* at Cuzco.

The figures 4 and 5, are of solid silver, moulded; they represent two naked indians, with the hunting caps upon their heads, their hands upon their breasts, chewing *Acullico*;† they are two inches seven lines long, seven lines wide, and the value of each one is two dollars. These, and those of gold, were found in a *huaca*, by Ulucurayo, a department of Junin.

These figures, we are told, represent a tribe of Indians, called *Opas*, a stupid and ugly people, who were consulted as oracles; but according to our manner of thinking, we rather believe that they may be images of the demi-gods whom they worshipped, and they offered in their great feasts to the principal, which was the sun.‡

The figure 5, represents a woman, seated, with her hands upon her knees, with a head-dress, and ear-rings attached below the ears, a tube projects from the back, and reaches to the neck, to this is attached another shorter one, which is contiguous, and rises above the head, through which the water is poured. This figure is entirely of black clay, and is very much like the Egyptian statues.

The remaining figures are those brought out by Mr. Coit, and which are mentioned at p. 46, of this number; we have no particular knowledge of their history; but as they appear to be connected with the subject of the above notice, we have had the figures drawn and engraved upon the same plate with those described above. There can be little doubt that these figures were connected both with the superstition of the ancient Peruvians, and with their veneration for the dead.

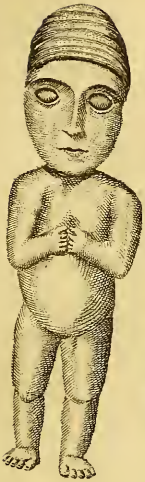
---

* The value of which is about seventy five cents.

† *Acullico*: a species of plant.

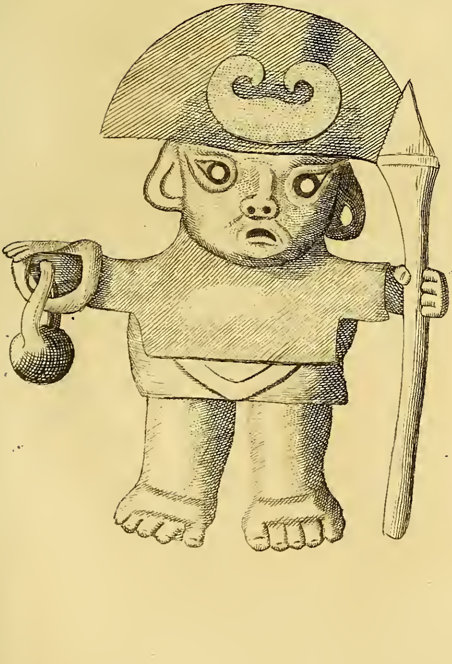
‡ What appears most probable is, that these were a kind of *penates*, protectors of private families.

Im



Nº. 1.

Nº. 2.



Images found in the Huacas or Houses of Prayer of the ancient Peruvians.

Images found in their graves.
(brought out by Mr. Daniel Coit.) see pa. 46.

Art. XIV.—*Igneous Origin of some Trap Rocks.*—Editor.

INTRODUCTORY REMARKS.—VOLCANOS.

In former volumes of this Journal we have repeatedly called the attention of its readers to the evidence of the existence of fire in the interior of our planet.* Hecla, Etna, Vesuvius, Sumboa, Cotopaxi, Teneriffe, Kirauea, and nearly two hundred more active volcanos still continue to shake the earth by their convulsions, and to devastate the countries at their feet by their eruptions. Even long intermission in their activity affords no ground of confidence that the repose of the earth will not be again disturbed. Vesuvius has, in various instances, been quiet for centuries, till forests have come to crown its crater, and vineyards and villas to adorn its declivities. The first seventy years of the christian era saw Herculaneum, Pompeii and Stabia, flourishing in this condition, at its feet: a dense population, active in business or war, or sunk in voluptuousness, dreamed not of impending ruin: although their streets were paved with the lava of ancient eruptions, the inhabitants heeded not the legend which perhaps told them of the dormant fire of the olden time, and of rivers of molten rock, and of ignited stones flying through the air, and of showers of cinders and ashes veiling the sun and oppressing the earth. But the ruin came, and those who have been born almost eighteen centuries later, are now walking the streets, entering the houses, and collecting the relics of these disinterred towns.

It is equally impossible then to doubt either the present existence of great subterranean fires, or that in former periods of the planet, they were much more extensive and terrific in their operations, than at the present day.

Ancient Volcanic Action.

We have already adverted to the vast volcanic district of France,† where (although history and tradition are silent on the subject) for fifty leagues in both diameters, the evidences of volcanic action are as palpable as at the foot of Vesuvius or Etna; and we have sketch-

---

* See Vol. IV. for Prof. Cooper's lecture, and Vol. XIV. for the analysis and review of the works of Scrope and Daubeny.

† See Vol. XIV. of this Journal.

ed the outline of similar districts in several countries in Europe, particularly in Germany, Hungary and Italy.

Analogies with Trap Rocks.

These analogies are at this moment recalled, for the sake of introducing the subject of the present notice. The trap rocks, it is well known, graduate in their mineralogical characters into the acknowledged lavas; and not only into those which are compact and subcrystalline, but even into the vesicular; and the columnar lavas also find their counterparts in the rocks of this family. In their geological position too, there is great similarity. Lava currents observe no law but the law of the strongest; they burst forth, and they intrude, wherever the expansive power sufficiently impels them; and they flow over, or accumulate upon any and every species of rock and soil. The trap rocks are characterized by the same irregularity. We cannot say of any particular rocks, that they are the natural associates of the trap rocks; for the latter intrude among and repose upon granite and the other primitive rocks; they are equally recognized among the transition rocks; and they are found with and overlie the most recent, not excepting bituminous coal, and the tertiary; and even lignite, clay and gravel. They cut granite* and other primitive rocks in two with their dykes; and the sandstones,† limestones, and other rocks, are occasionally severed by the same kind of basaltic wall.

Trap Regions of the United States.

Those persons in this country to whom the name of trap is not familiar, may still remember the conspicuous ridges, with perpendicular mural fronts, composed of rude columns, with sloping backs; and the isolated peaks and groups that divide the states of Connecticut and Massachusetts almost centrally in two; commencing in the East and West Rocks at New Haven and terminating on the borders of Vermont; and thus occupying a region which is one hundred and twenty miles long, and varies from three to twenty five miles in diameter. The Pallisados, on the Hudson, are perhaps still more familiar to our domestic tourists; and it is well known that they cross the state of New Jersey, from the Hudson towards the Delaware. The cave

* At Red Hill, Lake Winipiseogee, New Hampshire.
† In East Haven, two miles from New Haven.

of Fingal, in the island of Staffa, and the Giant's Causeway, in the north of Ireland, are still more signal examples; on account of the regularity and height of the columns, and of their curiously jointed structure. The ironstone is the usual name of the common people for our trap, and this name has allusion, no doubt, to the dark color and great weight of many of the trap rocks.

Two opinions.

There has been much discussion among geologists on the question whether these rocks are of aqueous or of igneous origin. The Wernerian school have maintained the former opinion, and D'Aubuisson, one of its ablest disciples, after writing an interesting volume* to prove it, was led by an examination of the ancient volcanic district of Auvergne, Velay and Viverais, in France, to change his opinion. The Huttonian and, generally, the igneous geologists have sustained the opinion that the trap rocks have originated from fire; and the progress of investigation has done much of late years to establish it. I was accustomed to hear these subjects discussed with great interest and ability, at Edinburgh, by Dr. Hope on the Huttonian and Dr. Murray on the Wernerian side. Prof. Playfair had also at that time published his Illustrations, and Dr. Murray his Comparative View. If I was not convinced, I was always entertained, by these learned and luminous teachers; but without taking sides, I reserved myself for opportunities of future observation. I used indeed, at Edinburgh, to see the sandstone under the trap of Salisbury Craig,† apparently hardened, as if by the action of fire; and the Huttonian challenged this appearance as a proof in his favor; while the Wernerian claimed that it was an alteration produced simply by drying.

Rocky Hill.

Trap rocks abound in this country, and the two principal ranges already cited, with which I am personally acquainted; (those of New England and New Jersey,) repose upon sandstone, commonly considered as the old; but embracing, in different places, many varieties, from graywacke through conglomerate and puddingstone, to the micaceous and argillaceous sandstones.‡ Junctions of different

* D'Aubuisson on Basalt.

† Which much resembles the East Rock at New Haven, and the two trap ridges maintain nearly the same position in relation to the respective towns.

‡ As more fully described by Prof. Hitchcock, in his account of the Geology, &c. of the valley of the Connecticut, Vol. VI, p. 201 of this Journal.

formations of rocks are always interesting to the geologist; they often exhibit evidence of change as they approach each other, and indicate either that different causes were in operation, or that there was a different state of the same causes. The more widely the rocks differ in their nature, the more strikingly is this fact exhibited.

But, it is time to give the notice of Rocky Hill, to which the above remarks are introductory.

This is a ridge of trap rock, a subordinate member of the great trap ranges of Connecticut and Massachusetts, and like most of them, it runs north east and south west. It lies, about three miles nearly S. S. W. from the city of Hartford, to which it has for a century, supplied a large part of the stone used there in architecture. This has occasioned an extensive and deep excavation, and the geologist owes to the activity and wants of a populous region, the interesting exhibition of which I am now to give a statement.

This trap ridge, like all the trap of New England,* reposes upon a sedimentary rock; a variety of sandstone, but here colored, evidently by oxide of iron, of a deep brownish red, and so charged with clay, that it is with great propriety called an argillaceous sandstone. Although the trap rock is constantly carried away to repair the roads and to be used in Hartford, in building; the argillaceous sandstone which lies under it, appears to have been the great object for which the quarry has been worked. The trap ridge is, on the eastern exposure, almost covered with soil. As you come from Hartford on the old Farmington road, you gently rise the acclivity of a hill for perhaps three or four hundred yards, and as you reach its summit, you discover the trap ridge, breaking through the soil, on your right and left, and stretching away north east and south west like a line of fortification. This allusion appears still more appropriate, when you discover on coming to the edge of the parapet, that the vast rampart is faced with a deep ditch, just such an one as defence would require, were the ridge covered by cannon and bristling with bayonets. This ditch is the excavation which, (as its object was peaceful,) it has taken a century to make. It is cut, through both the incumbent trap and the subjacent sandstone, so that their junction is perfectly exhibited through nearly a mile in length, and with scarcely an interruption. The trap is cut entirely through, and is exposed, from the weathered surface, down to its junction with the sandstone; and this

* And like most of that which I have seen in the south of Scotland.

last rock is also cut down for several yards; far below the line, where any peculiarity of appearance derived from the trap ceases.

The general height* of this grand front is between forty and fifty feet, sometimes falling short of the latter, and rarely if ever, exceeding it. The trap rock is commonly from fifteen to thirty feet thick perpendicularly, and the section of the sandstone is from ten to fifteen or eighteen.

Both rocks, as thus cut through for nearly a mile, in this extensive quarry, exhibit a magnificent section; such as a geologist, wishing to study the origin of the trap rocks, would be most anxious to see, but would hardly expect to find. To others, the place is worth visiting on account of the beauty of the scenery. In the retrospect towards Hartford, is the grand and rich valley of the Connecticut—before you, the vales of Newington and West Hartford, almost equally beautiful; and the view, in both directions, is bounded by hills and mountains, which, to the north and south, appear interminable.

But the geologist, withdrawing his eyes from the landscape, will rivet them upon the junction of the trap with the sandstone; whose relative positions will be at once understood, by inspecting the section which forms the frontispiece of this number, and for which I am indebted to the pencil of Mr. Daniel Wadsworth, who, with the Rev. Dr. Wainwright, and other gentlemen, accompanied me to the spot. It will be seen, in the print, that the trap, in some parts rudely columnar, in others amorphous, reposes upon regular strata of the argillaceous sandstone; just as a collection of pieces of hewn timber may be supposed to stand, on end, and close together, upon a pile of boards or planks. The portion of the rocky ridge represented in the picture is about eighty feet, in the horizontal direction; the trap is there twenty eight feet thick, and the sandstone that is cut through is sixteen feet three inches, so that the whole height at that place does not exceed forty five feet. The figures of men at the foot will afford a palpable scale. The water in the hollow, is an accumulation from rain, in the bottom of the quarry.

This argillaceous sandstone has a few peculiarities which deserve description. The flat surfaces where the strata join each other, are glazed as if they were varnished, and they are marked by fluctuations, like those produced in soft moveable mud or sand, by undulating water; and also by irregular lines, running about upon their surfaces, like

* I speak of the depth of the excavation, not of the height of the ridge, above the adjacent country, which is much greater.

large veins just under the skin of an animal. This sandstone is not only argillaceous, but it is calcareous. Its numerous fissures are occupied by thin veins of calcareous spar, generally not thicker than a goose quill, but occasionally swelling into larger dimensions, and sometimes dying away in scarcely visible lines: crystals of calc-spar, sometimes of tolerable regularity, are not very uncommon, and there can be little doubt that the entire rock would effervesce, but I did not happen to have any acid with me when I was there, by which I could make the trial. A very curious circumstance in this sandstone, is its constant disposition to split into huge rhomboidal tables. It always has this figure marked out by regular fissures, as it lies in the quarry, and it comes out in this form, as may be seen abundantly in the pavements of the side walks and crossing places in Hartford. The appearance is too constant to justify the supposition that it was accidental; it undoubtedly resulted from some law, but I would not venture to say that the rhomboidal figure had any connexion with a tendency to crystallization, produced by the carbonate of lime, which is contained in the rock.*

The strata of this argillaceous sandstone are inclined, and dip to the S. E. at an angle of, apparently, from ten to fifteen degrees; it contains some veins of sulphate of barytes, occasionally stained by green carbonate of copper, and united to crystallized quartz.

The trap rock is of the variety called greenstone; it is, obviously to the eye, and still more distinctly to the magnifier, composed of hornblende† and felspar, and possibly quartz, aggregated in a confused and very compact crystallization. It is exceedingly firm, and if taken from the distance of four or five feet above the sandstone, it is very difficult to break. No person at all accustomed to chemical

---

* Nor am I quite certain that the rhomboidal figure is common to a looser kind of sandstone which forms the greater part of that kind of stone found in the quarry, and which on being exposed for a year or two to the air, crumbles into pieces, presenting an appearance like that produced by the slacking of lime. This kind of stone is rejected or used to make roads and paths, or for rough work, and only that which is in rhomboidal tables is carried into Hartford for pavements. The strata of this are continuous for a great extent in the quarry; a particular stratum being found regularly at a particular depth through the whole quarry. It is the decomposition of this argillaceous sandstone replete with clay, which has given the excellent basis that will always insure to this vicinity, the fine soil which it now enjoys; and the color, so strong as to have given origin to the application of it in paper printing, is owing to the oxide of iron, so abundant in this stone.

† Perhaps sometimes augite.

and mineralogical discrimination, would hesitate a moment to say, that this trap is a crystalline, and the sandstone under it, a mechanical rock; the sandstone was evidently formed by subsidence, from mechanical suspension in water, and is composed of the accumulated ruins of other rocks, or of other forms of mineral matter; the trap was as evidently deposited and aggregated, not from mechanical suspension, but from a state of chemical mobility. But, a chemical rock, lying upon a mechanical one! Greenstone trap* upon sandstone? How came it there? This is the knot which it would be desirable to untie, although it would be much easier to cut it, by saying it was made there just as we see; so was the Coliseum at Rome, or the Parthenon at Athens, as we might maintain with just as good reason.

As I have intimated, in the earlier part of these remarks, it has often been stated that the trap rocks produce changes upon other rocks, and other forms of mineral matter, with which they come in contact, or in whose vicinity they lie. However doubtful or imaginary this may be supposed to be in some cases; in the present instance, the change is so manifest, and even palpable, throughout the whole horizontal length of this vast mural front, that it cannot for a moment be questioned, whatever may be thought of the cause. For the vertical distance of between three and four feet, in the sandstone, and of four or five in the trap; from seven to eight in the whole depth, including the two rocks at the junction; both the trap and the sandstone unfold a record, of which it appears to me scarcely possible to give more than one interpretation.

Beginning with the sandstone, at the depth of from four to five feet below its junction with the trap, it appears perfectly unaltered, and possesses all the characters which have been stated in the description. Between three and four feet below the trap, going upward, the sandstone begins to grow firmer; and as we ascend, this firmness increases; the gloss disappears; the color grows lighter; the red vanishes, and becomes dark grey—light grey—ash grey, and in some places, almost white; while at the same time, the firmness is much increased, so that from being a very soft and tender argillaceous sandstone, easily splitting into laminæ, it has become hard, and difficult to break, striking fire with steel, like an overburnt brick, and its fissile character is almost or quite destroyed. We should not, where it approaches the trap,

* The trap at this place appears to contain but few foreign minerals; principally veins and spots of quartz, and geodes of quartz crystals.

suspect it to be the same rock which it is below, and might even suppose that it was not, did we not trace the change by an almost imperceptable gradation. But this is not all. At the depth of about two feet, rather less than more, the altered sandstone begins to grow vesicular. Fine pin-hole cavities make their appearance; they are very numerous, and the solid substance which surrounds them becomes semi-vitreous, and loses the appearance of sedimentary or fragmentary matter; as we ascend towards the trap, the vesicles increase rapidly in size, and at, and near the junction, they are both numerous and large. In a word then, for two or three feet below the junction, the sandstone is greatly indurated and inflated, and these appearances are the most remarkable at the junction.

Now for the Trap.—In many places, it is so blended with the sandstone, that for a few inches on each side of the line of junction we can scarcely tell which rock is which;* they look as if melted together. But in some places the sandstone has been removed from below the trap, so that the latter projects overhead, like the roof of a portico, and we can look upon its under surface. There it is most remarkably inflated; the cavities would often contain peas, or small bullets, and they are many times, so numerous, that the remains of the rock serve little more than to connect them, and vast quantities of this porous vesicular rock are easily torn down with the pick axe, and carried away to mend the roads. In hand specimens, I could scarcely tell it from the vesicular lava of Hecla. The vesicular character of this trap rock is most conspicuous at the junction with the sandstone, and continues to be very distinct for two or three feet above; but it becomes usually less conspicuous between three and four feet above, and this character rarely appears much, above four and five feet; beyond which limit the rock commonly resumes its compact and firm structure, and its sub-crystalline appearance, which often vanishes entirely, or is greatly obscured where the vesicles are the most numerous.

It has been already mentioned, that this trap is sometimes amorphous, and at other times indistinctly columnar; between the rude columns, or between the masses which are contiguous, and have fissures between them, there is occasionally the same vesicular ap-

* How then do we know where the line of junction is? By observing the graduated appearance both ways, and the perfectly distinct surfaces which, perhaps at a little distance to the right or left, we may discover.

pearance that has been described, and it extends up much higher than in the general mass, and is visible for some distance inward, from the contiguous surfaces of the masses of rock, penetrating into their substance. In a few places, the inflation of the trap rock continues higher than has been described in the general statement; it seems as if the force which produced the effect, suddenly hove up a wave, until it was repressed by superincumbent pressure, and again subsided to the general level. Perhaps it would imply too much of hypothesis, if we were to say that this arose from the mass above being less heavy, as the superincumbent trap appeared in such places generally thinner; but it was not always so in appearance, for there were places where the trap was only a few feet in thickness, and the inflation was not always increased.*

What is the impression which these remarkable appearances must make upon a common mind of good intelligence? Some of the specimens, both of the altered sandstones and traps, were exhibited to such persons, and without imparting to them any hint of their supposed origin, they were asked what gave those stones that appearance? the answer was, they have been in a furnace, and the different varieties have been subjected to different degrees of heat.

Such are the impressions of all who view the specimens, and it is decisive that they are of a very indubitable character, because all agree in their opinion of them, whether interested in such subjects,† or informed in geological facts and theories, or not. For myself, I must say, that the effects that have been produced, both upon the trap and sandstone, which are so distinctly and strikingly visible for an average depth of seven or eight feet, and in some places more, and for a continued distance of nearly a mile, are such as I can attribute to no agent but fire. That there was a great and pervading cause, which operated upon both rocks at their junction, cannot be doubted; that this cause was resident in the trap, seems almost equally certain, be-

---

* It does by no means, however, follow, that this was the original condition of the trap; the contrary is perhaps highly probable: that is to say, that there was originally a much thicker mass, either of trap or other matter, above the whole of that which we now see, and that in the progress of ages, it has been removed by the operation of both gradual and violent causes.

† In my last visit to this place, I was in company with several highly intelligent gentlemen, and in a former one, with ladies of a similar character, and the impression made upon them all, was the same. I found it even among the workmen in the quarry.

cause the trap was deposited after the sandstone, and the effects are common to both rocks, although most conspicuous as regards inflation in the trap; but as regards induration and change of color, they are most striking in the sandstone; the effects on both rocks are just such as, from their nature, we must expect from intense heat acting under great pressure.

It is well known, that in deep currents of lava, the surface, under no pressure but that of the atmosphere, is usually covered with scoriæ and slag, resembling the ordinary rejections of furnaces, and that near the upper surface, the lava is often extremely inflated and vesicular, and that these appearances, although existing often below, do on the whole decline, and finally vanish, so that the mass at a certain depth becomes like a rock. Such portions would never be suspected to be of volcanic origin, except by a person familiar with such appearances, and it is this passage, on the one hand, of the undoubted lava currents into rocks which cannot, in many instances, be distinguished from basalt and other members of the trap family; and on the other hand, of trap rocks into the porous and vesicular strata, and into other forms which can scarcely be distinguished from the same varieties of lava; it is this double approximation which, among many other considerations, gives such strong countenance to the igneous origin of trap rocks. The subject is a great one, and has often occupied the attention of able men.* We cannot now pursue it any farther, than to apply it to the case of the Hartford Quarry. No theory can, in this case be admitted, which does not embrace also the vast formation of which this ridge is a member; or at least the contiguous chains, some of which, within a few miles of this place, present mural fronts composed of columns of several hundred feet in elevation, and form a part of trap ranges that run almost continuously, for one hundred and twenty miles.† These ridges and peaks of trap present indubitable evidence, that they are not in their original condition. Their slopes are covered with their ruins, and these in enormous quantity, are often scattered over the plains and valleys. It seems fair to infer, that the present surface is not the original one, and that these trap ranges were formed under superincumbent masses, which have been

---

* See President Cooper's lecture, Vol. IV. of this Journal.

† We may say continuously, in a geological sense, for, although the ranges are often interrupted, they are on the whole continuous, and the subjacent sandstone is strictly so, except where it is cut in two, by dykes of trap or other rocks.

swept away in the progress of time, and that they were subjected to a vast pressure of solid materials, and not improbably of the ocean; the ancient ocean which enveloped the globe, before it attained its habitable condition.

If fire were the agent, it is not now necessary to stop to account for it; for its existence at the present moment, and in all ages, is an unquestionable fact, and must be admitted, whatever theories of its origin we adopt or reject, and no geologist will question the original, or at least early submergence, of our planet under a deep ocean.

If then we suppose that the materials of the trap rocks were melted below, and were forced upward through the incumbent strata, either from fissures or vents, and that upon those superior strata, the ocean itself was also incumbent, we have all the conditions necessary for the solution of this problem.* Had the trap rocks been erupted into day light like currents of lava, there would be no reason why they should not exhibit all the variety of appearance that belongs to lavas; but, if only forced through, and among superior strata, or even if forced quite through them, but still remaining under the pressure of many miles of ocean; they would congeal under enormous pressure, and of course would be long in cooling, and would in the main assume the stony or rocky, rather than the vitreous character. Sir James Hall, and Mr. Gregory Watt proved, a good many years since, that trap rocks, if melted and cooled very slowly, and under pressure, do, in fact, reassume the stony and subcrystalline appearance; if rapidly and without pressure, they become vitreous, and the same pieces may be made to pass from one stage to the other at pleasure; the slag becoming rock again, and the rock again slag;† the same fact is true also, of acknowledged lavas.

In the case of the Hartford quarry, if we suppose that the melted trap came in contact with the argillaceous sandstone, still charged with abundant moisture, which the evident circumstances of its deposition would necessarily imply,‡ and replete too with carbonic acid in

* All compound rocks are fusible, and as we have every reason to believe are actually melted in volcanos: trap is fusible in our furnaces, and bottles were some years since in France, blown from this material. I have melted the New Haven trap, so that it flowed and congealed on the grates of the furnace in stalactites.

† I saw the specimens of Sir James Hall, (father of Capt. Basil Hall, the celebrated traveller in America.) They were exhibited by Dr. Hope, at one of his public lectures during his discussion of the Huttonian theory.

‡ If any proof were wanting that this class of rocks was laid down under water, it is at hand. In quarrying the coarse conglomerate sandstone, (a part of the very

the calcareous spar, which it embosoms; steam and gas would of course be copiously formed, and being rendered very elastic by the intense heat, they would make every effort to pass upward, according to statical laws; but, the viscous and tenacious character of the melted trap and of the softened sandstone would oppose great obstacles to their free passage; which, aided by the enormous pressure, would eventually prevail, and at some distance from the surface where the action of the trap upon the sandstone was going on, the extrication and passage of the bubbles would eventually cease. The sandstone, below the depth to which the heat reached, would remain unaffected, and the trap, above where the elastic agents were extricated, would be slowly consolidated, without those marks of igneous action, which were derived chiefly from the nature and condition of the argillaceous and calcareous sandstone.

It is not, however, necessary to the inflation of trap, that it should be in contact with sandstone or with any other particular rock; there are in the trap itself materials to afford aerial products, and whether they would be evolved or not, must depend upon circumstances, principally the intensity of the heat and the superincumbent pressure. There are many cases of inflated traps, where we can discover no immediate connexion with another rock. But in the case before us, that connexion is palpable, and is coextensive with the observed phenomena. Mr. Seymour, one of the tutors of Yale College, informs me that similar appearances are common in other trap ranges in the vicinity of Rocky Hill, especially in Newington, his home, where there is a parallel and a higher range that has been cut through in making the road, and which has been otherwise exposed in quarrying. It must be remembered, that it is only where sections, derived from such causes, enable us to examine the junction of trap with other

formation that continues to Rocky Hill,) which has been used at New Haven, during the two late seasons, in constructing a great building, the new State House, the cavities in the rock which were entirely secluded from the atmosphere, were often found full of wet clay and other comminuted materials, evidently the mud and dust of the primitive rocks whose ruins compose this sandstone, and during its deposition, accidental cavities appear to have been filled with this mud and water, and then to have been closed up by the accumulation of more of the materials of the rock, so that the clay, wet often to the consistence of soft mortar, has remained, we know not how many ages, and might have remained, we know not how many more, unchanged. A mass of this mortar, which I carried home, and worked in my hand like dough, lay in the hot air of July, for several days, before it was quite dry.

rocks, that we can expect to find any such remarkable appearances, originating from similar causes.

I am acquainted with several places where there are junctions of trap with other rocks, but as I wish to examine them again, and to make more precise observations upon them, I do not cite them now. Many other junctions must be known, in various parts of the trap regions of New England, New Jersey, and other parts of this country; and I take the liberty to request, that those who may have it in their power, will make precise observations upon the appearances at the junctions, and transmit to me the result, accompanied by drawings and specimens when it is convenient; and at least with accurate descriptions.* We might thus be in a condition to form a general opinion of the origin of our trap rocks. Hasty generalization from a few facts is a great evil in science; and if there should eventually appear to be sufficient evidence to admit the aqueous origin of trap in some cases; (as we must I think without doubt admit its igneous origin in many;) we must not hesitate to go where truth and evidence, and sound reasoning will carry us.†

This caution seems the more necessary in the present case, because there are instances in which there is apparently no direct evidence of fire, in cases where trap is in contact with other rocks.

Such appears to be the case in the Campsie Hills in Scotland, in Stirlingshire, as described by Lt. Col. Imrie, in the second volume of the Transactions of the Wernerian Society of Edinburgh. For the illustration of his memoir, he has given a large and beautiful section, exhibiting the junction of the trap with stratified rocks below; and the case is extremely similar to that of the Hartford quarry, only no appearances of igneous action are mentioned, and it is fair to presume that they would not have escaped so acute an observer as Lt. Col. Imrie, accustomed also as he had been to the observation of

* Which, if permitted, shall appear in this Journal.

† If some are disposed to say, it is absurd to admit that the same result may proceed from opposite causes, as of fire and water, we must resort to our experience in order to ascertain whether there are any parallel cases; and we shall not be long in finding them. Camphor crystallizes from its solution in alcohol, and also from sublimation by heat. Boracic acid crystallizes from the mother water in which the borax that affords it, is decomposed by sulphuric acid; and it rises also and congeals in beautiful crystals from the effect of heat. Corrosive sublimate is another example; and there are many saline bodies, (common salt, nitrate of potash, sulphate of potash, &c.) that are both fusible and soluble in water, and afford, if not crystals, at least solid deposits from both.

igneous action at Etna and Vesuvius, and in the Lipari or Eolian Islands; and occupied as he is in this very paper with the discussion of the subject. Under the trap described by Lt. Col. Imrie, there are several stratified rocks, among which are sandstone, limestone, and bituminous shale; and the sandstone is the stratum upon which the trap immediately reposes, and it alternates more than once with the other rocks, but it is not described as being at all altered in the vicinity of, or contact with the trap. Prof. J. W. Webster, in the first volume of this Journal, has well described similar facts, at the Calton Hill, in Edinburgh; a place with which I was myself familiar.

These remarks have been extended far beyond my original design, and I will conclude them, by again calling the attention of geologists, and of all intelligent observers; in the first place, to the delineated section which illustrates these remarks; and in the next place, to the scene itself, which is well worth the trouble of an excursion from Hartford, and which, notwithstanding the interest so properly excited by its fine institutions, and surrounding country, and by the gratifying exhibition of a flourishing and beautiful city, should hereafter stand preeminent among the *Lions* of this region, and be visited by all travellers, who are admirers of rich and noble landscape, or of astonishing geological facts.

Art. XIV.—*Danger from the premature explosion of gunpowder in the blasting of rocks, with suggestions as to the means of prevention.*

The deep interest excited by the following letter, induced me to submit the subject to the consideration of a gentleman whom I knew to have had considerable experience in blasting rocks, and in whose science and skill, I have the greatest confidence. As he has favored me with an answer, which contains very important suggestions, I am happy to lay it before the public, in connexion with the letter of Dr. Catlin. I have added also, some suggestions of my own.—*Ed.*

I. *Letter of Dr. Catlin.*

Haddam, Con. August 25, 1829.

TO PROF. SILLIMAN.

Dear Sir—Being desirous to promote the welfare of my fellow-citizens, and to render the situation of those engaged in a hazardous employment, as safe as the nature of the case will admit, I take the liberty to address you for the purpose of obtaining some information, on a subject important to mankind.

It is undoubtedly well known to you, Sir, that a large number of men in this place, are engaged in the quarrying of stone.* They are under the necessity of using large quantities of gunpowder, for the purpose of liberating the rocks, and injuries have not unfrequently been received, from premature explosions. But till recently, the injuries have seldom been serious, and the explosion has readily been accounted for, and has generally, perhaps always, except in the last case that occurred, been owing to the carelessness of the operator. The lives of two valuable young men of this place, have within a few weeks, been destroyed by explosions, which has alarmed us; the last case particularly, as we are unable to discover the manner in which the powder became ignited. I will relate the circumstances: the hole which was charged was eighteen or twenty inches deep, and about three in diameter, and was made by drilling into a solid rock. The spindle used was made of copper, and that it might be easily drawn, it was oiled ; a wad of dry tow was first put down, with a wooden rammer, and followed by two wet wads, pushed in with the same instrument. The hole was then filled up a few inches with gypsum, by putting in a little at a time, and pounding it down forcibly with an iron tampering bar, held in the hole and struck upon with a hammer. The spindle was then withdrawn a little, by placing the tampering bar through the ring at the upper end of the spindle, holding one end in the hand, and striking under the other with the hammer ; after this, the workman proceeded to tamper down as before, and again drew his spindle as at first, but thinking that it was not withdrawn sufficiently, he gave another blow and it exploded. The end of the tampering bar, (as is supposed,) struck in his right eye, fractured the orbitar plates of the os frontis, and destroyed life in thirty-six hours.

Now, Sir, if you can inform me, how the powder became ignited, and how the danger may be avoided in future, you will confer a benefit on all those engaged in quarrying and much oblige

Your servant,

BENJAMIN H. CATLIN.

* In the vast strata of hornblende-gneiss, which, below Middletown, for thirty or forty miles, form the banks of the Connecticut, to its mouth. This rock affords an admirable flagging and building stone for our cities, and is transported even to the Southern States. In this region are found, also, the crysoberyl, beryl, and many other interesting minerals.—*Ed.*

II. *Letter of Mr. Blake.*

Whitneyville, September 5, 1829.

TO PROF. SILLIMAN.

My dear sir—In blasting rocks, as you know, it is not an uncommon thing for explosions to take place before the charging is completed. Almost every year some of our numerous newspapers give accounts of such premature explosions, attended with fatal consequences to the operators. The cause of the accidental ignition of the powder in these cases, is sometimes clearly indicated by the known circumstances of the case, and at others it can only be referred to the unknown circumstances, which may have attended the operation. I have read with attention the letter on this subject, which you did me the honor to refer to me, which was addressed to you by Dr. B. H. Catlin, of Haddam, giving an account of an accident of this kind, and soliciting information as to the cause of the ignition of the powder and the means of avoiding similar accidents in future; and shall now with pleasure proceed to state to you my views of the subject, as you desired.

The method of charging the rock in this case, as minutely described by Mr. Catlin, was that which is now most generally practised, and it is perhaps the only method that was in use twenty years since. The workman appears to have used more than the ordinary degree of caution; and I cannot see that there was any thing in the case to produce explosion, which is not liable to exist, in every case, in which this method of charging is practised. In the Journal of Science, Vol. XIII. p. 161, are given the results of some experiments tried by M. Aubert, which go to show that violent shocks and percussions, between any two hard substances, may occasion the disengagement of sufficient heat to inflame gunpowder; and it is well known that violent *attrition* is still more favorable to the disengagement of heat than percussion. To both of these the process, as described by Mr. Catlin, is evidently in some degree liable. In tamping down the first quantity of gypsum, which was put in next above the wad, the irregular pressure of those pieces which were in contact with the wad, would be very liable to force the wad down on one side of the hole or in the centre, which would cause the powder to be thrown up on the other side or on all sides. The spindle is usually inserted into the powder on one side of the hole; consequently the wadding would not be likely to close the hole entirely around the spindle, and the powder would be therefore, particularly liable to be thrown up around the spindle. By proceeding with the tamping, this powder would be brought in close and hard contact with the spindle, and in withdrawing the spindle in the manner mentioned by Mr. Catlin, would be subjected to violent attrition, between the spindle and the gypsum or between the spindle and the rock. Whether this was or was not the precise cause of the explosion, cannot perhaps be determined; nor will it be important to know, if, without this knowledge, satisfactory information can be given in regard to the manner in which the recurrence of similar accidents may be prevented in future.

About twenty years since another method of charging a blast was proposed and circulated in the newspapers, which, since that time, has been practised to some extent in different parts of this country. This method may be briefly described as follows, viz. After putting in the powder, take a rye or wheat straw, which is long enough to reach from the powder to the top of the hole, and having filled it with powder, insert one end of it into the charge; after which put in a small quantity of wadding, and then fill up the hole with coarse dry sand, simply poured in without any ramming.

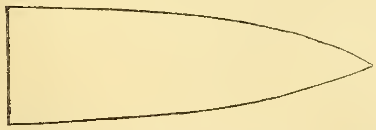
When about ten years since my attention was turned to blasting, I made a trial of this method, with great success in some cases but without any effect in others. I soon found that when the hole was *deep*, the effect was not only certain, but also more powerful than when charged in the old method. But when the hole was shallow, the sand would generally be thrown out without producing any effect on the rock. When the depth of the sand above the powder is not less than ten times its diameter, I have never known it to be thrown out. In all such cases therefore, I can from experience recommend this method as one which is perfectly safe and sure, and at the same time more expeditious and more effectual than the old method.

Since my attention has been drawn to this subject by Mr. Catlin's letter, an equally safe method has occurred to me, of securing a blast in holes of less depth. This method is as follows; viz. Having put in the powder, and inserted into it, on one side, the straw filled with powder, as directed above, put in a small quantity of wadding and press it compactly down; then make a cone of wood, the diameter of whose base is a little less than the smallest diameter of the hole, and whose height is a little less than the distance from the top of the wad to the top of the hole. Set the base of this cone on the wad, and then keeping the vertex in the centre of the hole, fill in around it with coarse dry sand. If the hole be very shallow, the sand may be pressed down around the cone with a small wooden rod, but if the length of the cone be eight or ten inches this will be unnecessary.

For the purpose of testing this method, before I proposed it to you, I have, within the last week, made seven trials of it, six of which were successful. The failure of the other, I attributed to the circumstance that the cone was so large at the base as to bind on the sides of the hole. The same hole was afterward charged, using a smaller one, and the blast was effectual.

I have spoken of the piece of wood to be used in this method of blasting as a *cone*. Strictly speaking, however, its form should not be that of a true cone. In a cone, the areas of the sections which are parallel to the base, are as the squares of their distances from the vertex; but the proper form for the pieces of wood, is that in which these areas are not in the *duplicate*, but in the *simple* ratio of the distances from the vertex. This gives the form of the true *paraboloid;* and to this form the workman, in making the piece, should certainly approximate as nearly as convenient; particularly as it respects the main part of the length, from the base toward the vertex. Near the vertex the form will not be so important. It is more conveniently formed, and is perhaps better, to *terminate* in a conical point, rather than in the more obtuse form of the paraboloid.

I here give a longitudinal section, showing on a small scale, nearly the form of the pieces which I used in my experiments.



It will be proper to remark here, that no very great degree of precision will be necessary in forming the pieces, particularly for holes which will receive one as long as eight or ten inches. When the workman has formed a just conception of the proper form, he may make one with sufficient precision, for any depth of hole, with no other instrument but a common axe. The pieces, especially when not more than five or six inches long, should be made of hard seasoned wood. When once made they may sometimes be used several times in succession, as they will not often be thrown to a great distance; sometimes not even out of the hole. In my experiments I used one piece three times and another twice.

Though the time occupied in charging in this way, is somewhat more than it takes to charge in those cases where sand alone may be used, it is still much less than is required to charge in the old method, as described by Mr. Catlin. Should this method, on further trial, be found to be sure and effectual, it will afford as full a remedy, as can perhaps be expected, for the hitherto hazardous nature of the employment. With the most respectful consideration,

I am, Sir, your friend and servant,

ELI W. BLAKE.

III. *Letter of the Editor to Dr. Catlin.*

Dear Sir—It is perhaps hardly necessary to add any thing, after the able and clear instructions, given by Mr. Blake. But as people are more prone to go on as they have been accustomed to do, than to adopt new modes, although improved ones, it may not be amiss to say, that Mr. Blake's method appears to me, to embrace all the desiderata, both theoretical and practical, which the case requires.

1. You are aware that *the explosion of gunpowder, arises from the instantaneous production of a vast quantity of gases,* which being also expanded by the red heat, cannot be confined, and of course, when not permitted to escape, rend their enclosure. With a given quantity of powder the tendency of the gases to rend the enclosure, is increased, in proportion as we increase the resistance which we present, tending to prevent their escape; and we modify this resistance, to suit our views, in different cases. In a gun, we add a wad, not only to retain the powder, but to cause its more instantaneous combustion, and to confine the action of the gases in that direction, to the bullet; it is not our object to do more, and if our charge is too great; or the wadding is rammed down too hard; or there is upon it, too great a load of metal, the reaction is so violent, as to burst the piece. This is a rare accident, considering how many discharges are made by careless people; and we are scarcely aware how much the force of an explosion is increased by even slight resistance.—A train of gunpowder laid on a board, burns, as we know, with so little rapidity, that we easily walk or run faster than it goes; but, if another board be laid over the train, and weights placed upon it, although still open at the sides, the powder then burns with amazing rapidity. Powder merely flashes in the pan of a musket, but the same powder placed in a quill, burns vehemently; still more, fulminating mercury, which also flashes, (although with intense brightness,) when fired in a heap, explodes with great violence, in a quill.

2. *Our object, then, is to repress the force to such a degree as to accomplish our purpose;* which, in fire arms, is to give velocity to a ball; but, in the case before us, it is to rend asunder the surrounding matter. In the old method of blasting rocks, this was most effectually accomplished, by ramming down pounded brick upon the wadding. This closed the hole so thoroughly, that commonly, the brick would remain undisturbed by the explosion, which of course, spent itself upon the rock, and tore it asunder.

In blasting logs, also, the same object was attained, by driving a wooden pin into the hole above the wadding; and here again the pin often remained in its place, after the explosion which burst the log.

3. But, *in blasting rocks, painful experience has shown, that great danger of premature explosion is encountered, whenever firm substances are made use of to close the canal above the powder;* and multitudes have been killed outright, or dreadfully mutilated by these casualities.

4. *The ingenious remedy, first proposed by the French, and employed, if I mistake not, by the Engineers of Napoleon in constructing his famous roads through the Alps, removed the danger of explosion, but was not in every case effectual.*—Mr. Blake has, however, given us the rule, by which the desired effect may be rendered certain, and there can be no hesitation in applying it, as is indicated by him, when the hole is bored to a certain depth. But, as the success is not universal, and the reason and remedy were unknown to the workmen, this method seems not to have been generally adopted in this country.

5. *The method of Mr. Blake combines all the advantages of the French mode, with another important one, which is peculiar to his contrivance.*—It is equally safe with the French method, (both are perfectly safe,) and Mr. Blake's supplies the only deficiency in the French mode. The latter was effectual, evidently, because the resistance afforded by the column of sand, when of a certain depth, was sufficient to produce the necessary reaction upon the rock; perhaps the movement which would be given to the sand, by the first expansive lift, when the powder was kindled, would even facilitate its thorough and sudden inflammation, by giving room to the flame to dart at once, into, and among the grains; while the pressure would force the flame to pervade, instantaneously, the whole magazine.

In Mr. Blake's mode, this advantage is equally attained, and when the wooden stopper begins to rise, in consequence of the expansive effort of the gases, it is immediately wedged by the sand, which is crowded between it and the walls of the cavity; more sand presses down from above, and thus a firm resistance is created, by the very effort which the explosion makes to overcome it. It is a peculiar species of valve, which operates at the moment when it is wanted, and not before. It appears to me to combine in a sufficient degree, all the advantages of the early, effectual, but dangerous mode of ramming in brick fragments; of the other more recent use of gypsum, and other soft substances, and of the filling with sand. Should the experience of the quarrymen confirm the *certainty* of the method, *its safety* being perfect, this new mode of blasting will prove to that dangerous branch of the arts, what the safety lamp has already proved to the coal miners.

Should any practical difficulties occur, such as are frequent in new undertakings, however promising; it is to be hoped that the attempt will not be precipitately abandoned, as it is highly probable that the united efforts of science and mechanical skill will overcome them.

6. *A few remarks on the theory of these accidental explosions*, and I shall have done. To any one acquainted with chemistry, it will not appear very extraordinary, if we reason from the nature of the elements concerned, that there should be cases in which gunpowder explodes without a red heat.

Gunpowder consists of highly inflammable bodies, charcoal and sulphur, most intimately blended with three times their weight of nitre. Nitre contains more than half its weight of nitric acid, and nearly four fifths of this is oxygen. Oxygen is the great agent in combustion, and it is rather wonderful than otherwise, that it should lie in close union with dry inflammables, without acting upon them; it is the tiger, reposing peacefully with his prey, and attacking it only when he is roused: the proper stimulus to bring on the action in gunpowder, is a red heat, but it is clearly possible, that much smaller degrees of heat may answer the same purpose, and such degrees are often rendered sensible, by mechanical action. Chemistry abounds with similar cases. If, as has been repeatedly done, chlorate of potash be substituted for nitre, in the composition of gunpowder, no well informed man would dare to ram down a cartridge made of it, much less to charge a rock with it in the ordinary way; it would inevitably explode, by a very gentle pressure; as was fatally experienced at

Essore in France, where, during the trituration of a gunpowder, of this description, although it was conducted with all possible care, an explosion killed several persons.

Fulminating mercury, and fulminating silver are still more irritable, and the latter, when thoroughly dry, will not permit even the weight of a knife blade to rest upon it, without inducing a violent explosion; in a quantity equal to a common musket charge of gunpowder, it would, probably, be always fatal.*

7. It is not therefore theoretically improbable, that the heat necessary to the action of the oxygen upon the combustibles in gunpowder, may be evolved by pressure, and the particles may also be brought within the distance of effectual attraction, by the blow applied in ramming down, and thus it is possible, that the action may come on, even when there is no spark.† May not some of the premature explosions of cannon and other fire arms be attributed to similar causes, especially when the piece is hot, in consequence of previous firing, although there should be no spark?

All these views conspire to render it highly desirable that Mr. Blake's method should prove successful, and I shall be much interested to learn the result, which, after sufficient experience, I shall hope that you will communicate to the public. I remain respectfully, your very obedient servant. B. Silliman.

Yale College, Sept. 17, 1829.

Art. XV.—*On Crystallized Native Terrestrial Iron, Ferro-silicate of Manganese, and various other American Minerals;* by Charles U. Shepard, Assistant to the Professor of Chemistry, and Lecturer on Botany, in Yale College.

1. *Crystallized Native Terrestrial Iron.*

In looking over a suite of rock specimens collected by Prof. Olmsted, with a view to illustrate the Geology of North Carolina, and deposited by that gentleman in the cabinet of the American Geological Society, my attention was arrested by two pieces of Native Iron. Of one of these, the larger of the two, an account is given in Prof.

---

* I had nearly lost both my eyes in 1811, by the explosion of fulminating silver, which took place in consequence of gentle pressure, even when it was under fluids. The particulars of the accident are related in Dr. Bruce's Journal, Vol. I.

† As in the cases that occurred in France and which have been cited by Mr. Blake.

Olmsted's catalogue of the collection, which was published in the fifth volume of this Journal. It is described as distinctly plated; hard; assuming under the file the lustre of steel; highly magnetic; breaking under the hammer, with the lustre of steel; and having the specific gravity of 7.4. Its weight is a little short of two pounds. It was found in the vicinity of a bed of Iron ore, of the argillaceous kind. The smaller specimen, which weighs seven ounces, is possessed of the same characters in the main, though a little less brittle; but is a *distinct crystal, in the form of an octahedron.* Prof. Olmsted informs me that it comes from Guildford county, ten or fifteen miles distant from the locality of the first specimen, which was found in Randolph county. The individual from whom he obtained it, informed him, that it was detached from a mass weighing twenty eight pounds, which was wrought by a blacksmith of the neighborhood, into horse-nails. The crystalline structure of this specimen is what particularly interested me; for, although the existence of native terrestrial iron may now be considered as established beyond all doubt, yet it had hitherto been observed only in a massive state. The axis of the crystal measures three inches. The angle at the summit is 60°, that at the base 120°. It is, therefore, a regular octahedron. Its structure is distinctly foliated, the laminæ being pretty uniformly one twentieth of an inch in thickness, and arranged parallel with the planes of the octahedron, which must consequently be considered as the primary form of the species. On one or two of the planes, the laminæ extend beyond the edges of the adjoining and opposite faces, or those which are external do not in all cases cover the layers upon which they rest; but stopping somewhat short of their borders, enable us to discover the internal structure of the crystal with great distinctness.

In farther examining fragments freshly detached from these masses, I was struck with their resemblance to the native iron from Pennsylvania, of which I gave some account in Vol. XIV. p. 183, of this Journal, and which was found to contain a trifling per-centage of arsenic. Having satisfied myself, by forming a solution in nitric acid, that the brittleness and want of malleability in the present case, was not owing to the presence of carbon, no carbonaceous discoloration taking place; and, moreover, being assured, by the applications of the customary tests, of the absence of silver, copper, and nickel, I felt no hesitation in concluding that it was identical with that substance. Had the compound blow-pipe been in operation, it would have been easy to detect the arsenic by its odor; the common blowpipe being insufficient, on account of the feeble proportion in which it exists, to render it obvious in either the North Carolina, or the Pennsylvania specimens.

In the mass examined from Pennsylvania, which formed a part of a regular crystal, (the base being somewhat elongated, and the summits obliterated,) I suggested that it might belong to the class of rhombic prisms; an opinion which I am now happy in having an opportunity to rectify. The larger angle then obtained, overlooking the error of one degree in the measurement, it is obvious, belongs to the base of the octahedron; while the smaller angle of 59° corresponds to the angle over the summit of this figure.

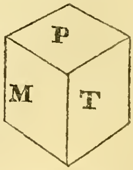
2. *Ferro-silicate of Manganese.*

I am about to announce the existence of the present species in mineralogy, (recently established by Dr. Thomson,) in Cumberland, Rhode Island; with some farther information concerning its crystallization, than is given in the original description: but as an account of this mineral is not yet to be found in any system of the science, and has not been noticed in this Journal, I shall first abstract from the original memoir, published in the "Annals of the Lyceum of Natural History of New York," (Vol. III. p. 28.) the substance of Dr. Thomson's description, and then append to it the remarks proposed.

Color brown, with a shade of red; externally, it is dull, having an earthy aspect and may be scratched by the nail; but internally, it is foliated, splendent, of a grey color, with a shade of red; hardness nearly the same as felspar: specific gravity 3.44.

It has three cleavages, indicating a doubly oblique prism for its primitive form.

P on M - - - - -	108°
P on T - - - - - -	86. 30′
M on T - - - - -	86. 30′



The faces not being smooth or flat, these measurements are only given as approximations; and on the examination of another crystal, Dr. T. suggests that the primary form may be a right oblique prism.

A portion of the mineral was treated with muriatic acid, till it assumed a white color. Much chlorine was evolved, and nearly one fourth of the mineral was dissolved. The solution gave

Detoxide of Manganese, - - - -	17.716
Peroxide of Iron, - - - - - - -	6.480
The residue, which became white, was composed of	
Silica, - - - - - - -	29.480
Protoxide of Manganese, - - - - -	34.640
Peroxide of Iron, - - - - -	6.740
Moisture - - - - - - -	3.170
	98.226

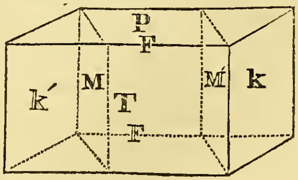
Dr. Thomson supposes the mineral to have undergone a species of decomposition externally, from the action of the air; the protoxide of manganese having been converted into deutoxide; and originally, that the mineral must have been a compound of four atoms silicate of manganese, and one atom persilicate of iron.

The specimens examined were obtained through Dr. Torrey, from Franklin, New Jersey; where this mineral has long been known to exist under the denomination of the Crystallized siliceous oxide of Manganese.

The Ferro-silicate of Manganese, I found in Cumberland some years ago, at the same time I discovered the Yenite.* Both of these minerals occur, engaged in the same gangue, and were for a long time considered by myself, as identical, in consequence of an early blow-pipe experiment which I made upon them,—both fusing with equal ease into a black, shining globule, attractable by the magnet; though the former I had not then met with, except in massive specimens. Afterwards, observing that it invariably appeared distinct from the Yenite, though accompanying it upon the same specimen, that it possessed a distinct threefold cleavage, and, moreover, a hardness above that of Yenite, I ceased to consider it any longer as such, and placed it among my specimens of doubtful minerals.

Lately, however, my attention has been called to it by a specimen of the same substance, ticketed "Yenite," in a case of minerals presented to the American Geological Society, by the late Dr. Robinson. It was distinctly crystallized, and under a form quite incompatible with Yenite. The crystals consisted of parallel rows of short, thin, oblique angled prisms, traversing the mass, and leaving channels between them. The largest of these did not exceed one fourth of an inch in length, one fifth in height, and one tenth in breadth. Their form is exhibited in the following diagram.

P on T	- -	85°
k on T	- -	149. 30′
- on P	- -	90.



* Vide this Journal, Vol. VII, p. 254.

In some of the crystals, the acute terminal edges, F, were replaced by one or two planes; but their dimensions were too small to admit of ascertaining their inclinetions to the adjoining faces.

These crystals cleaved with ease parallel to the planes P, T, and M; thus, giving rise to the doubly oblique prism, as their primitive nucleus. P on T is given above; the remaining angles are,

P on M - - - - - - - - - -	90°
M on T - - - - - - - - -	113.

The utmost accuracy is not claimed for these measurements, which were made with the common goniometer, and must therefore be regarded, only, as approximations to the truth.

Externally the crystals were of a black color, and so soft as to be scratched with a knife; but, within, of a reddish brown color, and of the hardness of felspar. Specific gravity 3·4. Reduced to powder and treated with muriatic acid, they partly dissolved, the insoluble remainder assuming a white color. Before the blowpipe, like the massive portions with which they were associated, they fused into a shining black globule attractable by the magnet; and with borax they gave a violet glass.

The common lamellar variety is disseminated through quartz in plates, quite after the manner of Clevelandite Felspar. When a mass of the rock containing it, is freshly broken, the ferro-silicate of manganese presents a pale rose-red color with felspathic lustre, and might be mistaken for that substance; but whenever the air has found access to it, its color and lustre are changed, as well as hardness, and even chemical constitution, as is supposed by Dr. Thomson.

3. *Anthophyllite in Haddam, (Con.)*

This mineral is found upon the east side of the Connecticut, in an extensive quarry of flagstone. It exists in connexion with a fibrous brown tourmaline, (which is sometimes in distinct crystals,) and a granular decomposing iron pyrites; forming very often, a third part of the mass in bulk; and may be obtained in any quantity desired. The tendency of the pyrites to decompose, frequently obscures the characters of the anthophyllite; but, when a mass is freshly broken, it presents the mineral so much resembling the Norway specimens, of the same substance, in the color, lustre and mode of aggregation of its crystalline fibres, that it is impossible to distinguish them apart.— The crystals are occasionally, remarkable for their distinctness and transparency, and are sometimes levelled upon their acute lateral edges.

4. *Tabular Spar and Idocrase at Moriah, (N. Y.)*

These minerals were found by Dr. Lewis Heermann and myself, during a mineralogical excursion upon the western shores of Lake Champlain. The Tabular Spar we found in loose blocks, in a wood by the road side, about one mile west of Major Dallarby's. It occurs in foliated prismatic masses of considerable dimensions, highly translucent, having a greyish white color with a tinge of olive. Intermingled with it is a brown mica, and more sparingly, scales of Plumbago. We did not find it *in place;* but, from the nature of the rocks in the vicinity, we were disposed to consider it as coming from the primitive limestone. The Idocrase is found near Maj. Dallarby's mills, and occurs among the rocks thrown out in forming a mill-sluice. It is of a dark reddish brown color, and in masses of considerable size, one of which we obtained, presenting several crystalline facets. It is associated with iron pyrites, calcareous spar, and the delicate hair brown hornblende, which elsewhere in the United States, so frequently accompanies the spinelle.

Yale College, Sept. 8th, 1829.

Art. XVI.—*Observations on the Magnetism of the Earth, especially of the Arctic Regions; in a letter from Capt. Edward Sabine, to Professor Renwick.*

Communicated for this Journal.

TO PROF. RENWICK.

My dear Sir,—I received a few days ago, a letter from Professor Hansteen, of Christiania, dated from Irkutsk, in Siberia, in April last. M. Hansteen is travelling, as you know, at the expense of his King, and with the permission of the Emperor of Russia, for the purpose of observing the Magnetic Dip, Variation, and Intensity, over the whole of the north of Europe, and of Asia; and of comparing the actual phenomena with the system of terrestrial magnetism, propounded by himself, in his celebrated treatise, entitled "Magnetismus der Erde."

The observations that M. Hansteen has already made in the first year of his undertaking, and the conclusions which they establish in regard to the direction assumed by the isodynamic curves, or curves of equal magnetic intensity, are in the highest degree curious and important. In the letter with which he has favored me, he has taken the trouble to communicate his observations in full detail, and has expressly permitted me to make every use of them that I may think proper, "especially when it may encourage to new undertakings, and accordingly forward the science." Having been requested by you to superintend the construction in this country, of a part of the magnetic instruments, designed for the expedition now preparing by the government of the United States, for scientific researches in the southern hemisphere, I cannot anticipate a more favorable opportunity of turning to good account the information of which M. Hansteen has so liberally made me the depository. Since analogy would lead us to expect that a corresponding system of magnetism prevails on the two hemispheres of our globe, a knowledge of the arrangement of the system in the northern hemisphere, may prove an important guide and direction for corresponding researches in the southern; whilst the example of M. Hansteen's undertaking may stimulate, and his success is well calculated to encourage, those who are about to enter on a career honorable alike to themselves, and to the government under whose instructions they are employed.

For some years past it has been the opinion of several persons, who have attentively considered the subject, that a knowledge of the general system of the magnetism of our globe is more likely to be attained by experiments on the relative intensity of the magnetic attraction in different parts of the earth's surface, than by observations on the dip or variation of the needle. In conformity with this opinion, M. Hansteen, (without neglecting to observe, on all occasions, the three phenomena conjunctively,) has applied himself especially to trace the lines connecting these places on the globe, where a needle, freely suspended in the magnetic direction, and drawn a certain number of degrees from rest, is found to make an equal number of vibrations around its point of rest in a given time. It was to be expected that these lines of equal intensity would arrange themselves systematically around the point or points in each hemisphere, where the intensity was greatest; and on the supposition that two such points would be found, opposite to each other on the globe, one in the northern and the other in the southern hemisphere, that the isodynamic lines would form parallel circles, analogous to those of geographical latitude, progressively diminishing in intensity from the two points of maximum or poles, to the boundary circle of the two hemispheres, which, following the same analogy, might receive the appellation of the Magnetic Equator. Such was in fact the system, which, until the decisive discoveries which M. Hansteen has now made, appeared sufficiently conformable to the existing observations, to receive their countenance and support. It had so happened that the previous observations, although extending widely over the magnetic parallels in the northern hemisphere, namely, from the least almost to the greatest intensity, were confined, in respect to longitude, to a space, little more than the quarter of an hemisphere; and to that quarter which is immediately opposite to the countries visited by M. Hansteen. Within the space that had been thus examined, the isodynamic curves appeared to arrange themselves, with comparatively insignificant deviations, in parallel circles around a point situated in the north-eastern part of Hudson's Bay, and as nearly as could be judged, about the intersection of the 60th degree of geographical latitude, with the meridian of 80° west of Greenwich. That a system apparently so simple, so like the arrangement of induced magnetism in a sphere of iron, and corroborated by the approximation of results observed over a fourth part of an hemisphere, should have been viewed as likely to prove eventually the general system of the globe, is not surprising. It is the peculiar distinction of M. Hansteen, to have been led by a more careful consideration of the slight apparent deviations which have been noticed, and of the general disposition on the globe of the lines of dip and variation, to infer the existence of a second point of principal magnetic action in the northern hemisphere; a fact which, by his recent observations, must now be regarded as fully established; the isodynamic curves being found to arrange themselves systematically around the two points, in Hudson's Bay, and in Siberia, and to be governed in the courses which they follow, partly by their distances respectively from those points, and partly by a disparity in the absolute attractive force of the two points, the maximum intensity in Siberia appearing to be greater than the maximum in Hudson's Bay.

The accompanying sketch of the northern hemisphere, may enable me to convey a more distinct notion of the arrangement of the isodynamic curves, than could be done by description alone: the portions traced in unbroken lines mark the connection between places at which an equal intensity has been observed; and those in dotted lines exhibit the supposed completion of the curves, in parts of the hemisphere where the intensity has not been as yet examined. The portions which arrange themselves around the point in Hudson's Bay are chiefly laid down from observations made by myself in two voyages of north west discovery, those of 1818, and of 1819—1820; in a voyage in 1822, to the equatorial shores of the Atlantic, and to several of the Islands in the Atlantic and Caribbean seas; and in a fourth voyage, in 1823, to Greenland, Spitsbergen, and Norway. Their prolongations around the point in Siberia, are from the recent observations of M. Hansteen, and the gentlemen who accompany him. A brief notice of each of the curves in succession, will enable me to point out generally the places which furnished their respective authorities.

Commencing with the intensities of the highest order, the curve drawn through the countries surrounding Hudson's Bay, is laid down from observations made at occasional intervals from Regent's Inlet in the north west quarter, by Baffin's Bay in the north, to Davis' Straits in the north east; and again at New York in the south. In places situated under this curve, a needle freely suspended, which required three hundred seconds to perform one hundred vibrations in London, would perform the same number of vibrations (in integer numbers) in two hundred sixty nine seconds. In the space included by this curve, in which no observations have hitherto been made, it may be presumed that the intensity progressively increases to a central point of maximum; for the observations made in receding from the curve in different directions, namely in Melville Island, in Greenland, and to the southward of New York, all manifest an opposite tendency.

The observations of M. Hansteen have made known the reappearance in Siberia of an equal intensity to that beneath the curve which has been just described; forming a curve, probably similar in figure but of smaller dimensions, around a point of maximum intensity, situated in long. 102° east of Greenwich, (which is as nearly as can be judged 180° from the present position of the corresponding point in Hudson's Bay,) and in latitude apparently somewhat to the north of 60°, but which will be more particularly determined in the present summer. M. Hansteen has traced the southern bend of this curve below the 60th parallel, from the Jenisei River on the west, to the longitude of 115° E. (25° east of the Jenisei,) and to the latitude of 61°, where it has already gained a direction nearly north and south.

It may be remarked of the Siberian curve, that the space which it encloses is considerably less than its parallel in America; a circumstance consistent with the supposition already noticed, that the maximum intensity in Siberia is inferior in attractive force to the maximum in Hudson's Bay: consequently curves of equal intensity are encountered at a less distance from the point of maximum in Siberia than in America.

The second curve on the American side connects those places where the needle, introduced for illustration, would perform its one hundred vibrations in two hundred and seventy eight seconds. The points which have determined it are, Melville Island in the north west; several stations on the west side of Greenland, from lat. 76° to lat. 66°, in the north east; and finally a greater intensity observed at New York and a lesser at the Havanna; whence it is concluded that this curve intersects the sea board of the United States at an intermediate point between those cities. A corresponding intensity has been traced by Dr. Erman of Berlin, (who accompanied M. Hansteen to Siberia,) from the mouth of the River Oby, in lat. 68° and long. 70° E. preserving nearly the direction of a meridian, to lat. 60°, whence it bends gradually to the eastward, passes between Tobolsk and Naryon, and has been observed at Kainsk by M. Hansteen, on its way to its probable southern limit on the Asiatic side, a few degrees south of Lake Baikal.

No. 3 is that in which the needle would perform one hundred vibrations in two hundred and eighty seven seconds. Its points of observation have been, north of the Havanna, east of the Pendulum Islands on the eastern side of Greenland in lat. 74° 5′, between the North Cape and Spitzbergen, by myself in 1823, and by M. Keilhau in 1827. By M. Hansteen's observations it enters the continent of Europe between Archangel and Nova Zembla, and was crossed by him, on the route from Moscow to Tobolsk, in 56° and 57° east longitude, and 57° and 58° latitude.

The curve marked No. 4 is that in which the needle would make one hundred vibrations in two hundred and ninety seven seconds. Its tracing by observation commences on the American side, with the islands of Caymen and Jamaica. Crossing the Atlantic, it passes through the northern parts of the British islands, and enters Norway south of Bergen. It there became subject to M. Hansteen's observation, who has ascertained its northern limit, and where it begins to bend to the southward, to be on the shores of the gulf of Bothnia, midway between Stockholm and Tornea. He has since traced its prolongation through St. Petersburg and Moscow.

It is M. Hansteen's intention to commence the present summer by descending the Jenisei to Touroukansk, under the polar circle, in order to extend the tracing of the curve No. 1: returning to Krasnojarsk, to cross, in a route from thence to the Caspian Sea, the curves 2, 3 and 4, in their further prolongation to the south east: whilst Dr. Erman, who quits him at Irkutsk, and is furnished with the necessary instruments, will proceed by Jakutsk and Ochotsk to Kamschatka, in which route he expects again to cross the same curves 2, 3 and 4, after they have passed their southern Asiatic limit, and resumed for a second time a north easterly direction.

These are all the curves of which M. Hansteen has ascertained the reappearance on the Asiatic side, those of lesser intensity passing altogether to the south of his present journey. I shall, however, briefly notice the remainder, in order to complete the sketch of the isodynamic curves in the northern hemisphere. No. 5, in which the needle would make one hundred vibrations in three hundred and eight seconds, was observed by M. Humboldt in 1800—1805, to pass near the cities of Mexico and Carthagena; by myself in 1822 between Teneriffe and Madeira; and again by M. Humboldt at Madrid and in the south of France. No. 6, in which the needle would require three hundred and twenty one seconds for its one hundred vibrations, was observed both by M. Humboldt and myself, on the South American shore of the Atlantic, near the 10th degree of north latitude; and by my observations at Port Praya, was ascertained to pass to the north of the Cape Verd Islands. No. 7, in which the needle would make one hundred vibrations in three hundred and thirty five seconds, was frequently observed by M. Humboldt in the interior and on the western side of Columbia; after crossing the Atlantic, it enters the continent of Africa somewhat to the south of the Gambia River, as is shown by my observations at Bathurst where the intensity was greater, and at Sierra Leone where it was less. No. 8, where the needle would require three hundred and fifty one seconds, was observed by M. Humbolt at Tompenda in Peru on the western side of South America; at Marenham on the eastern side, by myself; and on the African side of the Atlantic, enters the continent of Africa somewhat south of Sierra Leone. Finally, No. 9, in which the needle would require three hundred and seventy seconds for its one hundred vibrations, was found by myself at the island of St. Thomas, in the

Gulf of Guinea, in the northern hemisphere; and in the southern hemisphere, at the Island of Ascension, and at Bahia on the coast of Brazil.

We may hope that the further tracing of the curves, which have not been subject to M. Hansteen's observation in Siberia, will ere long be accomplished in the Asiatic quarter, by the scientific industry of British officers employed in India; where a line through the British dominions, from Ceylon on the south, to the Himalaya Mountains on the north, would probably intersect Nos. 5, 6, 7, and 8, nearly at right angles to their course.

Mr. David Douglas, well known to you as the enterprising traveller and successful naturalist in the countries adjacent to the Columbia river and its tributaries, returns in September, to the north west coast of America, on an undertaking which will occupy him there many months. He will be well provided with instruments, and is practised in the modes of observation. He hopes to determine the magnetic phenomena, from California in the south, to the farthest extent towards the north, to which circumstances may enable him to prosecute his researches; and from the ocean on the west, occasionally to the Rocky Mountains on the east. He will probably ascertain the situation on the western side of North America, of the curves 3 and 4, and will approach No. 2, when at his eastern limits. But it is from travellers in the interior of the United States, and in the countries adjacent to the Slave Lake and Coppermine River, that we must expect exact determinations of this interesting curve No. 2. Unquestionably, however, the space included by the innermost curve, is the field for observations of the very highest importance on the subject of the magnetism of the globe; and as it is traversed annually under the direction of the Hudson's Bay company, we may confidently hope, from the ready disposition which that company has shewn in so many instances to promote scientific researches, that much time will not elapse, before that really important journey will be performed by some person, properly qualified by previous practise, to observe with the precision necessary on so particular occasion.

In regard to the great space in the northern hemisphere occupied by the Pacific Ocean, the numerous islands with which it is interspersed, present points of observation of easier access than many parts of the respective continents. A commencement has already been made by Captain Lütke, commanding one of the Russian ships of war, at present engaged in a scientific voyage. In a letter which I have received from him, dated from New Archangel, (Norfolk Sound,) in July, 1827, he has been so obliging as to communicate to me the results of several observations, which he had found opportunities of making in the passage from Conception. I have not availed myself of them in the accompanying sketch of the isodynamic curves, because I regard his communication as private, until he shall have returned and made his own observations public. At the date of his letter, he was on the point of sailing for Bhering's Strait and Kamtchatka, in which voyage, as well as in his subsequent operations, he will doubtless have obtained results of great interest.

If we now direct our attention to the southern hemisphere, we find nearly the whole field of enquiry untrodden. Of published observations, there are only those made by M. de Rossel, in the voyage of D'Entrecasteaux, at Java, Amboyna, and Van Diemen's Land. Of observations made, but not yet published, there are, (1st.) those of Captain de Freycinet, at several stations visited by the expedition under his command : of these no public account has yet, I believe, been given : (2d.) those which are at present in progress by Captain King, whilst engaged in the survey of the southern parts of South America. The results obtained by him in the first year of his survey, have been received in England : they commence at Rio Janeiro, and are continued at intervals down the eastern coast, as far as Port Famine : he will probably have since extended them to Conception, on the western side, the limit of his survey in that quarter. The results transmitted will require some slight modifications on his return to this country, to compensate for differences of temperature, &c. : but none that can interfere with their general effect, in evidencing a progressively and rapidly increasing intensity, from the neighborhood of Rio, where it corresponds with the curve marked No. 9, in the sketch of the northern hemisphere, to the Straits of Magellan, where it is intermediate between the intensities designated by No. 2 and 3. The observations of M. de Rossel, indicate in like manner, that at the period of his voyage, (towards the close of the last century,) the several intensities, from that represented by No. 9, to that represented by No. 2, were all comprised between Java in the north west, and Van Diemen's Land in the south east. Hence, as far as the evidence hitherto extends, it would appear that there are two points of maximum intensity, in the southern as well as in the northern hemisphere : but the geographical position of those points, and their respective intensities, relatively to each other, and to the points of maximum in the northern hemisphere, remain to be determined; and must be acknowledged to be subjects of highly curious and important enquiry. In the arrangement of magnetism, as exhibited to us on the great scale of our globe; differing, as it is now known to do, so widely from those analogies with which it had been associated, and indeed, I believe, from all analogy whatsoever with which we are acquainted, we cannot too soon inform ourselves accurately of the facts.

In selecting the parts of the southern hemisphere, in which, enquiries of this nature can be most advantageously pursued, regard must be paid, in the first instance, to the distribution of land, on account of the convenience which its coasts and islands afford in determining and connecting the isodynamic curves. The eastern and western coasts of New Holland, and the adjoining islands of New Zealand—the western coast of South America, from Lima to Cape Horn, and a continuation of the lands to the southward of Cape Horn—approaching the Antarctic Circle—the islands which might be successively visited in a course from the Cape of Good Hope to Desolation Island, and from thence to the Mauritius—present in this view, the directions of principal interest. Careful observation systematically made in them, combined with the observations already made, would advance our knowledge of the magnetic phenomena of the southern hemisphere, to the same stage that it has attained in regard to those of the northern: it would establish the number of the governing points of intensity in the hemisphere: determine their respective geographical positions, and, in great measure at least, their relative intensities: ascertain the general arrangement of the curves: and finally, point out those localities of peculiar interest, which it might be expedient to visit for more particular enquiry. A single expedition might accomplish all this, without extending the duration of the voyage to an undue length, or interfering with other important objects of scientific research: and we may assuredly affirm, that were this service, the *single purpose*, and *sole object accomplished*, by a scientific expedition, it would of itself confer no ordinary distinction.

In what has hitherto been said, observations made on land have alone been taken into account: the motion of a ship, and the quantity of iron necessarily employed in her equipment, impeding the prosecution of such researches at sea, and presenting embarrassments, which, to say the least of them, are very difficult to surmount, and but too likely to impair the accuracy of the results. Still, when we consider how large a portion of the southern hemisphere is covered by the ocean, it does appear desirable to make the endeavor to obtain the best results, that circumstances will permit, over such extensive portions of the globe; and particularly as in the opinion of those, who from experience are most competent to judge, it is possible by great care, to obtain results worthy of confidence. M. Humboldt has recorded several observations which he made himself, at sea in the northern Atlantic, both of the dip and of the intensity; the latter of which accord well with the curves of intensity traced in the accompanying sketch.

M. Hansteen believes, that by giving a dipping needle the sort of suspension used in Captain Cook's 3d voyage—by choosing those times for observation where a calm sea and moderate wind allow the ship to keep a steady course—by confining the use of the instrument always to the same place on the ship's deck—and by comparing the results on land and on shore on all occasions when in harbor—observations on board ship, might become very valuable. I will venture to add an extract on this subject, from Captain Lütkes' letter, whose remarks are the more encouraging, as when he quitted Europe he was by no means sanguine of success in the use of delicate magnetic instruments at sea:—"Je dois pourtant faire quelques remarques sur les observations faites à bord. J'avais èté, comme vous, en doute qu' elles puissent donner des resultats dignes de confiance, mais l'expèrience m'a appris, qu'en faisant choix d'un endroit assez eloignè de toute grande masse de matiere ferrugineuse, on peut atteindre á une précision suffisante. Dans toutes mes rélâches je n'ai jamais manqué de comparer les indications des aiguilles à bord, à celles de terre. 'A Rio et à la Conception les resultats ont été á peu près identiques; ici (at Norfolk Sound) où l'inclinaison comme la force ont atteint leurs maximum (c. à. d. pour nous,) et par consequent, où l'influence du fer sur les aiguilles—ceteris paribus—est aussi à son maximum, ici l'inclinaison à bord ne differoit de celle à terre que d'un petit nombre de minutes; l'intensité de la force indiquée par l'aiguille verticalle fut précisement la même, et d'apres l'aiguille—horizontalle un peu moindre. En considerant que l'epreuve fut faite par les circonstances les plus desavantageuses, on conviendra que les observations faites à bord meritent quelque confiance. Mais il est essentiel de mettre toute l'attention possible au choix du propre endroit; car voulant faire les observations dans ma chambre, je n'etois parvenu qu'à des resultats très fautifs."

For experiments on the magnetic force, it is of the first necessity that the needles employed should retain, throughout, the same degree of magnetism ; or should undergo merely such slight and gradual alterations in that respect, as admit of corrections being applied by interpolation, from experiments made at the same spot before and after the series in which they have been employed. This property of the needles ought always to have been ascertained by previous trial during several months.

Those which I send you belonged originally to M. Hansteen, and have been in my possession and in constant use for three years past ; their magnetism has hitherto undergone a slight but very regular diminution, from year to year, well admitting of interpolation. It will be proper, therefore, that observations should be made with them, at the port from which the expedition sails, a few days before its departure, and again in the same place, as soon as convenient after its return. It will then be proper, that the needles should be sent back to London, that observations may be repeated with them here, to ensure the connexion of the results obtained by their means, with those of the other experimenters, which regard London, Paris and Christiania, as their base. The needles should be kept apart from each other, and from contact with iron, and particularly with magnetised iron.

I do not attempt in this letter to enter at any length on the consideration of the curves of Dip and of Variation. M. Hansteen has shewn, in the treatise already named, the general conformity of these phenomena to such an arrangement of magnetic attraction, as is indicated by the course of the isodynamic curves. His observations in Siberia, in as far as they go, confirm this view. Thus for example, in the parallel of 55° north, the Dip, which in tracing the parallel to the eastward progressively decreases, from Labrador, where it exceeds 80°, is found by M. Hansteen to attain a maximum $67\frac{3}{4}$°, about the 42° of longitude east of Greenwich ; from thence it increases, until the intersection of the parallel with the meridian of the Siberian maximum of intensity, (102° east,) where its amount is $70\frac{2}{3}$° : from that meridian it again decreases to a second maximum, by the observations of Russian Officers, in the meridian of Kamtchatka, (163° east.) Hence as regards the dip in the parallel of 55° north, there are two points of maximum and two of minimum ; those of maximum are in the same geographical meridians, or nearly so, as the points of maximum intensity ; and those of minimum occur respectively in meridians 120° on either side of the Hudson's bay maximum, and 60° on either side of the Siberian maximum. In like manner, the variation in the 55th parallel is 0 in the longitude of the minimum of Dip, 42° east; is easterly, increasing, for the next 30° of longitude, and easterly, decreasing, for the following 30°; so that the variation becomes again 0 in, or about the meridian of 102° east, which is that of the Siberian maximum.

In the sincere hope that this letter may be instrumental in promoting this highly curious and philosophical enquiry, which would be the best return I can make to M. Hansteen for his kindness in giving me so early and so full an account of the progress of his discoveries,

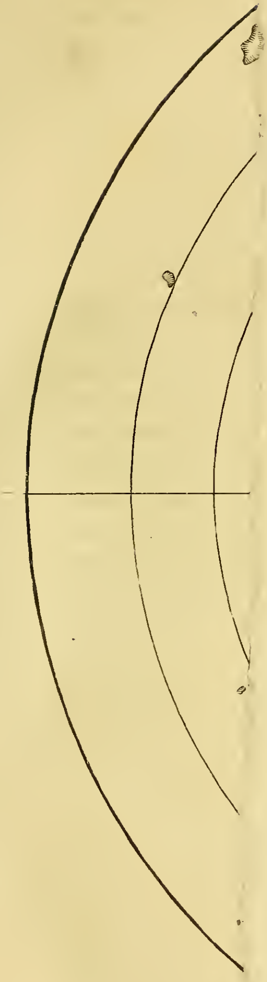
I remain, my dear Sir,

very faithfully yours,

EDWARD SABINE.

P. S. Since I wrote the above I have substituted a needle made by M. Dollond for myself, for one of the two which originally belonged to M. Hansteen, and which it was my first intention to have sent you. You will perceive by the memoranda which accompany the needles, that No. XX. (the one I have substituted,) has remained perfectly steady in its magnetism, for a twelve month past, and will probably, therefore, continue so. No. XI. (which I received from M. Hansteen three years ago,) has increased its time of making 300 vibrations, from 15′ 46.1″ to 15′ 52.7″, since June 1827, when the last published observations were made with it; Phil. Trans. 1828, Art. I. page 14; consequently its magnetism has diminished in two years, between one and two parts in one hundred. It will be prudent, however, to treat both needles as if liable to farther changes.

1829



Arrangement of the Magnetic Isodynamic Curves in the Northern Hemisphere

Art. XVII.—*Necrology.*—Sir Humphrey Davy.*

Not having observed in the British Scientific Journals which have reached us since the death of this distinguished benefactor of science, any account of his life and death which deserves the name of a biographical sketch, we avail ourselves of a brief notice of him, which we find in the Geneva Journal, (Bibliotheque Universelle,) of May, 1829, translated by Prof. Griscom.

" Sir Humphrey Davy, who has just terminated at Geneva, his brilliant scientific career, was born on the 17th of December, 1778, at Penzance, in the county of Cornwall.

" It was at Bristol, while engaged with Dr. Beddoes, in 1799, that he first became known to the scientific world, by several ingenious memoirs, in a journal entitled *West Contributions;* and in a short time after, he gave to the public his *Analysis of Nitric Acid*, in which various new facts are brought forward, and in which the indications of genius are clearly discoverable. Called to London by the founders of the Royal Institution, among whom was Count Rumford, he was made professor of chemistry, and his lectures were received with enthusiasm. Having at his disposal the powerful resources of that establishment, he availed himself of them in studying the new phenomena which the Voltaic apparatus presented, and, in his hands, this apparatus gave a strong impulse to the progress of science.

" The limits of this hasty notice do not allow us to trace this philosopher through his minifold labors ; we can only point out, summarily, those which are the most remarkable.

" In 1806, he read to the Royal Society of London, his memoir *On the Chemical Agencies of Electricity*, a memoir which will ever constitute an epoch in the science ; and in which he demonstrated by a series of facts entirely new, that electricity is a powerful chemical agent, having the faculty of decomposing bodies whose constituent principles are united by the strongest affinities, and transporting to a distance, through moist conductors, these same constituent parts ; the most oxigenized substances uniting round the positive pole, while the

* We are promised for the January number, (1830,) a fuller notice of the scientific labors and character of Sir H. Davy, but in the meantime, with pleasure, insert the Genevan obituary.

others are arranged around the negative pole. This new and powerful means of analysis soon conducted him to a series of brilliant discoveries. Substances reputed elementary, were discovered to be compound; the alkalies, alkaline earths, and almost all the other earths, which were reckoned among simple bodies, were ascertained to be oxides of metals before unknown; and these new metals, on account of their specific levity, constituted an exception to the laws which governed this class of bodies. The consequences of these discoveries were immense; a new theory, styled *electro-chemistry*, was based upon these new facts.

"In pursuing his researches, Davy found that some substances which were regarded as compound, must be considered as simple, and he was one of the first who discovered that chlorine was a substance not yet decomposed.

"He endeavored to turn his chemical discoveries to the benefit of agriculture; and we are indebted to him for a good method of analyzing soils, as well as a treatise on agricultural chemistry replete with the most ingenious views. Humanity received also a benefaction from his hands. His researches led him, in 1815, to discover the singular property possessed by metallic gause, of opposing the transmission of flame, and it is to this observation that we are indebted for the miner's lamp. It is well known that this class of men devoted to labors so painful and dangerous, find in this instrument a means of preservation from one of the most fatal accidents of their profession.

"At the death of Sir Joseph Banks, Sir H. Davy succeeded him as President of the Royal Society of London. He had some years before been elected one of the eight foreign associates of the Royal Academy of Science of Paris, and all the principal scientific societies of Europe, ranked him in the number of their correspondents.

"In travelling through Italy, and during his sojourn at Naples and Rome, he amused himself in studying the substances which the ancients used as colors in their pictures; he sought also in chemistry the means of separating more easily the leaves of the Herculaneum manuscripts. He also attempted, not long since, to explain upon his own chemical theories, the phenomena of volcanos. Even his diversions were not useless to science; the last work which he published, and which was a treatise on fishing, entitled *Salmonia*, includes a great number of interesting observations on the manners of fishes, and upon other points of natural history.

"The fine climate of Italy suited his health; on which account, in the course of 1828, he went to Rome to obtain relief from his bodily afflictions. About the close of the last winter, his friends apprehended his life to be in danger. On receiving this intelligence, Lady Davy immediately left London for Rome, and travelled with so much haste, as to accomplish the journey in the short period of twelve days and a half. She found him better, and he determined, accompanied by Lady Davy and his brother, John Davy, to come to Geneva, where he had made a long sojourn in 1814, and where he had numerous friends. He bore the journey well; but a few hours after his arrival in this city, he suddenly sunk under an attack of appoplexy in the night of the 28th of May, aged fifty and a half years. The learned of all countries will appreciate the immense loss which they have just sustained. The friends of science in Geneva, were the first to manifest that expression of regret which will be rapidly extended throughout the learned of Europe. The Academy of our city united with Dr. Davy, in rendering the last duties to the former president of the Royal Society, and claimed the privilege of occupying the place of absent parents. The government, the clergy, the society of Arts and of Medicine, the English who were incidentally in Geneva, the students of the Academy, the artists, and a crowd of citizens of the Canton attended the funeral; they were anxious to render a final homage to an illustrious philosopher, and to prove that he who, like Davy, has extended the bounds of human knowledge, and has employed his talents in the service of humanity, is not a stranger in any country."

DR. WOLLASTON.

From the Minutes of the Astronomical Society, at the anniversary meeting, February 13, 1829.

Dr. Wollaston was born August 6, 1766, at East Dereham; was graduated at Cambridge, and became a fellow of Caius College, which he left in 1789; from that period to 1800 he spent in London, in medical studies and practice, which, not coinciding with his taste, he abandoned, on receiving an accession of fortune, and thenceforward became a public scientific character. He was many years V. P. R. S. and P. for a short time in 1820. He was a zealous and active commissioner of longitude, a member of the Astron. Soc. and his last observations were made on the relative brightness of the sun and fixed stars. He died on the 22d of December, 1828.

To Dr. Wollaston every part of science seemed equally familiar; and of him it might perhaps be more truly said than of any philosopher who has preceded him, that "nil erat quod non tetigit, nil tetigit quod non ornavit." Astronomy was one of his chief and favorite pursuits—a taste inherited from his father, and cherished by his intimacy with the late Astronomer Royal of Dublin (now Bishop of Cloyne) and the present Astronomer Royal of Greenwich—an intimacy commenced in early youth at Cambridge, and maintained through life. Science is indebted to him for many ingenious and important speculations; such are his papers published in the Philosophical Transactions, on horizontal refractions, and on the horizontal refraction and dip of the horizon, containing his curious and ingenious invention of the dip-sector. Among the most remarkable of his astronomical papers, however, is that on the finite extent of the atmosphere, which affords a striking instance of the advantages that may accrue to science by the union of remote branches of knowledge in the same mind. The arguments brought forward in that paper in favor of the non-divisibility of matter *in infinitum*, from astronomical phenomena, carry with them at least every semblance of soundness, and afford a singular specimen of his acute and scrutinizing habit of thought; while the almost miraculous delicacy and curious felicity of his manipulation in the practical departments of science—that microscopic tact, which in a thousand instances led him, through routes impervious to grosser intellects, to the most striking, unexpected, and novel results—is there exemplified in a remarkable manner, in the minute and apparently insignificant apparatus with which he was enabled to verify his own views, under circumstances which would effectually baffle ordinary instruments and ordinary observers.

The sister science of optics is even more indebted to Dr. Wollaston than astronomy. His verification of the Huygenian law of double refraction; his investigation of the refractive and dispersive powers of bodies, as a separate branch of physical inquiry, on which the perfection of the achromatic telescope depends; his discovery of the dark lines in the spectrum, since independently observed, with more refined means, and in greater detail, by Fraunhofer; but chiefly, the ingenious and elegant method practised by him for perfecting the adjustment of the triple achromatic object glass, give him the highest claims to eminence in this department. The instrument on which he tried and perfected this mode of adjustment is now, through his liberality, the property of this society.

SCIENTIFIC INTELLIGENCE.

Translated and extracted by Prof. J. Griscom.

MECHANICAL PHILOSOPHY.

1. *Invention of Stereotyping.*—The honor of this important invention is at present claimed by Holland, and apparently with justice. Baron *Van Westreemen Van Tiellandt*, encouraged by the government, has made very active researches on this subject, and has lately received from the bookseller *Luchtmans*, of Leyden, a stereotype form of a Bible, in 4to, from which many impressions have been taken since 1711. At Harlem, also the booksellers Enschedé, have furnished him with another stereotype form of a Dutch Bible, which dates from the first years of the eighteenth century. These are two substantial proofs of stereotyping in Holland, before it was thought of in France. It is well known, that in a note annexed to No. 1316, of the Catalogue of *Alex. Barbier*, a note extracted from the papers of *Prosper Marchand*, it is affirmed that *John Muller*, minister of the German church at Leyden, contrived about 1701, a new method of printing, similar to stereotyping as now practised. The method of John Muller, consisted in composing the letters in the common way, correcting these forms very exactly, binding them in a very solid manner in frames of iron, then inverting the letters, and uniting them with metal, or still better with mastic. The first essay of this method, was a small prayer book entitled, *Gebeede-Bookjen, Van Johan Haverman*, printed in 1701, by W. Muller, son of the inventor. This method of printing was afterwards transported to Halle. In a letter of the 28th of June, 1709, Muller acknowledges that he had printed in this manner, a Syriac New Testament with a Lexicon. Camus makes no mention of these facts in his history of stereotyping.—*Rev. Encyc. Mars*, 1829.

2. *Hydrostatic Lamp with a double current of air.*—A report was presented to the Academy of Sciences at Paris, on the 15th of December, by M. Ampere, on a newly constructed hydrostatic lamp, which concludes as follows:—The modifications of the lamps submitted to our examination, are designed to prevent disagreeable emanations. M. M. Thilorier and Barrachin, by making the beak

of their lamp narrow at the top, and thus increasing the capillary action of the wick, obtained a light which might be compared to that of lamps of a constant level. Masson-Moinat, Milan and Osmond, independently of the use of capillary tubes, have modified their lamps so as to keep them at a constant level, a condition essential to a lamp with a double air current. The disposition of their lengthened reservoir renders the use of this apparatus easy, without loss of oil, which is not unimportant to those who use them. Experience has proved that in both of these lamps, the wick, though raised seven millimetres, (one fourth of an inch,) above the beak, is carbonized only two millimetres during the combustion of the oil. This elevation of the wick above the beak, has the further advantage of not being deteriorated, nor even blackened, whence it results that these lamps have rarely any need of being cleaned. We propose to the Academy, that it approve this apparatus, and testify to the inventors, the interest which it takes in the perfection of these hydrostatic lamps with a double current."—(Adopted.)—*Idem.*

3. *Watkins' dry Galvanic battery.*—Prof. De Rive, in his account of this pile, (noticed in a former number,) states that the plates must be at a very small distance from each other, ($\frac{1}{25}$ or $\frac{1}{15}$ inch,) so as to be separated by a very thin stratum of air. Humidity favors the action of the instrument, the results of which tend to confirm the purely chemical theory of Voltaic electricity, for there is here no point of contact of heterogeneous metals, and the developement of electricity appears to be due uniformly to the oxidating action of the air. The trough itself must serve as a conductor, for he has ascertained that with a very dry wooden trough, the effect is much less, and that when the plates are connected simply by glass rods with a little cement, the effect ceases. Hence, in common Voltaic batteries, the liquid acts two distinct parts, viz. as an exciter, and as a conductor. In this dry battery, the air is the exciter, and the trough itself the conductor; and the example proves that if the chemical action be not equally intense upon the two surfaces of the metal, there is no absolute necessity of contact between two heterogeneous surfaces for the developement of electricity.—*Idem.*

4. *Eccentricity of Saturn's Ring.*—Extract of a letter from Prof. Schumacher to Prof. G. Maurice, one of the Editors of the Bib. Univ.

"The most interesting thing in astronomy, at this time, is the eccentricity of Saturn's Ring. M. Schwalz of Dessau, was the first to perceive it. He informed M. Harding of it, who thought he saw the same thing. M. Harding informed me of it, and both I and my adjuncts perceived what these gentlemen had observed, but I persisted in believing it to be an optical illusion, occasioned by the shadow of the planet upon the ring. I applied therefore to Mr. Struve, to settle the question, by means of the superb micrometers, attached to his great telescope. He had the complaisance to measure the distance between the ring and the body of the planet on five different days, and he ascertained that what we had seen was not only an appearance, but that Saturn's ring is really eccentric.—*Altona, Mai,* 1828.—*Idem.*

5. *An improved process for drying wood for glass houses, described in the Jarbuch. des Polytechn. in Wein,* consists in placing the wood in cast iron boxes, situated over the annealing oven, and communicating with it. The excess of the heat, which in this situation is commonly lost, penetrates the boxes and dries the wood, with an economy of time and fuel, and with much less danger of fire than when dried in the common way.—*Fer. Bull. Nov.* 1828.

6. *Blowpipe simplified.*—A modification of the blowpipe has been contrived by *M. Danger*, and is described in the Bulletin d'Encouragement, which has simplicity and cheapness to recommend it. A wooden clamp, with a screw underneath to attach it to the edge of a table, has a hole bored vertically through it in front, and to this hole underneath is attached a tube to the other end of which a bladder is tied. Another tube, which terminates with a jet piece, is attached to the hole above. It is obvious that if this bladder be inflated, and its sides pressed together by the knees of the operator or by any other means, a stream of air will issue through the jet, and maintain the flame of the lamp. To keep up the supply of air, a mouth tube is inserted into a lateral opening in front of the clamp, and which reaches upwards to a convenient height for the mouth. By blowing into this tube occasionally, the supply of air in the bladder is preserved, and to prevent its return a valve is placed at the end of the mouth tube. This valve is simply a piece of cork, fashioned to a conical opening in a tin or brass piece adjusted to the end of the tube. A short wire, fastened to the cork, passes freely through a little guide,

and is provided with a catch to keep it just within the conical opening. The mouth tube may consist of two pieces, one sliding into the other, so as to be readily adjusted to any convenient length. The lamp should be covered, when in action, with a hood having two openings, one in front for the admission of the blowpipe, and the other opposite for the exit of the jet of flame. The air may be forced out of the bladder mechanically, by surrounding it with a coarse net of twine, and hanging a weight to the bottom of it. This blowpipe unites great simplicity to cheapness and facility of adjustment.—*Bull. d'Encour. Sep.* 1828.

7. *Linear unit.*—If the earth should ever be struck by a comet, its axis of rotation and its form would indubitably be changed, and from that time the measure of the pendulum or the arc of the meridian could no longer be resorted to, for the recovery of the metre. This speculative question having been one day debated in Paris in a company of scientific gentlemen, Sir Humphrey Davy proposed a scale, which, in his opinion, might be resorted to or rediscovered after the greatest changes in the form of the globe: this linear unit would be the *diameter* of a capillary tube of glass, in which the ascent of the water would be exactly equal to that same diameter. In reflecting on the various difficulties of the experiment, (observes the editor,) I suggested, in turn, the measure of the length of luminous undulations in a vacuum, as a method which would lead more certainly to the object proposed. Although these two projects are very old, and the means of observing them had been prepared, they have been hitherto attended with no results, and indeed it is no cause of regret, as there is no probability that they would be attended with any real utility.—*Ann. de Chim. et de Phys. Fev.* 1829.

8. *Smoke Disperser of M. Millet.* (Bull. Soc. Enc.)—A report upon this apparatus, made by M. Derosne, speaks favorably of its powers. The apparatus is simple, consisting of a kind of tub, pierced with a great number of holes, having the burs outwards. It has been taken into practice by many persons. In order to prove its efficacy, one of them was fixed on the top of the funnel pipe of a stove, and a very close smoky fire made below. By means of a ventilator, an artificial wind was then made to strike directly and powerfully on the smoke disperser for the purpose of driving the current downwards and making the stove smoke; but neither by this,

nor even additional means, could any effect of the kind be produced. The committee could not explain the effect, except by supposing that the cylindrical form of the apparatus, presenting only a small surface to the action of the wind, was favorable, and that the form of the small apertures in this cylinder, occasioning a great number of contrary currents, produced almost a perfect neutralization of the force of the wind. Whatever may be the cause, the apparatus offers a cheap and effectual remedy for smoky chimneys, when this fault in them, is dependent upon the pressure exerted by winds upon the upper aperture of the flue.—*Quarterly Jour. of Sci. &c. Jan. to June*, 1829.

9. *Conductibility conferred by water.* (Bib. Univ. 11. 205.)—In the second volume of this series, p. 465, we noticed the curious fact, observed by M. de la Rive, that a fluid (bromine) having no conducting powers for electricity, was competent, when taken into solution by water, very much to increase the conducting powers of the latter. M. de la Rive has added another to the curious facts of that kind, there referred to. Fluid sulphurous acid, he finds to be a substance which does not conduct voltaic electricity. The platina wire of the voltaic pile, when plunged into it, allowed of no transference of electricity from one to the other; but so soon as a little water was added to the acid, then the current passed, and action immediately appeared. The sulphur of the acid, and the hydrogen of the water, went to the negative pole, and the oxygen of both to the positive pole; and the galvanometer was now influenced by the current, which passed through it in the ordinary manner.—*Idem.*

CHEMICAL PHILOSOPHY.

1. *Litmus Paper.*—In a memoir containing popular directions for the examination of the different kinds of potash, known in commerce, Gay Lussac recommends the following mode of preparing test paper. "Take letter paper, or any other that is well sized, and color it on one side only, with the tincture of Litmus, or Tournesol (prepared by boiling powdered litmus in water,) by means of a brush. When dry, it should have a tender blue color; and if not deep enough, it may receive a second coat. The paper is then cut into strips about one third of an inch wide. The color is not changed by alkalies and neutral substances, but it becomes red by a very small portion of acid.—

Hence it indicates the moment when an alkaline solution is saturated by an acid, for it remains blue as long as there is any free alkali in the solution, and acquires the color of onion peelings as soon as the acid is slightly in excess.

"Litmus may serve equally well for detecting the presence of an alkali. If the blue paper be passed through water containing a few drops of an acid, it is reddened, and then will be restored to a blue, by a very small quantity of alkali." To determine the neutral point of a saline compound, a small glass rod may be dipped into the solution, and a mark drawn over the litmus paper. To distinguish between the change of color occasioned by the liberation of carbonic acid, and that produced by a stronger acid, it is observed that the former gives a *wine-red*, while the latter produces that of onion peelings, which is permanent.—*Ann. de Chimie et de Phys. Decem.* 1828.

2. *Liquid Sulphurous acid.*—In an interesting memoir on the condensation of sulphurous acid gas, by Auguste de la Rive, of Geneva, the author, after some judicious remarks on the distinction between gases and vapors, observes, that in order to obtain liquid sulphurous acid, the gas must be as dry as possible, before it is condensed. For this purpose it should be received as it arises from the action of sulphuric acid on mercury, in a vessel No. 1, surrounded by a freezing mixture ; and from this it should pass through a tube filled with well dried muriate of lime, into a vessel No. 2, surrounded like the first : and lastly, the portion which has not then been condensed, should pass through a second tube, filled with muriate of lime, into a third vessel, cooled like the others, when the condensation is finished. A tube may proceed from this third vessel into mercury, which occasions a slight pressure of the gas that might have escaped condensation, from spreading in the chamber, and compels it, like the rest, to become liquid. Care must be taken to lute the junctures well. After the gas has been disengaged, during eight or ten hours, there are found in No. 1, white crystals, composed of water and sulphurous acid, and in Nos. 2 and 3, liquid sulphurous acid, very pure, which must be immediately corked up hermetically in a flask. To preserve it, the flask must be constantly surrounded with a freezing mixture, otherwise the gas will either escape through the cork, or it will explode the vessel.

The *crystals of sulphurous acid* and water, formed in the first vessel, are of a beautiful white, and have an agreeable, acid taste. They are formed in thin laminæ, and appear to be quite similar in their structure to crystals of water and chlorine, with which they have a close analogy. They remain solid at a temp. of 4° or 5° cent. but at that temperature they emit a portion of their gas. When the whole of the gas is driven off by a gentle heat, there remains nothing but pure water, which constituted four fifths of their weight. It is probable that ammoniacal gas, hydro-sulphuric acid, (sulphuretted hydrogen ?) and all other gases soluble in water, susceptible of being liquified, might also form crystals with water, but hitherto it is not known that they have been obtained.

The properties of the *Liquid sulphurous* acid, have been described chiefly either by Mr. Faraday or M. de Bussy. It is perfectly limpid and transparent, and heavier than water, (sp. gr. 1.45.) When open to the air it disappears immediately, producing such intense cold, that a few drops thrown upon water produces a crust of ice, and if a small quantity be poured on water in a watch glass, the latter is wholly congealed into a spongy crystalline mass, a portion of the acid probably remaining combined with the water, while the evaporation of the rest, occasions the congelation of the mixture. Mercury may also be frozen by it. If a few drops of the liquid acid be placed on a quantity equal in bulk to a small hazle nut, and the glass put under a receiver and the air exhausted, the mercury becomes solid. A considerable mass may thus be congealed and preserved in that state, during several minutes.

The author has determined, by this convenient method, the electric conductibility of mercury. By means of the double galvanometer, he has found that when two globules of mercury are properly adjusted between two platina points, and having the same conductibility, if one of them be frozen by means of the liquid acid, it becomes immediately a much better conductor than the other. Can this phenomenon be connected with the sudden contraction of mercury when it freezes ?

The cold produced by the evaporation of this liquid acid, was carried by M. de Bussy as far as — 60°; but he was not able to congeal either absolute alcohol or ether. A remarkable fact, with respect to the refrigerative powers of this liquid, is, that one part of it becomes congealed by the evaporation of the other, as may be shown by the crystals that are formed in a watch glass by spontaneous evaporation. In this case the acid unites with the moisture of the air, condensed by the sudden cold.

It was found by the ingenious author of this memoir, that in its pure liquid state, sulphurous acid is a non-conductor of electricity. Under circumstances the most favorable, it exhibited no traces of decomposition by a battery of forty pairs and a very sensible galvanometer. But when a little water was added to it, sulphuretted hydrogen immediately appeared at the negative pole, and oxygen at the positive. In this respect, it is analagous to sulphuric and other acids, to Brome, &c.

Some attempts have been made to ascertain the relative refractive powers of sulphurous acid in its gaseous and liquid states, but not very successfully. It would appear from the results that have been obtained, that in several instances, the refractive power of the condensed gases, increases in a greater ratio than that of their increased densities, a result which is considered to be adverse to the theory of the *emission* of light; for upon that theory there should be no change in the refractive power, by a change of density, as long as the chemical nature of the medium remains unchanged.—*Bibliotheque Universelle, Mars*, 1829.

3. *Crystallization of Iodine.*—During the course of his researches on the combinations of Iodine and Arsenic, *M. A. Plisson* has ascertained that Iodine crystallizes in acute octahedrons and in rhomboids, and that it may be obtained under those two forms, by exposing ioduretted hydriodic acid. He also remarked that iodine assumes rhomboidal forms in the upper part of a flask, in which ioduret of arsenic has been kept.—*Ann. de Chimie. Nov.* 1828.

4. *Note on the action of metals upon inflammable gases, by Aug. de la Rive and F. Marcet.*—Mr. Pleischl has shewn that the best method of obtaining platina in a state the most fit for becoming incandescent by a current of hydrogen, is to dip a piece of filtering paper three times successively, into a solution of hydro-chlorate of platina, burn the paper and collect the ashes.* These ashes contain the platina in a condition much more suitable for producing the required incandescence, than when in the spongy state, and it preserves this property at a much lower temperature. They have observed it to become red even when cooled to $-20°$ cent.

Palladium prepared in the same manner, exhibits the same phenomenon, with nearly the same facility as platina.

---

* I have observed this after burning the paper filter, on which the orange colored oxide precipitated by muriate of ammonia from muriate of platina, had been collected.—*Ed.*

Gold prepared in the same way becomes incandescent only at about the temp. of 50° cent.

Paper impregnated in the same manner with the nitrate of silver becomes red between 120° and 130° cent.

A current of per carburetted hydrogen, (olefiant gas,) renders platina incandescent at 100° cent. and the gas inflames from time to time. Sulphuretted hydrogen produces the same effect at a temperature somewhat higher. The sulphur which is deposited on the metal, must be cleared by the action of nitric acid, prior to a second experiment.

The protoxide of carbon determines the incandescence of platina at about 80° cent.

The force of the combustion produced by a current of hydrogen directed on platina is very great, since it requires the presence of only an extremely small portion of oxygen. When the current is thrown upon the metal in a vacuum, it produces no effect, which proves that the effect is not due, as Dobereiner supposed, to the immediate action of the hydrogen on the platina. But in letting into the receiver sufficient air to support an inch and a half of mercury, the platina became sensibly red, and a thermometer, which, in the vacuum shewed no elevation of temperature, was broken by the heat, being incapable of rising higher than 150°. The quantity of oxygen in this case was not more than the 18th part of that which the receiver would have contained under the common pressure.—*Ann. de Chim. Nov.* 1828.

5. *Preservation of bones, and the employment of gelatine.*—J. Bornaud, manufacturer of gelatine, at Geneva, has furnished the editors of the Bibliotheque with the following information.

It is well known, that the best means of preserving bones, is to pass them through a caustic ley, which removing the grease and odor which they acquire, allows of their being kept in heaps even many years. Bones may thus be preserved in pits, in the ground or under water; which latter mode is preferable, if they are to be employed in a few months.

From late experiments, it appears that one of the most economical uses of gelatine, consists in uniting it with bread in the form of soup. If it be well deprived of grease, it makes no alteration in the appearance of the bread, and prevents it from moulding so easily. The bread thus prepared is exactly like biscuit, if it be left a little longer in the oven. If the fat has been left in, a kind of cake may be made, of an agreeable taste, and which is more easily kept than that made of butter. When this bread has become dry, it may be pulverised under a rolling mill, and a kind of flour is obtained, very savory and nourishing, and suitable for making a good potage, or for mixing advantageously with other aliments of a less nutritive quality. This flour is easily transported, and contains much nourishment in a small bulk.—*Bibliotheque Universelle, Juillet*, 1828.

6. The *color of the sea*, is ascribed by Sir Humphrey Davy, in part at least, to the presence of iodine and bromine, which its waters certainly contain, and which result perhaps from the decomposition of marine vegetables. These two substances, dissolved in a small quantity of water, give a yellow tint, and this tint mingled with the blue tint of pure water may produce the sea green.—*Salmonia.*

7. *Solar phosphori.*—M. Osann has found that a superior phosphorescent substance is obtained by calcining oyster shells, (selecting for this purpose the whitest and most porous,) and when cleaned placing them in a crucible, previously covering the bottom with finely pulverised sulphuret of antimony, and then alternating the shells and antimonial powder, sifting on the latter to the depth of two lines between each layer of shells. The crucible is then closed and exposed during an hour to a red heat. The superior and inferior strata of shells are commonly soiled, and may be rejected. The phosphorus thus obtained, after having been exposed to the sun, shines in the dark with a greenish white light, and is superior to the Bolognian phosphorus, both in intensity and duration.

When sulphuret of arsenic (realgar) is substituted for sulphuret of antimony, the pieces shine with a blue light, analogous to the flame of sulphur. In this, as in the preceding, only the places that are perfectly white are phosphorescent. It presents here and there points which shine with a purple red. If exposed long to a red heat, its light is decolored and becomes completely white.

These compounds may be preserved in closed vessels. They will remain good for three weeks, if exposed to the air, and it is only when the lime falls into powder that their light is extinct.—*Bib. Univ. Fev.* 1829.

8. *Test of the strength of chlorine or chloride of lime.*—The solution of indigo, which has long been employed in estimating the

quantity of chlorine in any fluid, is found to be uncertain, or at least inconvenient, on account of the variable quality of indigo, and also of the changes of color which a dilute solution of indigo in sulphuric acid spontaneously undergoes. If the solution be concentrated, the sulphuric acid expels the chlorine too rapidly from its solution, and thus prevents a portion of it from reacting on the indigo. *Muriate of manganese*, proposed by *A. Morin*, is a more certain and preferable test. He has been able to appreciate the half of a hundredth parts of chlorine by this reagent, and nothing is more easy, he remarks, than to prepare it in determined proportions, and to preserve it unaltered for a long time. To prepare this chlorometric fluid, it is sufficient to dissolve some oxide of manganese in hydrochloric acid, taking care to have an excess of the oxide. Filter the liquid, which is of a pale rose color, and scarcely reddens litmus. A single drop of a weak solution of sub-carbonate of soda, produces in it a white precipitate, which does not disappear by agitation. These characters indicate that the saturation is sufficient. In this state, the solution of muriate of manganese is precipitated, of a deep brown, by the chloride of lime; the oxide being set free by the union of the muriatic acid with the lime, which the chlorine kept in suspension. It is obvious that the solution of the chloride contains lime foreign to its own composition, only in the state of muriate, of chlorate, or of lime water. Now the muriate and chlorate of lime give no precipitate with muriate of manganese; lime water it is true yields a brownish color but this proves to be of no importance, for on decomposing muriate of manganese, by equal volumes of lime water and solution of chloride reduced to 14°, more than 100 parts of hydrochlorate of manganese were necessary for the chloride of lime, while less than one part was sufficient for the lime water.

The advantage which the solution of muriate of manganese offers as a chlorometric substance, are threefold.

1. The uniform condition of the test.

2. The disengagement of the chlorine is produced by an acid which acts only while the metallic oxide, with which it is combined, is precipitated.

3. The precipitation of the oxide, which indicates the quantity of chlorine, precedes the disengagement of the gas, or at most is simultaneous with it; whereas in employing a solution of indigo, the chlorine becomes at first free to react on the coloring matter, the destruction of which serves as the measure of its quantity. Hence the trial

by muriate of manganese can be made slowly, and is consequently more certain.—*Bib. Univ. Juin*, 1828.

9. *New indelible ink, by Henry Braconnot.*—This enterprising chemist describes an ink, which, agreeably to his account of its properties, will prove to be a valuable accession to the arts of writing, marking, and dyeing.

Being engaged, conjointly with M. Parisot de Nancy, in the production of a cheap and solid brown dye, he torrified with potash, various organic matters, and thus ascertained that substances containing the most azote, such as flesh, leather, horns, &c. gave the deepest color. From a hint, also, which they derived from Fourcroy, he was induced to add to the mixture, prior to torrefaction, flowers of sulphur, and by this means they produced a deep chesnut brown, more substantial than any like color known to the dyer.

The proportions which he found most convenient, and the method of proceeding were to dissolve 20 parts of Dantzick potash in boiling water, and add to the solution 10 parts of animal matter, minutely divided, (leather parings from the tanners were found to be convenient,) and 5 parts of flowers of sulphur. These are boiled to dryness in a cast iron pot, and the heat is urged until the mixture softens, taking care to prevent ignition, and, after adding by degrees a suitable portion of water, the fluid portion is filtered through a loose cloth. There is thus produced a deep colored dye or ink which can be easily preserved in a well stopped bottle. A single pen full of this ink is said to be sufficient to write one or two quarto pages, and that it possesses all the desired properties of an indestructible ink, flowing more freely from the pen than common ink, and resisting the most powerful chemical agents.

A strip of paper written with this liquid, treated with a concentrated solution of boiling caustic potash, was mostly destroyed, but the scraps which escaped destruction, plainly showed the letters in their perfect shapes. Paper, written with the same liquor, immersed for an instant in moderately concentrated sulphuric acid, was dissolved, passing in part to the condition of gum, but on the thin undissolved portion, the writing might easily be read.

The characters of this liquor, experienced no change in twenty four hours, in concentrated nitric acid, even assisted by heat, to an extent not quite sufficient to destroy the paper entirely.

Another strip of paper was immersed for some time in a strong solution of chloride of lime, mixed with muriatic acid; then placed for twenty four hours in caustic potash, which was afterwards boiled to dryness, and then diluted with water: there remained from this double action of chlorine and potash, only a small scrap of the paper, but on this the letters were very distinct. From these facts the author thinks he may offer this liquor with confidence, as an indelible ink; and he doubts not that it may be employed with the greatest advantage in fixing different shades of brown on cotton, hemp, linen and silk, or in browning other colors, and that it will possess a great superiority over other browns. It may be used also with the greatest success, in marking linen, without the aid of any other mixture.—*Avril*, 1829.—*Idem.*

Memorandum by Prof. Griscom, addressed to the Editor.

My attention having been arrested by this account of Braconnot's new indelible ink, I hastily prepared some of it by heating in an iron ladle the prescribed proportions of pearlash, leather shavings, and flowers of sulphur. The result is, the ink with which this paper is written.* I find it to be indestructible by chlorine, either gaseous or in solution. For marking on linen, it spreads too easily; perhaps a little gum would help it.

Compared with common ink in a solution of chloride of lime, its superiority is very manifest. J. G.

10. *Detection of potatoe flour in that of wheat.*—To effect this object, M. Henri examined from twenty five to thirty samples of pure wheat flour, from the harvest of 1827 and 1828, and without regarding the other constituent principles, he ascertained that upon an average, they contained 10¼ per cent. of gluten, perfectly dry and pulverulent, while the flour reputed to be mixtures, gave but 6 to 6½ per cent. of perfectly dry gluten.—*Idem.*

11. *Aspartic acid.*—*M. Plisson*, Pharmacien of Paris, having shewn the identity of the crystalline matters contained in young shoots of asparagus, in liquorice root, in that of marsh-mallows, and of the large comfrey, and ranked the whole under the name of *Asparagin,*

* The color is light brown, but perfectly distinct.—*Ed.*

has further determined that this substance, when brought into contact with hydrate of lead, produces an insoluble salt, hitherto unknown: and having separated the base of this salt by sulphuretted hydrogen, he obtained a new acid, to which he has given the name of *Aspartic.*

Properties.—It crystallizes in water in a brilliant powder, which examined by a microscope, appears to be composed of long prisms of four sides with a dihedral summit, transparent and colorless. It is inodorous, gives a slightly acid taste, and reddens litmus, dissolves in 128 times its weight of water at $8\frac{1}{2}^{\circ}$ cent.; sp. gr. 1.874; decomposes by heat, producing ammonia, prussic acid, &c.

It forms salts, *Aspartates*, which are decomposed by the action of heat; those of a mineral alkaline base are transformed into ammonia, hydro-cyanic acid, metallic cyanuret, &c. All those which are soluble, have a remarkable taste of meat gravy, which becomes one of their principal characteristics. In the neutral salts with alkaline or earthy bases, this taste is distinct and free, in those with metallic bases, it is followed by stypticity, and in those of vegetable, it is completely disguised by bitterness.

The memoir of the author exhibits other properties of individual salts.—*Ann. de Chim. Mars*, 1829.

12. *Extrication of gas from mushrooms.*—*F. Marcet* of Geneva, has shewn that mushrooms exposed under water to the sun's rays, liberate a quantity of air, which consists almost entirely of hydrogen and azote; the former in general being the predominant volume. In the dark, little or no gas is set free. While growing in the open air, the only gas which appeared to be set free, was a small quantity of carbonic acid.—*Idem.*

13. *Antidote to Prussic acid.*—*M. Dauvergne*, in a letter to *M. Gay Lussac*, dated Paris, April 25th, 1829, states, that M. Simeon, apothecary to the hospital Saint-Louis, poisoned a cat with hydrocyanic acid, by placing two drops in the corner of his eye; the animal was violently affected, and when to all appearance past recovery, a large quantity of chlorine was diffused in his throat, which very soon alleviated the symptoms, and when able to raise his head, which before he could not do, he appeared to take pleasure in smelling the chlorine, from the relief which it afforded. In an hour he rose on his feet, and in the course of two hours more, scarcely any

traces of morbific symptoms remained. The experiment has been tried on various other animals, with similar results.—*Idem.*

14. *Copal Varnish, by J. J. Berzelius.*—Copal reduced to coarse powder, and watered with caustic liquid Ammonia, swells, and is converted into a gelatinous mass, which is entirely soluble in alcohol. To effect this solution, which makes a very beautiful varnish, liquid ammonia is to be added by degrees, to pulverized copal till the swelling ceases, and it becomes a clear and consistent mass. It is then heated to 35° cent., and introduced in small portions at a time, to alcohol of 8, having a temperature of about 5° cent., shaking it well after each addition. A solution is thus obtained, which, after depositing an insignificant portion of sediment, is absolutely colorless, and as clear as water.—*Jour. de Con. Usuelles, Oct.* 1828.

15. *On the Oily and Resinous products of the distillation of Wood, by M. Berzelius.* (An. de Pog. 1828, p. 76.)—It is well known that the distillation of wood furnishes four distinct products: 1st. An empyreumatic oil; 2d. An aqueous liquid; 3d. Various gases; and 4th. Charcoal.

By repeatedly distilling the empyreumatic oil with water, a portion of limpid oil is separated from it, which I call *pyrelaïde*, and a resin, which I shall designate by the name of *pyrétine.*

The pyrelaïde varies with the vegetable substance from which it is obtained; it is colorless, or slightly yellow, of a very strong and disagreeable odor, and a sharp and nauseous taste; it burns with a clear flame and smoke; it dissolves more or less easily in alcohol, and very readily in ether, as well as in the fixed and volatile oils; it forms with concentrated sulphuric acid, a compound analogous to sulphovinic acid; it dissolves resins and caoutchouc; nitric acid converts it into resin; it sometimes preserves its fluidity in the air, and sometimes is transformed into a dark resin.

The pyrétine is of a very variable composition. Some varieties contain free acetic acid, and others none. A substance analagous to *ulmine*, may be extracted from it.

The aqueous liquid contains, 1, water, 2. acetic acid, rarely acetate of ammonia, 3, empyreumatic oil, and some pyrétine acid, 4, an azotized substance, similar to extract, 5, a liquid volatile substance, analogous to alcohol, and known under the name of *pyroligneous acid.* When the aqueous liquid is subjected to a redistillation the pyrolignite spirit comes over first; then follows the acetic acid, with water and empyreumatic oil, colorless, and there remains in the retort a dark brown mass, similar to extract.—*Ann. des Mines, Tom. V. p.* 78.

16. *New method of discovering the presence of Nitric Acid, by Just. Leibig.* (Ann. de Chem. t. 35, p. 80.)—Mix the liquid to be examined with as much indigo as is necessary to color it distinctly blue; add a few drops of concentrated sulphuric acid, and heat it to ebullition. If the liquid contains a nitrate it is discolored, or if the portion of nitrate is very small, its blue color changes to yellow. In adding to the liquid a little muriate of soda, prior to heating it, we may easily detect the presence of $\frac{1}{500}$ of nitric acid.—*Idem.*

17. *Reduction of Boracic Acid by Hydrogen; by M. Varvinski.* (Fer. Bull. Tom. 10, p. 159.)—When hydrogen gas is passed through a porcelain tube filled with boracic acid in scales, and heated to redness, the acid is vitrified, and colored brown. If after this operation, it is treated with boiling water, there remains a floculent and olive colored substance, which is no other than boron.—*Idem.*

18. *On Pyrophorus; by Gay Lussac.*—(Ann. de Ch. t. 37. p. 415.)—The causes to which pyrophorus owes its inflammation not appearing to me sufficiently determined, I made the following experiments:

A mixture of calcined alum and calcined lampblack was heated in an earthen retort. Carbonic acid and sulphurous gases are at first disengaged, in nearly equal volumes; then carbonic acid, pure, but afterwards mixed with oxide of carbon, which in the end became predominant. The remainder, when quite cold, inflamed like the best pyrophorus, spreading a suffocating odour, of sulphurous acid, and burning even with a slight blue flame. This pyrophorous is a mixture of carbon, alumine, and poly-sulphuret of potassium, which is formed at the expense of a part of the sulphuric acid, and sulphate of alumine.

The carbon is not indispensible to its formation; for, by employing 75 gr. alum, and 3.33 gr. of calcined lampblack, I obtained a reddish brown matter, in which there remained no carbon, and which was very inflammable.

Neither is alumine essential; for I prepared a very good pyrophorus with 1 atom of sulphate of potash, 3 atoms of sulphate of magnesia and lamp black.

Sulphuret of potassium, with one or several atoms of sulphur, or even an oxysulphuret, not inflaming in the air when in mass; and the presence of alumine and magnesia appearing to me to have no other agency than that of dividing the sulphuret of potassium, it seemed to me that I might advantageously replace these two bases by charcoal. Accordingly with 25.3 of sulph. of potash 1 at.
7.5 of lamp black 4 at.
I obtained a sulphuret in mass, not inflammable; but, by doubling the dose of lamp black, I had a pulverulent matter, which inflamed even in dry air with astonishing rapidity. This matter is composed of polysulphuret of potassium and potash intimately mingled with carbon. It is more inflammable than common pyrophorus, because the carbon being itself combustible, does not remain passive in the phenomenon, like alumine and magnesia; the ignition having commenced, it feeds it.

Sulphate of soda, treated with lamp black, gives a pyrophorus, but sulphate of barytes yields none.—*Idem.*

19. *Ioduret of Calcium and Potassium.* (J. de Phar. 1828. p. 44.)—In mixing together 1½ part of quick lime, which is to be slacked in water, with 1 part of iodine, and 2 to 3 parts of water, there is formed ioduret of calcium which remains in the liquid, and iodate of lime insoluble, which mingles with excess of lime.

In decomposing the ioduret of calcium by carb. of potash, we obtain ioduret of potassium, pure.—*Idem.*

20. *Instructions relative to the art of Refining. Two memoirs published in* 1827 *and* 1828; *by M. D'Arcet, Assayer of the Mint, Paris.*—The art of refining is that of separating gold and silver from metals of less value, with which they are combined. It has been practised from the earliest periods of the metallurgic arts.

The method formerly used was to melt the ingot of metal to be refined, with saltpetre, in order to separate the oxydable metals. It was then converted into grains, which were heated in earthen vessels at first with weak nitric acid, and in a second operation with that which was more concentrated. The gold alone remained undissolved. It was collected, washed, dried, and then melted with saltpetre. The acid liquids united, were placed in contact with plates of copper, which separated the silver entirely, which being washed, was melted with saltpetre and borax. The liquid nitrate of copper was evaporated, and then exposed to a heat capable of decomposing it. The oxide of copper was reduced by charcoal in an air furnace. In this operation the nitric acid, which is very expensive, was almost entirely lost—a great deal of saltpetre was used—the vessels employed were often broken, as they were unfit to resist the great variations of temperature to which they were exposed—deleterious gases and vapors were copiously produced—the waste was very great—and considerable expense was incurred in reducing the copper.

In the new process, nearly all these inconveniences are avoided. The ingot is melted and granulated without saltpetre—the grains are treated with sulphuric acid in large vessels of platina, at a high temperature, by which the silver and copper are dissolved. The gold being thus separated from the silver, is treated with fresh acid, then washed, dried and melted with a little saltpetre. The sulphate of silver is decomposed by plates of copper aided by heat, and the silver is washed, dried and melted with a little saltpetre and borax. The solution of sulphate of copper is saturated by adding oxide of copper, then evaporated and crystallized. In this process much labor is saved, and less expense incurred in saltpetre, acid, crucibles and charcoal; there is less waste, and the amount of saleable products is greater,—while, no other gases being disengaged than sulphurous acid with a little sulphuric, the operations are performed with less injury to the workmen.

The alloy most easily refined by sulphuric acid, ought, in general, to consist of gold, silver and copper, in nearly the following proportions.

Silver, - - - - - -	725
Gold, - - - - - -	200
Copper, - - - - - -	75
	1000

If the proportion of copper be much greater than the above, anhydrous sulphate of copper, will be held in suspension in the solutions which prevents the gold from separating easily; and if the gold be in greater quantity, the alloy is not easily attacked by boiling sulphuric acid; the refiner should therefore previously analyze a small portion of the ingot, and add to the melting mass, some silver or copper as the case may require.

If lead or other base metal than copper, be present, it must first be separated, either by saltpetre or by cupellation.

Refiners, in general, employ 3 parts of sulphuric acid (sp. gr. 1844) for 1 part of alloy, of the foregoing composition,—varying the quantity of acid, however, with that of the relative proportion of gold or copper. The acid should be free from nitric or hydrochloric acid.

The only precaution requisite with respect to the copper, is, that it be free from lead or tin, as these metals form, with sulphuric acid, insoluble compounds which would remain mingled with the silver.—In general it requires 28 parts of copper to precipitate 100 of silver, and this furnishes from 100 to 104 parts of crystallized sulphate of copper.

The *Platina boilers* employed at Paris, were constructed by M. Bréant. They hold about 11 gallons, weight 18lbs. and cost 8500 francs. They are surrounded by an iron defence which serves to transport them, and prevent injuries. Fine gold, at the moment in which it is separated from the alloy, by sulphuric acid, is in very fine powder, which coming in contact with the platina, under the influence of boiling acid, is easily soldered to the platina, and requires to be detached from time to time, by the action of a little weak aqua regia which dissolves the gold without attacking the platina.—*Bib. Univ. Avril*, 1829.

21. *Pectic acid convertible into oxalic by an alkali.*—In a memoir on pectic acid and on carrots, by M. Vauquelin, read to the Academy of Sciences, April 27, 1829, the following method is recommended for preparing pectic acid.

Take carrots, of the yellow variety, and after having rasped them and pressed the pulp, and washed it with common rain-water until it comes off quite limpid, convert it into a pap by boiling it gently in a solution of bi-carbonate of potash (5 parts of bi-carbonate to 100 of the pressed pulp.) By pressing this pap, (bouillie,) a liquor is obtained highly charged with pectate of potash, from which the pectic acid may be easily obtained, by treating it with an excess of hydrochlorate of lime, washing, and treating the insoluble pectate of lime with water sharpened with hydrochloric acid, and then washing it with pure water. The pectic acid thus obtained is much whiter than when caustic potash is employed.

In substituting the carbonate of soda for that of potash, taking the crystallized salt in the same proportion as that above mentioned, a very concentrated pectate may be obtained, which will furnish a very white pectic acid, either by the addition of an acid or of some other precipitating substance. To obtain the total quantity of the pectic acid, new decoctions are to be made, with increased successive portions of carbonate of soda.

If to this gelatinous pectic acid, contained in a small platina crucible, there be added an excess of caustic potash, and the mass be gently warmed and stirred, it soon becomes liquid and assumes a brown color; and if it be slowly evaporated, the saline matter which remains in the crucible becomes, when the operation is well conducted and the heat carefully managed, speedily white.

This white matter dissolves easily in water—the alkali is almost entirely saturated, and if nitric acid be added to the solution until it becomes slightly acid, we observe the disengagement of carbonic acid, without any precipitation of the pectic. If nitrate of silver be then added, an abundant precipitate of a granulated white powder takes place, which exposed again to moisture and light becomes slightly red. When this precipitate is treated with muriatic acid, it produces chloride of silver, which, well washed, contains no vegetable matter. The washings, evaporated by a gentle heat, become eventually of a light yellow, and some vapors of hydrochloric acid are perceived. When the evaporation is completed, in a stove, perfectly white transparent crystals are formed without an atom of mother water. They have the form of square columns, without pyramids, some of them in groups. When dissolved, these crystals precipitate lime water and all the soluble calcareous salts, properties which clearly indicate oxalic acid.

Of this remarkable transformation of pectic into oxalic acid, by the influence of a weak alkaline action, two explanations may be admitted. 1. The action of an alkali may be assimilated to that of nitric acid on the same body. It deranges its elements, and hence arises a compound, which appears to be one of the last in the organic scale—oxalic acid. 2. If we compare the chemical characters of oxalic and pectic acids, we find often a near resemblance with respect to the insolubility of their salts. We may admit that pectic acid is a compound of oxalic acid and a gelatinous matter which is intimately associated with it: the action of potash is limited to the destruction of this gelatinous substance, and in combining with the oxalic acid, which preserves greater fixity in uniting with that alkali: we have not however yet succeeded in isolating this gelatinous matter, and in forming pectic acid by combining it with oxalic.

The views which I have often developed in my course, with respect to the formation of acids in vegetables, are, that they are caused principally by the presence of alkalies. We find, in fact, that acids are almost always neutralized, in whole or in part, by various alkalies, such as lime, potash, soda, magnesia, and sometimes also by vegetable alkalies; and I do not know that these last have yet been found uncombined in the vegetable kingdom.

Among these alkalies, lime has certainly the greatest effect in the vegetable kingdom, because it is more generally diffused over the surface and attracts powerfully the acids. It does not, it is true, in the condition of lime, enter organic substances, but rather in the state of carbonate, which without exerting any deleterious action on vegetables, preserves sufficient alkaline force to determine the formation of acids, and particularly the oxalic acid, which it prefers to all others.

In this manner we may explain the effect of calcareous marls. Immediately on its introduction into the organs of plants, the carbonate of lime determines the developement of an acid which decomposes it and sets free its carbonic acid, which, aided by light, turns to the profit of the vegetable nature. Hence, it may be concluded, that calcareous marls perform at once two important functions, viz. the division of the soil, and the nutrition of plants.—*Ann. de Chim. Mai*, 1829.

22. *Detection of corrosive sublimate.*—*M. Orfila* discovers that the test proposed by James Smittson, of dipping a strip of gold, surmounted by a spiral of tin foil, into the suspected liquid, and adding one or two drops of muriatic acid, does not afford a certain indication of the presence of mercury. The gold becomes whitened without it, by the action of the muriatic acid on the tin; this effect ensues, even in a solution of common salt, made by adding twelve drops of a saturated solution of muriate of soda to one and a half ounce of distilled water. When, however, the strip of gold becomes whitened in the experiment, it may be ascertained by strong muriatic acid, whether the effect has been produced by mercury or by tin. If the latter, the tin dissolves entirely and the gold resumes its primitive color, but if the gold be whitened by mercury, it resists the action of the acid, and remains of a greyish white. The muriatic acid

in this case must be pure, for aqua regia will remove the color in either case.

But the most delicate test of mercury is, after whitening the gold of this little galvanic apparatus, to coil the strip of gold, place it in the bottom of a tube, draw out the tube at the other end so as nearly to close it, and then by heating the bottom expel the mercury from the gold, and allow it to condense in the contracted part of the tube. The smallest portions of mercurial salt may in this way be detected.—*Idem.*

23. *On Potassium and Sodium.* (Ann. de Chim. XL. 327.)—M. Serullas remarks, that a piece of potassium put upon a bath of mercury, gradually amalgamates, acquiring a rotatory motion due to its action upon the water in the atmosphere which evolves hydrogen. In dry air, the amalgamation takes place without motion. But if pieces of sodium be thrown upon mercury, they are again thrown off with a small explosion, accompanied with light and heat. On the other hand, potassium burns on the surface of water, whilst sodium decomposes, without producing combustion, so that the phenomena produced by the metals with the two fluids, are the reverse of each other.

The effects on water are of course due to the superior temperature acquired by the potassium, occasioning inflammation, whilst that obtained by the sodium is not sufficient for the purpose; but if a solution of gum arabic be used, not too dense nor too thin, then the sodium fires, because the fragments, being retained at one point, become sufficiently heated to ignite with a yellow flame, and then move over the surface of the fluid like potassium. If sodium be fixed upon a bad conductor of heat, as wood, then a drop of water will fire it; but if it be placed upon glass or porcelain, then the effect will not take place; the abstraction of heat in these cases, as well as in that where a surface of pure water is used, is too rapid to allow of the sufficient elevation of temperature.—*Idem.*

24. *Test for vegetable and animal matter.* (Jameson's Jour.)—The nitrate of silver is the test which Dr. Davy thinks to be one of the best for detecting the presence of organic matter in solution. A pure solution of this salt is not altered by the sun's rays; but if the minutest quantity of animal or vegetable substance be dissolved in the water, the solution is discolored; with common distilled water,

the discoloration is strong. To prove that the cause of change assigned is the true one, it is only necessary to decant the colorless solution and expose it again to sunshine, however powerful the sun's rays, no further effects will be produced, unless a little more common distilled water be added, and then it reappears. When used as a test for such substances, of course any chloride of silver that may be formed in consequence of the presence of muriates should be allowed to subside in the dark, and the subsidence should be complete before the fluid is decanted and exposed to light.—*Idem.*

NATURAL HISTORY.

1. *Couzeranite.*—M. de Charpentier, in an important work which he has published on the geological constitution of the Pyrenees, announces that he has frequently found in the transition limestone of that country, a mineral to which, as he could not refer it to any other, he gave the above name, from the part of the chain in which it was principally found, and which is called Couzeran. This mineral has been examined by *Dufrenoy.* The primitive, which is also the prevailing form, is an oblique rhomboidal prism, resting on one edge, except that in the latter, there is frequently a truncation on the obtuse edges. The crystals are rarely terminated, and they are striated longitudinally, *fracture,* slightly lamellar, parallel to the shorter diagonal, and conchoidal and unequal in the other direction ; *splendor,* vitreous and resinite, which gives the fragments some resemblance to hilvaite. *Crystals,* opake ; *hardness,* scratches glass but not quartz ; *color,* commonly perfect black, probably from carbon, like that of the limestone which envelopes it ; *sp. gr.* 2.69 ; *fusible* by the blowpipe into a white enamel, somewhat like felspar ; *acids* do not affect it. From these external characters, it has some analogy to pyroxene and macle, but its fracture is very different, and its fusibility into a white enamel, prevents its being confounded with either.

Its composition agreeably to the analyses of Dufrenoy is

Silica, - - - - -	0.5237
Alumine, - - - -	0.2402
Lime, - - - - -	0.1185
Magnesia, - - - -	0.0140
Potash, - - - - -	0.0552
Soda, - - - -	0.0396
	0.9912

Annales des Mines, tome IV. 327.

2. *Belemnites.*—M. Raspail informed the French Academy on the 17th of November last, that a careful study of two hundred and fifty belemnites, collected in the Alps of Provence, had taught him that belemnites are not testaceous coverings of animals, as the moderns suppose, but that they are cutaneous appendices belonging to marine animals, approaching to the echinodermes, the living species being no longer found.—*Idem.*

3. *Number of salts—divisibility of matter.*—About forty years ago, only thirty salts in all were known. At present, the precise number is not known, but there are above two thousand! There are few subjects in natural philosophy, the contemplation of which is better calculated to exalt and improve the understanding, than the vast and almost inconceivable divisibility of matter.

The vegetable and animal kingdoms afford the most wonderful instances of the attenuation of matter. The *vibrio undula,* found in duck weed, is computed to be ten thousand million times smaller than a hemp seed; and the *monas gelatinosa,* discovered in ditch water, appears, in the field of a microscope, a mere atom, endued with vitality, millions of which are seen playing, like the sun beams, in a single drop of liquid. It has been calculated, that the skin is perforated by a thousand holes in the length of an inch; and if we estimate the whole surface of the body of a middle sized man to be sixteen square feet; it must contain not less than two million three hundred and four thousand pores. These pores are the mouths of so many excretory vessels, which perform the important function of *insensible perspiration.* The lungs discharge every minute six grains, and the surface of the skin from three to twenty grains, the average over the whole body being about fifteen grains of lymph, which consists of water, with a very minute admixture of salt, acetic acid, and a trace of iron.—*Graham's Chemistry, p.* 456.

4. *Preservation of Cloth, Furs, &c.*—The English successfully use the following process to destroy moths, or to expel them from cloths, tippets, and muffs. The seeds of the purple sweet sultan, (*hibiscus abelmoscus,*) are spread lightly among the stuff to be preserved, between its folds, &c. This grain, besides the advantage of expelling moths, gives to the stuff or clothes, an agreeable odor. Furriers, in order to preserve tippets, muffs, skins, and woolen stuffs, and to destroy the vitality of the eggs of the insects which eat them,

moisten or rub them over with a weak solution of corros. sublimate in alcohol, (half a dram to a quart,) or else with an alcoholic solution of arseniate of potash, prepared in the proportion of fifteen grains to a quart. These solutions are also of use in preserving stuffed birds. —*Recueil Industriel*, VII, 85.

We would suggest, as an easier and cheaper preservative against the depredation of moths, a weak solution of chloride of lime. Should any unpleasant odor result from its use, it might be removed by a little aqua-ammoniæ, or by some vegetable essence.—*Ed.*

5. *Vision of the Mole; by Geoffroy St. Hilaire.*—Does the Mole see? Aristotle, and all the Greek philosophers, thought it blind. Galen, on the other hand, maintained that the Mole saw. He affirmed that it has all the known means of sight. The question has been resumed in modern times. Naturalists have found the eyes of the animal. It is very small—not larger than a millet seed; its color is an ebony black; it is hard to the touch; and can scarcely be depressed by squeezing it between the fingers. Besides the eye-lid which covers it, it is protected by long hairs, which crossing each other, form a thick and strong bandage. Such an eye ought to be destined to see. But anatomists do not find the optic nerve. What use could an eye be of, deprived of a nerve, which in other animals, transmits the visual sensations to the brain. This consideration naturally tends to restore the opinion of Aristotle and the Greeks, and to induce the belief that the mole does not see, and that its eye is only a rudimental point, without use.

Direct experiments, however, made at the request of G. St. Hilaire, shew most incontestibly, that the mole makes use of its eyes, since it turns to avoid obstacles placed in its way. But if the mole sees, how is this accomplished without an optic nerve. M. Serres was of opinion that the place of this nerve was supplied by a superior branch of the fifth pair, analogous to the opthalmic branch of Willis.

According to Geoffroy St. Hilaire, this change of function in a nerve, which it is not naturally destined to fill, does not exist. The mole sees by aid of a particular nerve, being unable, on account of the too great extension of the olfactory apparatus, to follow the direction which it takes in other animals, towards the tubercula quadrigemina, takes another direction, and anastomes, in the nearest point, (au plus pres,) with the nerve of the fifth pair.—*Ann. des Sciences d'Observation, I.* 144.

6. *Observations on the influence of Cold on New-born Children.*—Dr. Trevisan has been making researches in Italy, principally at Castle Franco, analogous to those of M. M. Villermi, and Milne Edwards, in France. The conclusions at which he arrives, are:—In Italy, of one hundred Infants born in December, January, and February, sixty six died in the first month, fifteen more in the course of the year, and nineteen survived; of one hundred born in spring, forty eight survive the first year; of one hundred born in summer, eighty three survive the first year; of one hundred born in autumn, fifty eight survive the first twelve months. He attributes this mortality of the infants solely to the practice of exposing them to cold air a few days after their birth, for the purpose of having them baptized at the church. As well as M. M. Milne, Edwards, and Villermi, Dr. Trevisan calls the attention of the ecclesiastical authority to measures suited to put a stop to such disasters, without violating the precepts or practices of religion.—*Idem.*

7. *Mortality among Leeches during storms.* (Fer. Bull.)—That atmospheric changes have a remarkable influence upon leeches, is a well established fact. In 1825, M. Derheims, of St. Omer, ascribes the almost sudden death of them, at the approach of, or during storms, to the coagulation of the blood of these creatures, caused by the impression of the atmospheric electricity. This opinion, which at that time was the result of theory, he confirmed in the month of March last, by direct experiment.—*Idem.*

8. *Ossification of the Vitreous Humor.* (La Clinique.)—M. Krekn has lately met with that rare case, the ossification of the vitreous humor of the eye. It occurred in a man seventy years old, who died of gastritis; the preparation is placed in the Strasburgh Museum. The left eye was healthy, but the right presented the following appearance:—The globe was diminished in size, had lost its spheroidal figure, and presented the appearance of four wrinkles or furrows, corresponding with the insertion of the recti muscles. It was heavy and hard. When a horizontal section was made from behind forward, the schlerotic was found to be very thick, particularly at its posterior part, near the entrance of the optic nerve; the instrument was soon arrested by a hard body, filling the whole space of the eyeball behind the crystalline lens, and consequently occupying the place of the vitreous humor. Immediately within the schlerotic was the choroide

membrane, distinct, and rather thicker than natural. The retina was unchanged; the solid body within was marked by the same depression which had been observed externally. It was of a pale white color, and was internally of a cellular texture, like the cancelli of the long bones. The crystalline was indurated and of a yellowish white color; the optic nerve was wasted.—*Idem.*

9. *Zoological Weather Glass.* (Mag. of Nat. Hist. IV. 479.)—At Schwitzengen, in the post house, we witnessed for the first time, what we have since seen frequently, an amusing application of zoological knowledge, for the purpose of prognosticating the weather. Two frogs, of the species *Rana arborea*, are kept in a glass jar about eighteen inches in height, and six inches in diameter, with the depth of three or four inches of water at the bottom, and a small ladder reaching to the top of the jar. On the approach of dry weather the frogs mount the ladder, but when wet weather is expected, they descend into the water. These animals are of a bright green, and in their wild state, here climb the trees in search of insects, and make a peculiar singing noise before rain. In the jar they get no other food than now and then a fly, one of which we were assured, would serve a frog for a week, though it will eat from six to twelve in a day, if it can get them. In catching the flies, put alive into the jars, the frogs display great adroitness.—*Idem.*

ARTS.

1. *Manufacture of Red Crayons, for Drawing.*—Pulverize a certain quantity of hematite in porphyritic or other hard mortar, mingling it with filtered water, so as to reduce it to an impalpable powder. This is to be diluted with a sufficient quantity of water to allow the finest portions of the mixture to pass through a fine seive, placed over a vessel of water. The liquid holding the hematite in suspension, is agitated and left in repose for twenty four hours; the water is then decanted cautiously, and the fine powder remains at the bottom. This is to be incorporated with gum arabic, or isinglass, in proportions, varying according to the use to which the crayon is to be applied, viz: 1. For those of a tender quality, which leave large marks, eighteen grains of dry gum arabic, to one ounce of well prepared hematite. 2. For harder crayons, destined for small delicate strokes, twenty two grains of gum to one ounce of powdered hematite.

3. For the hardest crayons, twenty seven grains to one ounce ; and
4. For those which are to leave brilliant traces, thirty six grains of isinglass, (ichthyocolla,) to one ounce of hematite.

The gum, or isinglass, is dissolved separately, and passed through a woolen strainer ; the powder is then added, and the mixture is placed over a moderate fire, until the mass acquires a suitable consistency to bear rubbing in a mortar of porphyry, to render it homogeneous. To form the crayon, the paste is forced through a cylinder, and the sticks are dried and divided into pencils two inches long. They are then pointed, and the crust, formed during desiccation, is removed.—*Idem. VI.* 294.

2. *On the Preservation of Potatoes.* (Ann. Soc. d'Agric.)—Potatoes at the depth of one foot in the ground, produce shoots near the end of spring ; at the depth of two feet, they appear in the middle of summer ; at three feet of depth, they are very short, and never come to the surface ; and between three and five feet, they cease to vegetate. In consequence of observing these effects, several parcels of potatoes were buried in a garden, at the depth of three feet and a half, and were not removed till after intervals of one and two years. They were then found without any appearance of germination, and possessing their original firmness, freshness, goodness and taste.—*Idem.*

MEDICAL STATISTICS.

1. In a work entitled "*Elements of Medical Statistics :* &c." by F. Bisset Hawkins, M. D. &c. London, 1829, the following facts are stated in a review of this work, in the Quar. Journal.

The mean term of Roman life, was thirty years—that is to say, taking one thousand persons—adding together the years they individually attained, and dividing the total by the number of persons, the result is thirty. It is curious to contemplate the improvements which have been effected in the course of time in the value of human life. Mr. Finlayson has ascertained, that in England, at the present time, the expectation of life, for persons similarly circumstanced, is at least fifty years, giving us a superiority of twenty years above the Roman citizen. The mean term among the *easy* classes at Paris, is at present forty-two. At Florence, to the whole population, it is still not more than thirty.

In 1780 the annual mortality of England and Wales, was 1 in 40. By the last census, (1821,) it had fallen to 1 in 58, nearly one third. The rate of mortality is of course not equal throughout the country. Sussex enjoys the lowest rate of any English country: it is 1 in 72. Middlesex affords the other extreme, 1 in 47. Yet here, in 1811 the mortality was as great as 1 in 36. It is a circumstance well worthy of note, that the aguish counties of England do not, as might have been expected, stand high in the list. In Lincolnshire, the rate of mortality is only 1 in 62. This is attributed to the exemption of fenny countries generally from consumption.—Dr. Wells went so far as to advise the removal of consumptive patients to the heart of the Cambridgeshire fens, rather than to Hastings or Sidmouth.

The decline in mortality is even more striking in the cities than in rural districts. While the metropolis has extended itself in all directions, and multiplied its inhabitants to an enormous amount,—in other words, while the seeming sources of its unhealthiness have been largely augmented, it has actually become more friendly to health. In the middle of the last century, the annual mortality was about 1 in 20, By the census of 1821 it appeared as 1 in 40; so that in the space of 70 years, the chances of existence are exactly doubled in London. The rate of mortality in Manchester, at the present time, does not appear to exceed 1 in 74. As far back as the fourteenth century, M. Villermé has calculated that the mortality in Paris, was about 1 in 17. About the middle of the last century, it was about 1 in 25, in Paris, and 1 in 29 for the whole of France. At the present time it is 1 in 32 in Paris, and 1 in 40 for the whole country. The annual mortality of Nice, a small town enjoying a factitious reputation of salubrity, is as high as 1 in 31; Naples, 1 in 28: Leghorn, 1 in 35; Berlin, 1 in 34; Madrid, 1 in 29; Rome, 1 in 25; Amsterdam, 1 in 24; Vienna, 1 in 22. The average annual deaths throughout England and Wales, is only 1 in 60: Sweden and Holland lose annually 1 in 48; France, 1 in 40; Prussia and Naples, 1 in 34; Wirtemberg, 1 in 33. In Sweden, among the deaths in 1823, only five persons exceeded one hundred years, of whom, one was a man and four women. The marriages were nearly 24,000, among which, ten men married for the fourth time, one for the fifth time, and one for the sixth time! Upwards of 1400 women bore children from the age of forty-five to fifty. Ffty-three women had borne children beyond the age of fifty. Among nearly 100,000 women in labor, 1400 had twins, and 27 had triplets. In Paris, the poor district produces more children than the rich, in the proportion of 32 to 26, but when there are fifty deaths in the rich arrondisement, there are one hundred in the poor one. The number of illegitimate children is immense, and seven out of nine are abandoned by their parents, and of these, one half perish in the first year of their existence. Dupin has ascertained that *one half* of the deaths in Paris, take place in the hospitals and other asylums of charity. *Not a fourth part of the inhabitants are buried at private cost.* It appears from the statistics of Prague, that neither bachelor nor spinster, has for an average, of several years, exceeded the age of ninty-five, whereas several married persons have lived to see one hundred and fifteen. At New York, the mortality of the whites, on an average of the seven years, from 1820 to 1826, is 1 in 40. Among the blacks, on the same average, 1 in 19. At Philadelphia, the whites, 1 in 34 ; the blacks, on the same average, 1 in 19. At Baltimore, the blacks 1 in 33, and the whites 1 in 39.

In 1750 at the British Lying-in Hospital, one woman died out of forty-two ; in 1780, one died in sixty ; and at the city of London Hospital, in 1826, the deaths were only 1 in 70. At the Dublin Lying-in Hospital, the most magnificent institution of the kind in the world, the proportion of women dying in child-bed, on an average of seventy years, has been but 1 in 89. At Stockholm and at Paris in 1822, the deaths at the Lying-in Hospital, were 1 in 29. At Berlin, between 1807 and 1817, one case was fatal, out of forty-five. The mortality had then been once as high as 1 in 32.—*Lon. Quar. Jour. of Sci. April to June*, 1829.

2. *Urinary Calculi.* (Naturwissench Abhand, v. e. Gessellsch in Wurt.)—M. Rapp, having analysed eighty one urinary calculi, which he had obtained in different parts of the kingdom of Wirtemberg, has obtained the following results :—

1. Calculi, with oxalate of lime, (almost always with a nucleus of uric acid,)

Calculi, formed by oxalate of lime alone, - -	22
Oxalate of lime, with an exterior fusible coat (of ammoniaco-magnesian phosphate,) - - - -	28
Oxalate of lime, covered with a thick coat of uric acid, -	3
Oxalate of lime mixed with a considerable quantity of uric acid, so that their external characters are no longer distinguishable,	3

Uric acid, - - - - - -	7
Uric acid, covered with one or more fusible coats, -	9
Urate of ammonia, - - - - -	1
Fusible calculi, without a distinct nucleus, - -	7
Phosphate, with a considerable proportion, (0.13) of carbonate of lime, - - - - - -	1
	81

One remarkable fact is the variety in Wirtemberg of calculi formed of uric acid, if the number of them be compared with that which is generally found in England. M. Rapp has found seven out of 81 in his collection; while in the collection of Guy's Hospital in London, 22 are met with among 87; at Norwich, 66 out of 181 (Marcet); at Manchester, 71 out of 187, (Henry,) without counting 39 others, composed of uric acid and of phosphate; of 150 calculi, in Hunter's Museum, and in the collection of Sir E. Home, there are 61 formed of Uric acid, including 45 containing a small proportion of phosphate (Brande.) In the collection of Bristol, Smith found 73 calculi of uric acid, out of 218, the total number.

Calculi of uric acid are not, therefore, common in Wirtemburg; this substance, however, is the most generally diffused throughout them. M. Rapp counted fifty seven of which only the nucleus was formed of it. This nucleus is frequently very small, sometimes only a line in diameter; in many of these concretions the oxalate of lime is mixed with uric acid; sometimes, but rarely, coats of uric acid alternate with coats of phosphate.

M. Rapp found no stone composed entirely of phosphate of lime, but frequently this salt was mixed with ammoniaco-magnesian phosphate. The phosphated earths form but rarely the first nucleus of a stone; most frequently they form the external coats when the nucleus is already formed. This is frequently observed in mulberry calculi; occasionally, a certain quantity of carbonate of lime is mixed with the phosphates. These calculi may be formed without any particular diathesis, and in a man in good health, whenever any extraneous body get into the bladder, they become the most voluminous calculi. Earle described one (Phil. Trans. 1807,) that weighed four ounces. An animal regimen appears singularly favorable to the deposition of phosphated earths in the urine.

The presence of urate of ammonia in urinary calculi has been contested by M. M. Brande, Henry, and Marcet; and the signs which Prout has indicated, to recognise this salt, are all doubtful. M.

Rapp has, however, found it in three calculi, two of which had a crust of oxalate of lime, and the third, a crust of ammoniaco-magnesian phosphate. It is best recognised by means of a solution of caustic potash, in which these calculi completely dissolve, disengaging ammoniacal gas; but it is necessary to be certain that they do not contain ammoniaco-magnesian phosphate. Silica has not been found in any of the calculi examined by M. Rapp. Calculi of oxalate of lime are the most common in the kingdom of Wirtemburg; in England, on the contrary, they are rare; in the former there were 56 out of 81, while at Norwich, there were only 59 out of 181; in the Hunterian Museum, 6 out of 150; 28 out of 87 at Guy's Hospital; 11 out of 187 at Manchester, and 65 out of 208 in the collection of Bristol.—*Idem.*

MISCELLANEOUS.

1. *Religious toleration in Russia.*—Independently of the people who profess the orthodox religion of Russia, there are in the country Roman Catholics, Unitarians, Lutherans, Calvinists, Arminians, Mennonists, Mahometans, Jews, Worshippers of the Grand Lama, and Idolaters. The number of Roman Catholics may be estimated at seven millions, and of other Christians, rather more than two millions and a half. The Mahometans of Kasan, Astrakhan, Siberia, Orenburgh, the Crimea, Caucasus, Lithuania, and other places, have mosques in the places where they have fixed their abode. Their number amounts to more than three millions. Synagogues have long existed in the cantons and cities inhabited by Jews, the total of whom is about five hundred thousand. With respect to Paganism, we must add to the gross idolaters who wander in the deserts of Siberia and in the Steppes of Kirguis-Kaissaks, the worshippers of the Grand Lama, and those of the Fetishes and Schahmans. We should not omit, either the heretics and schismatics of the different sects, whose religion seems limited to vain prejudices and superstitious practices. In the midst of such a variety of worship, religious toleration has always been maintained in Russia. During the ten centuries of the existence of the empire, its history does not produce a single example of persecution by the Russian government against a foreign religion, and the bloody name of religious wars is not found in its annals. It would seem that in its ancient attachment to the spirit of the eastern church, it has learned the moderation which characterized true Christians in the origin of Christianity.—*Ferrusac's Bulletin, Nov.* 1828.

2. *Examination of Patent claims.*—Since 1826, the application for patents in Piedmont and Sardinia, have been referred to the Academy of Sciences at Turin, with the intention of negativing all those founded in ignorance or knavery, and supporting only those which are true improvements, and in their effects really advantageous to the arts. Although the number of patents has been excessively diminished in consequence, yet it appears that the applications have increased in an extraordinary degree. The academicians, though much engaged in the year 1826, in examining claims, were poorly rewarded by the occurrence of actual improvements : only two machines were brought forward which received their sanction.—*Idem.*

3. *French eggs and apples.*—63,109,618 hens' eggs, and 14,182 bushels of apples were imported from France into England, in the year 1827.—*Idem.*

UNARRANGED MISCELLANIES, DOMESTIC AND FOREIGN.

1. *Particulars of the striking of Lightning over a great surface, but with little injury, communicated to Mr. N. Clark of New Haven, by Mr. O. H. Bryant, clerk in the State Prison at Charlestown, Mass. July* 31*st*, 1829.—Yesterday, we had a severe shock of lightning at the prison. It rained in torrents, and a dense mass of highly charged clouds spent their embosomed electricity on and about us. I was looking out of my office window, to discover the direction in which the clouds were moving, when a flash, accompanied by a rustling noise like that of small shot thrown upon stiff paper, and a feeling as if all the energy of my muscles was at once withdrawn, and an almost insuperable inclination to fall back on the floor, convinced me that I had been struck with lightning. But I only tottered back a few steps and recovered myself immediately. On leaving my office to inquire what mischief had been done, I learned of the officers, that almost all of them, as well as many of the convicts, had been affected like myself. My office is in the brick building directly south, and in front of the prison, about three hundred and sixty feet from the north wall of the prison yard. Between the office and the prison building, is a large yard, perhaps one hundred and fifty feet wide ; the length enclosed by the wall is four hundred and eighty feet ; the width three hundred and sixty feet. The prison has three conductors on it, about equidistant from each other, say eighteen feet. The lightning passed

down each of these without any injury to the building, except starting a few slates near the ridge post. Now, what appears singular in this case, is, that no person out of nearly three hundred, officers and convicts, was in the least injured, although almost every one was more or less affected by it. Nearly all of these persons had either a steeled hammer, a musket with bayonet fixed, or some metallic utensil in their hands. Within a yard of my situation, is an armory with thirty guns, and as many steel pointed pikes—the points and bayonets pointing up. I can account for our escape, only by supposing that the fluid was attracted by so many different objects, on all parts of the building, and all over the yard, that it divided itself just before it reached us, and passed off in such small quantities as almost to lose its effects.

It is singular that men standing five hundred feet distant from me, should be affected in the same degree. I suppose that one hundred tons of iron are exposed on the different buildings, in grates, doors, pillars, &c. &c. One of the officers had a saw in his hand, which, he says, seemed to be "light red fire." Another was stooping and picking up nails from the floor, and the instant after the flash, found himself standing bolt upright, with his hands tightly clenched together. The effects of this bolt were felt over a surface of one hundred and seventy two thousand five hundred feet, in nearly the same degree, without any permanent injury being sustained.

2. *Electro-galvanic phenomena.**—*Singular.*—On Wednesday of last week, while the workmen were soldering the iron water pipes in Water street, electric shocks were produced to such a degree as to cause them to discontinue their labors through the remainder of the day. Several of our citizens who were standing by, got into the ditch, and tried the experiment, when the effect was the same on all. The pipes are united in the following manner :—they are nine feet long, perfect cylinders, with a bore of six inches, and a bowl at one end four inches deep. At the spring, is a funnel pipe which is inserted into the bowl of the succeeding pipe ; the spigot end of which is inserted into the bowl of the next, and so on. When fifty or one hundred pipes are laid down in this manner, the process of soldering commences. This is done by first ramming into the joint a few strands of rope-yarn, and then applying clay around the joint, leaving

* From the Winchester Republican.

an aperture at the top into which the molten lead is poured. The clay is then taken off and the lead driven home with a blunt chisel and hammer. It was in driving home the lead that the shocks were produced. The sun was nearly vertical, and the thermometer at 93° ; the ditch somewhat damp, and the pipes warm from the action of the sun upon them. The principle is no doubt that of galvanism, but as the cause is supposed to be entirely new, the plumber, (Mr. Johnson, from Philadelphia,) having never known any thing like it during his long experience in that city, we should be glad to receive the opinion of scientific men upon it.

We have since been informed, that after a heavy rain on the ensuing day, and the covering of a few feet of the pipes some distance above with earth, the phenomenon did not occur, nor has it since occurred.

Remarks by a correspondent.—The phenomenon belongs, without doubt, to thermo-electricity. The exciting agent in the voltaic series, (for the chain of pipes with interposed lead soldering, may surely be considered as such a series,) was made active by the intense heat of the sun. The pipes being of a black color, probably acquired a temperature much above that of the surrounding air ; they were probably also *unequally acted on* in consequence of their lying in a ditch.

* * * * *

We agree entirely in opinion with our correspondent, and cannot doubt that much of terrestrial and atmospheric electricity arises from similar natural galvano-electric combinations existing in the various arrangements of matter.—*Ed.*

3. *Test for lead in oil of Vitriol, by A. A. Hayes.*—Commercial oil of vitriol often contains much sulphate of lead, to detect which and separate it in part, a few drops of strong muriatic acid may be dropped into the cold acid, an opaline, or milky appearance, indicates the presence of a minute portion only ; if considerably contaminated, a precipitate falls, from which the clear acid may be decanted. This effect seems to depend on the insolubility of chloride of lead in *cold* sulphuric acid ; when heated, the acid dissolves it. Muriatic acid in water, readily dissolves and decomposes sulphate of lead ; the solution containing free sulphuric acid, may be boiled a long time without decomposition. By evaporating the liquor and heating the salt, decomposition of the chloride is effected. Commercial oil of vitriol dissolves much more sulphate of lead, than concentrated sulphuric acid does ; the result of one experiment gave $\frac{7}{1000}$ parts.

4. *Eaton Galena, Id.*—Three specimens of the ore from Eaton, N. H. presenting different structures, were separately cupelled with care. 300 parts of the broad and small foliated, each gave .634 parts, or .2113 per 100 of pure silver. 300 parts small granular, left a few grains of quartz, with 6.19 parts of pure silver. If judiciously worked, this ore would doubtless yield more silver, than the Hartz ores. 8400 parts of the lead from that ore, equal to about 12400 parts of picked ore, are stated to yield from 12 to 15 parts of silver slightly alloyed. Taking the above results, 12400 parts of the ore from Eaton, would give a mean quantity equal to 26 parts pure silver.

5. *Description of a new locality of zircon, particularly referring to its geological character, by Wm. Meade, M.D.; in a letter addressed to the Editor, dated Newburgh, Sept.* 18, 1829.—While on an excursion this summer, through part of the Highlands in the county of Orange, state of New York, I was presented with a spęcimen of iron ore, which had been obtained from the neighborhood, where a shaft had been dug many years ago, in an unsuccessful attempt to discover a productive mine of that mineral. The specimen was evidently similar to that species of magnetic oxide of iron or the fer oxidulè of Haüy, which I have described in a former number of this Journal; and which is abundantly disseminated in these mountains, being that with which the principal forges are supplied for the manufacture of their best iron. On examining the specimen with some attention, I found crystals of zircon imbedded in it in all directions, which induced me to visit the place where it had been obtained, which I found was in the mountainous part of the town of Cornwall, called *Deer Hill*, from the numerous herds of deer that formerly occupied these mountains. Here I observed, that a considerable quantity of this ore had been raised from a pit which had been opened only to the depth of eight or ten feet: these blocks lay scattered on the surface of the ground, and from being exposed to the atmosphere for many years, were much disintegrated, and their matrix which was gneiss, was quite decomposed and brittle. On examiniug these specimens, which differed only from the oxidulated iron ore of that neighborhood in being more friable, I found numerous crystals of zircon imbedded in it, some of them so loosely invested in their matrix, that they scarcely adhered to it, but fell out on being handled, leaving the cast or model of the crystal quite smooth, and so perfect

that it seemed as if they had been previously formed and imbedded in the ore, while it was soft or in a state of fusion.

The crystals of zircon were of a deep brownish red color, some of them translucent and of a metallic or bronze lustre: those on the surface, exposed to the atmosphere, were extremely friable or brittle, but the interior showed perfect well defined crystals of all sizes, from those that were excessively small to others of the dimensions of one inch in length and one fourth of an inch at each side of the plane of the crystals, which were uniformly a four sided prism, terminated at each extremity by pyramids, with additional faces on their edges or angles; precisely similar to those found near Trenton and at Schooley's Mountain, described in Cleaveland's Mineralogy, page 298 and illustrated in plate iii. fig. 38 and 39. I am in possession of one crystal of this form, the length of which is more than one inch, and the sides of the prism one third of an inch in diameter. It is not unfrequent also to find zircon, in the same specimen, massive and in round grains.

It appears from the above description, that there is nothing peculiar in the character of the zircon found in this locality, or in the form of its crystallization: it only adds another *geological situation* to those described by former mineralogists. The occurrence of zircon in the United States is not uncommon: in almost every other instance I have seen it imbedded in primitive rocks, such as granite or sienite, and particularly in that species of sienite with a green colored felspar, but I have never heard before of its having been noticed in primitive iron ore. The only deviation from its usual geological situation which I have observed, except in this instance, is at Easton in Pennsylvania, where zircon has been found, by Dr. Swift, in large and beautiful crystals, imbedded in steatite or talc, of so soft a nature that the crystals can be completely developed, by separating the steatite with the point of a pen knife.

6. *Geology.*—In the gulf of Bengal, an island has lately been formed, by the accumulation of the alluvial matter, brought down by the waters which empty into this bay. This island was discovered in the year 1806, together with the channel, by a boat which was bound to St. Gur. It increases rapidly: it is about two miles long and one and a half wide. The southern beach consists of a solid sand, making an insensible declivity; the eastern part appears at a distance to be a green plain; this island is the retreat of crabs, turtles, and of an infinity of birds.—*Diario de Fisica.*

7. *Magnetic Variations.—Prof. B. Silliman, Sir*—I observe in the April number of the American Journal of Science and Arts, the result of a series of observations, and calculations to ascertain the variation of the compass needle. In the year of 1827 in Troy, N. Y. I made some observations myself for the same purpose; I will send you my result, and if you think it worth an insertion in one of the numbers of your Journal, it is at your service.

1827, *June 24th.*—The result of twelve observations of the sun, in both forenoon and afternoon, of Altitude and Azimuth, in mean.

In forenoon Alt.	22° 21′—Az.	N. 83° 51′ E.
In afternoon Alt.	22° 21′—Az.	N. 71° 42′ W.
		2 | 12° 09′
Magnetical variations	- -	N. 6° 04.5′ W.

Yours most respectfully,

ALBERT DANKER,

Civil Engineer and Land Surveyor, and Member of Rensselaer School.

Troy, N. Y. August 18th, 1829.

8. *Elements of Technology, by Jacob Bigelow, M. D. late Rumford Professor in Harvard University,* 8vo. *pp.* 507, *Boston.*—This book is taken chiefly from the lectures delivered by Professor Bigelow at Cambridge, and is intended for students, to whom it must be an acceptable present. It presupposes, in the reader, a knowledge of scientific principles; but takes him, thus prepared, by the hand, and leading him round, shews him the application of these principles to a variety of the most useful and familiar arts. The information it contains, while most desirable, is such as is frequently not to be found, except in scarce and voluminous authors; some of it, that on architecture for instance, we have frequently known to be sought after in a manner to make us regret that it was not more accessible. If we were inclined to qualify our favorable opinion of this work, we should perhaps say, that the multiplicity of articles, and the consequent brevity of each, may have hindered the author from being as copious and thorough-going on all of them as he would no doubt, have wished to be; but the book is intended to be practical; and practical scientific men, while they lead the community, must not go too far ahead. The author himself, is certainly at home in science; his book shews a familiar acquaintance with his subject; the matter is well selected and the style lucid and happy. The reader will find himself at the end

of each article, much wiser than before, and desirous of knowing more concerning it. The public are indebted to the author for his book; we strongly recommend it to their attention.

9. *Elementary works on astronomy.*—"Elements of Astronomy," by Hervey Wilbur, A. M.—"View of the Heaven," by Rev. Amos Pettengill.

The two foregoing elementary treatises on astronomy have been recently published, being severally designed to furnish to young learners an easy introduction to the instructive and delightful study of the heavenly bodies. The treatise of Mr. Wilbur, who is extensively and advantageously known as a popular lecturer on astronomy, is intended more particularly as a companion to his lectures; while that of Mr. Pettengill is especially adapted to the STELLAROTA—an ingenious and very useful instrument, of which we gave some account in our last number. Both treatises, however, may be advantageously read by those who are entering on the study of astronomy, independently of every other aid or illustration. We sincerely hope that these little books may conspire with the other efforts of the same gentlemen, to diffuse a more general taste for the study of astronomy, particularly throughout our primary schools and academies.

10. *Catalogue of plants in the vicinity of Amherst College.*—This catalogue was prepared by Prof. Hitchcock, and published by the Junior Class of 1829, in Amherst College, for the benefit of botanical students in that institution. It embraces all the indigenous and naturalized plants, that have been discovered within forty or fifty miles of Amherst, to which have been added such as are peculiar to the White Mountains and the sea coast of New England; so that its utility may be shared by botanists situated in any part of the northern section of the United States. Its particular design, as declared in the preface, is, to facilitate the student's examination of plants, by pointing him to those species, which he may expect to find in his district, and whose descriptions, therefore, he may select in the Floras and Manuals of American plants; to present him with an authority for each specimen, with the most important synonymes; and, in case of rare plants, to particularize the precise spot where it may be found. Exclusive of the plants peculiar to the White Mountains and the sea coast, it contains five hundred and thirty one genera, and one thousand four hundred and forty seven species, which occur within fifty

miles of Amherst College. Of these, three hundred and ninety five genera, and nine hundred and ninety seven species, are phenogamous plants; while one hundred and thirty six genera, and four hundred and fifty species belong to the class Cryptogamia.

11. *Agenda Geognostica.*

Translated by Prof. Fiske, and communicated by Prof. Hitchcock, of Amherst.

A Help Book for travelling geologists, (mountain searchers,) and Guide to Lecturers on practical Geognosy, by Prof. Leonhard, Heidleberg, Germany.

1. *Introduction.*—Scientific preparation for a journey: ex. gr. study of existing works, maps, collections, &c.—apparatus, mode of travelling, time of journey, determination of bearings, and selection of favorable points for observation, the collecting of specimens, diary, profiles, and views, geological maps.

2. *Examination of the external relations and appearances of mountains.*—General and particular geographical relations of the mountain to be examined; direction, extent, height of hills and mountains, their separation from, or connection with others.

Physiognomic relations; mountain structure in general and particular, direction and ramifications of chains, slopes, ridges, passes, interruptions by valleys and plains, &c. vegetation.

Limits of snow, glaciers, fountains, rivers, lakes, seas, volcanos, earthquakes.

3. *Examination of the internal structure and relations of hills and mountains.*—Existing rocks; position, structure, relations, intermixtures, transitions, changes produced by the atmosphere.

Division of rock masses, by stratification, by separation, by fissures.

Stratified arrangement; alluvium, diluvium, tertiary, secondary, transition, primitive.

Unstratified arrangement; granite, syenite, porphyry, &c. basalt, dolerite, phonolite, &c. trachyte, lava, recent volcanos, &c.

Metallic repositories; veins and beds, excavations, precipices, caves.

4. *Execution of a geognostic description.*—The geological reader will see that such an outline as this, filled up by so able a writer as the Councellor Von Leonhard, must be an extremely valuable guide, in the examination of rocks, and will only regret that so few observers in this country, will be profited by it, unless some one should undertake its translation into English.

12. *Naval Sketches.*—A New York correspondent, who signs himself *A Subscriber*, after expressing his warm approbation of the *Naval Sketches* and of our notice of it in the last number, expresses also his regret, that we did not continue our extracts from Mr. Jones' work, particularly in that part which relates to Constantinople and the willingness of the Turkish government to form a treaty with us, and desires us to resume our quotations in this number.

Agreeing perfectly with our correspondent, that "the author is not a mere man of books, but a well informed practical man"—it would have given us great pleasure to gratify "A Subscriber," by additional extracts; but on looking over the part referred to, we found it was too long for insertion, consistently with our obligations, and as the Naval Sketches have been extensively read and quoted, since our last number appeared, perhaps the step is now the less necessary.—*Ed.*

13. *Turner's Chemistry, 2d American Edition.*—For the American reprint of this excellent work, in a cheap but neat form, and for its consequent general diffusion over the United States, we are indebted to Mr. John Grigg of Philadelphia. The work, particularly in the second American edition, has been revised by Dr. F. Bache, from whose accurate eye it has received various corrections that have anticipated, in part, those of the author in the second London edition.

14. *Foreign Memoirs and Pamphlets.*—The Editor has received from Mr. Brongniart of Paris—

1. Notice sur les Brèches osseus et les Minerais de fer pisiforme de même position geognostique; also, Observations additionelles sur les minerais de fer pisiforme, &c.

2. Notice sur les Blocs de Roches des Terrains de Transport en Suède.

3. From Mr. Murchison of London, Sec. Geol. Soc.—A memoir, by himself, on the Bituminous Schist and Fossil Fish of Seefeld, in the Tyrol.

4. On the relations of the Tertiary and Secondary Rocks, forming the southern flanks of the Tyrolese Alps, near Bassano.—*Id.*

5. On the Coal-field of Brora, in Sutherland, and some other Stratified Deposits in the north of Scotland.—*Id.*

6. On the Excavation of Valleys, as illustrated by the Volcanic Rocks of Central France, by Charles Lyell, Esq. F. R. S. V. P. G. Soc. &c. and R. I. Murchison, Esq. F. R. S. &c.

7. From Dr. John Frost, Lecturer at St. Thomas' Hospital, &c. &c.—His Oration delivered before the Medico Botanical Society of London, by Dr. F.

8. From W. H. Fitton, M. D. F. R. S. P. G. Soc.—His anniversary Address at the meeting of the Geological Society of London.

9. Three Lectures on the transmission of the precious metals from country to country, and the mercantile theory of wealth, delivered before the university of Oxford, by N. W. Senior, late Fellow of Magdalen College, and Professor of Political Economy.

10. Proceedings of the Phil. and Lit. Soc. of Bristol, England, at their sixth annual meeting.

11. Catalogues and Circulars of the collection of minerals and rocks, for sale and exchange at the Mineral Comptoir, at Heidelberg, Germany.

15. *Gifts to the Geological Society, by Dr. Jacob Porter.*—Two boxes of minerals.

Secret History of the Court and Cabinet of Saint Cloud.

Report on a Canal (or Canals,) from Boston to Connecticut and Hudson Rivers.

Report on a Rail Road from Providence to Boston.

Report on a Rail Road from Boston to Albany.

16. *Gold in Maryland.*—A letter just received from a correspondent in Baltimore, informs us that gold has been recently found in Maryland. It is known to exist in Virginia, and these localities, with those of North Carolina, appear to form a straight line parallel or nearly so, it is believed, with the Alleghany range. Quartz is abundant in the region about that discovered in Maryland, as is the case also in that of North Carolina.

17. *Culture of Silk.*—Dr. Felix Pascalis, has published "Practical Instructions for the culture of Silk and the Mulberry Tree," Vol. I.; to which is added, "The Natural History of the Silk Worm." This work abounds with valuable and pleasing information, and cannot fail to arrest the attention of all who are interested in the important manufacture to which it refers.

The 2d volume of the Practical Instructions is promised to appear in October, and with it the 2d No. of a quarterly periodical work, called the Silk Culturist, to be devoted, as its name implies, to the promotion of that branch of industry.

18. *Acidulous sulphate of iron,* (*from a correspondent.*)—In Vol. XV, at p. 238, is a notice by Prof. Eaton, of native sulphuric acid; a substance possessing the same properties, is said to be often found in the vicinity of beds of sulphuret of iron. "I have, (says our correspondent,) several times analyzed a compound from Strafford, Vt. whose characters, so far as observed, correspond with that noticed by Prof. E. Sulphate of protoxide of iron, decomposed by air and light, ultimately retains but *one half* the quantity of peroxide of iron, which our bi-persulphate does. Very dilute sulphuric acid chars vegetable substances *when exposed to the sun's rays;* crystallized sulphate of zinc, is even quite an active acidule under such circumstances."

19. *Roxbury Laboratory,* (*near Boston.*)—The company incorporated under the name of the Roxbury, Color and Chemical, Co. employ Mr. A. A. Hayes, to superintend the manufacture of sulphuric, nitric and muriatic acids; sulphates of copper, zinc, and potash; alum, white vitriol, ferro-prussiate of potash, and Prussian blue, in its different forms. Verditer blue and green, French green, rose and Dutch pinks, slip yellow, and fig blue. Some of the processes are original, and the quantities are such as the market warrants.

19. *Correction.*—By a letter from the Rev. Isaac Bird, dated Malta, March 24, 1829, we learn with regret, that the note on page 377, Vol. XV. of this Journal, is erroneously referred, by the asterisk, to the late Mr. Fisk, and that the reference should have been to the end of line 3d, on the top of the page, which would fix the criticism where it belongs, upon an author always indeed animated and interesting but somewhat remarkable for "bold speculations."

Mr. Fisk was not an author, and never wrote or published any thing on the subject referred to in the note.—*Ed.*

21. *Iron Mines.*—*Extract of a letter to the Editor, dated New York, August,* 1829.—On a late visit to the Monroe Iron Works, in Orange county, in this state, I rode over to the iron mines of the Messrs. Townsend, distant about five miles, in a south westerly direction, from the extensive iron works of Messrs. Blackwell and McFarlan. The larger of the two mines has been worked for upwards of seventy years, and the vein of iron, which is a rich oxide, seems to be inexhaustible. It appears to be about four feet in the narrowest part, running in a nearly horizontal line at about ten feet below the surface, and is very easily worked. The proprietors have, within ten or

twelve weeks, discovered on their land, at a distance of about half a mile from this, another bed of exceeding richness, yielding, as Mr. Townsend informed me, about seventy five per cent. of pure ore. It was discovered by the aid of a compass, the needle of which struck upon the dial on being brought over the ground. The ore is a friable, strongly magnetic oxide; the particles when knocked off adhering to the point of the pickaxe. There is no overlying stratum of rock, nor any one contiguous, as far as the excavation has been made, which is to the depth of six or eight feet. It appears to be one great bed of solid and very pure ore.

22. *Hydrophobia.*—We are indebted to a highly valued medical friend, for the following interesting communication. The importance of the subject on which it treats, will, no doubt, obtain for it an extensive circulation. The writer is a man of science and worthy of every confidence.—*Ed. U. S. Tel.*

At the present moment our fellow citizens are considerably excited by the fear of mad dogs, by whom at least two children, in this city have, within a few days, been bitten. The horrible nature of the disease consequent to the bite—a disease so utterly beyond the reach of medical aid, renders it the imperious duty of every one to communicate to the public any thing he may know tending to mitigate or prevent the awful issue.

By the late foreign medical Journals we learn that M. Coster, a French surgeon of great eminence, has devoted his attention to the subject of animal poisons. He has discovered that chlorine has the wonderful power of decomposing and destroying the poison of the most deadly.

The saliva of the mad dog, has the property, when inserted under the skin, of communicating hydrophobia to other animals, and to man. M. Coster has been able, by the use of chlorine, to decompose this deadly poison, and render it harmless, preventing the approach of hydrophobia in animals bitten by dogs decidedly rabid.—There can be no doubt of the accuracy of the experiment on which this statement is predicated.

From this the most important practical results follow:

Make a strong wash by dissolving two table spoonfuls of the chloruret of lime in half a pint of water, and instantly and repeatedly bathe the part bitten. The poison will in this way be decomposed. It has proved successful when applied within six hours after the animal has been bitten.

I wish these facts generally known, as they may be of service to our fellow citizens at large.

Singular case of Hydrophobia.—A case is related in the Lancet, a London Monthly Periodical, of a man having died with all the horrors of hydrophobia, and the dog that had bitten him betraying no such symptoms. The statement is from an eminent surgeon, and is well attested by several respectable names. Soon after the man was bitten, he applied to a medical gentleman, intimating, however, his firm conviction that the dog was not mad. As the dog was evidently sick, the surgeon took the precaution of having him placed in a secure situation, and from day to day watched the progress of his symptoms till he died. From the most attentive observation, the surgeon could not observe the slightest appearance of *rabies;* the animal lay quiet, walked firmly, breathed easily, had no abhorrence of fluids, and caressed his master as usual. His death appeared to be accompanied with pain, and on being opened, the body presented none of those appearances which are generally produced by *hydrophobia.* In about a fortnight after the decease of the animal, the man was taken with the usual symptoms of *rabies*, and died in dreadful convulsions. The case has excited considerable interest, as it proves that hydrophobia, in animals, is not confined to one character, but assumes different shapes.

Remarks on the above cases and on the uses of the chloric preparations.*—*Ed.*

We have added the account of the last hydrophobic case, for the purpose of saying, that it might be prudent in every instance of a bite from a dog, or other animal, whether supposed to be rabid or not, to wash the wound frequently with the solution of chloride of lime. From what we now know of the powers of chlorine, it is not too much to hope for, that it may prove an antidote to every case of poison, provided it be applied in season, and before the system is fatally affected.

It appears highly probable that hydrogen, from its being the lightest and most subtle of all known ponderable bodies, may enter into the composition of such active agents as poisons. Fontana examined the poison of the viper and of other animals, but we know not whether, as in prussic acid, hydrogen is the active principle. In the present No. it appears (p. 174,) that chlorine destroyed the effect

* Ingenious views of the nature and action of these preparations are presented by Dr. L. C. Beck, in a memoir, Vol. XIV, p. 251, of this Journal.

of prussic acid, the most active poison known, even after it had gone far towards producing death. It is therefore credible, that it may destroy other poisons, having a similar constitution; and we can readily understand the modus operandi in such cases; for chlorine takes hydrogen from every combination, and of course destroys the peculiar character of the compound. Prussic acid itself consists of nothing but the ordinary elements of animal matter, such as are daily used for food; but in the acid they are combined in a peculiar manner, and the withdrawing of hydrogen from it, at once subverts the combination, and renders it harmless.

The practical use which we would make of the facts which we know, and of the theoretical views which we entertain, is, that chloride of lime should be kept in every family ready for instant use in the multiplied cases in which it is applicable.

It is already manufactured in this country in large quantities, and we observe with great satisfaction, that it is hereafter to form a part of the stores of our ships of war. This will greatly encourage the manufacture, and the time is not distant, when the price will be much less than at present.*

* * * * * * * * *

We add with pleasure that LABARRAQUE's celebrated pamphlet on the uses of the CHLORIDES OF LIME AND SODA has been recently translated by Dr. Jacob Porter, of Plainfield, Mass. and is to be sold by the principal booksellers. Some additions have been made by the translator, from recent publications, and we trust that this little work will contribute to extend the knowledge of this subject.

* * * * * * * * *

We would observe that as there are various chloric preparations, and of course an endless diversity of cases in which they may be applied, we should not give over, even should they not prove effectual in every instance; for some variety in strength, and mode of preparation, and application, may be necessary to accommodate the remedy to different cases.

23. *Crystallization of Tin.*—Mr. Allard, rue St. Lazare, No. 11, to whom we are indebted for the means of producing upon metallic plates, the most brilliant changeable lustre, creates also upon tin plate a varied and splendid play of light to which he has given the name of *moiré métallique.*

---

* We understand about eight or nine dollars per cwt.—double this rate or a little more, at retail.

It is universally known, that the acids, either single or combined, in different degrees, are the agents, employed in producing these beautiful effects upon tinned iron.

The following mixtures may be employed with perfect success, upon tin plate gently heated.

1. Four parts of nitric acid, one of muriate of soda or of muriate of ammonia, two of distilled water.

2. Two parts of nitric acid, one of muriatic acid, and from two to four parts of distilled water.

3. One part of nitric acid, two of muriatic acid, three of distilled water.

4. Two parts of nitric acid, two of muriatic acid, two of distilled water, and two of sulphuric acid.

Process.—Either of the above mixtures being placed in a common glass, a sponge is wet with the fluid, and immediately applied to the tin plate, until it is every where equally moistened. If the plate has been slightly heated, or the acid has been but little diluted, the peculiar configuration, (*moiré*,) is produced in less than a minute, otherwise it will require from five to ten minutes. Afterwards the plate is wet with cold water, and washed by rubbing it gently with a piece of cotton, or with the plume of a quill, but by no means with the hand; it is then left to dry. It is never proper to pour the acid upon the plate, because this will produce great black spots where it falls; frequently one part will be oxidized before the other parts are sufficiently crystallized, because the acid is not every where equally diffused at the same moment. Oxidation takes place also, if the plate after washing be dried too near the fire, and, as the same effect will happen from the gradual action of the air, it is necessary to varnish the work.*

What is called *le moiré forcé*, is produced by bringing the tin plate into contact with red hot iron, and then applying the acids to the opposite side. Stars and other very beautiful designs are made by bringing into contact with the tin plate, the flame of an enameller's lamp, but with so much caution as to be sure that the tin is not melted.

Although these operations appear to be easy, it is impossible to succeed well without acquiring a certain tact by practice.

The washing is the most important thing. An instant, more or less, alters the effect entirely. If the process be stopped too soon, there is no beauty or lustre, if not soon enough, the plate becomes dull and

* By employing colored and transparent varnishes, the beauty of the work is greatly increased.—*Ed.*

blackened. The washing should be done when we perceive that grey and black spots are forming. For this purpose, river water is used, or better still, distilled water slightly acidulated either with vinegar or with one of the acids which enter into the above mixtures, in the proportion of a spoonful of acid to a litre of water.—*Ann. de L'Industrie Nat. Avril*, 1820.—*Translated and abstracted by the Editor.*

24. *Albany Institute.*—In our No. for April last, we quoted at length, from the first number of the Transactions of the Albany Institute for June 1828, an interesting paper on the variation of the magnetic needle, including a very important document, shewing the rate of the variation at Boston, Falmouth, and Penobscot, for one hundred and twenty eight years, and which would alone have given importance to the number, had the other communications in it been less valuable and interesting than they were. Their titles are

On the luminous appearance of the Ocean, by Lt. T. R. Ingalls.

On the Geographical Botany of the United States, Part I. by Dr. L. C. Beck.

On some modifications of the electro-magnetic apparatus, (with a plate,) by Prof. Henry.

The Institute has, the present summer, (1829,) published a second number, containing valuable papers, of which the following are the titles :

Notes on Mr. Pickering's "Vocabulary of Words and Phrases, which have been supposed to be peculiar to the United States," with preliminary observations, by T. R. Beck.

On the Uvularia grandiflora, as a remedy for the bite of a Rattlesnake, by J. G. Tracy.

An examination of the question, whether the climate of the valley of the Mississippi, under similar parallels of latitude, is warmer than than that of the Atlantic ocean, by L. C. Beck, M. D.

Observations on the Geological features of the south side of the Ontario valley, in a letter to T. R. Beck, M. D., by J. Geddes, Civil Engineer.

An appendix contains the Charter of the Society, for the promotion of useful Arts, and of the Albany Lyceum of Natural History, which institutions have been united to form the Albany Institute. The valuable papers which have been already published, are in accordance with the design of the Institute, to embrace both "Science and Literature," in its plan.

As far back as 1791, a Society was instituted at Albany, for the promotion of Agriculture, and the useful Arts, three volumes of whose Transactions now lie before us, containing instructive and interesting papers. Among the contributors to the Transactions of the Institute, we observe with pleasure, names which give the assurance that the work will not be permitted to languish, especially under the Presidency of a gentleman whose love of science and useful practical knowledge, is equalled only by the munificence with which he sustains its interests.* Indeed it is with great satisfaction that we observe the fine region of which Albany is the centre, becoming not less remarkable for its institutions, tending to promote knowledge and virtue, than for its great advantages, as an emporium of both foreign and inland trade; we trust that Albany and Troy will become still more what they already are in so great a degree, both a focal and a radiant point of intellectual light.

We present, from No. 1, of the Transactions of the Albany Institute, the following short paper, which has appeared to us particularly interesting.

"*On the luminous appearance of the Ocean, by* Lieut. THOMAS R. INGALLS, *U. S. Army, corresponding member.—Read March 26th,* 1828.—This beautiful phenomenon, which once bore the poetical title of "phosphorescence of the ocean," has more recently, I believe, rested between two solutions: that it is caused by animalculæ, or by the ovula of fishes. A writer in a recent foreign periodical, inclines to the former opinion, viz. that the luminous appearance of the ocean is caused by animalculæ. As I have been for some time inclined to the opposite view of this subject, I am induced to submit an account of some observations made a few years since in the humble pursuit of science.

"In the practice of sea bathing at night, in a southern latitude, I had of course noticed and admired the beautiful sparkling of the water when agitated or resisted—but the myriads of bodies of whatsoever sort which emitted these corruscation, were alike invisible and impalpable. On one occasion, however, I struck my arm against a small soft mass, which immediately emitted a flash of two or three inches in diameter. But the mass eluded my attempts to secure it, as it was invisible the moment it parted from its accidental contact

* Witness the geological survey on the Erie Canal; the still greater survey of the state of New York, &c. which is now in hand; and the Rensselaer school at Troy

with my arm. This occurred several times afterwards, and I began to think I perceived a sensation of warmth whenever I struck one of these bodies, though aware how liable I was to be deceived by the almost irresistable association of light and heat in the mind. A very large one ultimately convinced me I was not deceived; the sensation being on this occasion perfectly distinct—grateful—and continuing for a minute or two after the touch.

"The masses of marine ovula, left by the tide to heat and hatch on the beach, I had long before observed through the whole process of vivification. First, a transparent mass of jelly—next marked by a white opake speck, a little distant from the centre—third, this spot fringed with a red border, of the color of arterial blood; next, a kind of irregular pulsation, accompanied by the developement of certain white contractile fibres, and the extension of several large red lines, in radial directions from the focal opake speck—the appearance of a black speck, ultimately a defined head—and finally, I have seen the rising tide shake out from the mass, the perfect animal, apparently in the full possession of life; certainly exercising the important function of apprehension of danger.

"The identity of this ovulum, with the luminous bodies I encountered in the water, appeared probable, from their size, consistency, and abounding in the same regions. It was soon after ascertained: for on a night when the sea was somewhat agitated, I observed the same corruscations in the waves breaking on the beach, and succeeded in obtaining several of the illuminating bodies, by the light of their own flashes. They appeared, as I expected, identical.

When examined by candle-light, to overcome the glare of their brilliancy, and at the same time observe their action more clearly, the power of illumination appeared to reside in a similar focal point, to that described as the place of the first phenomena of vivification; and the flashes which could be procured by irritating the mass with the end of a pencil, diverged from this point in lines similar in magnitude and direction, to the large red ones, mentioned in that process. I regret, that it did not occur to me, to insulate one of these bodies electrically, and endeavor to obtain shocks; but I was too much occupied with the question above stated, to avail myself of the means in my hands, of making some interesting experiments on the theory of life.

"The existence of those large corruscating bodies in the ocean, has been before recorded, and there is, I believe, a paper on this subject, by Dr. Mitchill, published ten or twelve years ago; but it is thought some parts of the observations are not on record, and they are now submitted in the hope of being, in some small degree, useful—or pardoned if superfluous.

"The conclusions I formed on this subject were, that in this instance a luminous appearance in the ocean was produced by marine ovula; and by a rule of philosophising, all such appearances not proved to proceed from another source, and not inconsistant with this cause, are fairly assignable to the same origin.—*Watervliet Arsenal.*"

25. *Oxy-chlorine blowpipe.—Extract of a letter from Prof. Lewis C. Beck to the Editor, dated Albany, March* 31, 1827.*—Prof. J. Henry and myself, have recently performed an experiment which I have not heretofore seen noticed. The extraordinary effects produced by the oxy-hydrogen blowpipe, suggested to us the idea of uniting a stream of chlorine and hydrogen in the same manner. We were aware that the degree of heat in the latter case would not be so great as in the former, there not being that great difference in the capacity for heat of the resulting compound. But it was thought the formation of an acid instead of water, might lead to useful results, not to be expected from the oxy-hydrogen blowpipe.

For the purpose of ascertaining the correctness of these views, the reservoirs used in the construction of the oxy-hydrogen blowpipe were filled, one with chlorine and the other with hydrogen. These reservoirs were connected with leaden tubes; the latter again with smaller ones of brass, and the streams of the two gases united in a small plate of platinum, at about one sixteenth of an inch from the extremity. As a preventative against accident, the tubes were filled at different parts with matted iron wire.

In conducting the experiments with the chloro-hydrogen blowpipe, the hydrogen was first fired, and then the stream of chlorine brought in contact with it. The united flame was of a bluish white color, and was attended with the peculiar hissing noise of the oxy-hydrogen blowpipe. A strong smell of muriatic acid is produced, which renders the use of this instrument somewhat unpleasant in a confined situation; but common ingenuity will suggest an apparatus for avoiding this inconvenience.

No very striking results were produced by this instrument, as our stock of chlorine was soon exhausted. We however ascertained its heating power to be very considerable, although far inferior to that of the oxy-hydrogen blowpipe. We intend shortly to repeat the experiment, with a view of ascertaining its exact measure, and also of determining whether the instrument can be applied to any useful purpose.

* The publication of this notice has been thus long delayed in expectation of an additional communication on the subject. We are not aware that this curious experiment has been elsewhere made.—*Ed.*

APPENDIX.

An Account of the Siamese twin brothers, united together from their birth; by* Prof. John C. Warren, M. D. &c.

My attention was called to the Siamese boys, by a highly respectable gentleman, who wished me to examine them, in order to ascertain if there was any thing indecorous or fallacious in their appearance. On examination, I found that the medium of their connection, was more complicated, than I had expected, and that they exhibited other phenomena worthy to justify a statement of their condition.

They were purchased of their mother, by Capt. Coffin and Mr. Hunter, (the owners,) in a village of Siam. Here they had subsisted in a state of poverty, from their birth. They were confined within certain limits by order of government, and supported themselves, principally by taking fish.

The boys are supposed to be about eighteen years old. They are of moderate stature; though not as tall as boys of that age in this country. They have the Chinese complexion and physiognomy. The forehead is more elevated and less broad than that of the Chinese, owing to malformation. They much resemble each other; yet not so much, but that on a little observation, various points of dissimilarity may be noticed.

The substance by which they are connected, is a mass two inches long at its upper edge, and about five at the lower. Its breadth from above downwards, may be four inches; and its thickness in a horizontal direction, two inches. Of course it is not a rounded cord, but thicker in the perpendicular, than in the horizontal direction.—At its lower edge is perceived a single umbilicus, through which passed a single umbilical cord, to nourish both children in the fetal state.

---

* Notices of these boys have already appeared in various forms, but it was thought advisable to preserve, in this Journal, a revised account of this most remarkable deviation from regular laws, and we are much indebted to the eminent professional man, who has found time to prepare it. The lithographic print, by the Messrs. Pendletons, who by their graphic skill, are seriously aiding the progress of science and the arts, in this country, will render the case perfectly intelligible, while the picture is as little painful as any unnatural exhibition can be. This paper having been communicated at a late hour, is necessarily added in the form of an appendix.—*Ed.*

Placing my hand on this substance, which I will denominate the cord, I was surprised to find it extremely hard. On further examination, this hardness was found to exist at the upper part of the cord only; and to be prolonged into the breast of each boy. Tracing it upwards, I found it to be constituted by a prolongation of the *ensiform cartilage of the sternum*, or extremity of the breast bone. The breadth of this cartilage is an inch and a half; its thickness may be about the eighth of an inch. The cartilages proceeding from each sternum meet at an angle, and they seem to be connected by ligament so as to form a joint. This joint has a motion upwards and downwards, and also a lateral motion; the latter operating in such way, that when the boys turn in either direction, the edges of the cartilage are found to open and shut. The lower face of this cartilage is concave; and under it is felt a rounded cord, which may be the remains of the umbilical cord. Besides this there is nothing remarkable felt in the connecting substance. I could distinguish no pulsating vessel.

The whole of this cord is covered by the skin. It is remarkably strong, and has no great sensibility; for they allow themselves to be pulled by a rope fastened to it, without exhibiting uneasiness. On ship board, one of them sometimes climbed on the capstan of the vessel, the other following as well as he could, without complaining.

When I first visited the boys, I expected to see them pull on this cord in different directions, as their attention was attracted by different objects. I soon perceived that this did not happen. The slightest impulse of one to move in any direction, is immediately followed by the other; so that they would appear to be influenced by the same wish. This harmony in their movements is not the result of a volition, excited at the same moment. It is a habit, formed by necessity. At an early period of life it is probable they sometimes differed. At present this is so rarely the case, that the gentlemen who brought them, have noticed only a single instance. Having been accustomed to use the cold bath, one of them wished it when the weather was cool; to which the other objected. They were soon reconciled by the interference of the commander of the ship. They never hold a consultation as to their movements. In truth, I have rarely seen them speak to each other, although they converse constantly with a Siamese lad, who is their companion. They always face in one direction; standing nearly side by side; and are not able, without inconvenience, to face in the opposite direction; so that one is always at the right, the other at the left. Although not placed exactly in a parallel line, they are able to run and leap with surprising activity. On some occasions, a gentleman, in sport, pursued them round the ship, when they came suddenly to the hatchway, which had been inadvertently left open. The least check would have thrown them down the hatchway, and probably killed one or both; but they leaped over it without difficulty.

They are quite cheerful; appear intelligent; attending to whatever is presented to them, and readily acknowledging any civility.—As a proof of their intelligence, it is stated, that in a few days, they learned to play at drafts well enough to become antagonists of those who had long been versed in the game. They sometimes play with each other; and it has been noticed, that when one made a bad move, the other would sometimes correct it, and propose it should be taken back. They differ in intellectual vigor. The perceptions of one are more acute than those of the other; and there is a corresponding coincidence in moral qualities. He who appears most intelligent, is somewhat irritable in temper; while the disposition of the other is extremely mild.

The connexion between these boys might present an opportunity for some interesting observations, in regard to physiology and pathology. There is, no doubt, a network of blood vessels, lymphatics and some minute nerves passing from one to the other. How far these parts are capable of transmitting the action of medicines, and of diseases, and especially of what particular medicines, and what diseases, are points well worthy of investigation. Captain Coffin informed me, that they had never taken medicine since they had been under his care. Once they were ill from eating too heartily, but were relieved by the efforts of nature. He thinks that any indisposition of one extends to the other; that they are inclined to sleep at the same time; eat about the same quantity, and perform other acts with great similarity. Both he and Mr. Hunter, the gentleman who united with him in bringing them here, are of opinion that touching one of them when they are asleep, awakens both. When they are awake, an impulse given to one, does not in the least, affect the other. There is evidently no impression received by him who is not touched. Of course the opinion just mentioned, is undoubtedly erroneous. The slightest movement of one is so speedily perceived by the other; as to deceive those who have not observed closely.—There is no part of them, which has a common perception, excepting the middle of the connecting cord and a space near it. When a pointed instrument is applied precisely in the middle of the cord, it is felt by both; and also for about an inch on each side; beyond which the impression is limited to the individual of the side touched.

As to the influence of medicines, taken by one, on the body of the other, it would, I suppose, be inconsiderable; since the vascular and nervous communications must be very limited. The same remark may be applied to most diseases. I do not suppose that a febrile affection, slight in degree, would extend from the one to the other. How it would be with a continued fever, appears to me uncertain. But such diseases as are communicable through the absorbent vessels, or capillary blood vessels, would readily pass from one system to the other; as for example, the morbid poisons, syphilis, cowpox, smallpox, &c.

Those who have resided with them say, that the alvine and urinary evacuations take place at about the same intervals in both, though not at the same time. In the function of the circulation, there is a more remarkable uniformity in the two bodies. The pulsations of the hearts of both coincide exactly, under ordinary circumstances. I counted seventy three pulsations in a minute, while they were sitting; counting first in one boy, then in the other. I then placed my fingers on an arm of each boy, and found the pulsations take place exactly together. One of them stooping suddenly to look at my watch, his pulse became much quicker than that of the other; but after he had returned to his former posture, in about a quarter of a minute, his pulse was precisely like that of the other boy. This happened repeatedly. Their respirations are, of consequence, simultaneous.

This harmony of action in primary functions, shows a reciprocal influence, which may lead to curious observations and important deductions. Observations to be useful, would require much time and great accuracy.

Among the curious questions which have arisen in regard to these individuals, one has been made as to the moral identity of the two persons. There is no reason to doubt that the intellectual operations of the two are as perfectly distinct, as those of any two individuals, who might be accidentally confined together. Whether similarity of education and identity of position, as to external objects, have inspired them with any extraordinary sameness of mental action, I am unable to say; any farther, at least, than that they seem to agree, in their habits and tastes.

Another question which has presented itself in relation to them, is, whether it would be possible to separate them from each other with safety. There seems to me nothing in the connecting medium, which would render such an operation necessarily fatal. It is not improbable that the peritoneum is continuous from the abdomen of one to that of the other. The division of this membrane would involve some danger, though not very considerable. The attempt to separate them, does not, however, appear to me to be authorized under existing circumstances. Surgeons are justified in putting the life of an individual at risk, when it becomes necessary in order to relieve him of a menacing disease; but it would not be proper to hazard life, in order to procure some convenience, however desirable this might be. When the minds of these boys have been sufficiently cultivated to enable them to understand the nature and dangers of an operation; and the advantages they would derive from it, the subject might be presented to them; and if, with a full knowledge of the consequences, they desired and demanded the separation to be effected, it might be proper to undertake it. Should one die before the other, they should be cut apart immediately. The success of the operation would, of course, be affected by the nature of the mortal disease, and its influence on the constitution of the survivor.

A union of the bodies of twins by various parts, is not an unusual occurrence. The collections of anatomists present many such objects. Ambrose Paré has depicted for the entertainment of his readers, instances of union by the back, belly, and forehead. The last occurred in two girls, who lived to the age of ten years, when one of them dying, a separation was made; the wound of the living girl assumed a bad character, and soon proved fatal. The Hungarian sisters, who lived about a century since, were united by the back; had one passage from the intestines, and one from the urinary organs. They died when they were twenty two years of age. In the Philosophical Transactions and various other works, a multitude of similar monstrosities are recorded; most of them born dead, or dying soon after birth.

The Siamese boys, present, I believe, the most remarkable case of this *lusus naturæ*, which has yet been known, taking into view the perfection and distinctness of their organization, and the length of time they have lived. Their health is at present good; but it is probable that the change of their simple habits of living, for the luxuries they now obtain, together with the confinement their situation necessarily involves, will bring their lives to a close within a few years.

Dr

rawn on s[illegible] by D C Johnston

THE SIAMESE BOYS.

AGED 18.

Of the New Town
of the
Hill of Pasco

Edd. delin. on Stone.

Explanation.

⊛ *Steam engine, upon the excavation of St. Judas the only one that goes.* —

VIEW, & TOPOGRAPHICAL PLAN,

Of the New Town of the Hill of Pasco

Taken from the Lake of Quinlacocha 1827.

Eddy deln. on Stone.

Pendletons Lithog. Boston

Explanation.

⊛ Steam engine, upon the excavation of St. Judas the only one that goes. —

† Hill of St. Catalina is the highest point, in the skirts of it, are the mines of St. Catalina Trinidad, the Great mine, St. Rita Pampuma, Mercedes, Descuvridora, Velez &c. which now produce rich metals.

▭ Mines easily exploded, but the greater part abandoned and full of water; except those mentioned.

• Mines full of water & in ruins.

The Hills of St. John, Olachin & part of Fargas, are composed of strata of sandstone & limestone with the last the granite is found, well formed, & called in the country Fly-Wing. The centre of the mine is composed of black esquito (slate) with pyrites known by the name of Bronze. The metallic strata run from N. to S. inclining to the E. like the calcareous. The soil through which the excavation of Quinlacocha passes, is composed of black esquit, & extends to the mine of Aypoto, then entering the Caseaje.

The mineral soil of Pasco is divided into 4 parts, Yanacancha, Caya, St. Rosa & Yauricocha.

The town of the Hill of Pasco is 5206 Yards above the level of the sea, in Lat. 10°55' S. Lon. 75°-40' Mer. of Greenwich.

- Granite.
- Esquito (or slate)
- Gres (or sand stone)
- Calcareo (or limestone)
- Conglomera or pudding stone.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Review of the Scientific Labors and Character of Sir Humphry Davy.*

The last number of this Journal contained an obituary notice of Sir Humphry Davy, who closed his extraordinary career, on earth, at Geneva, on the 28th of May last. A character of no ordinary stamp has thus disappeared from our view: one of those meteors, which visit our world at distant intervals, has suddenly withdrawn itself from our firmament.

No full biography of this great chemist has yet reached us, nor has the writer of this article, enjoyed the happiness of being personally acquainted with him. Indeed, we have learned but few particulars of his private history. Rarely, therefore, have we been presented with so fair an opportunity as the present, for estimating the character of an eminent cotemporary from his works alone, or of tracing the march of genius from its own naked monuments. If we have felt a strong admiration of Sir Humphry Davy, it has not been because he has enjoyed unbounded popularity, or been crowned with distinguished honors, but because a character in which splendor of genius, and majesty of intellect, and greatness of soul, were united, could not be viewed without admiration. While, therefore, the opinion we have formed of the character of Davy, remains simply that which his achievements and writings have inspired, unbiased as yet by the portraiture with which perhaps the partial hand of friendship may shortly present us, we hasten to review his scientific life and labors;—to trace, as we shall of course do, the progress of chemical science for the same period; and to learn from so striking an example, both the characteristics of intellectual greatness, and the methods by which the powers of a great mind are most successfully developed and applied.

Sir Humphry Davy was born December 17th, 1779, at Penzance, in Cornwall. Although his family is represented as somewhat above the middle rank, yet his father's estate had been so much reduced as to afford him little or no prospect of a patrimony ;* but at the age of sixteen, when his father died, he was thrown upon the world, like many others who have risen to the highest eminence, with no resources but such as he could create for himself by the efforts of his own mind.

Of his early years, we are furnished with the following particulars. "He was always considered as a distinguished boy ; and there are many natives of Penzance, who remember his poems and verses written at the early age of nine years.† At that period his mind seems to have received a bias in favor of poetry, which he continued to cultivate until his fifteenth year, when he became the pupil of Dr. Borlase, of Penzance, a very ingenious surgeon and accomplished man, intending to prepare himself for graduating as a physician at Edinburgh. Conscious of uncommon powers, and resolved to attempt a nobler career than circumstances appeared to promise, or his friends could expect, Mr. Davy laid down for himself a plan of education which embraced the circle of the sciences. By his eighteenth year, he had acquired the rudiments of botany, anatomy and physiology, the simpler mathematics, metaphysics, natural philosophy and chemistry. But chemistry soon arrested his whole attention, for he at once saw that this science offered the best unexplored field for the exertion of talent.‡"

To begin the study of chemistry was, for a genius so inventive as his, to begin the career of discovery ; and, accordingly, his first experiments bore the impress of originality. He proved, by the examination of sea-weed, that marine plants exert the same influence upon the air contained in the water of the ocean, as land vegetables exert on the atmosphere. We recognize in this tendency of a mind to strike out new lights in science, its likeness to such master spirits as Bacon and Newton and Leibnitz, whose originality did not wait until they had explored every dark corner of the sciences to which they severally devoted themselves, but begun to display itself almost

---

* Monthly Mag. 1. 377.

† It is stated in "The Artisan," that several of these effusions, written before Davy was ten years of age, were published in the periodicals of the time, and were much admired.

‡ Monthly Mag. 1. 378.

at the very moment when they first set their foot on the territory of any science. Bacon had projected his great work, the Instauration of the Sciences, before he was twenty two years old; Newton had made the greater part of his grand discoveries previous to his twenty fourth year; and Leibnitz, though considerably advanced in life when he began the study of mathematics, had scarcely commenced, when he made his great discovery of the infinitesimal calculus.*

These experiments on sea-weed, introduced young Davy to the notice of Dr. Beddoes, who was about forming an Institution at Bristol, for experiments on the medical properties of the gases, of the virtues of which in certain diseases, especially those of the lungs, the Doctor had conceived the most sanguine hopes; since, being received into the system by respiration, they were susceptible of an application to organs which were inaccessible to grosser medicines, while one of them at least, oxygen, exhibited properties most friendly to animal life. Young Davy gave an earnest of the lofty independence of his mind, by stipulating that the entire control of the pneumatic institution should be submitted to him. It does not appear that with all his youthful ardor and enthusiasm, he was ever deluded by the visionary notions of his patron; while the Institution furnished by its novelty a most favorable opportunity for the development of his powers.

We now find our young philosopher fairly embarked in the career which he was to pursue for life. We are not informed what it was that drew off his attention from the study of the medical profession, to which he had purposed to devote himself; still we cannot but conjecture, that it was the admiration kindled in his youthful bosom already panting for distinction, at the splendid honors that were achieved by Scheele and Black and Priestley and Lavoisier. We have seen some examples, and read of many more, where early genius was determined to some particular pursuit, in which it afterwards attained to great eminence, by some incident trifling in itself perhaps, but still such as to arrest the admiration of the young aspirant. Thus Demosthenes first conceived his passion for eloquence, on hearing the orator Callistratus, and witnessing the applauses with which his performance was rewarded. Tycho Brahe resolved to devote his life to astronomy in consequence of his witnessing, when a child, an eclipse of the sun, and being smitten with admiration for a science which could thus penetrate into the secrets of futurity. We do not regard the genius in such cases as created, but as developed. We

* Playfair, Diss. II. Part 2. p. 9.

look upon the genius of childhood or youth, while undetermined in its choice of objects, as wandering unconfined, and as liable to be fixed and bound by any object upon which it may chance to light, that is powerful enough to arrest it; like those meteors which are said to be wandering in the regions of space, that have never yet found a resting place, but are liable to have their orbits determined by any grand luminary near which they may happen to pass, around which they forever afterwards revolve. The impressions of admiration produced by any incident that strongly arrests the attention of a child, are to be sedulously guarded against when the object is dangerous, and as sedulously cherished when the object is elevated and good. While many a child of genius has had its ambition turned into a noble channel by strong examples of the rewards of virtue, many others, like Hannibal, have burned through life with unhallowed fire that was kindled in the bosom of the child. But whether we suppose that the genius of Davy was originally adapted to chemical pursuits, or that some incident connected with this science powerfully excited his admiration, we cannot but regard his choice as most fortunate; not because powers like his would not have reached the highest elevation in many other spheres of action, but because the talents required to make an accomplished chemist are peculiar and extraordinary, implying as they do the union of a dexterous hand with a discriminating eye and a logical mind; the whole being kept in steady and vigorous action by untiring diligence.

With all these qualities in their highest degree, Davy took the field. He gives us the date at which he commenced his chemical studies.* It was in March, 1798; and only two years afterwards, in 1800, appeared his "Researches," a book evincing great skill in chemical analysis, and publishing to the world, a great number of original experiments and discoveries. In the preface to this work he observes, 'early experience has taught me the folly of hasty generalization.' He probably alludes here to an hypothesis which he had already framed and made public in the "West Country Contributions," contained in an essay on heat, light, &c. Nothing is more natural than for a young enthusiast to proceed at once from the knowledge of a few facts to the formation of hypotheses, which subvert all the established principles of science. We are not surprised to find our author yielding to this propensity; but we are truly surprised to find him

* Researches, p. 453.

so soon sensible of his error, and so early confirmed in the true principles of the inductive philosophy. The foregoing passage proceeds with the following judicious remarks. 'We are ignorant of the laws of corpuscular motion; and an immense mass of minute observations concerning the more complicated chemical changes must be collected, probably before we shall be able to ascertain even whether we are capable of discovering them. Chemistry, in its present state, is simply a partial history of phenomena, consisting of many series, more or less extensive, of accurately connected facts."* The pertinacity with which he afterwards maintained his opinions, particularly in the controversy respecting chlorine, must inspire a greater confidence in his conviction of their truth, on account of the frankness with which, at the early period of his life now passing under review, he renounced a theory he had formed respecting certain combinations of light, as soon as he found it unsupported by facts. This renunciation (the only one so far as we recollect, that he found it necessary to make during his life,) followed as it was by the foregoing remarks on the 'folly of hasty generalization,' proves how early he had imbibed the love of truth, and formed the determination to surrender himself to her guidance. "The admission of such inferences, he observes, (speaking of recent experiments upon the production of light,) would be favorable to my theory of the combinations of light; but facts have occured to me with regard to the decomposition of bodies, which I have supposed to contain light, without any luminous appearance. *Until I have satisfactorily explained these facts by new experiments, I beg to be considered as a sceptic with regard to my own particular theory of the combinations of light*, and theories of light in general."†

At the time when the volume of Researches was published, Davy was only twenty years old, and had been engaged in the study of chemistry only two years; yet this work immediately placed him among the ablest chemists of the age. None but chemists themselves can duly appreciate the difficulties which he had already mastered, in having so soon acquired so great a familiarity with a science, which is apt at first to confound the learner with the numberless objects and facts it crowds upon his memory; and still more, in his having so well learned the practical duties of the laboratory, that he had been able to perform a great number of analyses with an accuracy, that has ever

* Researches, p. 13. † Nicholson's Journal, Feb. 1800.

since inspired the greatest respect for his authority in regard to the composition of the bodies which he examined. Chemical analysis is a very difficult art, and few chemists ever attain to any high degree of excellence in it. A familiar knowledge of the peculiar properties of all bodies—a discriminating eye to detect an individual constituent of a compound, as soon as it discovers itself by any of its properties, either physical or chemical—great ingenuity and address in conducting delicate manipulations—a sound judgment to draw the proper conclusion, as the principles of the compound are successively developed—great accuracy in estimating the respective quantities of the constituent elements—and unwearied perseverance in conducting tedious processes, which often last for several days or even weeks: these are some of the qualifications that unite to form such accomplished analysts as Klaproth, Vauquelin, and Berzelius.

But the most remarkable portion of this volume of Researches, is that which relates to the properties of nitrous oxide. So fully were these properties disclosed, that time has added scarcely any thing to their number; and few examples can be found of more thorough and successful experimental investigations, than were exhibited in these researches into the nature of a substance, at that time just introduced to the notice of the chemical world. But the merit of these analytical researches has been almost overlooked, in the astonishment that followed the discovery of the effects of nitrous oxide in *respiration*. So sudden and transforming, and sometimes indeed so appalling, are the effects produced by inhaling the "exhilirating gas," that even now, one can hardly encounter them without some slight emotions of fear. How undaunted then must have been the spirit, that first embarked on this unknown sea! How few but would have recognised in the symptoms that attended the first inspirations, "the giddiness and fulness of the head," accompanied with "a loss of distinct sensation and voluntary power," as admonitions that they were entering a region of death! To plunge forward into the unknown abyss, revealed a spirit cased in more folds of brass than his, who first braved the open sea.*

It is not the least remarkable among the circumstances of this exploit, that it was performed in the face of an hypothesis which had

* Illi robur et æs triplex
Circa pectus erat, qui fragilem truci
Commisit pelago ratem
Primus.

been proposed, founded on the deadly effects of this gas on small animals, that here was at length discovered *the principle of the plague itself!**

The sufferings which our young philosopher voluntarily inflicted on himself, in prosecuting these researches on the respiration of the gases, remind us of Spallanzani's experiments upon the gastric juice; while the dangers he encountered carry our minds back to Pelletier, who lost his life in the audacious attempt to breathe oxymuriatic acid gas. It was deemed necessary to compare the effects of nitrous oxide with those of common stimulants, both to ascertain its relation to them, and its tendency either to increase or to diminish their effects upon the system. With this view he submitted himself to excessive intoxication, so extreme as to produce distressing and alarming symptoms.† To ascertain the effects of an atmosphere containing large portions of the same gas, he enclosed himself in a box, and at three successive intervals for an hour and a quarter (during which time he remained in the box) had sixty quarts of the gas thrown into the box, finally constituting a large proportion of the air within. When the last twenty quarts were thrown in, his emotions became similar to those usually experienced by a moderate dose of the pure gas; but not satisfied with this, immediately after coming out of his cage, he began to respire twenty quarts of unmingled nitrous oxide. As this was probably the most effectual trial ever made of this wonderful agent, the consequences are worth remarking, as detailed in the expressive terms of the adventurous experimenter. "A thrilling (he observes) extending from the chest to the extremities, was almost immediately produced. I felt a sense of tangible extension highly pleasurable in every limb; my visible impressions were dazzling and apparently magnified; I heard, distinctly, every sound in the room, and was perfectly aware of my situation. By degrees, as the pleasurable sensations increased, I lost all connection with external things; trains of vivid visible images rapidly passed through my mind, and were connected with words in such a manner, as to produce perceptions perfectly novel. I existed in a world of newly connected and newly modified ideas. I theorised; I imagined that I made discoveries. When I was awakened from this semi-delirious trance by Dr. Kinglake, who took the bag from my mouth, indignation and pride were the first feelings produced by

---

* Researches, p. 453. † Ib. 481.

the sight of the persons about me. My emotions were enthusiastic and sublime; and for a minute I walked round the room perfectly regardless of what was said to me. As I recovered my former state of mind, I felt an inclination to communicate the discoveries I had made during the experiment. I endeavored to recal the ideas : they were feeble and indistinct. One collection of terms, however, presented itself; and with the most intense belief and prophetic manner, I exclaimed to Doctor Kinglake, "*Nothing exists but thoughts !—the universe is composed of impressions, ideas, pleasures, and pains !*"*

The impunity with which Davy had sustained these wonderful trials, emboldened him to attempt the respiration of the deadly gases from charcoal. His first attempt was made upon four quarts of carburetted hydrogen gas, of which he made three inspirations. "The first inspiration produced a sort of numbness and loss of feeling in the chest and about the pectoral muscles. After the second inspiration, I lost all power of perceiving external things, and had no distinct sensation except a terrible oppression on the chest. During the third inspiration, this feeling disappeared,—I seemed sinking into annihilation, and had just power enough to drop the mouth-piece from my unclosed lips. A short interval must have passed during which I respired common air before the objects about me were distinguishable. On recollecting myself, I faintly articulated, *I do not think I shall die.* Putting my finger on my wrist, I found my pulse thread-like and beating with excessive quickness." Extreme giddiness, loss of memory, and numbness succeeded, with excruciating pain in the forehead and between the eyes, with transient pains in the chest and extremities.

In these experiments, which we cannot but condemn for their temerity, it is evident that Davy narrowly escaped being numbered among the early martyrs of science. He has finally died of apoplexy; and we can scarcely refrain from believing that his constitution, which was so vigorous in youth, withered and decayed long before it reached old age, from the effects of these early injuries; like some tree of noble growth, which fades and casts its leaves, ere it reaches the autumn, in consequence of wounds inflicted while in its vernal bloom.

Knowledge is proverbially quiet and serene, and little has been either said or thought of the heroism of men of science. But they sometimes encounter danger as real as those which are braved in the field

---

* Researches, 487.

of battle or on the stormy deep; and, we may venture to add, with a spirit as fearless as that of the warrior or the navigator. Even the alchymists groped their way amid tremendous elements, which, (in some mysterious manner they were unable to explain,) not unfrequently gave them most durable proofs of the energies of the powers of nature. A lost eye, a dismembered limb, or a scorched and crisped visage, bore frequent testimony of the conflicts they had carried on with the powers of darkness. If men of science have now learned to control these ordinary dangers, they have encountered others still of a no less formidable character. Some have ascended the air in balloons; others have climbed to heights to which the eagle never soars; others have braved the terrors of a polar winter; some have descended into the fiery craters of volcanoes; and some have waged war with the lightning of heaven.

We have dwelt the longer on this period of the life of Sir Humphry, because during this period, short as it was, many of his great qualities, both moral and intellectual, were fully developed. We are next to view him in a new sphere of life. The Royal Institution of Great Britain, founded by the exertions and influence of our countryman Count Rumford, for the purpose of promoting the general diffusion of useful knowledge, and the improvement of the mechanic arts, had just come into operation; and so strong was the impression made in favor of young Davy by the volume of Researches, that he was immediately after its publication, designated by Count Rumford to fill the chemical chair in that Institution. The nature of this establishment concurred with his own practical turn of mind, to lead him into inquiries directly connected with the improvement of the arts. His first experiments were directed towards the ascertaining of a method for accelerating the process of tanning leather. Such a method he found no difficulty in discovering; but he had the candor to acknowledge, that the quality of the leather was impaired, by any process which he had been able to institute for abridging the time of tanning it. This was indeed no more than candor and truth required him to acknowledge; still there was something in the circumstances of the case, which implied in his doing this so frankly, a fair and upright mind; for this was his first essay in the application of chemistry to the arts, since he had entered on his office at the Royal Institution, while high and probably extravagant expectations were entertained by the public, respecting the light that was to shine upon the arts from the torch of science, to be held out to them from the new Institution, especially when kindled by the magic powers of young Davy.

In the year 1802, the new professor was invited to deliver a course of lectures on Agricultural Chemistry to the Board of Agriculture. This association consisted of a number of intelligent and wealthy landed proprietors, led by Sir John Sinclair, one of the most public spirited and enterprising men of the realm. In their efforts to improve the art of agriculture, they very wisely adopted the following measures. In the first place, by circulars addressed to gentlemen of the first intelligence on matters of this kind in every county in the kingdom, they endeavored to ascertain the state of facts, or the state of agriculture as it actually existed; and, secondly, upon the knowledge of these facts, to found their plans for improving the art. Accordingly, after collecting these materials, they proceeded to combine the light of science with the light of experience. It was under these favorable auspices, that Professor Davy was called on to lend his extraordinary powers to the improvement of the art of husbandry.

It gives us a very favorable opinion of the character of Davy that, flattered as he was in the lecture room of the Royal Institution, by the admiration of courtiers and the nobility of the great metropolis, and honored as he was throughout the scientific world, with encomiums which were enough to turn the brain of any ordinary young man, he could still condescend to carry his observations and experiments into the tannery and the farm yard, and unite his labors with those of the humblest of our race. This benevolent zeal to render himself useful to his fellow men, displayed itself on many other occasions; and the benefits which thus accrued from his labors to numerous classes of society, were strikingly acknowledged in the homage that was paid to his memory by different orders of artisans, who joined themselves to the funeral procession at Geneva.* In descending from his lofty elevation to make experiments upon different species of manures for the benefit of the farmer, he imitated the eminent surgeon, who performs the humblest and most disagreeable offices to relieve the distress or to save the life of his patient. "Every man acquainted with the common principles of human nature, (says Dr. Johnson in his life of Dr. Watts,) will look with veneration on the writer who is at one time combating Locke, and at another making a catechism for children in their fourth year. A voluntary descent

* See the obituary notice in the present volume of this Journal, p. 157.

from the dignity of science, is perhaps the hardest lesson for humility to teach." But there is no loss of dignity in the performance of any duties that are necessary to the promotion of the happiness of our fellow men. To do good is a work of inherent dignity.

The principal objects which our author proposed to himself were, first, to ascertain *the food of plants*, and hence to learn the best method of supplying it; secondly, to investigate *the nature of different soils*, and thus to detect the latent causes of productiveness or sterility, with the view of promoting the one and applying the proper remedy to the other; and, thirdly, to examine *the nature of manures*, for the purpose of augmenting their fertilizing powers, preventing their waste, and multiplying their number and variety. We regard his efforts as having been by far the most successful on the last point. Inquiries respecting the food of plants, connected as they are with the functions of living vegetables, belong rather to physiology than to chemistry; the method of deciding on the qualities of a soil, from the knowledge of its constituent principles, is too refined for the simple art of husbandry; but since manures undergo various chemical changes, and owe their peculiar properties to these changes, they present inquiries which are strictly chemical, and which none but the chemist can satisfactorily answer. Had Davy, by his agricultural inquiries, ascertained nothing more than that the most fertilizing portions of many of the best manures, are likewise the most volatile, and had he done nothing more than furnish the rules which he established to prevent the waste of these portions, he would have conferred a benefit upon agriculture of the greatest importance. Although treatises had previously been written with the view of reducing several branches of husbandry to a science, yet the Agricultural Chemistry of Sir Humphry Davy, was the first, and continues to be the last work, that presents to the agriculturist, a digested code of laws constituting the scientific principles of his art. Many of the members of the Board of Agriculture, were practically acquainted with farming; and the high authority conceded to this work, not only by them but by all enlightened agriculturists, is a sufficient proof of the soundness of its doctrines, and its freedom from all visionary hypotheses, incompatible with experience. Considering that, when he commenced this course of lectures he was only twenty two years of age, and had not been bred on the farm, but had spent his life chiefly with books and in the laboratory, we cannot but admire the facility with which he adapted himself to the circumstances of the practical agriculturist;

and we recognize in him, as in our own Franklin, an uncommon union of the philosopher with the man of strong common sense.

The foregoing lectures, together with his public lectures as professor of Chemistry at the Royal Institution, appear to have occupied a great share of his attention from 1802 to 1806, when we arrive at a new era in his life. It was during this and the following year, that he made his brilliant discoveries in Galvanism. The discovery of the metallic bases of the fixed alkalies, which has led also to the knowledge of the composition of the earths, was one of the most important discoveries hitherto made in chemistry, and deservedly ranks with the discovery of carbonic acid by Dr. Black, of oxygen gas by Dr. Priestley, and of the composition of water by Mr. Cavendish. Some men of intelligence, however, not particularly conversant with chemical science, have expressed to us their inability to comprehend the reason why so much importance has been attached to the galvanic discoveries of Davy, or why they have been rewarded with such unbounded applause. To evolve from a piece of potash a metallic globule, seems too inconsiderable a matter, to deserve the popularity with which the achievement has been rewarded. But they do not reflect that it is one of the peculiarities of chemical analysis, that discoveries made with the minutest quantities of bodies, often lead to the grandest conclusions. Thus a drop of water was no sooner resolved into its constituent elements, oxygen and hydrogen, than a new flood of light beamed forth upon the world; not only displaying to the mind, in a new and more interesting view, the expanse of waters, but revealing at once the cause of innumerable phenomena of chemistry which depend on the agencies of water, and disclosing the mysterious constitution of the vegetable kingdom. In like manner, the knowledge of the composition of a particle of potash, conducted us to a knowledge of the elementary constitution of the solid globe itself. To pass by the remarkable and brilliant physical properties of potassium, it became, moreover, in its turn, a most powerful auxiliary in investigating the composition of many other bodies; for, it was its strong affinity for oxygen, the strongest possessed by any known body, that had enabled it, under all previous trials, to disguise its metallic nature; but this oxygen being withdrawn from it, potassium itself now became a powerful agent of analysis, appropriating to itself as it does the oxygen of every other substance that contains it.

It is far greater merit in science to discover new powers of nature, or new facts which admit of extensive generalization, than to arrive at the knowledge of new individual bodies, or insulated facts. How widely have the Pythagorean proposition, and that of the similarity of equiangular triangles, extended the empire of mathematics! The discovery of Jupiter's Satellites and of Saturn's Ring, was each an interesting occurrence in astronomy; but it was a fact of comparatively small extent; while Newton's discovery of the law of gravitation, was finding the true key which unlocked the system of the world. No higher proof could be given of the estimation in which the galvanic discoveries of Davy, were held by the most competent judges, than that which was given by the French Institute, in awarding to him the splendid prize offered by them for the greatest discovery in galvanism. The laws of nature and the powers and properties of natural bodies, are the birthright of no nation or tribe, but belong in common to the whole family of man; and he who develops those laws, and extends the empire of man over matter, becomes a citizen of the world, and a benefactor of the human race. Hence, it is reasonable that in relation to discoveries of this kind, national partialities should give way to a feeling as enlarged as the laws of nature are universal. This doctrine is clear; but to see it when the prize is to adorn the crown, and swell the triumphs of an ancient and hated rival,—a rival no less in arts than in arms; to see it through schemes of conquest designed to humble and destroy the nation itself,—evinces a magnanimity of which the records of science afford but few examples. The honor which this deed reflects on the memory of the late Emperor of France, under whose sanction and approbation the prize is understood to have been awarded, plainly shows, how much shorter and surer a way ambition may find to distinction and renown, by splendid acts of justice and magnanimity, than by deeds of oppression and rapine.*

The year 1810 marks another distinct epoch in the life of Sir Humphry Davy. It was during this year that he brought forward his theory respecting the nature of chlorine or oxy-muriatic acid, which gave rise to the memorable controversy on this subject, that agitated the schools of chemistry during the ten following years. At the commencement of this period, our philosopher saw himself standing alone with the whole army of chemists arrayed against him; at the close

---

* It is stated in the "Artisan," that Napoleon, at the same time, transmitted to Mr. Davy a free passport to travel in any part of his empire, accompanied by a present of money to defray the expences of such a journey.

of it, he had the satisfaction of seeing nearly all of them on his side.

To enable such of our readers as may not have had opportunity to understand the nature of this controversy, it may be mentioned, that the great Swedish Chemist, Scheele, who discovered chlorine, supposed it to be muriatic acid deprived of its inflammable principle, and hence denominated it *dephlogisticated marine acid.* This was in the year 1774. In 1785, Berthollet, one of the most distinguished of the French chemists, afterwards subjected this substance to numerous experiments, and concluded it to be a compound of muriatic acid and oxygen, and hence named it *oxy-muriatic acid.* In 1809, Gay-Lussac and Thenard published a number of experiments on it, in which they intimated the possibility that it was a simple body, although they adhered to the opinion of Berthollet. Such was the state of opinion respecting oxy-muriatic acid, when Davy began his experiments upon it in 1810. These led him to adopt and publicly to assert the opinion, that oxy-muriatic acid, (or *chlorine** as he proposed to call it,) is a simple body, analogous in many of its properties and relations to oxygen; and that muriatic acid itself is a compound of chlorine and hydrogen, as sulphuric acid is a compound of oxygen and sulphur.

The simple enunciation of this doctrine, does not indicate to those who are but little acquainted with chemical science, the reason why chemists have attached so much importance to it; nor would they perhaps consider it as a point worth disputing about, *whether chlorine is a simple or a compound body.* But two consequences resulted from the doctrine asserted by Davy, which went to subvert the very pillars of chemical science, although they were supposed to be immovably fixed by Lavoisier. For if chlorine contained no oxygen, but is, like that, an independent supporter of combustion, and like that also is capable of forming acids with combustible bases, then the doctrines of combustion and acidification established by Lavoisier, must be given up, since here is a case in which combustion and acidification both take place without the presence of oxygen. A single experiment which is found to be incompatible with a received doctrine, is frequently sufficient entirely to subvert that doctrine; and such were the experiments in question. They required a great part of

* A new name obviously became necessary, because the name *oxy-muriatic acid* implied that it was an acid, and that it was composed of oxygen and muriatic acid, both of which positions were now in controversy.

the philosophy of chemistry to be remodelled, and its nomenclature to be changed. Lavoisier's definition of combustion, "the combination of oxygen with a combustible base," could no longer be admitted, but a new classification was to be instituted, comprehending not only those cases of combustion which depend on the agency of oxygen, but those also which depend on the agency of chlorine, and other analogous bodies which might afterwards be discovered.*

Now combustion and acidification are processes of such extent, and are concerned in so many of the chemical changes which bodies undergo, that any new theory which alters the explanation of these phenomena, affects in a great degree the whole philosophy of chemistry. It is by the *relations* which a body sustains to chemical agents, and especially to caloric and oxygen, that its chemical nature is determined. Hence, a complete history of the properties of almost any substance, *in all its relations*, involves an application of nearly all the leading principles of the science. Scheele wrote an essay on manganese, in which, after the labor of three years, he unfolded most of the properties of that substance, many of which had been before unknown. During his experiments on manganese, he discovered both oxygen and chlorine, and learned the most important properties of these extensive agents. The selection of manganese, as a subject for experimental research, was in some respects fortunate; but had Scheele investigated the properties of several other substances, with the same persevering attention and singular acuteness, he would have made the same discoveries. In like manner, to settle all the relations of chlorine to various chemical agents, must involve an application of nearly all the leading principles of chemical science;

---

* Although it be admitted that the views of Sir Humphry Davy respecting chlorine, required a new classification of the phenomena of combustion and acidification, yet it must be admitted also that Lavoisier reasoned logically from his premises. In a great multitude of cases of combustion and acidification which fell under the examination of Lavoisier, oxygen was proved to be present, nor was any case of either of those processes found where oxygen was not present; hence, upon the true principles of induction, Lavoisier was entitled to lay it down as a general law*—"In every case of combustion, oxygen combines with the burning body." But subsequent discoveries have shewn, that several other agents as well as oxygen act in producing combustion, and in forming acids. Hence oxygen, which before stood at the head of a *genus*, now takes its place at the head of a *species* only, comprehending a a certain number of cases of combustion, while chlorine stands at the head of another species, and iodine at the head of another, and all of them are to be classed under some more general agent which is a still remoter cause of combustion.

* See Newton's Rules of philosophizing.

and to ascertain, as Davy did, that chlorine had properties and relations which could not be explained in accordance with existing theories, was to prove that these theories were either defective or erroneous, and were therefore to be either limited or discarded.

But it was not merely on account of the reformation, which these views of the nature and relations of chlorine carried into the science of chemistry, that they have contributed to the advancement of that science. As is common in able controversies, every corner of the science was hunted for arguments in favor of one hypothesis or the other; new discoveries were made incidentally; and various facts before known, were more fully confirmed and illustrated.

The *manner in which this great controversy was conducted* between Sir Humphry Davy and Mr. Murray of Edinburgh, is worthy of being particularly remarked. It is rare in any debate, to find the parties so well matched, and both so able. Davy and Murray were both ingenious and accurate experimenters, and equally acute and logical reasoners. They were both gentlemen; and exhibited throughout this protracted discussion, a rare example of courtesy and good temper. Each had the right kind of obstinacy;—not a determination to persist in error, but that perseverance which is founded on a strong conviction of the truth, and which produces a corresponding determination to support it. Davy had great obstacles to overcome. The opinions of the chemical world were made up and settled on this point, and settled against him. Several of the leading chemists of the day had "made their book," and had thus entered into bonds with society to support the prevailing doctrine. Chemists also being familiar with the explanations made on the old theory, for that reason imagined them to be much *simpler* than the explanations proposed. It generally happens in warm and protracted disputes, that each of the parties is apt to think that the reason why his opponents do not see his opinions to be true and incontrovertible, is owing either to their obstinacy or want of penetration. Hence he is prone to regard his antagonists with resentment or contempt; not to *see* things so plain argues stupidity; not to *acknowledge* what they cannot but see, argues wilful obstinacy. We have not been able to find anything of this temper in any of the controversial writings of Sir Humphry Davy.

Between Mr. Murray and Dr. John Davy there was, however, at one time a little jarring. The Doctor, after proving as he thought the insufficiency of one of Mr. Murray's arguments, adds in a tone which savors a little of haughtiness, "After the preceding statement of facts, Mr. Murray, I should conceive, will be induced to renounce his conclusion; and I should likewise imagine, that this gentleman in future will be more cautious in his assertions, and criticisms on the labors of others."* Mr. Murray, in his next paper, shews that Doctor Davy had admitted the *fact* in controversy which he had before steadily denied; and that what the Doctor had advanced to account for it in conformity with his theory, was a series of hypotheses unsupported by proofs, and then adds,—"he therefore, I trust, will in future be more cautious in his assertions, and in calling in question the results of the experiments of others."†

But we are not aware that Sir Humphry Davy was ever betrayed into any want of courtesy, although he was assailed at different times by Gay Lussac and Thenard, by Dalton, by Murray, by Berzelius, and by many others. Nor have the records of science often exhibited such uniform modesty, in the pretensions of those who have extended its boundaries. When the occasion calls upon him to allude to his own discoveries, he speaks of them as things which *he had the good fortune to discover*. When circumstances demand the application of a new name, as that of Chlorine, his language is, *After consulting several eminent men, I have ventured to propose this name.* It was probably this modesty in asserting his claims, (so characteristic of true greatness,) this respectful regard to the feelings and rights of others, which has made the world so freely acquiesce in his praises, and preserved him from that envy which is so apt to be displayed towards eminent cotemporaries.

In the progress of the dispute between Murray and Davy, each party seemed several times, both in his own opinion and in that of lookers-on, to have fairly laid his adversary; but to their surprise, the latter soon returned to the attack only invigorated by the blow. Every man of science, whichever side he may have taken in this discussion, must rejoice that it was conducted by two such champions as Davy and Murray; for had either of them encountered almost any common man, he would have established his own views too soon;—if he had been in an error, he would have led the world astray; or if right, he would have had no occasion, as in the present instance, to encompass this doctrine with such a panoply of arguments.

---

* Nicholson's Journal, XXXIX. 32. † Nicholson's Journal, XXX. 230.

The controversy was conducted with such consummate skill, that each rejoinder seemed conclusive in favor of the writer; and the reader could hardly help saying as the country justice did, to each of the advocates in succession, "You've got your case." For example, when Davy brings forward the fact, that charcoal ignited to whiteness and presented to chlorine under the most favorable circumstances, abstracts no oxygen from it, we feel compelled to believe, that it has none. Nor does it satisfy us to say, as his antagonist did, that this fact makes equally against his own hypothesis; since, if chlorine be a supporter of combustion analogous to oxygen, as Davy supposed, it ought to enter into combination with the carbon under these circumstances.* Murray here forgot, that it is not necessary for bodies to agree *in all respects* in order to be arranged in the same class;—that if they did thus agree, they would not be *analogous* in their characters but *identical.* Gold undoubtedly belongs to the same class of bodies with lead; but in their affinities for oxygen, these two bodies differ widely. Ammonia belongs to the same class of bodies with potash; but in their composition, they differ as much as possible. But though we do not attach any weight to this reply urged by Dr. Murray, and repeated by his son,† yet when he urges the argument that the chlorine does not give up its oxygen to the carbon, because the muriatic acid which would be left, cannot exist without water, we are confounded, if not convinced; for, to say that muriatic acid can exist without water, was assuming one of the principal points at issue.

On the other hand, when Murray converts carbonic oxide into carbonic acid by mixing it with chlorine,‡ we feel it impossible any longer to resist the evidence that chlorine contains oxygen; but in the reply of his antagonist, we are shewn that this change might take place in consequence, not of the transfer of oxygen from the chlorine to the carbonic oxide, but by the abstraction of carbon from the latter, forming with chlorine and hydrogen (for the presence of this ele-

---

* This method of evading the conclusion of Davy in favor of his hypothesis, derived from the want of action of white hot charcoal upon chlorine, has been often repeated, and by chemists of eminence; but the objection appears to us to be unfair, because a strong attraction for ignited carbon is a known property of oxygen; and if a body when exposed to the action of charcoal white hot, does not exhibit this property, the fact furnishes a strong presumption, that the body contains no oxygen; but this fact does not prove that the body in question is not a supporter of combustion. It may still be entitled to that character on account of its burning sulphur, phosphorus, and the metals, while its want of affinity for charcoal marks a specific difference between it and oxygen.

† In the recent edition of Murray's Elements.

‡ Nich. Journal, vol. 28.

ment was essential to the success of the experiment) a triple compound, as in olefiant gas.* This argument, if it did not *demonstrate* that the carbonic acid *was* developed in this manner, proved at least that it *might be* thus accounted for, and thus rendered Murray's experiment *inconclusive;* but a subsequent experiment of Dr. Davy developed a new compound formed from these elements, which Murray had mixed, namely, chloro-carbonous acid, which was the substance that Murray had mistaken for carbonic acid.

Again, Davy asserted a superiority in favor of his doctrine, on the ground that it was only *a simple expression of facts*, while that of his antagonist, was an hypothesis. Thus, to say that muriatic acid is composed of chlorine and hydrogen, was only the expression of a simple fact, which we saw take place before our eyes; while the assertion that the hydrogen unites with the oxygen of the chlorine and forms water, which instantly combines with the muriatic acid, is hypothetical. All this seemed very clear, until Murray shewed that Davy's views were as hypothetical as his. For, although to assert that from the mutual action of oxymuriatic acid and hydrogen, *muriatic acid is produced*, is a simple expression of a fact, yet that this fact results from a direct combination of those two gases is an inference, and that it results from the union of the hydrogen with the oxygen of the oxymuriatic acid, is another inference. And, though the latter inference may be less simple than the former, yet the most simple conclusion is not always the just one. This observation was pressed home by an appeal to their own principles. For example, we combine (says Murray) protoxide of mercury with muriatic acid and form calomel. The most simple conclusion, and one quite analogous to the conclusion in question, is that calomel is a compound of protoxide of mercury and muriatic acid: but no, you say, it is a compound of chlorine and metallic mercury.†—This was a pungent application of the argumentum ad hominem.—The dexterity of the combatants was equally manifested on another point. When muriatic acid was combined with a metallic oxide, as oxide of tin, a quantity of water made its appearance, and a compound resulted, the same as that which is formed by the direct combination of chlorine and metallic tin. From this experiment, Davy drew the inference, that the chlorine of the muriatic acid united with the metallic part of the oxide of tin, while the hydrogen of the acid united with the oxygen of the metal to form

* Nich. Journal, XXX. 29.

† See Murray's Elements, 6th edition, Appendix.

the water that appeared; and it seemed decisive in favor of this conclusion, that *the quantity of oxygen contained in the water, was exactly that which existed in the oxide of tin.* This last fact left a strong impression in favor of Davy's hypothesis, and against the idea supported by Murray, that the water present was the same as had before existed in the muriatic acid, and which was released when the acid went into combination with the base. But the doctrine of equivalent quantities has proved, that the quantity of oxygen which is contained in the water produced in this experiment, would be precisely the same, whether derived from the oxide or the acid.*

In this manner did the controversy proceed, each successive paper producing arguments which seemed invincible in favor of the writer and against his antagonist, while every thrust was parried with the dexterity of the most accomplished masters. Nor did it seem possible to settle the question, until the discovery of iodine so much strengthened the hypothesis of Davy, that almost every chemist of the age from that period has adopted it.

It has been said of Sir Isaac Newton, that he was so well acquainted with nature and understood her analogies so fully, that *he always guessed right.* The increasing probability which has followed many of the novel hints and suggestions thrown out by our philosopher, at a very early period, (for example those respecting the identity of chemical and electrical attractions, the geological agencies of the metallic bases of the earths and alkalies, and the simple nature of chlorine,) almost persuades us to apply to Sir Humphry Davy a similar remark.

It is hardly possible to review the history of the foregoing controversy, without being strongly impressed with the delusive nature of hypotheses in general, if by hypothesis we understand a supposition of which there is no other proof, than that it explains all the phenomena to which it is applied. The two hypotheses of electricity as well as those respecting oxy-muriatic acid, applying as they respectively do to a great multitude of facts, while we know that one or the other of them must be false, prove the danger of relying on such a conformity of our supposition with facts, as a criterion of their truth.

In the year 1812, at the age of 32, Davy stood on one of the proudest heights of science. By his extraordinary discoveries he had extended the empire of man over matter; by strong powers of reasoning united with great ingenuity of research, he had changed

* Murray's Elements, 6th edition, II. 707.

the features of chemical science; he had brought over to his own views nearly the whole chemical world; he had secured the homage of many scientific bodies in different countries, and commanded universal admiration. If we look over the Philosophical Transactions, and Scientific Journals from 1798 to 1812, the rapidity with which we find his great achievements to have followed each other, reminds us of nothing less than the victories of Alexander; which, it will be recollected, were gained within the same short period, and at nearly the same time of life. Nor did the Macedonian distinguish his youth by more extraordinary conquests over man, than our philosopher signalized his by conquests over matter. Nor can we forbear to pursue the comparison, and remark, how transient were the monuments which the hero erected for himself;—for how short a space he broke the stream of time, which soon closed up again and flowed on as before, while the achievements of the philosopher, developing as they do, the immutable laws of nature, are alike imperishable, and bear in themselves the elements of immortality. It was therefore with universal approbation, that the Prince Regent, now George IV, selected Mr. Davy as the first subject to receive at his hands the honors of knighthood.

Released now from the arduous duties of professor of Chemistry at the Royal Institution, and having become the possessor at once of an amiable lady and a large fortune,* he seems to have seated himself to take an account of his stock of science, and to digest plans for a life of learned leisure. How far it proved to be the true otium cum dignitate, his subsequent history will shew. His "Elements of Chemical Philosophy" shortly appeared as the first fruits of this retirement, purporting to be, as was supposed,† the first of a series of volumes to embrace the entire philosophy of the science. Although it advances no farther in the system, than to expound the "laws of chemical changes," and to give the history of "undecompounded bodies," which is all included in a small volume of less than three hundred pages, yet it comprehends so much of chemical science, that Dr. Ure acknowledges that much of the purely chemical part of his dictionary, is derived from this work alone.‡ His "Lec-

* Monthly Mag. I. 381.

† Such was the expectation of Dr. Thomson, (Annals of Phil. I. 372,) who supposes the entire work cannot consist of less than five or six volumes. We are not informed of the reason, why the author did not proceed with the work.

‡ Ure's Dict. Chem. *Introduction.*

tures on Agricultural Chemistry" were published about the same time; and these works along with the volume of Researches before mentioned, each of which has been a rich mine from which compilers have drawn, have made Sir Humphry extensively known to the world as an author.* The "Elements" are characterized by a strictness of method, and a purity and elegance of diction, not often to be found in the writings of those, who in early life have been precluded from the advantages of an academic education. Retirement from the active and professional duties of science, is frequently attended with the same inglorious sloth and barren inactivity, as retirement from the active scenes of business; but from the variety of knowledge displayed in some of the subsequent writings of Sir Humphry, particularly in his discourses before the Royal Society, we are induced to believe, that he devoted much of the time now at his disposal to the cultivation of general science and literature.

But among the privileges conferred by a learned leisure and an easy fortune, few could have been so gratifying to Sir Humphry as the opportunity for *foreign travel.* Nature and art, and the society of the greatest men of the age, severally offered their allurements. If he had become intimately acquainted with the laws and operations of nature in his laboratory, it was, like the sight of Belzoni's models of the eternal pyramids, only in those miniature representations, which inspire a restless curiosity to see the grand originals. Art also conspires with nature to exemplify the principles which he had so faithfully studied; and the choicest productions of the one, and the most stupendous as well as delightful exhibitions of the other, invited him to the south of Europe. The continent also abounded with the luminaries of science, with which a mind like his would love to blend its light. A nation is interested in the travels of such a citizen. The whole world is to him an El Dorado; from every land and sea he gathers gold and pearls; and returns deeply freighted with the intellectual riches of other climes, to pour them into the lap of his country. The Philosophical Transactions bear ample testimony how justly this remark applies to Sir Humphry Davy.†

The beautiful *remains of ancient painting* at Rome and Pompeii, suggested the means of ascertaining, by actual analysis, the nature of

* The whole of his works consist of forty six papers in the Philosophical Transactions, and eight separate volumes.

† Professor Playfair has given another fine example, of the benefits that may accrue to a country from the foreign excursions of her men of science, in his remarks on the "Slide of Alpnach."—(Edinburgh Phil. Jour.)

those pigments which have retained their freshness and brilliancy through so many centuries. By such means, the artist is taught how to prepare for himself the azure of Egypt and the purple of Tyre. The *manuscripts found in the ruins of Herculaneum*, originally 1696 in number,* excited the hopes of the scholar, that could some method be devised for unrolling them, we should find many of those works of the ancients, (as the deficient parts of Aristotle or of Livy) the loss of which is so deeply deplored. Sir Humphry had made a few experiments on certain fragments of papyri while in England in 1818, which encouraged the belief that chemical agents might be found, which could be so applied to the manuscripts, as to separate their folds without destroying their texture. Lord Liverpool, Lord Castlereagh, and even the Prince Regent, afforded ample means for defraying the expenses of such an undertaking; and the experiments were prosecuted for two months upon the MSS. belonging to the Museum at Naples. During this period he succeeded in partially unrolling twenty-three MSS., and he examined about one hundred and twenty more which afforded no hopes of success. In addition to the labor, in itself difficult and unpleasant, he had to encounter unexpected obstacles thrown in his way by the jealous superintendants of the Museum; and he was therefore induced to abandon the undertaking, before he had fulfilled the anticipations he had inspired. The enterprize, however, does not appear to have been entirely abortive. Its results threw some light upon the character of this collection of manuscripts, and upon the modes of writing employed by the ancients.

The *volcano of Vesuvius* presented an object to his curiosity unembarrassed by any impediments of human jealousy. It was the more interesting to our philosophic observer, because it afforded peculiar facilities for comparing its phenomena with a conjecture he had thrown out in a paper on the decomposition of the earths, published in the Philosophical Transactions in 1812, *that the metals of the alkalies and earths might exist in the interior of the globe; and on being exposed to the action of air and water, give rise to volcanic fires.* The facts as observed at Vesuvius, appeared to strengthen this supposition, and the opinion is evidently gaining ground among geologists.†

---

* Phil. Trans. 1821.

† See "Outline of the Course of Geological Lectures" of Professor Silliman, p. 115.

In a passage on the Danube, the attention of Sir Humphry was attracted towards the *morning fogs* that hang over rivers, and he was led to investigate the circumstances, and to propose an explanation which is generally received in meteorology as the true theory of Mists.* His explanation however we cannot but consider as erroneous. The true cause we believe to be this: a fog is formed whenever watery vapor rising from the earth meets with colder air, which condenses it. Now a large river like the Danube, does not become sensibly colder during the night than it was the preceding day, but continues to send off vapor nearly in the same quantity. But the air over the land becomes a number of degrees colder at night than by day; and the vapor coming into contact with the colder air, is condensed into fog. Sir Humphry supposes the fog to be produced as follows: the air over the river, by the influence of the stream, remains warmer than the air over the land on each side; and the colder and the warmer portions of air being mixed, the fog is precipitated from the latter. But this phenomenon takes place over rivulets, the breadth of which is so small that we cannot suppose the temperature of the incumbent air, to be at any moment essentially different from that of the banks.

The year 1815 was rendered memorable by the invention of the SAFETY LAMP. As the business of mining for coal, has made comparatively little progress in our country, we have had no occasions to witness the terrible disasters so common in England, against which the safety lamp affords protection.† A species of carburetted hydrogen gas, called by the miners *fire-damp*, is extricated in the coal mines of that country, which, on being mixed with atmospheric air, takes fire from the flame of a lamp, and explodes with the violence of a magazine. The explosion that occurred at the Felling colliery in the year 1812, when one hundred and one persons suddenly lost their lives under aggravated horrors, filled all the coal districts of England with terror and dismay. Several methods had been devised to obviate these formidable dangers, but they had all proved either ineffectual, or inapplicable to common use. The poor miners were left to grope their way in the dark caverns of the coal

---

* Phil. Trans. 1819, p. 126.

† Our great repositories of bituminous coal, are as yet chiefly open to the day; and the operations are so near the surface of the ground, as to afford little or no opportunity for fire-damp to collect. The mines of anthracite are not liable to these accidents.

pits, with no other light than that derived from sparks of steel, or encounter the hazard of a sudden and awful death. Their families were on the rack of tormenting fears, and parted with them, as they left their homes in the morning, with sad and gloomy forebodings.*

In such a state of things, application was made to Sir Humphry Davy, whose rare union of scientific knowledge with mechanical ingenuity, marked him out as the man of all others most likely to afford relief. It seemed however a hopeless undertaking. It was like asking him to discover a method of making a coal of fire burn in the midst of a barrel of gun powder, without inflaming it. The process by which he advanced to the discovery was so curious and instructive, that we are induced to follow it step by step. First, he ascertained by full and exact inquiries, all the facts of the case as known to the miners. Secondly, he proceeded to learn more fully the properties of the agent which he was to attempt to control. *What is this fire-damp?* He analyzed it and found it to be, as other chemists had said, a variety of carburetted hydrogen gas. *What will kindle it?* A red-hot iron will not—a burning coal will not. It therefore requires a higher degree of heat to inflame it, than most other explosive gaseous mixtures. And here an important inference met him, *that if the gas, when on fire, were cooled, it would be extinguished.* Again, carburetted hydrogen, by burning, produces *carbonic acid*, and the atmospheric air with which it is mixed in the explosive compound, produces *nitrogen;* and each of these products, added to the explosive mixture, greatly impairs or even destroys its power of exploding; and therefore, since these rise from a burning lamp, they would of themselves prevent the communication of the flame through the open chimney of the lamp. *Under what circumstances does the fire-damp burn with explosion?* The general reply is, when mixed with air; but experiments were instituted to ascertain the effect of different proportions of air. One part of fire damp, and any portion of air less than four parts, burnt without explosion. Seven or eight of air to one of the other, constituted the most highly explosive mixture. In fifteen of air to one of fire-damp, a lamp burnt without explosion, and with the flame greatly enlarged. *Through what channels (if there be any) between two separate portions of these explosive mixtures, will the flame when applied to one*

* See an interesting account of the explosion at the Felling Colliery, in the Annals of Philosophy for 1813.

of them refuse to pass to the other? Will it pass through a tube? This brought him to the grand discovery; for it appeared, that the flame of the most explosive mixture would not pass through a small tube,—that the communication was more easily prevented, in proportion as the tube was of a better conducting substance, and therefore operated by *cooling* the flame below the point of kindling. It was only then to surround a lamp with a transparent envelop communicating with the surrounding air by metallic tubes, and thus the air might enter freely to feed the lamp, while the flame would not be communicated to the surrounding atmosphere, in the most explosive state in which it ever could exist in a coal mine. Subsequent experiments proved, that in case the diameters of the tubes were very small, their lengths might be diminished to mere apertures; and hence it was only necessary to surround the lamp with wire gauze, and the air would enter freely to supply the lamp, while the flame could not pass through the apertures of the gauze.

The experience of fourteen years, while the safety lamp has been in constant and extensive use in the coal mines of England, without the occurrence of a single explosion,* is the best comment upon the correctness of the principles which led on step by step to its construction, as well as the highest testimony in favor of the benefits which this invention has conferred upon society. We are not aware of any other example of a great invention so purely philosophical as this. Most inventions have been partly at least the suggestion of accident. But here our philosopher *commenced*, not with constructing a lamp, but with inquiring into the *nature* and *properties* of the agent which he had to control. He *began*, like the Philistines of old, by learning where lay the secret of its might; this being discovered, it was shorn of its strength as easily as the giant of Israel. But he did more than simply disarm the foe: he made him his slave. In the most explosive mixtures, the flame of the lamp is greatly enlarged, and its light much augmented; and by this change, it gives to the miner instant warning of the approach of danger.

These researches on the specific nature of explosive mixtures of carburetted hydrogen and common air, led to the more general inquiry, *What is the nature of flame?* It is somewhat remarkable, that in all the researches which had been made, and the theories which had been proposed, on the subject of combustion, the nature of flame

---

* Graham's Elements of Chemistry, 1829.

itself had never been investigated. The inquiries of our philosopher on this point, evince how much an original and inventive genius may find to exercise its powers, even in subjects that seem to have been entirely settled and exhausted.

After the year 1812, Sir Humphry does not appear to have exercised the vocation of a chemist professionally; but his attention was immediately recalled to the subject, whenever any new discovery of importance was announced. Thus, in 1813, soon after the discovery of *Iodine*, he happened to be at Paris, "receiving (says Dr. Ure) amid the political convulsions of France, the tranquil homage due to his genius." Two able chemists, Messrs. Clement and Desormes, had investigated some of the properties of this singular substance, but had come to no decisive conclusions respecting its nature. Dr. Ure informs us,* that the English philosopher penetrated at once, with intuitive sagacity, the mystery which hung over it, while he and M. Gay-Lussac set out about the same time, and with equal ardor, to investigate its relations to other bodies, that is, to ascertain its nature. In finding its relations to such chemical agents as oxygen, hydrogen, and potassium, it soon became evident, that it was a body of the same class with oxygen and chlorine; and so much strength was thus acquired by Davy's views respecting the nature of chlorine, that, as we have already remarked, scarcely a chemist of the age any longer hesitated to embrace them.

In 1820, the discoveries of Mr. Oersted of Copenhagen, respecting *the connexion between magnetism and electricity*, opened another new field for original research, and Sir Humphry appeared again among the foremost to explore it.† Thus, while he seemed to have retired from the profession of a chemist, yet in every thing that appertained to the enlargement of the science, he resumed his labors so effectually, that his authority was still quoted oftener than that of almost any other man.

By the death of Sir Joseph Banks, in 1820, the presidency of the Royal Society became vacant. The pontifical throne, or the regal diadem, could hardly present to the ecclesiastical or political aspirant a nobler prize, than the chair of Newton presents to the philosopher or the scholar. Of the manner in which Sir Humphry Davy was placed in it, we are furnished with the following account.‡ "Sev-

---

* Dictionary of Chemistry, Art. Iodine.

† Phil. Trans. 1821, pp. 7 and 425. ‡ Month. Mag. 1. 383.

eral individuals of high, and even very exalted rank, were named as candidates; but the scientific part of the society, justly considered this honor, the highest that a scientific man can attain in Britain, not as a proper appendage to mere rank and fortune, but as a reward for scientific merit. Amongst the philosophers whose labors have enriched the Transactions of the Royal Society, two were most generally adverted to, Sir Humphry Davy and Doctor Wollaston; but Dr. Wollaston, whose modesty is only equalled by his profound knowledge and extraordinary sagacity, declined being a candidate after his friend had been nominated, and received from the council of the society, the unanimous compliment of being placed in the chair of the Royal Society, till the election by the body in November. A trifling opposition was made to Sir Humphry Davy's election, by some unknown persons, who proposed Lord Colchester; but Sir Humphry was placed in the chair by a majority of nearly two hundred to thirteen. For this honor, (continues the journalist) no man could be more completely qualified. Sir Humphry is perfectly independent; and in circumstances which enable him to support his office with dignity. He is acquainted with foreign languages, and extensively connected with foreign men of science. He possesses that general knowledge necessary for justly estimating all the different branches of science, and his reputation, in his own particular pursuits, is such as to place him above all jealousy."

The last great scientific effort of Davy, was *his discovery of a method of protecting the copper sheathing of ships from corrosion by sea water*. The history of this undertaking, as well as its mode of accomplishment, bears a strong analogy to that of the safety lamp. He entered upon it at the request of the Navy Board of Great Britain, and prosecuted it by steps indicated solely by philosophical principles. The method of proceeding in this and all similar cases, seems indeed to be sufficiently simple and obvious—namely, first to ascertain the cause of the evil, and then to find out how to control it by studying its nature. But obvious as this method of making great discoveries is, yet it has rarely been followed; but most discoveries, in their first stages at least, have either been stumbled on by accident, or been the fruit of experiments, that were more or less empirical. The principles that guided Sir Humphry, on the present occasion, were suggested by a theory proposed and expounded by him in the Bakerian Lecture for 1806, of which the leading points were as follows: That chemical and electrical attractions are identical, or at least dependent on the same cause; that, consequently, substances will combine only when they are in different electrical states; and that, by bringing a body naturally positive into a negative state, its usual powers of combination are altogether destroyed.* He informs us, that he was conducted by these principles, to the discovery of the metallic bases of the alkalies. For, if potash, for example, were a compound, and its constituents were held together in consequence of their being in opposite electrical states, then, according to known laws of electrical attraction and repulsion, it was only to apply to them electrical powers of greater intensity, and they would be separated from each other,—the negative constituent would leave the positive for a body positive in a higher degree, and the positive constituent would leave the negative for a body negative in a higher degree. Now the voltaic apparatus, (which admits of indefinite extension,) affords the means of producing the opposite electricities, at the two poles, of a degree of intensity exceeding that which exists between the constituents of any given compound, and thus all the combinations of matter are brought under its dominion. Although this hypothesis was adopted by Berzelius, certainly one of the most competent judges in the world, yet it had not been generally received by chemists. Its author, however, had some reason to feel attached to an hypothesis, which had conducted him to so successful a result in his galvanic researches, and he resolved once more to follow its suggestions. He reasoned thus:—the cause of the corrosion of the copper sheathing of ships is a chemical action of sea water upon copper, and this is owing to their being in opposite electrical states, the copper positive and the water negative. How shall this action be destroyed? By rendering the copper negative; for then the metal and the water being in the same electrical state, no affinity can exist between them. Now tin, and zinc, and iron, being respectively positive in a much higher degree than copper, have each the power, when joined to copper, of rendering it negative. Indeed it was ascertained by trial, that so great was the power of these oxidable metals over copper, that a piece of tin soldered to a sheet of copper, would protect a surface one hundred and fifty times as large as itself *perfectly*, and would *partially* protect a surface one thousand times as large as its own. After various trials, cast iron was found to be on all accounts, the most eligible substance for protecting copper from

* Phil. Trans. 1824, p. 153.

the action of sea water. All the facilities for trying these experiments on a large scale, were afforded him by the government, at the magnificent naval establishments at Chatham and Portsmouth; and the results promised to provide a complete remedy for the evil under which the navy and commerce of Great Britain had suffered so severely. But a consequence which ought to follow in accordance with the hypothesis, and which the author had anticipated, (though not to the extent it occurred,) has limited, if not entirely subverted the practical utility of the discovery. The copper sheathing, rendered artificially negative, acquires the power of attracting all those ingredients of sea water, which are naturally positive, as lime and magnesia. These form a crust on the surface of the copper to which seaweeds and shell fish adhere, which in long voyages create an impediment, that is paramount to the advantages derived from the protection of the copper from corrosion. Although an unexpected consequence has limited, or at least for the present embarrassed, the practical applications of this discovery, yet the object sought for, namely, *to protect copper sheathing from corrosion by sea water*, was fairly and fully attained; and the philosophical process which conducted to the discovery, was complete and perfect, like that which led to the invention of the safety lamp.

We have watched this bright orb in its ascent through an unclouded and glorious morning, and have traced its radiant path as it moved along its zenith; but we are now pained to behold it suddenly arrested, and in a moment withdrawn forever from our gaze. We have learned, that from the year 1827, the health of Sir Humphry began to decline, and that after many months of severe and dangerous illness,* he had recovered so far as to be able to resort to his favorite climate in the south, but still led the life of an invalid, until a sudden death released him from his sufferings. We presume he alludes to himself in one of the concluding sentences of his last beautiful little work, *Salmonia*, where he makes one of his characters say, "Ah! could I recover any of that freshness of mind, which I possessed at twenty five, and which, like the dew of the morning, covered all objects, and nourished all things that grew, and in which they were more beautiful even than in sunshine, what would I not give!—All that I have gained in an active and not unprofitable life."†

---

* Salmonia, p. v. † Ib. 271.

We can hardly trace the progress of a man through life, whose actions were all great and whose enterprises were all successful, without seeming to indulge too much in the spirit of eulogy; but it is certainly true of here and there a mind, *Nihil tetigit, quod non ornavit.* We pretend not to know any thing of the private history of Sir Humphry Davy, but we have for a number of years contemplated his character through the medium of his works, and we are free to say that we regard it as constituted of a very unusual assemblage of great and noble qualities. Quickness of perception and "patient thought"*—inventive genius and strong reasoning powers—perseverance to complete what ingenuity has begun, and an eloquent tongue to utter, what a profound and brilliant mind has conceived: these qualities were all interwoven, in fine proportions, to form its bright and varied tissue. And, although we must not presume, from his works alone, to make a complete analysis of his moral qualities, yet it is impossible not to recognize in his history, as derived from these sources, many incidental marks of an amiable temper and refined feelings, allied with heroic courage. Pursuits which have early engrossed the powers of genius, and opened its pathway to fame, sometimes create, artificially, a disrelish for other objects, and a tendency to undervalue their importance. But the personage we are contemplating, was evidently incapable of any such exclusive feelings. The noble progeny of genius or intellect, wherever found, a spirit like his would at once acknowledge as its kindred. Accordingly, his Discourses before the Royal Society exhibit striking proofs of liberal and generous feelings, towards all the votaries of science. We have been so strongly impressed on this point, that we cannot deny ourselves the pleasure of making one or two extracts from these Discourses, in illustration of it. Our first extract shall be taken from the discourse delivered on the occasion of presenting the Society's medal to M. Arago, of France, for his discoveries in magnetism.

'Far be from us that narrow policy which would contract the minds of individuals, and injure the interests of nations, by cold and exclusive selfishness; which would raise the greatness of one people, by lowering the standard of that of another. As in commerce, so in science, no country can become worthily pre-eminent, except in profiting by the wants, resources, and wealth of its neighbors. Every new

---

* The motto of Newton.

discovery may be considered as a new species of manufacture, awakening moral industry and sagacity, and employing as it were new capital of mind. When Newton developed the system of the universe, and established his own glory and that of the country, on imperishable foundations, he might be regarded as giving a boon to the civilized world, for which no adequate compensation could ever be made; yet, even in this, the most difficult and sublime field of discovery, Britain has been paid, if not fully, yet fairly, by the labors of Eüler, La Grange, and above all, La Place; perfecting the theory of the lunar motions and planetary perturbations, and affording data of infinite importance in the theory and practice of navigation. Fortunately science, like that nature to which it belongs, is neither limited by time nor space. It belongs to the world, and is of no country and no age. The more we know, the more we feel our ignorance, the more we feel how much remains unknown; and in philosophy, the sentiment of the Macedonian hero can never apply; there are always new worlds to conquer.'—(Discourse IV.)

The Royal Society of London has been censured for having of late years suffered their attention to be withdrawn from those severer sciences, for which that body, as their earlier volumes of Transactions clearly prove, were formerly much distinguished. It is peculiarly gratifying therefore to find their president so orthodox on this point, as he shows himself to be, in the discourse delivered on presenting the medal to Mr. Ivory for his mathematical performances.

'I feel the highest satisfaction (says the President,) in anticipating that this reward may renovate the activity of the Society upon this department of science, and that it will return—'Veteris vestigia flammæ'—with new ardor to its so long neglected fields of glory. Whether we consider the nature of mathematical science, or its results, it appears equally amongst the noblest objects of human pursuit and ambition. Arising a work of intellectual creation from a few self-evident propositions on the nature of magnitudes and numbers, it is gradually formed into an instrument of pure reason of the most refined kind, applying to and illustrating all the phenomena of nature and art, and embracing the whole system of the visible universe; and the same calculus measures and points out the application of labor, whether by animals or machines, determines the force of vapor, and confines the power of the most explosive agents in the steam engine, —regulates the forms and structures best fitted to move through the waves—ascertains the strength of the chain-bridge necessary to pass across the arms of the ocean—fixes the principles of permanent foundations in the most rapid torrents; and, leaving the earth filled with monuments of its power, ascends to the stars, measures and weighs the sun and the planets, and determines the laws of their motions, and can bring under its dominion those cometary masses that are, as it were, strangers to us, wanderers in the immensity of space; and applies data gained from contemplation of the sidereal heavens, to measure and establish time, and movement, and magnitude below.'*—(Discourse V.)

To conclude, we look upon Sir Humphry Davy as having afforded a striking example of what the Romans called *a man of good fortune;*—whose success, even in their view, was not however the result of accident, but of ingenuity and wisdom to devise plans, and of skill and industry to bring them to a successful issue. He was fortunate in his theories, fortunate in his discoveries, and fortunate in living in an age sufficiently enlightened to appreciate his merits;—unlike, in this last particular, to Newton, who, (says Voltaire) although he lived forty years after the publication of the Principia, had not at the time of his death, twenty readers out of Britain.† Some might even entertain the apprehension that so extensive a popularity among his cotemporaries, is the presage of a short-lived fame; but his reputation is too intimately associated with the eternal laws of nature to suffer decay; and the name of Davy, like those of Archimedes and Galileo and Newton, which grow greener by time, will descend to the latest posterity. O.

Art. II.—*Architecture in the United States.*

To my former remarks on the importance of this subject to our country, I beg leave to add a short extract from Lord Kames' Elements of Criticism, which is valuable as it brings experience to our support, the best support in our reasonings about men.

"I add another observation, that both gardening and architecture contribute to the same end, by inspiring a taste for neatness and elegance. In Scotland, the regularity and polish even of a turnpike-road has some influence of this kind upon the low people in the neighbourhood. They become fond of regularity and neatness; which is

---

* See Edinburgh Review, Oct. 1827. † Playfair, Diss. II.

displayed, first upon their yards and little enclosures, and next within doors. A taste for regularity and neatness, thus acquired, is extended by degrees to dress, and even to behavior and manners. The author of a history of Switzerland, describing the fierce manners of the Plebeians of Bern three or four centuries ago, continually inured to success in war, which made them insolently aim at a change of government in order to establish a pure democracy, observes that no circumstance tended more to soften their manners, and to make them fond of peace, than the public buildings carried on by the senate for ornamenting their capital: particularly a fine town-house, and a magnificent church, which to this day, says our author, stands its ground as one of the finest in Europe."

I now proceed to the more practical part of the subject, and shall consider it under the following heads:

1. The best ground for a city or town, with the best mode of laying out such ground.
2. Public edifices and public monuments—with the architecture best adapted to them.
3. Private buildings and private grounds.

The reader and I may keep company through an article or two beside this, and we should be better acquainted before we start. He must excuse then the title: there is no word in the language exactly suited to the subject, and this will answer perhaps as well as any other. He must also excuse some egotism: it will be necessary to apply individual taste to the matters under discussion, and the first person singular must often come in from necessity. On the other hand, he is invited to criticise freely and to find fault whenever he may choose. My remarks will be based on some observation both at home and in other countries, and on some thought and study; but still I wish no one *in verba mea jurare*, and particularly in matters of taste. I wish the public to use their own judgment and their own taste, and shall think my time well spent if I can only draw their attention to a subject so interesting and important.

In selecting ground for a town or city, regard should be had to convenience, beauty and health. The first of these is so changeful in its character and so little subject to rule, that we must leave it to take care of itself, which it will never fail to do: health and beauty are fair subjects for our consideration. The usual practice in our country, and particularly in the West, is to give even ground the preference, and where it cannot be obtained, the surface is generally levelled, often at considerable expense. This is perfectly natural. On meeting with a level tract of country near a handsome stream, our first exclamation is apt to be, "what a beautiful spot for a town;" and in selecting ground to be passed over frequently,—perhaps in after ages to be constantly traversed by dense crowds, it seems proper that the most level should be selected. But natural as such a choice may seem, still it is not wise. A city on level ground can never be a cleanly one. Extreme muddiness may be avoided by paving, and extreme filth by frequent application of the scavenger's broom; after all this expense, however, such a place will be filled with offensive sights and smells. The offals of shops and kitchens will still accumulate: stables will still send up their noisome effluvia, and mire will still every where abound. There is no sweeping so good, while there is none half so cheap, as that which we may receive from a smart shower of rain. Such a cleansing however is impossible in a level town. The waters, instead of forming themselves into rapid and healthy streams, here flood the street, or gather into pools, which send us in long circuits by day, and deceive our eyes by night: collecting the essence of every putrifying substance by our very door, they change from black to yellow, and from yellow to green, while from day to day they load the air with loathsome smells and sickening vapors. From this there is no escape, and in our changeful climate it is frequent. Every one of our level cities will satisfy us that this is no caricature; and if such is the case now, what will it be when the population becomes far denser, and poorer also, and therefore less able to consult cleanliness or comfort than it is now?

Such a city can never be a handsome one. We may enrich it with marble palaces, and deck them with ivory and gold, still it will be heavy and gloomy and dull. Every one has read of Babylon, the city of sixty miles in circuit, and one hundred brazen gates. It was the perfection of cities, if we make evenness of ground the standard; yet who that thinks of it, stretching league after league over the same unvaried plain, does not immediately tire of its uniformity. We turn from street to street, but the same dead level is before us. We look to the right and left, but the same prospect opens on either side; our feelings become stagnant, and we can consent to live there only by consenting to become as dull as it. Such is a level city. Let us now take a view of Rome. The simple word, "in Capitolium *ascendit*," conveys to my mind, and doubtless conveyed to that of the ancient Romans, a more cheerful idea, than is suggested by all the wealth, and pomp, and splendor of the proud drowsy city of the East. Rome draws half its interest from its seven hills: from the days when Romulus and Remus took their auguries on the Palatine and Aventine mounts, till the choosing of the present Pope, on mons Vaticanus, they have figured most in its history: they mingle in our recollections of every fine description or heroic deed, and were at once the defence and ornament, and just boast of that city—the queen of cities. Even the forum took much of its character, and its orators much of their power from the Capitoline hill, *immobile saxum*, which overhung it, and on which the citadel and the temples of their gods stood out distinct and clear against the bright blue sky. Those spots still breathe a thrilling eloquence; what must they have been in the days of their splendor and glory! We have a Rome or two in our country: I have never seen them, but will venture to affirm that they are built on the most level ground the districts could afford. The ancients understood these things far better. Constantinople is celebrated far and wide for its beauty as it is approached. It has minarets and domes without number: the minaret, tall and delicate, and always white, is a beautiful thing, and scarcely less so is the white swelling dome. But these alone would not produce an effect so like fascination, as the scene rises first before the traveller. It is because these domes and minarets rise from their proud elevation in splendid relief against the sky; because the hills bring now an ivy-draped aqueduct, now a cypress grove, now a palace, now a tower into view, making what is really beautiful appear so, and because that the dense mass of houses below is on every variety of ground, that Constantinople takes the preeminence among handsome views. New York has sometimes been compared to it in regard to position, and the comparison is just; but if the citizens of New York would have the comparison go further, they must save their hills, which I understand, are now fast disappearing before the levelling system, so prevalent in our land. A level spot may serve admirably for a corn-field, but whether it is best for a city I must now submit to the reader's judgment. I would not have abrupt eminences, or high ones, or many: but should still prefer them to a plain: rolling ground, with sufficient inclination throughout, to give a brisk current after a rain, is probably the best. I was going to say that the subject deserves further discussion, but it is so plain, that if our practice were not so universally on the wrong side, it would seem to deserve no discussion at all: *reprobation* is perhaps the more proper word. But this I must leave to the feeling of the public, and pass now to consider the best rules for planning a city or town.

This subject is still more important than the other. We may choose our ground well, but if it is not well used the choice loses half its worth. The ground too for many of our cities is already chosen, and they cannot be removed; but they are extending their limits every year: New York, Philadelphia and Baltimore, have doubled their circuit in the last twenty years; our other cities have increased theirs rapidly: Cincinnati has quadrupled hers in the last twelve or fifteen, and so with many other of our western cities—and all this is still going on and will go on, for many years to come. Our towns also are enlarging with a rapidity this huge world, old as it is, never knew before. Much, very much then can still be done, and the question, as I said, is a very important one—what is the best mode of planning a town? I shall endeavor to go into it at considerable length.

Our practice here too is beginning to set strongly towards one mode, that of squares or rectangular parallelograms. Philadelphia is laid out so, and it is a handsome city: Cincinnati is in the same fashion: I believe nearly all our western towns are so, and the custom is every year extending more and more. I am sorry to see it, and I hope the reader will be so too before we dismiss the subject. Experience shall be our guide in the discussion.

Convenience and beauty should be our governing principle in forming the plan of a city;—and for the first. The citizens of New York I understand, complain on this score; the numerous sharp angles, they say, give their houses, and consequently, the rooms and furniture, an inconvenient shape. The shape may sometimes admit of tasteful lines, and may be agreeable enough to those who own their dwelling and are permanently settled; but for those who are not so well off, it is found difficult to adjust the carpets, furniture and hangings, to such a variety of forms. The rooms also have often an unsightly character. A triangle may be a pretty thing in geometry, but it is difficult to be managed in a house, particularly if its angles be acute. The yard and other grounds they say are also badly adapted for their comfort. I have heard no complaints from Boston, or Baltimore, or Washington, where such angles are common, but the thing seems reasonable enough, and should by no means be disregarded. The rectangular form is certainly the most convenient and handsomest, and therefore the best for a room. Curves are not devoid of beauty and may sometimes be admitted, but sharp angles should be avoided whenever it is possible. They have neither symmetry nor comfort, and I know indeed nothing that can be said in their favor. Such angles will necessarily occur in a very irregular town. Convenience is so far in favor of rectangles in our plan: I was going to add that in such a place, streets and houses are more easily found, but this is easily done in Washington which has every variety of angle. But convenience is not *always* in favor of rectangles. The main paths across a public green are very seldom at right angles, or if made so by the public authorities are soon abandoned by the citizens, for others in an oblique direction. This shows, that if in building, the rectangle is most comfortable, yet in passing from place to place it is not. I would not follow cow-paths in laying out streets, as one of our cities is facetiously accused of having done: but should certainly not disregard those of men. Rectangles may also lead our streets over very inappropriate spots, up steep eminences, or over deep glens and valleys. We should not sacrifice our eminences, and what is then to be done? The reader answers, "in such cases depart from your rectangles"—and this is just the point to which I wished to lead him: but more of this by and by.

Beauty is not in favor of the rectangle. We should judge of the beauty of our city, more from its impression on strangers, than on ourselves. We are accustomed to its forms; its associations affect us; we are warped by our attachment to family and friends, and are no longer fit judges on the subject. We feel all this, and inquire with some anxiety of the stranger what he thinks of it. This may not always be perfectly polite, but the question is still natural enough, and we must only take care that intimacy or friendly confidence between us may warrant it. Who so capable of setting us right where we are wrong, as he who sees with other eyes, and hears with other ears, and who may properly be expected to judge with greater candor than ourselves? I say then we should watch the impression of our city on visiters, and learn wisdom from their remarks. A rectangular city, as far as its plan is concerned, will not be found to interest a visiter long. He understands it easily and its dimensions shrink: he turns angle after angle and it is all the same, till the houses take also this character of uniformity, and however beautiful, cease to interest. He looks along a street: it stretches far before him, and he feels as we do in looking up a long straight road—it may be very convenient but we feel no disposition to pursue it further, though it may be planted with elms and dressed with rich vines, and enlivened with the sweet melody of birds: we are just as well off where we are, why go further? But give that road a turn near us, and our curiosity is immediately excited to pursue it further. I recollect a road not far from Wooster in Ohio. It ran, I think, six or seven miles as straight as an arrow, and when I travelled on it, became at last absolutely painful to me. I began to feel like a man in a strait jacket, and perhaps the road contractors would have said I deserved one. But to return to our rectangular city. Every one will recollect his sensations, on turning from street to street, and finding the same long vista before him. It may please for a few moments at first, but the feelings soon grow dull and stagnate, and he turns listlessly away. Such a city has two important principles of beauty, symmetry and neatness; but, in a city at least, variety is essential to beauty: this is uniform, and therefore soon becomes dull. We love variety, and nature has provided largely for it: no two scenes are alike, though rocks, hills, trees, valleys and streams may go to the composition of both. We should soon tire of nature if things were so, at least if they were often so. At a first visit to a spot, it is the constant succession of new views taking us by surprise and sharpening curiosity, that delights us: afterwards it is this adaptation of forms to our nature, this variety suited to our love of variety, that fixes itself so strongly on our souls. Other principles of our nature, no doubt, are acted on, but this is among the uppermost. Let us bring it to the test. Suppose close together two beautiful scenes exactly alike in all parts: they would excite our wonder, but apart from this, would there not be a strong disappointment in our feelings? Would not the one we saw first, sink in our estimation because the other was just like it? Let us go further: suppose there were three such, we should wonder more for a short while and then begin to be indifferent: four, we should begin to tire: five, we should be weary: six, it would require an effort to look at them, and we should then begin to dislike. I will change the case. Let the reader suppose himself in a forest with a handsome glade by his side: he turns and has one exactly like it by him again: a few feet more and another comes; and again another, and so on without end. Those trees might be different in shape and in their leaves, but if disposed, as was said, exactly alike in all cases, would he seek that forest again for a pleasant walk? Again, suppose this variety of trees were disposed in the form of uniform avenues, stretching far as the eye could reach, whould he then be greatly pleased? But suppose these avenues in every variety, now broad and open, now shaded and narrow, one while opening to a wide stretch of landscape, and at another pointing to a rocky glen: how our feelings change at the thought! This is the effect of variety. No city then should be uniform, not even uniform in beauty, or it will pall and tire. I love, myself, in traversing a city to be taken by surprise; to be able to anticipate some new form, or combination of forms, at every turn; to have my admiration constantly drawn upon by the taste and judgment shewn in these combinations, and to have the city swell out and magnify its dimensions from my only half successful effort to comprehend them. A word or two on this last subject: it is of no great consequence, but should not be altogether neglected, in our discussion. Every one will recollect his surprise on ascending a steeple in an irregular town, or an adjoining eminence, and looking down on it to find it so small: it is but a short time since I took such a view of Hartford, and found it but little more than half as large as I had imagined. This is natural: the constant effect of partial obscurity is to magnify, and no one will neglect it when he wishes to strike us by the vast or grand. I recollect my chagrin at Niagara Falls, when after a toilsome effort to see it from every point, I found that the best view was most easily had. It was on a spot some dozen or twenty yards S. W. from the table rock. The water there rushes by our feet, in large volume and with terrific rapidity, is precipitated over the ledge and lost to our sight: further on we can trace the roaring element nearly to the bottom, but the bottom can no where be seen, and from the shaking of the ground, the deep roar and the spray, our imagination makes the descent twice as great as it really is.

The conclusion then from the whole is this: that rectangles are convenient for building, and should therefore be used; but that they produce a tiresome sameness, against which we should carefully guard: that irregular cities are best accommodated to motion or change of place; that they keep our interest alive by their variety, and other things being equal, affect us most by their size. Each has its advantages: they may be easily combined, and I shall proceed to some remarks on the best character of such a combination.

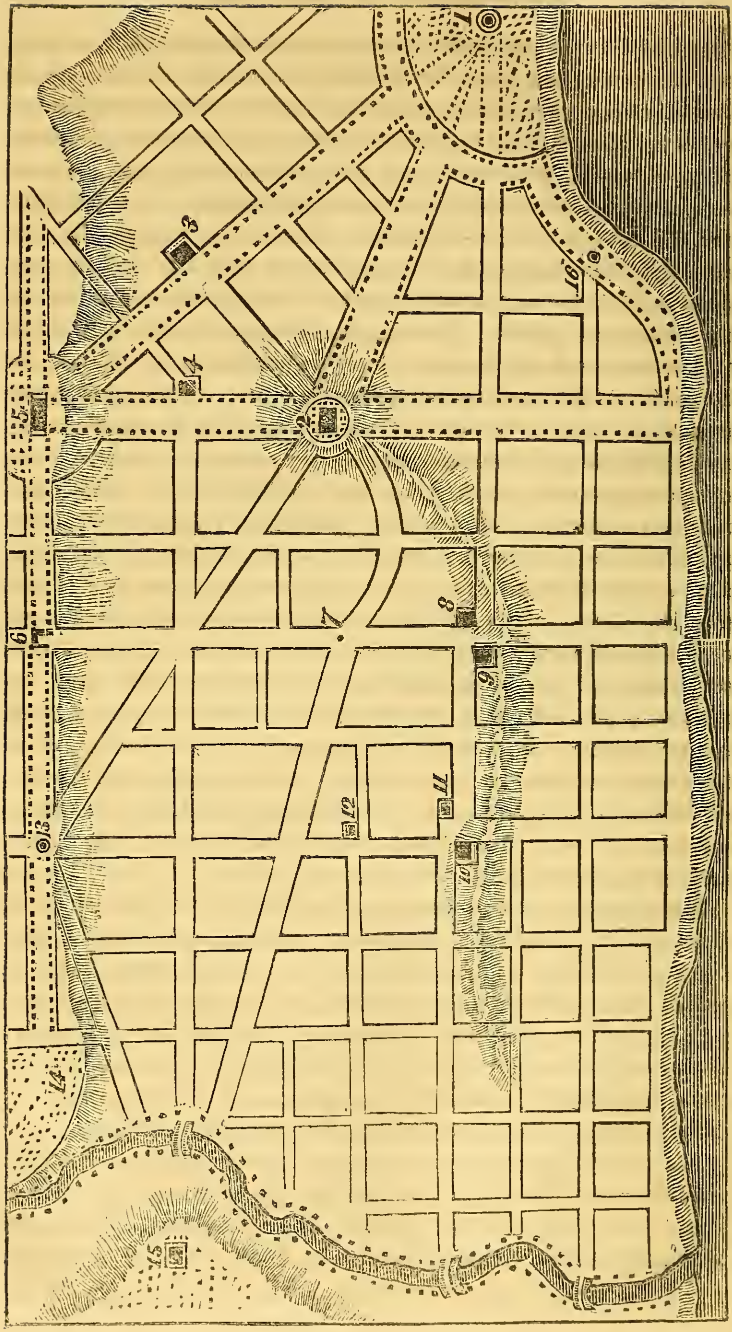
In laying out a town, we should first carefully study the ground. There are no places, even the most level, that do not offer in some spots greater advantages of ground than in others. These should be seized upon and turned to the best account for beauty or convenience, but particularly for beauty; for convenience will usually take good care of itself. A proper use of these will insure sufficient variety to a city, and the remainder of the site may be occupied by squares and rectangular parallelograms. Even these last however, if carefully adjusted, will admit of very great variety, as I shall presently show: Sameness should always be avoided: if it is tiresome in a landscape, it is doubly so in the plan of a city, in which walls and windows and roofs are necessarily much alike, and uniformity is apt enough to come without being sought. A city like the one I propose, would unite convenience, symmetry, neatness, variety, and beauty: I add also elegance, and shall now proceed to take it up in detail.

We are first to study the ground, and ascertaining its several advantages, form the main features of our plan from these: I consider rounded eminences of moderate elevation a very great advantage. There are few towns that have not some heights: where there are none, other spots may be selected for the same purpose, though they will not suit so well. To show the reader what use I wish to be made of them, I will convey him for a few moments to Marseilles, in France. In the new part of that city, are two wide streets, called Les allées des Capuchins, and Les allées de Meilhan. They start from another called Le Boulevard, and meet at no great distance from it, forming with each other an angle of about thirty degress. Each is planted with four rows of trees, forming three well arched and handsome avenues, the ground below being firm, dry, and rounded from the middle to a channel on each side: the parts outside and next the houses are appropriated to carriages and wagons, which are excluded from the avenues. At the point where the central avenues of the two streets meet, is a fountain, cheap and plain, but of exceeding beauty. It is a large basin of water, elevated five or six feet, and handsomely sodded around: from the centre shoots up to a great height a single, delicate, silvery jet. I have seen the splendid fountains in the portico of St. Peter's, at Rome, but they did not affect me with half the pleasure that was given by this simple small stream amid the green well arched trees. It goes to prove what I have already said, that great wealth is not necessary to the cultivation of taste. Indeed most of the fountains at Rome err on this point. They pour forth immense volumes of water amid marble basins and tritons, and seahorses and cars; but I think taste would prefer even the simple

Turkish fountain with its soft gurgle, the huge plane overshadowing it, the rude bench beneath the tree, and the doves cooing in the branches. But I have wandered from my object and return. The fountain at Marseilles, from its position, belongs to both the streets of les Capuchins and Meilhan, and is an exquisitely beautiful termination to the vista in both. At the point where Les Allées des Capuchins meets Le Boulevard is a handsome obelisk, thus an ornament to both these streets. I was pleased with this method of multiplying ornamental objects, and should keep it constantly in view in drawing the first and main features in the plan of a city. A handsome edifice with five streets diverging from it, would be equal to five such edifices placed so as to have only one point of view. With so many radiating lines, however, our city would be greatly cut up and filled with sharp angles, and we must be extremely cautious how the system is used. It would be best to have but a few points for numerous radiating lines, but the principle might be employed on a smaller scale through most parts of the city. Those few points should be on eminences, for a handsome object always appears best on an elevated position : the edifices placed there should be the most important and beautiful in the city, and some of the streets diverging from them, should be the widest and handsomest. To all these our main attention should be directed : a few other points for a few radiating streets and objects of less consequence should be selected, and the remainder of the ground be filled up with rectangular or oblique streets, as convenience might dictate, without however a total disregard to beauty.

The reader who has been at Washington will immediately think of the plan of that city, and there is a very strong resemblance between it and the one I propose. That of Washington has always been greatly admired, and if ever filled up as seems to have been originally expected, will give us indeed a beautiful and splendid city. Those who have not seen it, will readily understand the plan. The Capitol and the President's house, a mile distant from each other, are made radiating points for numerous wide streets which are called avenues, and are named after the several states. The whole plan is nearly four miles in length, and the parts not thus occupied are supplied with streets crossing each other at right angles, directed, I believe, to the four points of the compass. The whole is worthy of our national capital, and with some few exceptions, is an admirable plan. But it is not suited to a smaller city or a town. The avenues occupy too much ground to recommend it for extensive adoption, and are perhaps too numerous even for Washington, though all the ground should be filled up. Amid such a large number of handsome streets, proper regard would probably not be paid to any, and even if it were not so, I would not repeat even a handsome thing very often: a handsome object looses half its value the moment it is made common. I have two other objections. The first is the large breaks occurring frequently in the avenues where they are crossed at an acute angle by the rectangular streets. One of these occurs just below Williamson's hotel. The triangle adjoining will probably be filled up, but there will still remain a most unsightly gap on that side of the avenue. If I recollect right, there are two or three similar ones between that and the capitol. The other objection is connected with this. The plan has too much regularity: perhaps I should express my meaning better, should I say that it wants variety. Washington has great advantages in the nature of its ground: instead of consulting these, however, the two radiating points are determined on, the avenues from them are fixed, a few other avenues planned; the rectangular system is then applied; and the whole are left to run over steep hills and deep valleys as their fate may direct. Some of them are on the sides of abrupt descents, and beautiful as the plan appears on paper, I know of no city where the streets are so uncouth as are some of those in Washington. And I do not see how they can ever appear much better. An avenue of this character (called I believe Delaware avenue) passes just East of the botanical garden: and a street equally unmanageable ascends immediately back of Mr. Carroll's mansion.

We should not adopt, then, any one system to be carried uniformly through our whole plan. The nature of the ground should govern us; we should consult this in all parts: turn it to the best advantage, counteract its inconveniences, and fill up the intermediate parts as may best suit our purpose. I present a plan that will explain my views better than description. It is not given as a *beau ideal* of a town, but simply to elucidate my remarks. I have taken for it no other advantages of ground than can be found in any of our cities or towns. No. 2, is a circular eminence, which I seize upon for a town-house or other handsome building of general public interest. From it diverge six streets, three of which are broad avenues, and by directing them, not by a fixed rule, but at will, I make four or



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

five point to some interesting object. The sixth is a curved street:* the stranger enters it, wondering whither it may lead, and finds it open suddenly on a fountain or pillar: before him is the broad street pointing to No. 15, a handsome public or private house, a public monument or something of the kind. On his right, at No. 6, is an arch crowning an eminence, also a handsome termination to his view. The reader must not start at the mention of arch and pillar and obelisk: I will speak at length of them shortly, and will reconcile him, if not to their present use, at least to provision for them among our posterity. No. 5 is also on an eminence, and has five diverging streets: it is a retired spot, and is suited to a building or buildings requiring retirement; and we have many such—colleges, hospitals, retreats, gymnasia, &c. The remainder of the plan will be explained by the list of references which is attached.† A word on the objects from 8 to 10: their position combines the advantages of both the rectangular and the diverging system, and can be used to produce variety and to prevent the introduction of numerous acute angles, which should be avoided whenever it can be conveniently done. Some of the streets it will be observed are wider than others, a circumstance which builders, on account of their varied means, will find an advantage. Some persons prefer building or living in narrow and retired streets; others seek those more public and open to observation. In this plan, I think regularity will be found combined with variety, simplicity with beauty, and symmetry with a sufficient attention to the multifarious circumstances of man. There is scarcely a street in it that does not present some handsome object to the view: there is scarcely a turn that will not surprise us with something unexpected, and it is at the same time of such a character as to be accommodated

---

* There is a specimen of the curved street in Boston, which is admired by every one who visits that city: the curve however should be admitted cautiously into our plan.

† REFERENCES.

1. Public green, with a fountain in the centre.
2. Town house.
3. Church.
4. Small public building.
5. Large do. do.
6. Arch.
7. Fountain.
8. Bank.
9. Church.
10. Church.
11. Bank.
12. Church.
13. Pillar or obelisk.
14. Public burying ground.
15. Handsome dwelling, or Public monument.
16. Pillar or obelisk.

N. B. The dots represent trees.

to the circumstances of almost every town in our country. If it has not these advantages, as I have remarked freely on the plans of others, I am willing that they should remark freely on mine.

The spots marked 3, 4, 8, 9, 10, 11, and 12, I have reserved for public buildings, churches, banks, and the like. I say reserved, and the word is meant to have a meaning beyond a paper plan. Such edifices are always expected to be ornamental to a city, and the public complain when they are not so. The public act justly, but those who build them have also a right to expect something from the public. Duties are always reciprocal. If the public wish societies to erect handsome edifices, it should give them ground that will shew these edifices to advantage; not compel them to build, as it very often does, in lanes, and amid the very vilest tenements in the city. All this may easily be effected, by reserving ground at the first laying out of our towns. Let this be done: let the public then at proper times offer these desirable situations to those societies or companies that will improve them most, and architecture will take a start among us, of which we can now scarcely conceive. Cherished, it will labor hard for us in return; our cities will be ornamented; our towns will follow, and the land will become beautiful as it is blessed.

It will also be a better land. I have already noticed the action of handsome architectural objects both on the mind and morals, refining and enlarging the former, and giving to the latter a more cheerful and a purer cast. Some more remarks of the kind will come in, in connexion with the subject I now take up, which is public monuments, pillars, obelisks, arches, and fountains in a city. There is a well shaded street in Marseilles called *le Cours*, with a broad raised way in the centre, secured from wheel carriages by the public laws. It is the favorite place for the *promenade*, and must interest every visiter, if not by its own beauty, yet by that which every evening assembles there. Old age totters to the happy assemblage; childhood is there with its sparkling eyes and full hearty laugh: gain smooths its brow and comes to this holiday of the cheerful feelings, and the whole scene is a most animating and pleasing one; I am sorry we have nothing like it in our country;—but it is of the street I wished to speak. At one end, it ascends an abrupt eminence, and just on the brow of this is placed a marble arch, modelled after the antique. It is well contrasted with the green foliage, and is a splendid termination to the view. I have often regretted that of all the triumphal arches erected among us at the visit of that great, good man, LaFayette, not one remains. I believe all have already perished. That was a bright spot in the history of our country, I should rather say in the history of the world: it was honorable to human nature: it was almost above human nature; and as the whole nation rang with shouts of grateful welcome to its benefactor, angels might have mingled with pleasure in the scene. How I wish posterity could have some striking, tangible memorial of the event. He only who has stood before such memorials, those *stelae* to the proud ages of the past, can know their effect on the mind. We venerate them for their antiquity; our feelings grow softened and sedate before them; the lesson they teach is heard with reverence; all can understand it, and if it be good, all will be made wiser and better by it than by almost any other means. It was then with a true knowledge of human nature, that Joshua ordered his people to convey twelve stones from the middle of Jordan to the banks, and added, "when your children shall ask their fathers in time to come, saying what mean these stones? then ye shall let your children know, saying, &c." Had we an arch to commemorate the visit of that warm, noble hearted, tried, good friend, posterity would place on it a value, compared with which, the gold it might have cost would be a poor and despicable thing. They would lead their children to its base and would teach them there to love a country that had realized more than the highest fictions of the warmest heart; to love their forefathers and to love all their race. It is now too late, but regrets for the past are not futile, if they tend to make us wise for the future.

Let them make us wise for the present. I must beg the reader's permission to convey him to Marseilles again, for a few moments. There is in one of its streets a doric pillar, a simple and plain object, but with the following inscriptions on its base.

"To the lasting memory
of the intrepid men
whose names here follow,
Langeron, Commandant of Marseilles.
De Pilles, Captain Governor Viguier.

(Here follow the names of sixteen other distinguished men, officers and physicians.)

They devoted themselves
for the safety of the Marseillois
in the horrible plague of 1720."

On the other sides,

"Homage
to more than 120 religeuse,
to a large number of physicians and surgeons,
who died victims to their zeal
to succour and console the dying.
Homage to Clement XI.
who nourished Marseilles when afflicted.
Homage to a Tunisian Rais,
who respected the gift
which a Pope made to the distressed."

What incentives to noble feeling may be gathered from that simple pillar. Let us come home now. Philadelphia was visited about thirty years since, by a plague equal in its horrors and ravages to any on record; has it any public tribute to the courage and magnanimity of those men who stood, thinking only of others, amid its appalling scenes? Rush has gone down full of honors to the grave; the rest will soon follow. What a lesson of gratitude for present health, and of human virtue bold, firm and triumphant in danger, might be taught there on a monument, even of the plainest and simplest kind.

I have a word more on public monuments. Congress once passed a vote requesting the remains of Washington, that they might erect a cenotaph over them. The family, though in deep affliction at their still recent loss, granted the request:—nothing further has been done. I will make no comment and will pass the disgraceful matter by. They who say, as has been said in Congress, that the whole nation, or the whole world is the cenotaph of Washington, utter sentiments too fine for our earthly senses; they should offer it to ethereal beings, for it is like the gauze of ancient Cos,—woven wind.

I shall speak of the architecture of arches and columns and obelisks, at another time: at present their position is the object to be discussed. Such objects always appear best on high ground, and situations should there be reserved for them. We may not desire them now but other generations will: let us shew regard to their wants and interests: we are fond enough of making our boast of the future: let us shew that we are proud of it, by giving it reason to be proud of us.

Fountains will do very well on lower ground. They are so rare among us that the reader will be startled at the name. Baltimore I believe has two natural fountains: Philadelphia had formerly a handsome jet in Market street, and I still recollect what cheerful feelings the report of it mingled with my early ideas of that city: but, I believe, it has not played for several years. There may be others in the country, but I have not heard of them. Abroad they are common in every city, producing beauty, health, cleanliness and comfort. Why do we not have them? Our water companies surely are not so parsimonious that they will not give, or our city treasuries so scanty that they cannot purchase for our poor so essential a beverage. Even the Turks may here teach us a useful lesson. With private means not to be compared with ours, and a revenue not half so well systematized or productive, they have made fountains in their cities, in their meanest villages, and even in their high ways, as common and free as the atmosphere itself. The Turkish fountain is always a pleasing object. The whole structure consists of a wall five or six feet high, wide in proportion, and a foot in thickness: it is curved above, and the edges project a little, so as to form a border. In the face of this is a tube, from which gushes the water: a stone basin below, often a huge plane tree overshadowing it, and a rude bench by the side, are the only accompaniments. In Constantinople the fountain is often in a marble building, adjoining the street: the windows have gilded gratings, and between the bars are polished brass cups, attached by a chain. These are kept constantly filled with water, which all persons are at liberty to take, and for which no compensation is offered or received. Nothing strikes a visitor in Turkey so soon, or affects him so favorably towards the nation, as this universal provision of the rich for the wants of the poor. I wish I could see it in our own country. The lowly in life would come to such spots for the needful beverage, and feel that they were not neglected or forgotten: he, who had thought that society was a constant effort of the wealthy to grind and oppress the unfortunate, would leave such thoughts at the fountain: the rich would feel there the pleasure of doing good; and each exclamation of pleasure from the poor or stranger, as he quaffed the fluid, would rise to heaven to befriend his benefactor when gold shall be a mean and worthless thing. I shall remark at another time on the shape of fountains: at present I leave them, and pass to the consideration of—

Greens or public squares.—These are a beautiful ornament to a town, while at the same time they contribute to its health by promoting the free circulation of air. In the towns north of the Hudson, they are frequent, and are the first thing that strikes a traveller in that region of our country: the church, the town house and the academy are congregated there; and the most solemn and cheerful remembrances of a native of New England are always associated with this interesting spot. Further South, where the great heat makes such openings in a city still more desirable, they are seldom found: in the Western states they are occasionally seen. In Europe they are common; but the practice there is different from ours, and I think is the better of the two. Small breaks, sometimes regular, and sometimes irregular, often planted with trees, and, oftener still, ornamented with a fountain or pillar, are very frequent throughout their cities: but that which corresponds to our "green," is always placed on the edge. This is its proper place. I have no objection to retaining our public squares as they are, for they are certainly a great advantage; but we want something more, and in a different situation. This may be ascertained by a single evening's observation in one of our cities. New Haven, for instance, has two handsome greens nearly in its centre, but the evening walks of its inhabitants are never directed there: the most fashionable walk is to "the avenue," on its edge, and to the wooded hill beyond, where, in the latter case, they make public property of what is private. The wants of the public, as I said in the case of streets, are best learned by attending to the actions of the public. There should be, then annexed to each city a spot of proper size, in a situation neither solitary nor public, and so ornamented and shaded as to present in any of its parts a pleasant walk. The trees should be planted now in avenues, now irregularly, one while forming handsome glades, and at another, thick but natural groups: it should have a carriage road winding through it, for the accommodation of those who might wish to ride: it should have plain but solid stone seats, single or in circles or straight lines, for those who might wish to sit: it should in short be a spot where every one could find something to his taste; to which every one would repair on a pleasant evening; and I venture to affirm, that every one would return from it improved in body, heart and mind. No one works on such an evening: why sit listless at home? Here is a social retirement provided, to which all may come, which all may enjoy, where we may meet without parade, and from which we may retire just when we please. Let me exhibit such a spot in another country: it is the Prado or place for the evening *promenade* (in Span. Paseo) of Madrid: the extract is from a highly interesting book, just published, by one of our countrymen. "Thus I missed the pleasure of passing a summer's evening on the Prado; but I heard much upon the subject. It appears, that in that season the walks are carefully sprinkled in anticipation, and if it be a feast day the fountains throw their waters higher. In the evening, thousands of chairs are placed in readiness, in which the ladies take their seats in circles, and hold their *tertulias* under the trees. Bareheaded boys circulate with lighted matches for the accommodation of the smokers. *Aguadores* are at hand with water that is fresh and sparkling. Half-naked Valencians offer oranges and pomegranates. Old women praise their *dulces*, or sweetmeats, for which the *Medrilenias* have quite a passion, whilst the waiters of a neighboring *bottilleria* bring ices and sherbets to gratify the palates of the thirsty. Children are heard on every side, collected in noisy groups, at their pleasant games and pastimes, whilst the humbler crowd seat themselves in circles under the trees, and scratch their guitars, and raise their voices, to make music for a light-heeled couple, who trip it gaily in the midst. Meantime, the falling waters of the neighboring fountains impart a coolness to the air, which comes perfumed from the neighboring garden with the aromas of every clime, and burdened with the song of the *ruisenior*.

"Who can say enough in praise of the Paseo? It furnishes an amusement at once delightful and innocent, and from which, not even the poorest are excluded—a school where the public manners, and the public morals are beautified and refined by social intercourse, and by mutual observation; where families meet families, and friends meet friends, as upon a neutral ground, inform themselves of each other's affairs, unrestrained by ceremonial, and keep alive an intimacy, without the formalities of a visit. In these delightful associations, persons of every rank and of every calling forget their exclusive pretensions, whilst the softer sex to whom belong the attributes of modesty and grace, banish indecorum, and shed a charm over the whole assemblage."*

Whatever the public may think of the present importance of the subjects hitherto under discussion, all must feel the practical character of the one I now approach, which is burying grounds. Every city must have these, and I shall pass at once to consider their best position and plan, after which I shall depart somewhat from the course I have hitherto pursued, to say a few words on monuments, and monumental inscriptions. There seems to be so little probability that the custom of burying under churches, will become prevalent among us, that it seems scarcely necessary to spend time upon it here. I know only one thing that can be said in favor of it, which is, that monuments

* A year in Spain, by a young American, p. 153.

are there raised over the dead, and that such striking memorials of our mortality upon the walls of a church must aid our devotions. And so they might, if such memorials were meant to aid our devotion and adapted accordingly; but they are not. A single walk through an English or Italian church will satisfy us of this. The artist is made to use his best efforts, and we have as the result, an object not to remind us of man's inevitable lot, but of his wealth, his grandeur, his skill; and pride is cherished in us instead of humility. Make not your church a show-house is a lesson which cannot be too strongly inculcated. The Italians have another mode of burial, which is also common in Spain, and probably in other parts of Europe. They select a piece of ground which they surround by a range of small vaulted chambers, opening inward. Each chamber is secured in front by a fancy grating, and has in its floor a small opening, through which is a descent to the family vault below. The sides are lined with monuments, and the appearance of the whole as seen from within is extremely imposing. The enclosed ground is paved with flags above, and occupied beneath by large excavations for the poorer dead. When one of them is to be buried, the proper flag is raised; the body taken from the coffin; let down to putrify among piles of others, and the stone being immediately replaced, lime is poured around it to prevent the escape of effluvia. Naples is said to have one such a vault for every day of the year. The bones are gathered up at proper times and removed to a common receptacle or charnel house. The Greeks bury in walled graves under their churches, the flag above serving for a pavement to the church.

Our own mode is far better than any of these. The custom of having one cemetery common to all denominations, is, I observe, becoming every year more prevalent throughout the country. In New England it is general; in the Western States it is frequent: Washington has adopted the plan, and I believe it is beginning to be extensively introduced in the Middle and Southern States. I hope it will universally prevail. There is no reason why we should carry our distinctive religious characters to the grave, where speculations or forms can no longer profit us; and there *is* great reason that the whole public should unite in their regard to *one* spot, which by greater care and greater common interest, will thus be secured from depredation or insult, and may be made also a handsome ornament, as well as a moral blessing to the town. The best situation for such a cemetery is just without the suburbs, in a retired and quiet spot, and at a distance from great public roads: it should border on the more genteel part of the town, that the solemnity of the place may not be disturbed by unpleasant sights and sounds; and, above all, it should be in a part not liable to be encroached upon in the greater enlargement of the town. The lapse of a few years sees our waste places become villages, our villages towns, our towns cities, and our cities double and treble their extent. Should the burying ground then be in a neighborhood desirable for building, it will soon be surrounded, checked in its increase, filled and abandoned: in a few generations the reverence for it will be lost, and bones laid in the earth in hopes of a peaceful rest, will be thrown out on the world to be subject to vulgar insult and derision. No one can think without pain of this in regard to himself or his friends; and we should avoid it, as I have said, by seeking for our cemeteries, spots least exposed to such things.

There let us bury our dead without ostentation or parade. I have seen so many graves just torn open by hostile pillage, or curiosity, or avarice, that I exceedingly dislike any thing in a grave that can tempt the cupidity of man. I should reprobate even a leaden coffin and almost the common plate used to designate the name and age. A vault may please the living, but is apt to be an evil to the dead. To me certainly it would be distressing, to think that the remains of a dear friend were in an exposed and tempting situation, to be probably in a few ages torn from thence, and scattered wantonly on the world. Far better would it be to have them in the silent earth, where no one would care to search for them; there to repose and mingle quietly "dust with dust," till called to a brighter and happier state. This is a security which even the pyramids have failed to procure.

It would be an interesting employment to analyze the feelings that prompt to the erection of memorials over the dead. We should probably come from it somewhat wiser as to the world around us; for a burying ground with its "storied urns," is after all a better place to study the character of the living than of the dead: but all this is foreign to our purpose. It is sufficient to say that the very idea of a *monument* includes in it, *something that will last.* By a monument in this case, I mean any thing set up to commemorate the dead. In New England the word is generally used to signify a compound of a base and a square prism, surmounted by a pyramid, or urn, or both: in the middle states, a horizontal slab, elevated about two feet, is more common: in both, however, an upright marble slab at the head and feet, is in most general use. I fear a century from this will see most of them scattered on the ground. We want something more substantial, something that will bear the shock or the slow decay of years, unless we mean to build only for the contemporaries of the dead. A monument should be of solid material and of small elevation, or of such a shape as not to be easily overthrown. It should also be in good taste, but simple and plain. I should prefer generally a marble slab, thick and strong, and elevated on solid masonry, only about ten or twelve inches from the ground. This would seem at first thought, plain and simple, to a fault: but one of the handsomest, and I may add, one of the richest burying grounds any where to be seen, is throughout of this character. It is that of the Armenians of Pera and Galatá, suburbs of Constantinople. It occupies about an acre of ground, and is covered with white marbles in the shape and character I have designated. The graves are about eighteen inches from each other: there are wider alleys where needed, and the whole is planted thickly with mulberry trees, and is kept neat and clean. Some of its beauty may be owing to its situation, for it is on the brow of a steep hill, and looks immediately down on the glorious Bosphorus, with its changeful pageants. But close by and on the same height, is the cemetery of the Franks, whom commerce or diplomacy gathers about that proud capital. The monuments in this are rich and gorgeous, but going fast to ruin; the ground is neglected; not a tree or shrub is seen on it; the sun's rays are thrown with a sickening glare from the tombs, and the dust sweeps in eddies among them: the visitor throws a glance at the gilded desolation, and hurries on to the simple, yet beautiful and well ordered cemetry of the Armenians, where he seldom fails to meet some of that people on a visit to the graves of their friends. The Armenians have also a handsome grave-yard in Smyrna, planted with orange and lemon trees: the flags there, however, are flat on the ground, and have too much the appearance of a pavement: but still the spot is an interesting one. Simplicity is no where more suitable than in a burying ground: the solemn, silent abode of the dead is no place for ostentation and display. These may flatter the living, but are out of character with the place, and are a poor compliment to the dead. As well might we dress the corpse for its burial in scarlet, and lace, and brocade. A grave yard should be a spot to nourish fond remembrances of a friend, and to turn our thoughts to another world, not to make us more in love with this one and with ourselves. Let us then build over our deceased friends, monuments lasting and neat, rather than showy and expensive: let us keep the sod around well shorn and clean: let the tree that waves over it be trimmed and neat; let the spot bear witness to our frequent visits; and we honor the dead more than if we gave them a Mausoleum, or inclosed them in prophyry or gold; while at the same time we benefit the living.

Nothing is more difficult than to write a good monumental inscription: yet there is no kind of writing for the public more universally tried. I always reverence the language of sorrow and affection, whatever it may be, and shall treat it mildly, yet I wish to be plain. Such inscriptions should always be brief and simple, yet expressive. What is beyond mere name and date, is meant to be the language of deep grief or warm affection, or of both. The language of such passions is always brief, yet touching and powerful. When therefore I see an inscription very long, or labored, with swelling words and sentences neatly rounded, I think that the writer would have us admire himself rather than the dead, and turn disgusted away. How well the ancients understood this subject. The following is an inscription from a monument found at Delos: I premise that the marble represents two female figures, one seated, the other facing her and with arms crossed on the breast: both are of exquisite sculpture: beneath is in Greek letters,

AGATHOCLEA
DAUGHTER OF ANTIPATER
THOU GOOD MEMBER OF THE SACRED CITY.
FAREWELL.

The inscriptions on the tombs of the ancient Romans were equally brief and equally beautiful.

TO THE GODS MANES.*
THE FATHER
HAS ERECTED THIS
TO HIS EXCELLENT SON
C— B—.
HE LIVED XI Ys. 7Ms. XI Ds.

SER. VALERIUS
SEVERIANUS
HAS ERECTED THIS
TO HIS MUCH LOVED SON
B— M—.
HE LIVED XL Ys.

---

* This word had various applications among the ancients. When used on their tombs it seemed to have meant a kind of genii, who were supposed to take charge of the body at birth, and to watch over it after death: he who violated the tomb offered insult to the Manes.

TO THE GODS MANES.
T. FLAVIUS HERMA
TO HIS REVERED WIFE
FLAVIA HELPIS.*

The following is now preserved in the first gallery of the Vatican.

CINEIA PELAGIA.
MAY THE EARTH
BE LIGHT ON YOU.

These are pagan. There is on the opposite side of the same gallery in the Vatican, a large collection of inscriptions from the graves of the early christians. They are on rough fragments of marbles, and though very brief, carry us, at once, back to those times when the way to the peace of the grave was through torture, fire and blood. The following are some of them.

FELICIANUS AND APETUSA,
IN PEACE.

CONSTANTIA,
AGED XXX YS. XX DS.
IN PEACE.

TO MY HAPPY AND MUCH LOVED WIFE,
WHO LIVED XXVIII YS.
IN PEACE.

Without wishing to recommend any of these as models, I must still be allowed to express my admiration of the simplicity and strong power of the language. It is the language of deep feeling, short and touching; and such should always be the language of a monument where there is any attempt at sentiment. If we are incapable of such feeling, or of expressing it, we shall do best to confine our inscription to name, title and date. I like to see a short verse from Scripture, if appropriate: *poetry is almost uniformly an entire failure.*

A burying ground should be at first not very large, else there will be much waste ground; it will be neglected; will become overgrown with rank vegetation, and will be any thing else than the neat clean spot it ought to be. The plot should be divided into small family compartments, with very narrow passages between: alleys should pass through the whole, but these should also be narrow, for the sake of avoiding waste ground as much as possible. Trees should be planted, not in avenues but adjoining the graves. Avenues would be formal here and out of character: sorrow and affection bear rule in a grave yard, and we never expect them to make such provision for public comfort as is shewn in an avenue. There is a kind of selfish character about them: and it is the only instance in which selfishness

* Vide Montfauçon L'Antiquité Expliquée.

has not an unamiable appearance. Poplars have been used sometimes in cemeteries, but are going out of fashion, and I am glad to see it so: there are few places they can adorn, and a burying ground is not one of them: their roots are tender, but the sexton's axe or saw will soon make that matter equal in all trees, and the additional expense to each individual will be but trifling. Spreading, but delicate trees should always be preferred: the elm is too robust: the weeping willow is probably the best of all; but it should he intermingled with others of the like delicacy of shape.

Let us now turn to examine the cemetery we have been recommending. We pass to the edge of the city, retiring from its noise, and tumults, and cares: we find suddenly before us a neat little spot with a plain but tasteful enclosure. It is well shaded with handsome and delicate trees. We enter and find ourselves among the dead. The monuments are simple, and suited to the sedate and quiet character of the place. Here are those who once walked arm in arm, and shared the confidence and reciprocated the affection of the multitudes from whom we have just parted, and we find from the words of warm affection and of hope on the tombs, from the clean velvet sod around, from the well trimmed willow that throws its sober shade over the spot, and from the marks of frequent visits, that they are not forgotten. Here too, the living shall soon come to their last, long rest; and they know that their children and friends will then shew their memory the same honorable and virtuous affection. There must be a holy cheerfulness about the death-bed of such a people. To know that we are about going away from the world, to be soon forgotten:—that the rank grass will soon grow up, and intermingle with thorns over our grave; that the little mound itself will probably soon be obliterated:—that no one will come near to think of us or speak our name, —this is to add bitterness to bitter death. But here the dead and the living seem still to hold kind intercourse. The former, from their low abode, seem to utter words of friendly admonition, warning, or encouragement. The latter shew that affection in them is stronger than death: they here make themselves familiar with his form and character: the world looses its strong hold; virtue is strengthened; religion comes in her majesty and beauty, and they exclaim in triumph, "O death where is thy sting? O grave where is thy victory?"

Art. III.—*Synopsis of the Organic Remains of the Ferruginous Sand Formation of the United States; with geological remarks; by* Samuel G. Morton, M. D. of Philadelphia; Member of the Amer. Philos. Society; of the Academy of Natural Sciences of Philad. &c.

"Je regarde les caractères *d'epoque de formation* tirés de l'analogie des corps organisées, comme de première valeur en Geognosie, et comme devant l'emporter sur toutes les autres différences quelque grandes qu'elles paraissent."—*Alex. Brongniart.*

Introduction.

The study of that portion of American Geology embraced in this *Synopsis*, has constituted the chief recreation of my leisure hours for several years past; and almost every fact adduced in the following pages has been derived from my own personal observation. But while I speak with confidence of the fossils and mineralogical features of the region in question, I must confess considerable hesitation in repeating the *inferences* I have drawn from them. Not, however, because my opinions on this subject have changed from those already given in the Journal of the Academy; but because I find those opinions are strenuously opposed by a gentleman who is altogether my senior in geological pursuits. I allude to my friend Professor Eaton, whose indefatigable exertions in the cause of science have justly obtained for him a reputation which cannot be enhanced by any encomium from me.

Prof. Eaton, in a late *Geological Prodromus*, announces his intention to prove that "the detritus of New Jersey, embracing the marl, is antediluvial, or the genuine tertiary formation."* That it is antediluvial, strictly speaking, I have no doubt; but I am not yet convinced that it is tertiary. As the difference between us, therefore, is by no means inconsiderable, I beg leave to offer a few details on the subject.

About two years ago Mr. Vanuxem expressed to me his opinion that the fossils of New Jersey denoted a *secondary* origin, and that he considered them, in general terms, as characterizing a deposit contemporaneous with the chalk formation of Europe. I had about the

* Amer. Jour. of Science, Vol. XVII. No. 1. p. 60.

same time compared these fossils with a series from the *green sand** of England, and was so struck with the resemblance as to draw a conclusion which my subsequent investigations have confirmed.

By most of the geologists of continental Europe, the green sand is considered merely as a lower division of the chalk; while in England it is supposed to be a link in a distinct formation, intermediate between the chalk and the oolites. The facts and reasonings of Mr. Alex. Brongniart seem to establish the correctness of the former opinion. Be this as it may, I consider the marl of New Jersey as referrible to the great *ferruginous sand* series, which in Prof. Buckland's arrangement is designated by the name of *green sand;* though the latter appellative has generally been reserved for a *division* of this formation.† On the continent this series is called the *ancient chalk* (la craie ancienne), *lower chalk* (la craie inferieure), &c.—while particular beds of it are called, according to their mineralogical characters, *sable ferrugineux, craie chloritée, craie tufau, &c.* Finally, this formation appears to be embraced in the *quader sandstein?* and *plæner kalk* of Werner.

Extent and Localities.

The *ferruginous sand formation* of the United States contains a considerable proportion of clay, often in beds; hence if it were desirable to have a strictly descriptive name, (no common occurrence in geology) we might call it ferruginous sand and clay. So far as it has been explored, it already presents a considerable range. "It occupies a great part of the triangular peninsula of New Jersey, formed by the Atlantic, and the Delaware and Raritan rivers, and extends across the state of Delaware from near Delaware city to the Chesapeake: appears again near Annapolis, in Maryland; at Lynch's Creek, in South Carolina; at Cockspur Island, in Georgia; and several places in Alabama, Florida, &c."‡

In New Jersey, however, that tract which has been long known as the *marl district*, may be more specifically located, as follows:—Draw two lines, one from Amboy Bay to Trenton, the other from

* The papers by Mr. Vanuxem and myself will be found in the VI. Vol. Jour. Acad. of Nat. Sciences of Philadelphia.

† Conybeare and Phillips describe the ferruginous sand of England as composed of these four subdivisions, counting from below upwards: 1. Iron sand; 2. Weald clay; 3. Green sand; 4. Chalk marle. *Geol.* p. 60, 120, &c.

‡ *Vide* a paper by me in Jour. Acad. Nat. Sc. Vol. VI. p. 127.

Deal to Salem; let the Atlantic ocean connect the eastern, and the Delaware river the western points of these two lines. This irregular oblong tract encloses nearly the whole of the marl region of New Jersey, so far, at least, as it has hitherto been explored; though there is reason to believe that this formation occupies a great proportion of the triangular peninsula south of the Raritan river. Much of the ferruginous sand region, however, is overlaid by deposits of clay, containing lignite, which have been referred, with apparent correctness, to the *plastic clay* formation. Above these clay beds is an almost uniform covering of gray sand; yet in many places, however, the marl, with its peculiar fossils, is found immediately beneath the soil.

In Maryland commences a vast deposit of sand and clay, extending coastwise to the Mississippi; this tract abounds with tertiary fossils, which appear chiefly to belong to the *upper marine* formation of the European geologists.* The secondary strata are occasionally met with beneath it, and sometimes approach so near the surface as to be readily identified by their fossils, as in Maryland, S. Carolina, Georgia,† &c. as already quoted. It is therefore reasonable to suppose that the beds of ferruginous sand extend nearly the whole length of the Atlantic frontier of United States south of Long Island, *though for the most part concealed by the different members of the tertiary class.*

In all its localities this formation has been identified by similar genera and species of organic remains, though all the genera do not exist in every locality. Thus, at the Deep Cut of the Chesapeake and Delaware Canal, the strata are characterized by great numbers of ammonites, baculites and other multilocular univalves. The same remarks will apply to various parts of Burlington and Monmouth counties in New Jersey. Near Egypt, in the latter State, we find ten or twelve beds one above the other, with the genera terebratula and gryphæa. (Ostrea, *Say.*) Near Hornerstown the marl is extremely indurated, and contains terebratulæ exclusively. Near Walnford, also in New Jersey, the fossils are chiefly exogyræ and belemnites; while at Mullica Hill, in Gloucester county, the beds

---

* *Vide* a paper by me in Jour. Acad. Nat. Sc. Vol. VI. p. 116.

† Mr. Peirce (Amer. Jour. Sc. Vol. XI. p. 54) mentions that gryphites and belemnites occur in that portion of Maryland and Virginia, marked alluvial on Mr. Maclures map, but he does not give the particular localities.

contain all the bivalves of which we have spoken, and quantities of belemnites.

The calcareous beds of Gloucester county contain gryphæa, teredo, alcyonium? spatangus, and several species of Linnean madrepores. Crossing the Delaware river into the state of Delaware, we find at St. Georges and its vicinity, great numbers of the genera gryphæa, exogyra, and ostrea.* We have already adverted to the multilocular shells of the deep cut of the Chesapeake and Delaware canal, to which we may add the genus spatangus, and several other genera of echinideæ. The green sand below Annapolis, in Maryland, contains alcyonia. At Lynch's Creek, in South Carolina, exogyræ occur, specifically the same with those of New Jersey and Delaware. At Cockspur Island, in Georgia, the formation is recognized by a prodigious quantity of belemnites. The localities here enumerated will serve to convey a good idea of the productions of nearly all the others.

Mineralogical Characters.

These vary considerably; but our marl most frequently presents itself in minute grains, loose and friable, and of an uniform dull bluish, or greenish color, often with a shade of gray. A hundred grains of this variety gave Mr. Seybert the following constituents:

Silex,	49.83
Alumine,	6.00
Magnesia,	1.83
Potash,	10.12
Water,	9.80
Protoxide of Iron,	21.53
Loss,	.89
	100.00

In a less cautious analysis by Mr. J. P. Wetherill and myself, of an apparently similar marl from another locality, we obtained silex 49.00, protoxide of iron 30.00, alumine 5.50, lime 4.70, the remainder being chiefly water and carbonic acid. Hence it appears that the predominant constituents of these varieties of marl, are *silex* and *iron*. They often contain beds of a dark bluish, tenacious clay;

* The same fossils appear to abound at Middletown Point, and its vicinity in N. J. This locality, however, I have not been able to visit.

sometimes this clay is mixed with the marl, forming the *marly clay* of Mr. Peirce ; in other instances the two are seen in alternate layers.

Again, the *marl* is seen of a yellowish brown color, friable, or compact, and filled with green specks of the silicate of iron. Some of the greenish varieties are also very compact, rendering it extremely difficult to separate the fossils from their matrix. The friable blue marls often contain a large proportion of mica in minute scales.

Other localities present beds of siliceous gravel, (turtia ? of the French) the pebbles varying from the size of coarse sand to one and two inches in diameter. These are cemented together by oxide and phosphate of iron, and contain the same fossils as the earths already described. The most striking instance of this kind is at Mullica Hill, in New Jersey. Similar mineralogical appearances, but without fossils, occur in the lower beds at the Chesapeake and Delaware canal. At the latter place we also find a friable siliceous sand, of a bright green color, answering to the *glauconie sableuse* of Brongniart : also a fine, pure white sand, with abundance of lignite ; and extensive beds of brown and yellow ferruginous sands, more or less argillaceous.

Some of the blue marls which effervesce strongly with acids, contain but five per cent of lime.

Again, we find large beds of calcareous marl, containing at least thirty seven per cent of lime, the remainder being silex, iron, &c. Also a hard, well characterized, subcrystalline limestone, filled with zoophytes.

All these diversified appearances pass by insensible degrees into each other, exhibiting an almost endless variety of mineralogical characters.

The mineral substances found in these beds are, iron pyrites in profusion : chert, (in the calcareous beds) amber, retinasphalt, lignite, and small spherical masses of a dark green color and compact texture, apparently analogous to those found in the green sand of France.* Mr. Hayden suggests to me that these may be the *Discolites* of the Abbé Fortis. Their structure, however, does not appear to be organic, although they often have a shark's tooth, or a small shell, for a nucleus. Larger spherical bodies also occur, resembling the nodules of clay iron stone, so common in some parts of England.

---

* Cuv. and Brong. Desc. Geol. des Env. de Paris, p. 16, &c.

One of the most abundant mineral products of these beds is *lignite.* It is found at the Deep Cut of the Chesapeake and Delaware canal in almost every variety, from charred wood to well characterized jet. Sometimes it is in small fragments, and again it occurs in large masses, representing the trunks and limbs of trees thirty feet in length, and perforated in every direction by the teredo. I intimated on a former occasion* the probability that these lignites belonged not to the tertiary deposits, (as in New Jersey, &c.) but to the Ferruginous sand: this supposition appears now to be still more reasonable, inasmuch as the lignite beds of Delaware are found to be subordinate to strata, replete with extinct multilocular univalves, and other secondary reliquiæ.

Synopsis of Organic Remains.

The following synopsis is designed to present a view of the organic remains hitherto discovered in the American ferruginous sand. The species here enumerated are contained in the valuable collections of the Academy of Natural Sciences;† others are doubtless preserved in private cabinets, but I here introduce such only as I have seen and examined.

☞ Nearly all these fossils are described, and many of them figured by me, in the sixth volume of the Journal of the Academy of Natural Sciences; some are described by Mr. Say, in the first and second volumes of the American Journal of Science; and Dr. Dekay has also described a number of them in the Annals of the New York Lyceum.

CHAMBERED UNIVALVES.

AMMONITES.

1. *A. placenta.* (Dekay.) This species (the largest hitherto observed in America,) was described by Dr. Dekay from a fragment, and will be found in the second volume of the "Annals of the New York Lyceum of Natural History."‡ By some unacountable mistake the description there given refers to the wrong figure in the accompanying plate: thus fig. 2, of plate V, is the *A. placenta*, whereas the

---

* Jour. Acad. Nat. Sc. Vol. VI. p. 113.

† Many of these fossils were presented by Mr. Hugh Lee, Assistant Engineer, employed on the Delaware and Chesapeake Canal, to whom science is under many obligations for his zeal in this respect. The same observations will apply to my friend Mr. William L. Newbold, of Delaware city.

‡ Vol, II. p. 278.

text refers to fig. 5, which is in reality the *A. hippocrepis:* this unfortunate error led me into the mistake of calling the former species by the latter name; as will be seen in my papers in the Journal of the Academy, Vol. VI. pages 88 and 113, and plate V, fig. 4. My descriptions and drawing, therefore, refer to *A. placenta*.

Great numbers of this fossil were found in excavating the Deep Cut of the Chesapeake and Delaware Canal. A fine specimen about fifteen inches in diameter, has been deposited in the collections of the Academy, by Mr. Hugh Lee: and the same gentleman has presented another to the American Philosophical Society, nearly two feet in diameter. It has also been found in many parts of New Jersey. The figure of this fossil given by me in the Academy's Journal, is worse than none: that in the Annals of the Lyceum is better; but both were taken from mutilated fragments. It is to be hoped that the more perfect specimens lately obtained will be soon accurately figured.

2. *A. hippocrepis*. (Dekay.) Annals of the N. Y. Lyceum, Vol. 2, p. 277. This species (as just mentioned,) is represented on the accompanying plate by fig. 5, and not by fig. 2, as stated in the text.* This species is of rare occurrence. I give it on the authority of Dr. Dekay, having never myself seen a specimen of it.

BACULITES. *Faujas.*

B. ovatus. (Say.) This is among the largest species any where described. Some specimens have a diameter of an inch and a quarter; one in the collection of the Academy, is four and a half inches in length. It is found in the blue marls of Monmouth and Burlington counties, in New Jersey, and at the Deep Cut of the Chesapeake and Delaware canal. The smaller individuals strongly resemble those from Maestricht, as figured by Faujas in his description of the mountain of St. Pierre.

SCAPHITES. *Parkinson.*

S. cuvieri. (S. G. M.) This is one of the most perfect and beautiful fossils of our ferruginous sand. Its length is an inch and three fourths; the diameter of the larger whorl an inch and a half. Since I described and figured this shell in the journal of the Acad-

* Fig. 4 of the same plate should be *fig*. 5, and fig. 3 should be *fig*. 4. Without these corrections, (which Dr. Dekay has himself communicated to me,) the descriptions and drawings are unintelligible.

emy, several other specimens have been found, all precisely similar to each other. In England and France this genus is characteristic of the ferruginous sand.

BELEMNITES.

1. *B. americanus.* (S. G. M.) Allied to *B. mucronatus* of Europe. (*Vide* Blainville, Mem. sur les Belemnites, pl. 1. fig. 12. and Sowerby, pl. 600. figs. 1, 2, 4, 6, and 7.) Abundant in the blue marls in many parts of New Jersey. I have no question that some hundreds might be collected in the compass of a few cubic feet. In a paper printed in the Journal of Academy two years since, I referred this species to Lamarck's *B. subconicus*, chiefly, however, from an unwillingness to multiply specific names. The subsequent examination of numerous specimens, and the comparison of them with the descriptions and figures in Blainville, Sowerby, &c. have convinced me that the American belemnites require particular scrutiny. I therefore propose to give descriptions and accurate drawings of them, in an early number of the American Journal of Science.

2. *B. ambiguus.* (S. G. M.) This remarkable fossil is common in the calcareous beds of Gloucester county, N. J. and has an analogue in *B. cylindricus*, (Blainville,) as figured by that author, pl. 3, fig. 10, 10 *a*. It will be described and figured with the *B. americanus*.

SIMPLE AND SPIRAL UNIVALVES.

DENTALIUM.

Casts of a pretty large species are found at Mullica Hill, N. J. and at the Chesapeake and Delaware canal.

TURRITELLA.

1. A large species with about five convolutions, is common throughout this formation. It exists only in casts.

2. Casts of a smaller species are frequent at the Deep Cut of the Chesapeake and Delaware canal, in a matrix of dark clay and scales of mica.

SCALLARIA ?

This beautiful shell is in perfect preservation excepting the mouth; hence the difficulty of deciding the genus. It has four volutions, with numerous acute, longitudinal costæ, which are transversely striated. Length about an inch and a quarter. It is found in the calcareous marls of Gloucester county, N. J. This fossil has the external aspect of a chambered shell.

ROSTELLARIA.

Casts about an inch in length, with ten or twelve elevated longitudinal ribs. Abundant in the argillo-micaceous beds of the Chesapeake and Delaware canal. Much larger specimens of the same species occur at Mullica Hill, and other places in New Jersey.

NATICA.

Casts of a small indeterminate species.

BULLA?

Globose, with numerous transverse striæ. Length one inch. Casts only are found, and I may be wrong in referring them to the above genus.

TROCHUS.

Indeterminate casts, and even these are of rare occurrence.

SPIRORBIS?

This shell, which I have lately discovered in the calcareous marls of New Jersey, I have not yet had leisure to examine with attention. ***Description.*** Volutions four or five in number, in contact throughout: aperture quadrangular, which form is preserved in all the whorls: diameter of the largest specimens three eighths of an inch. It has a strong resemblance to ***Planorbis:*** Mr. Sowerby mentions that he found shells in the English green sand, which he referred to that genus, though, he thinks erroneously. I prefer placing the American specimens with the genus Spirorbis, until more information can be obtained respecting them: although a late number of Sowerby's work contains figures of some species of *Vermetus* extremely like the specimens in question: *vide* pl. 596, figs. 4. and 5.

SERPULA.

My friend, Dr. McEuen, procured a number of *Serpulæ* attached to Ostrea, &c. in yellowish brown marl, two miles west of Long Branch. The same locality abounds in *Terebratula Harlani.*

CYPRÆA. *Lin.*

A solitary cast of this genus was found at the Chesapeake and Delaware canal. It is now in the possession of Mr. John Finch.

BIVALVES.

TEREBRATULA.

1. *T. harlani.* (S. G. M.) This fine species, which often attains a length of two inches and a half, is found in vast numbers at New Egypt, in New Jersey, where the only accompanying fossil is Gryphæa. (Ostrea, *Say.*) It is also common in many other places in the peninsula.

2. *T. fragilis.* (S. G. M.) Found with the preceding, but is much more rare.

3. *T. Sayi.* (S. G. M.) A small plicated species, occasionally found in the blue marls of New Jersey. This fossil was first described by Mr. Say,* under the name of *T. plicata*, which name having been previously used by Lamarck for another species, was necessarily changed.

A terebratula which I once thought might be the *T. perovalis* of Sowerby, I am now convinced is only a variety of *T. harlani.*

GRYPHÆA. *Sowerby.*

1. *G. convexa.* (S. G. M.) } These two species are found abund-
2. *G. mutabilis.* (S. G. M.) } antly in almost every part of the marl region. Mr. Say was the first to notice them, which he did under the name of *Ostrea convexa.*† But as these fossils possess the characters of *Gryphæa* as defined by Mr. Sowerby, I have ventured, though perhaps wrongly, to transfer them to that genus.

Some varieties of G. mutabilis are so like *Ostrea vesicularis*, (Lam.) as to be easily mistaken for the same species. The O. vesicularis is characteristic of the European chalk.

3. *G. vomer.* (S. G. M.) This species was described by me, together with the two preceding, in the Jour. of the Academy, but the badness of the specimens enabled me to give but a very defective figure. I afterwards even suspected that it might be a mere variety of *G. convexa;* but I have lately received some perfect specimens which fully establish the correctness of the specific designation allotted to this fossil. I design giving an accurate drawing and description of it in the next number of this work.

---

* Amer. Jour. Science, Vol. II. p. 43.　　† Idem Vol. II. p. 42.

EXOGYRA. *Say.**

E. costata. (Say.) This fossil is equally abundant with those last described, and is found in the ferruginous sand from New Jersey to South Carolina. Mr. Say is certainly correct in making a distinct genus of this fossil, in proof of which it will be found that Mr. Sowerby has placed a congeneric shell with *Chama*, (C. conica) while Mr. Brongniart classes another with Gryphæa. (G. auricularis.†) The true *Exogyra* has but a single muscular impression in each valve, which sufficiently distinguishes it from Chama, while it differs still more strongly from Gryphæa. It is an interesting fact that all those European fossils which belong to the genus Exogyra have been found exclusively in acknowledged secondary deposits. Thus the Chama conica and C. haliotoidea of Sowerby are peculiar to the green sand of England, while the Gryphæa auricularis of Brongniart has been found, in France, only in chalk marl.

OSTREA. *Lam.*

1. *O. falcata.* (S. G. M.) This handsome species is about an inch and a half long, thin, curved, and plicated longitudinally from the hinge margin to the point. It is abundant at St. George's, in Delaware, and is also found in many parts of New Jersey.

2. *O. cristagalli?* I found a few valves at St. George's, which have so much resemblance to this species, that I shall for the present adopt the name. The O. cristagalli is a well known fossil of the English chalk.

3. *O.* . . . . I obtained at Mullica Hill, in N. J. a solitary inferior valve of an ostrea which differs from any I have seen. It is five inches long, deeply costated, and replaced with true flint.‡

4. *O.* . . . . My friend Mr. T. A. Conrad has lately presented me with a single valve, very convex, with ten or twelve deep plications. It is entirely different from any of the preceding species.

Anomia.

A. ephippium? (Lam.) It is extremely difficult to distinguish between the recent and fossil anomiæ, for which reason, for the present

---

* Amer. Jour. Science, Vol. II. p. 43.

† Cuv. and Brong. Des. Geolog. des Env. de Paris, pl. VI. fig. 9.

‡ In the Jour. Acad. Nat. Sc. I mentioned the *O. flabellula*, (Lam.) as a marl fossil. The specimens, however, were subsequently found to be from the tertiary deposit of Maryland.

at least, I refer the marl shells of this genus to the species just named, to which they bear a strong resemblance. This anomia is abundant in the blue marl at St. George's and other places in the vicinity. It is also found near Arneytown, N. J.

PECTEN.

1. *P. quinquecostatus.* (Sowerby.) If the American species is not positively identical with the European, it is at least an obvious analogue, and answers in almost every particular to the figures of Sowerby and Brongniart. The last named naturalist makes the following remarks on this species: "Ce peigne, qui parait presenter des variétés assez nombreuses de dimensions, et même de proportions dans les dimensions, *est une des coquilles les plus constantes dans les terrains de Craie inferieurs.*"*

2. A minute, flat shell, about half an inch in diameter, and having from fifteen to twenty costæ. It is of rare occurrence.

CARDIUM.

Casts of a smooth cardium are common in all the varieties of marl. They vary in size from an inch to an inch and half, but have never been found with any portion of the shell remaining. Casts, apparently of this genus, also occur, very globose and strongly ribbed.

CUCULLÆA.

1. *C. vulgaris.* (S. G. M.) Casts of this fossil occur abundantly throughout our marl formation: no part of the shell, however, had been found until very lately, when Mr. Wm. Riley obtained several specimens sufficiently perfect for description. These will be figured in a subsequent part of this work.

2. A large, globose cast, about two and a half inches in diameter, is occasionally found in excavating the Chesapeake and Delaware canal.

MYA.

Casts of shells about two inches long, with deep concentric sulci.

TRIGONIA?

I possess a single cast of a shell apparently referrible to this genus. It will be interesting to decide this question, when other and more perfect specimens may have been obtained.

---

* Descrip. Geol. &c. p. 385, edit. 1822.

TELLINA.

A small, handsome shell, in general appearance not unlike *T. punicea*, is found near Arneytown, N. J.

AVICULA.

Very perfect casts of a small species.

PECTUNCULUS.

A few indeterminate casts.

PINNA.

Casts, in fragments, resembling the *P. tetragona* of Sowerby, pl. 313, fig. 1.

TEREDO. *Lin.*

T. antenautæ? (Sowerby.) The teredo is abundant throughout the marl region. It is constantly found in the lignite of the Chesapeake and Delaware canal, where trunks of trees are pierced by it in every direction. The casts of this fossil are frequently half an inch in diameter. Sometimes these casts consist of pyrites. In the calcareous marls of New Jersey, the shelly tube of the Teredo is replaced by crystallized carbonate of lime.

VENUS. *Lin.*

A cast, about half an inch in diameter, with fifteen or twenty striæ radiating from the hinge to the margin. This is probably a *Venericardia* of Lamarck.

ECHINIDEÆ.

SPATANGUS. *Lam.*

1. A species with five deep sulci, and closely allied to the well known European chalk fossil *S. cor marinum*, as figured in Parkinson's Org. Rem. Vol. III. pl. 3. fig. 11. It is abundant in the calcareous formation of Gloucester county, New Jersey; the specimens are not casts, but on the contrary have their shell or crust replaced by carbonate of lime, and are as perfect as the European chalk echini. They vary in magnitude from the size of a filbert to an inch and a half in diameter.

2. Another species much more compressed than the preceding, but otherwise resembling it, is common at the Deep Cut of the Chesapeake and Delaware canal.

ANANCHYTES. *Lam.*

This genus is found in fine preservation in the calcareous deposits just mentioned. The species has much resemblance to one from the green sand of England in the collections of the Academy, but of which I do not know the specific name. The American specimens have five pair of ambulacra, one of which is contained in a deep sulcus. Length from half an inch to an inch and three fourths.

ECHINUS. *Lam.*

Of this genus I have hitherto found only pentagonal, oblong, detached plates; margin granulated, with a central, circular, smooth area, and a tubercle for the attachment of a spine. These remains are well represented by the sections of the mammillated echinus, figured by Parkinson, Vol. III. pl. 1. fig. 11.

CLYPEASTER. *Lam.*

The blue marls have furnished a few casts of this genus.

In the collection of the academy are some additional remains of *Echinideæ*, but too imperfect to justify a classification. In the calcareous beds of New Jersey, I found granulated echinal spines more than two inches in length, and not to be distinguished from those of the European chalk. I possess similar remains from the blue marls farther north.

CRUSTACEA.

ASTACUS. *Lam.*

A small species, but having nearly all its parts entire, was found in digging the Chesapeake and Delaware canal.

CANCER. *Lin.*

Dr. Van Rensselaer* has described and figured four specimens (cheifly the claws) of this genus, from New Jersey. Three very distinct species are preserved in the academy, but these also are only the claws. From these scanty remains it would be almost impossible to determine even the Lamarckian genera with any degree of accuracy.

Portions of other crustacea have come under my observation, but I have not yet been able to refer them to any definite place in the systems.

* Annals N. Y. Lyceum, Vol. I. p. 195, &c.

ZOOPHYTES.

ANTHOPHYLLUM. *Schweigg.*

A. atlanticum. (S. G. M.) This genus, a Linnean madrepore, is common in the limestone of Gloucester county, N. J. Its form is cylindrical, or subconical, seldom exceeding three fourths of an inch in length, and is about one third less in diameter. It is formed of longitudinal septa, or plates, which diverge from a central nucleus. Each individual is attached by its base, and is surrounded on the remaining sides by a large cavity. Faujas, in his history of the mountain of St. Pierre, pl. 37, fig. 3, and pl. 38, fig. 1, and 5, gives drawings of some fossils which appeared to be generically the same with those from New Jersey. But I derive the characters of the genus *Anthophyllum* from the splendid work of Dr. Goldfuss, tab. 13, fig. 11. The specimen delineated by that naturalist is stated to be from secondary limestone near the Falls of Niagara.

ESCHARA. *Lam.*

Fragments of this genus *(millepora, Lin.)* are of frequent occurrence with the fossil last described. They bear considerable general resemblance to a species in Ellis's Nat. Hist. of corallines, pl. 28, fig. 1.

FLUSTRA. *Lam.*

Abundant in the same matrix with the preceding genera, and is nearly allied to the species figured by Ellis, pl. 29, fig. *a.*

RETEPORA. *Lam.*

Found with the preceding fossils, in hard calcareous rock. It is well represented by a species from Maestricht, delineated in Faujas, pl. 39, fig. 3, who calls it a *Gorgonia.* Dr. Goldfuss figures a specimen of the same fossil, pl. 9, fig. 12, also from Maestricht, to which he gives the name of *Retepora clathrata.*

CARYOPHYLLIA. *Lam.*

Found, though rarely, in the blue marl of Gloucester county, N. J.

ALCYONIUM.

Occurs in the green sand below Annapolis, in Maryland. A fossil which I believe to belong to this family, is of frequent occurrence in the calcareous beds of New Jersey, and has also been found in blue marl at St. George's, in Delaware. It most resembles some specimens figured by Mr. Webster in the second Vol. of the Transactions of the Geological Society of London.

FOSSIL BONES.

MOSASAURUS? *Conybeare.*

This saurian, so well known by the names of monitor, Maestricht animal, &c. is supposed to have been an inhabitant of the shores of the American continent. This inference has been drawn from a few teeth and vertebræ found near Sandy Hook and Woodbury, in New Jersey. These remains have been described by Dr. Harlan, in the Journal of the Academy,* and by Dr. Mitchill in his notes to the American edition of Cuvier's Theory of the earth. M. de Blainville,† however, after examining the figure of a tooth given by Dr. Mitchill, declares unreservedly that it belongs to the genus *Ichthyosaurus:* I am not aware that the latter has ever been found in Europe above the Oolitic series.

PLESIOSAURUS.

Dr. Harlan has also described‡ some remains which he considers to belong to this animal. They consist chiefly of vertebræ, and are preserved in the collections of the Academy. If I recollect rightly, remains of this animal have not been hitherto found in Europe in any beds more recent than the Oolites.

CROCODILE.

The remains of the crocodile are of frequent occurrence. Considerable portions of jaws with the teeth, and other bones, have been obtained near White Hill§ and Haddonfield, in N. J. and at St. George's, in Delaware: at these places they occur in micaceous blue marl. They are also found in the limestone of Gloucester county.

WHALE?

Bones of the whale are said to have been observed near Middletown Point, N. J. and on the route of the Chesapeake and Delaware canal: those in the Academy, which are attributed to the whale, are too imperfect to permit of a positive decision.

SHARK.

Teeth and vertebral bones in abundance; the former are frequently two and a half inches long.

---

* Vol. IV. p. 232, et seq.

† Memoires sur les Belemnites, p. 48. ‡ Idem.

§ Ibidem, Vol. IV. p. 15, et seq.

TORTOISE.

Bones of some species of Linnean *Testudo* are found sparingly in the marls of Gloucester county.

Beside the preceding osseous remains, there are others in the collection of the Academy, (some of them of gigantic dimensions,) which have not yet been identified. These, when ascertained, may add several genera and species to the above catalogue.

With respect to the teeth and vertebræ of the horse, found near the Raritan River, if they are really in the fossil state, they belong doubtless to the *diluvial detritus* which overlies all our formations; to the same deposit belong the remains of the elephant and mastodon, which have been found in various parts of New Jersey, &c.

Remarks.

After a careful examination of the preceding fossils, I adopted the opinion of Mr. Vanuxem, viz.: that they denote a *secondary formation*, in the modern acceptation of that term; in other words, that they characterize a formation contemporaneous with the *super-medial order* of Phillips and Conybeare, the *terrains de sediment moyen* of Brongniart. From the same data (organic remains) I infer more specifically, as mentioned in the commencement of this paper, that our *marls* are geologically equivalent to those beds which in Europe are interposed between the white chalk and the Oolites; nor can I conceive how they can be classed with *tertiary* deposits, if zoological characters have any preponderance in deciding geological questions.

It appears to me to be altogether contrary to analogy, to suppose that the opposite shores of the Atlantic ocean should produce at the same epoch, two series of marine organic beings so widely different from each other as are those of our marls and the tertiary deposits of Europe. We know that there is at present a remarkable generic accordance between the living mollusca of the eastern and western shores of the Atlantic ocean; and I have elsewhere* shewn, that many *species* of shells are already identified as common to both; and doubtless the list will be greatly increased by extending the comparison. Is it not reasonable to suppose that this accordance was formerly as great as at present? And with existing analogies before us,

---

* Jour. Acad. Vol. VI. p. 119, 120.

may we not with confidence resort to similar data to ascertain the contemporaneous deposits of former ages?*

Again, I would ask—if the genera Ammonites, Baculites, Scaphites, Belemnites, Alcyonium, Spatangus, &c. &c. are of tertiary origin, by what zoological aids are we to recognize and distinguish the true secondary strata? The truth of the matter appears to be simply this: if these marl fossils are really referrible to the tertiary class, then there must be an end of geological distinctions founded on organic remains; and that beautiful system which was erected by Mr. William Smith, and which has since been sustained by the abilities of Cuvier, Brongniart, Phillips, Conybeare, and many others, must be abandoned as delusive.

Previous to taking leave of this part of my subject, I beg permission to quote an illustrative paragraph from the writings of Conybeare and Phillips, with respect to the *London clay*, to which particular division of the tertiary, Prof. Eaton refers the marl of New Jersey, &c.

"The testaceous mollusca [of the London clay] are very numerous and beautifully preserved, and often retaining nearly the appearance of recent shells. There are very few genera of recent shells, which have not some representation imbedded in this formation, but the specific character is usually different; that difference being often, however, so minute as to escape an unpractised eye. On the contrary, but few of the extinct genera, so common in the older formations, occur in this; so that it seems to hold a middle character in this respect between the earlier and more recent beds. Thus, although Nautilites, resembling those of the Indian seas, are common, specimens of the Cornu ammonis and Belemnite are so rare, that it is in a very high degree doubtful if they have ever really been found. Echinites, so common in the chalk, are very rare in this formation. Zoophytes are likewise extremely rare."†

These observations, (which are confirmed by all the more recent works on the subject which I have seen) considered in connexion with the facts detailed in the preceding synopsis, render it extremely

---

* The geological analogies between America and Europe are conspicuous in all the formations. *Vide* Prof. Buckland's note in Amer. Journal of Science, Vol. IV. p. 186. See also the very interesting observations contained in Chap. I. of Mr. Maclure's *Geology of the U. S.*

† Geology of England and Wales, p. 28. See also the observations of Mess. Cuvier and Brongniart, on the *calcaire grossier*, which is now admitted to be contemporaneous with the London clay.

doubtful if there be any *zoological* analogies between the London clay and the marls of New Jersey, &c.

I shall next offer a quotation from another celebrated naturalist, to shew the analogy between the latter formation and the green sands of Europe. I allude to Mr. Parkinson, a gentleman who has few rivals in the knowledge of organic remains. Speaking of the genus *Spatangus*, he observes—"The green sand presents some very curious and interesting facts respecting these fossils. In the water which deposited this formation, the Spatangi appear to have first existed; no remains of this genus having been found in the subjacent formations. It is also deserving of observation, that they are not found again but in the chalk, and in the seas of the present world."* We have already seen that Spatangi are of *frequent* occurrence in the American ferruginous sand; and I shall dismiss this fact without further comment.

I have yet to offer a few observations on a very interesting feature of our marls; I allude to the abundance of *lignite* and *amber* contained in some of them, and especially, as already noted, in the lower mass of strata traversed by the Chesapeake and Delaware canal. We might at first be led to consider these substances as denoting a *plastic clay* formation; but when we observe that they are subjacent to, and intermixed with, beds whose characteristic shells are extinct genera of chambered univalves, and that these fossils do not occur as insulated individuals, but on the contrary exist in surprising numbers, must we not consider even these lignites and this amber as portions of secondary strata?

The occurrence of lignites is not unfrequent in the green sand of Europe: and as analogies of geological arrangement in remote parts of the world, are both instructive and interesting, I may be allowed to adduce a few instances to the point in question. Thus, M. Bouë informs us that the marls which alternate with the green and ferruginous sandstones, (grès ferrugineux et vert) below the chalk in the South West of France, contain beds of lignite.† M. Bouë further remarks, that lignite and retinasphalt characterize the green sand formation (Craìe chloritée) at Obora, in Moravia. In allusion to these lignites he says, "Ces bois montrent qu'ils ont été longtemps sur la rivage de la mer, puisq' ils sont couverts d'huitres et de serpules et

---

* Introd. to the Study of Org. Rem. p. 142.

† Annales des Sciences Nat. (Paris) Tome 3, p. 309.

qu'ils sont percés de trous de Tarets, (Teredo) qui ont remplis posterieurement par de la pyrite." The last two circumstances are common to our own lignites.

Humboldt, in his *Tableau des Formations Geologiques*, gives as a synonym of the ferruginous sand series, *Grès secondaire à Lignites*, in contradistinction to his *Grès tertiaire à Lignites*, or Plastic Clay formation.

Cuvier* describes the green sands of France as containing both lignite and amber: the former is abundant in the green sand between Dives and Fecamp. The iron sand of England, say Phillips and Conybeare,† contains a considerable quantity of fossil wood; while in the neighborhood of Folkstone and Cambridge, the lignite even retains the woody fibre.

I will adduce but one other instance—that of the lignite beds in the green sand in the Isle d'Aix, near La Rochelle. At this place is a submarine forest of dicotyledonous trees, sometimes bituminous and brittle, and again having the texture of jet. These lignites are perforated by the Teredo, and accompanied by amber.‡

I have detailed these facts to shew (what some have doubted) that the vast deposits of lignite with amber, lately exposed in the Delaware and Chesapeake canal, do not offer insurmountable objections to the position I have taken—that the beds in which those substances occur are secondary.

I am aware, however, that some European geologists, relying more on the superposition of strata than on their organic products, have referred all those formations I have just quoted, to the *tertiary class*, including therein the whole chalk formation. But I am disposed in this case to adopt the opinion of Humboldt, who is known to consider fossil remains merely as collateral aids in deciding the relative position of strata. "Malgré les analogies que présentent les grès a lignites (sables verts et argiles plastiques) au-dessous et au-dessus de la Craie, cette formation pourtant appartient plutôt au terrain secondaire qu'au terrain tertiaire, auquel plusieurs géognostes célèbres le rapportent."||

It is almost certain, however, that the real *plastic clay* formation *does* occupy a considerable tract in New Jersey, Maryland, &c. In a letter recently addressed to me by Prof. Eaton, is the following

* Disc. sur les Revolutions, p. 294. † Geol. p. 137.

‡ Humboldt's Gissement des Roches, p. 294.

|| Gissement des Roches, p. 278.

just observation: "I believe all geologists agree that approximating strata pass into each other, and that alternations are made up of elements common to both. Hence it is that we often find much difficulty in fixing on the line of division." I cheerfully grant this difficulty in the present instance; nor am I prepared to speak decidedly on the subject.

It is my intention, when leisure permits, to visit the marl localities in the neighborhood of Amboy and Middletown Point; and to examine particularly the clay and lignite strata at Bordentown and White Hill, both which I suppose to be the *plastic clay* formation *resting on* the marls described in this paper. I design to embody these observations in a second part of this synopsis, which will also embrace notices of some additional fossils, which, from coming late to my hands, have been unavoidably omitted.

Note.—Since the preceding paper was transmitted to Professor Silliman, I have received the 104th number of Mr. Sowerby's *Mineral Conchology*, and it gives me much pleasure to observe that that gentleman has adopted Mr. Say's genus *Exogyra*. On this subject I shall make two quotations, and subjoin a few remarks.

"The mistake," says Mr. Sowerby, "under which several shells that might better have been called Gryphææ, were published in the first volume of the Mineral Conchology, as Chamæ, seems to have arisen from considering the tooth in the hinge, without taking into account the muscular impressions, which in Chama are two. This important tooth seems to have been overlooked by Mr. Say, though he mentions the cavity, or furrow, that receives it. In the sixth volume of the Journal of the Academy of Natural Sciences of Philadelphia, Dr. Morton, when describing the Exogyra costata of America, has rightly referred the Chama haliotoidea (Min. Conch. t. 25) to the same genus, and discovers the mistake above alluded to."

Mr. Sowerby then transfers to the genus Exogyra, five fossil shells (all found in, or below the chalk formation) which are described as Chamæ in his Mineral Conchology, and among them are the Chama haliotoidea, and C. conica, which I had indicated as belonging to Mr. Say's genus.

With respect to the geological inferences to be deduced from these fossils, Mr. Sowerby remarks as follows:

"Exogyræ appear confined principally to the green sand formation; but as we do not know that the American species, E. costata, has ever been found in Europe, it is going too far to consider that as a proof of the identity of the beds in which it occurs with our green sand. The smooth varieties of it, which are said to resemble the G. haliotoidea of Min. Conch. we have not seen; but it probably is that species: if so, the consideration of it with Gryphæa convexa of Mr. Vanuxem and Dr. Morton, (which is G. globosa of Min. Conch. and Podopsis gryphæoides of the French, and occurs in green sand, as well as chalk) Baculites and other shells, will go far to prove what those gentlemen have suggested, that the beds in which these shells occur are the equivalents of the green sand and chalk formation of Europe."

I will here observe, that although some of the Exogyræ of New Jersey are ribbed, and others are not, I believe them to be one and the same species, inasmuch as the young shells are mostly smooth, and specimens are found with every variety of surface, from incipient ridges to elevated costæ. Another fact, noticed by Mr. Say, is, that in old shells the ribs often became indistinct, and even obsolete. It seems therefore impossible to derive specific distinctions, in this instance, from the costæ of the Exogyræ; and we must be content to consider all our American specimens as identical until we can discover some less variable characters by which to distinguish them.

Although the Exogyra costata and E. haliotoidea appear to be *analogues*, they are evidently distinct species; which remark I am disposed also to apply to the English Gryphæa globosa, and the American G. convexa.

[The subject will be resumed in the next number of the Journal, and will there be illustrated with plates.—*Editor*.]

Art. IV.—*Fragment from Peron, with notices from other voyagers, on the Temperature of the Sea, at great depths, far from Land.*

Mr. Silliman—The following is translated from the "Voyage de Découvertes Aux Terres Australes," section 4. Vol. II. p. 334. It seems to me that the *facts* detailed by M. Péron are inconsistent with the *theory* of M. Cordier, as to central heat, if they do not prove conclusively its entire fallacy. The thermometer used by Péron was Reaumur's, it will be easy to estimate the changes of temperature by Fahrenheit, if it is recollected that the zero of Reaumur is the freezing point or 32° of Fahrenheit, and that four degrees of the former are equal to nine of the latter. Yours,

Steubenville, Ohio, Sept. 20th, 1829. Benj. Tappan.

First experiment of five hundred feet in the Atlantic Ocean.—The 22d November, 1800, by 8° north latitude, in the middle of the Atlantic Ocean, M. Dessuch and myself plunged the apparatus of which I have spoken, to the depth of five hundred feet; we were not permitted by the Captain, to let it remain longer than five minutes. It took twelve minutes to draw it up; the air was at the time at +24°, Reaumur; the surface of the sea at +24°.3′. Our thermometer, notwithstanding the short time it had remained in the water, and that more than double that time was occupied in drawing it up, and notwithstanding the influence of the water which had penentrated the interior of our apparatus; marked only +20°.0′: presenting a result of 4°.3′ less than the temperature of the surface.

Second experiment of three hundred feet.

The next day, by 7° north latitude, we tried a second experiment of three hundred feet depth; we were able to rest our apparatus at that depth three hours, thanks to the flat calm we then had. In withdrawing it, we found that the water, in spite of our precautions, had penetrated into the interior of our apparatus, had flattened the cylinder of tin which protected our case of wood, and that by the pressure, our thermometer had been broken in the powdered charcoal with which we had surrounded it. M. Dessuch and myself were lamenting the misfortune, when it occurred to me, after having taken away the fragments of the broken thermometer, to put in its place the second thermometer which we had used to determine the temperature of the water at its surface. That expedient succeeded beyond our hopes: we saw it descend rapidly from 24° where it stood at the time to 13°, at which it stood a short time and then slowly remounted. Thus our experiment was not altogether lost, and the results were the more agreeable, as they agreed perfectly with the preceding in the essential point, that the temperature of the water of the sea was much more cold at three hundred feet deep than at the surface, which at the time we speak of was in the air at +24°.

That second experiment afforded us yet a new subject of pleasure; it confirmed us in the opinion we had entertained of the superiority of my apparatus over the most perfect of those which had previously been used, the double valved cylinder. Indeed, M. Dessuch, desirous of making some observations on the degree of saltness at divers depths of the sea, had sunk with my thermometer, a metallic cylinder of that kind made by Lenoir. We withdrew it full of water. The thermometer which we instantly plunged into it descended but to 2° below the temperature of the surface, whilst the same thermometer, placed, as I have stated, in the place of the one broken by pressure, fell 11° : incontestible proof, in every respect, of the superiority of our apparatus, and of the defectiveness of the double valved cylinder.

Third experiment of one thousand two hundred feet, by 5° north latitude.

The experiments above related have been made at inconsiderable depths, and with a less perfect apparatus than the one of which I have given a description; it remains to describe two other observations of the same kind, more recent also, having been made during our return voyage from India to Europe, with an instrument better constructed, and at depths much greater. The 19th of February 1804, we found ourselves within the tropic, becalmed so that our vessel remained motionless on the surface of the water; to avail myself of such favorable circumstances, I desired the commanding officer to permit me to try some new experiments. I had previously constructed my apparatus nearly in the manner I had conceived proper. I sunk it to one thousand two hundred feet; it remained there one hour and fifty minutes, not including the time of drawing it up, which was seventeen minutes. It was at twenty seven minutes after five; the atmosphere indicated +25° 7′ of Reaumur; the surface of the water was at +24° 5′. My thermometer drawn from the depth of one thousand two hundred feet, marked no more than +7° 5′, coldness already very considerable, doubtless, and which had been much greater, had it not been for the difficulties of which I have spoken in the first experiment, the most part of which occurred in this. Nevertheless, the results of this kind of experiment, always analagous to the preceding ones become the more interesting, as they prove still further the progressive lowering of the temperature in descending to the bottom of the ocean. The following observation would have dissipated all my doubts, had any remained.

Fourth experiment of two thousand one hundred and forty four feet depth, by 4° north latitude.

The 22d of February, I took advantage of the continuance of the calm to repeat my interesting trials; two thousand one hundred and forty four feet of cord, were sent to the bottom of the sea at fifteen minutes after eleven in the morning, we commenced drawing it up at thirty minutes after noon; it took forty five minutes through the ill will of the crew, to whom observations of that kind afford little pleasure. The entire immersion lasted seventy five minutes, the air was at +25°; the surface of the water indicated +24° 8′. The thermometer drawn up, and promptly taken out of its case indicated but +6°, that is to say, nearly 19° less than the surface, an enormous difference, and which truly had been more considerable still, if the extraction, which took up three quarters of an hour, had not varied the temperature of the apparatus; that variance would however have been greater, if the pressure of the water, always too strong for my securities against it, had not introduced itself into its interior. In spite of those serious inconveniences the result was uniform, the temperature of the sea always decreased in exact proportion as the thermometer descended in its bosom. What may be the ultimate limit of such decrease? A problem not less curious than important, the solution of which, in the actual state of knowledge, does not appear as difficult as might at first have been supposed. But as the strictness required in all new experiments looks to the general concurrence of their results for evidence of their value, let us examine what are those results obtained by the men of science who have been occupied in the same object, and in the same circumstances, that is to say, in the mid-ocean, far from continents and islands.

If we except the celebrated traveller* whose return has rejoiced all the friends of science, but whose discoveries are as yet unknown to me, three persons only, have until this time, made experiments in the main ocean in a similar manner to ascertain its temperature at various depths, Forster, Irving, and myself. By a singular and fortunate chance, our experiments have been repeated at three of the most opposite points on the globe. Irving in Phipps' voyage towards the north pole, made his at 80° of north latitude. Forster in Cooke's expedition to the south pole, continued them to the 64° south, beyond which no voyager has as yet been able to penetrate, and myself, placed between those extremes, have made my experiments in the vicinity of the equator. Certainly it would be difficult to find any other fact in physics which would include terms of comparison taken at such distances from each other; and yet we shall see that all those experiments give results analagous to those which I have described.

* A. Humboldt.

Experiments of Forster on the temperature of the sea at divers depths.

Date.	Latitude.	Depth in fathoms.	Height of the thermometer. In the air. Fah.	In the air. Reau.	Surface of the sea. Fah.	Surface of the sea. Reau.	At a certain depth. Fah.	At a certain depth. Reau.	How long the ther. remained in the sea.	Time of drawing up the ther.
	° ′		° ′	° ′	° ′	° ′	° ′	° ′		′
1772, Sept. 5,	0.52 N.	86	+75.5	+19.3	+70.0	+16.9	+66.0	+15.1	30	27 1-2
27,	24.44 S.	80	+72.5	+18.0	+70.0	+16.9	+68.0	+15.1	15	7
Oct. 12.	34.48 S.	100	+60.0	+12.4	+59.0	+12.0	+58.0	+11.6	20	6
Dec. 15,	55.00 S.	100	+30.5	− 0.7	+30.0	− 0.9	+34.0	+ 0.9	17	5 1-2
23,	52.26 S.	100	+33.0	+ 0.4	+32.0	0.0	+34.5	+ 1.1	16	6 1-2
1773, Jan. 13,	64.00 S.	100	+37.0	+ 2.1	+33.5	+ 0.6	+32.0	0.0	20	7

Cooke's second voyage.

Experiments made by Irving, near the North pole with the thermometer of Cavendish.

Date.	Depth in fathoms.	Temperature of the water, as indicated by the instrument.	Correction for the compression and unequal expansion of the sp. wine.	Temperature of the sea at the greatest depth to which the thermometer has been plunged, corrected. Fahr.	Reau.	Heat of the air. Fahr.	Reau.
1773, June 20,	780	+15°	+11.°	+26.°0′	−2.°7′	+48.°5′	+ 7.°3′
30, M.	118	+30.	+ 1.	+31. 0	−0. 4	+40. 5	+ 3. 8
S . . .	115	+33.	0.	+33. 0	+0. 4	+44. 7	+ 5. 7
Aug. 31,	673	+22.	+10.	+32. 0		+59. 5	+12. 2

Voyage of Phipps.

Experiments, made by Dr. Irving, with a bottle, to determine the temperature of the sea at different depths.

Date.	Latitude North, &c.	Depth in Fathoms.	HEIGHT OF THE THERMOMETER. In the air. Fahr.	In the air. Reau.	Surface of the sea. Fahr.	Surface of the sea. Reau.	Depth in the sea. Fahr.	Depth in the sea. Reau.
1773. June 11,	-	32	+55.°0′	+10.°1′	+51.°0′	+ 8.°4′	+49.°0′	+7.°6′
12,	60.°00′	65	-	-	- .	-	+44. 0	+5. 3
July 3,	78. 00	-	+44. 0	+ 5. 3	+40. 0	+ 3. 6	-	-
Aug. 4,	80. 30	60	+32. 0	0. 0	+36. 0	+ 1. 8	+39. 0	+3. 1
31,	-	80	+48. 0	+ 7. 1	+51. 0	+ 8. 4	-	-
Sept. 4,	75. 00	683	+66. 5	+15. 3	+55. 0	+10. 1	+40. 0	+3. 6
7,	60. 14	56	+60. 0	+12. 4	+57. 0	+11. 1	+50. 0	+8. 0

Voyage of Phipps to the North Pole.

Art. V.—*On Malaria.*

TO PROFESSOR SILLIMAN.

Dear Sir—The cause of remitting and intermitting fevers, and of the chronic maladies which hang upon the constitution after it has resisted the first *attacks*, is a subject of the deepest concern, and worthy of the strictest scrutiny. It is of the more importance to pursue it to the most certain issues, because the treatment of diseases similar in appearance, but of different origin, is injurious or sanitive according to the cause of the complaint. This class of disorders has been attributed to marsh effluvia, and to various other sources, involving the subject in obscurity and error. Few people are aware of the prevalence of this noxious principle: and when I state, that it is believed by several experimental physiologists to be the cause, in some form or other, of nearly half the diseases which visit the human race, and that its existence, or the means of averting its effects are scarcely known,—I need not urge the importance of awakening public attention, and of appealing to the feelings of interest, patriotism, and humanity to unite with science in the investigation.

Presuming that the plan of your Journal embraces every branch of physical science, I take the liberty to request a place for some observations upon the phenomena of marsh exhalations or malaria.

It will be my object to shew

I. That the fever and ague, intermitting and remitting fevers, and some other complaints which afflict different sections of this country, result from those poisonous exhalations called by the Italians *mal'aria*, which are peculiar to the vicinity of marshes.

II. That this insalubrity may arise from morasses, salt marsh, ponds, canals, swamps, wet pastures and meadows, bogs, newly cleared lands, neglected gardens and ruins, and inundated plantations.

III. That it is practicable to control this deleterious influence, and in most instances to subdue it, by human skill and industry—and that by ascertaining those situations where it is impracticable, the waste of human life at present experienced, may, by suitable defences, be prevented.

I. There are various opinions of the nature and origin of malaria. Many have attributed the origin of the specific poison to unknown gases,—some to volcanic fumes—electrical agencies—or the mysterious influence of comets; some have charged it to cold and dampness; others to animal putrefaction—to vegetable decomposition or to animalcules in the atmosphere; while there are those, who deny it a material existence, attributing it to the vengeance of Heaven, as an infliction upon mankind for transgression, the proximate cause being inappreciable by philosophy. A recent writer affirms that "we are totally unacquainted with the causes of every kind of endemic disease."* This unqualified assertion is at variance with a long settled opinion, that a certain class of maladies unequivocally originate in the miasmata emanating from marshes, although the precise nature and quality of the poison, are not cognizable by our senses. I think it will require but few examples to establish the fact, that this emanation does produce certain endemic and epidemic diseases; and for this purpose I shall name some cases of peculiar violence, aggravated indeed by tropical heats, but yet so obviously proceeding from this source, as to leave no doubt of their origin.

On the island of St. Thomas, situated in the Gulf of Guinea, between Congo and Benin, the town is built to the leeward of an extensive marsh. In 1776, seven officers from the *Phenix* ship of war went on shore to visit the governor of the island, every one of whom was taken ill of intermitting fever, and all died except one, who returned to England in very ill health. Every seaman who went ashore for wood and water, if he slept ashore, was likewise taken ill, and only two escaped with life, while no other man of the ship's company was seized with any kind of distemper during that service."† In the following year, the *Phenix* made another voyage to the coast of Guinea, when again touching at St. Thomas, she lost eight out of ten who imprudently remained all night on shore.‡ In an attempt to settle a colony on an island near Borneo, the place was healthy for six months during the northeast monsoon which came from the sea, but when the southwest monsoon blew over vast marshes for six months, remitting fevers of the most malignant nature prevailed, "cutting off the stoutest men in a few hours."|| Dr. Trotter, physician to his Brittannic Majesty's ship Assistance, relates that in a voyage to the coast of Guinea, in 1762, scarcely a man was indisposed; but with a view to expedition, a tent was erected on a low shore for the men employed to procure wood and water, every one of whom died, and the rest of the ship's company remained perfectly healthy. A simi-

* Virginia Literary Museum. † Lind on Hot Climates. ‡ Ibid. || Ibid.

lar fatality occurred to some people from a Danish ship, sent on shore for water in a low wet place, "covered with impenetrable mangroves," near the streights of Sunda, every one was seized with fatal *remitting fever*, and not one recovered, while all on board continued in health.* Dr. Blane remarks, that "a land wind blowing over some ponds and marshes near Kingston, Jamaica, caused almost every man sent on shore for wood and water, to be attacked with bilious remitting fever, while not a man in the fleet was attacked who was not employed on that service." On the low banks of the *Spirito Santo*, a river on the east coast of Africa, of forty seven men, part of the crew of an Italian ship of war, who slept in tents on shore, not one escaped a malignant remitting fever. The low coasts of Indrapour, in Sumatra, and of Gombroon, in Persia, are subject to the same calamity from the same cause; and so violent are the attacks, that many are seized in the first instance with delirium, and others with apoplexy or palsy. A flood of the Euphrates, in 1780, surrounded Bassora with a salt marsh, for a salt desert reaches to the gates on one side, which, with the effect of an almost unparalleled degree of heat, nearly depopulated the city.† Fahrenheit's thermometer rose from 156° to 162° in the sun, and to 115° in the shade.

The epidemics which visit the countries bordering on the Nile, Euphrates and Ganges, after their annual inundation, are as notorious as the rise of the waters; and were it not for trespassing on the patience of your readers, examples without number might be cited, of the endemic fevers which have devastated Batavia, Bengal and Egypt—Spain, France and Italy, with other Asiatic and European countries. But I think it unnecessary to add any further proofs that marsh exhalations produce this form of febrile disease; for in the foregoing examples you will remark, that almost every instance is described as a remitting or intermitting fever.

Before I proceed to speak of the properties of these effluvia, I beg leave to shew that not only are the desperate fevers, and the terrific horrors attending those examples of exterminating mortality dependent upon this cause; but that we also, though blessed with a temperate climate, and genial seasons, may trace many of the indispositions that disturb us to the same origin, while most of the epidemic maladies which clothe our towns and villages in mourning, and ren-

---

* Dr. John Clarke's Obs. on Long Voyages.

† "This sickness was not the true plague, but a terrible remitting fever."—Tytler on Plague.

der families desolate in the open country, proceed from this inexhaustible and self renovating source.

A remarkable instance in Sheffield, Mass. may serve for a sufficient proof that this noxious influence is not confined to oriental or tropical countries, or even to southern Europe. Near that town are two large ponds, forming marshy grounds upon their margins, of considerable extent. In 1793, eighty out of one hundred and fifty persons who lived within one and a half miles of the south pond, were attacked in one month with bilious remittents: and in 1795, of two hundred inhabitants, within three quarters of a mile of the north pond, a hundred and fifty were attacked with the same fever. Early in the spring of 1796, intermittents prevailed, and as the season advanced, bilious remittents with dysentery, became epidemic within a mile of both ponds, not ten persons escaping of a hundred and fifty, while sickness was in every house in the settlement.*

This department of physiology is indebted to Dr. McCulloch of Edinburgh, for the scientific manner in which he has traced analogies—"purified and balanced evidence"—classified and described diseases upon determinate principles—and discovered their causes amidst a chaos of empyricism and error; he has also arranged them under such generic forms as render them intelligible and recognizable, under whatever circumstances. He substantiates his views on every part of the subject, by authorities, examples and tables, and his opinions are entitled to high confidence. If in any instance he merits the charge of exaggeration, it is attributable to the astonishing number of disorders that had been viewed and treated as of a distinct and independent nature, which he found to be only symptoms and varieties, "simulations and variations" of *a generic disease*. Diseases similar in appearance, but proceeding from different causes, engaged his particular attention, as when apoplexy ushers in a remittent or intermittent in place of the cold fit, if mistaken for ordinary apoplexy, the ordinary modes of treatment render it fatal. So also, in an obscure intermittent, with "a local rheumatic affection of the intercostal muscles, if mistaken for pleurisy, an error of frequent occurrence, blood letting would be pernicious and destructive, while the proper treatment for intermittents would render the complaint trivial and easily cured."† He further maintains that all supervening complaints

* See Webster on Pestilence.

† Review of McCulloch on Fevers. Lond. Quarterly Jour. Sci. and Arts. Jan. to April, 1828.

take the periodical character of the original intermittent, and partake so identically of its nature, as to require the same plan of medical treatment,* however anomalous in appearance, and however differently it might be requisite to treat them, if arising from other causes, and distinct from the previous effects of malarious influence. In addition to simple or malignant intermittents, remittents, cholera-morbus, dysenteries, &c. originating in malaria, he enumerates a long list of disorders, produced in mild climates by the same cause, often, but not always succeeding to attacks of fever, where rheumatism, dyspepsia, hypochondria, mania, ophthalmia, tooth-ache, and those undefinable complaints which are grouped, under the general name of nervous affections, make out, in fact, those *chronic remittents* of inveterate and almost endless duration, "occupying the better part of life. These may be the sequel of severe remittents, or of a milder form of attack, but while the disease consists of a series of relapses, with intervals of better health; or even if it becomes so mild as to display scarcely a febrile symptom, yet it is that durable remittent or intermittent which is the very condition of ill health, under which those suffer perenially, who inhabit the insalubrious districts of France and Italy."

An instance possessing a strict analogy to the foregoing views, has been under my own observation for four or five years. A friend of mine was attacked on Long Island, five years ago, with simple tertian fever, which affected him with continual relapses, although with intervals sometimes for several months, without a recurrence of agues. These intervals were marked, however, with nervous debility and irritation, but sometimes for a few days his alacrity of spirits and muscular energy, would seem to be nearly restored, when the least fatigue or disquietude, would bring on the chills, and the subsequent routine of distresses. After contending with these forms of disease, aggravated by dyspepsia, for two or three years, the gout supervened with great violence, and he still continues the victim of this endless intermittent.

The summer and autumn of 1828 furnish incontestible evidence of the truth of many of Dr. McCulloch's positions. It will not be forgotten by any of your readers, that endemic and epidemic fever prevailed

* "As to blood letting, or debilitating practice of whatever nature, it is invariably pernicious, and it is by mistaking diseases belonging to this genus for others, that they are often rendered inveterate or even mortal."—Review of McCulloch on Fevers, Lond. Quar. Jour. Sci.

in that year in Pennsylvania, Ohio, New Jersey, many parts of New England, Long Island, and the western counties of New York. On the low plashy grounds near the *Mohawk*, on *Schoharie Creek*, and in some tracts on the Erie canal, the complaint, though of frequent occurrence, did not generally run into the high bilious remittents, but it was very severe in some of the western counties. Perhaps a brief statement of the disease on Long Island may serve as a tolerable transcript of the epidemic so extensively prevalent in that season.

Early in the spring, sporadic cases of fever and ague appeared, increasing in frequency through the summer, becoming intermittents and remittents as the season advanced. In the latter part of August, these complaints became alarming epidemics, accompanied in many places with great mortality, and without abatement, until the accession of frost. In a single village, containing fifty or sixty families, there were twenty deaths, all of adult persons, with but one or two exceptions. In many places the noxious influence appeared to reach even the brute creation, for in a tract comprehending six small towns in the little county of *Kings*, on the south west end of Long Island, a distemper prevailed among horses, of which more than two hundred died in the course of a few weeks.* It is a curious and interesting fact, that the poisonous influence which occasions marsh fever, sometimes affects domestic as well as various agricultural animals, in a manner analogous to its attacks upon the human species.† Dr. McCulloch notices the case of a dog, which experienced a regular and well marked tertian, and adds, that "severe seasons of fever among the people in France and Italy, are similarly seasons of epidemic among black cattle and sheep."

The term *malaria* is so associated with Italy, as to indicate to our imaginations something peculiar to that country; but on examining the subject, it appears to operate with equal certainty, though with different degrees of malignancy, in Greece, Spain, Portugal and

---

* They sometimes appeared mad, at others in a stupor, but death always occurred in a few hours. Estimated at upwards of ten thousand dollars loss in that county.

† The opinion that cattle are affected by pestilential vapors, is as ancient as Homer. The same is remarked by Livy. Throughout the Roman history, cattle have been said to share in epidemic pestilence.

I have just received accounts from New Orleans, (Oct. 7th, 1829) which state, that "in addition to the prevailing fever, there is a general mortality among horses and cattle at this time. They mostly die within two or three days after the distemper attacks them."

France, in Holland, and in many parts of England, and on this continent, in several districts of New England, and in all the middle, western, and southern portions of the United States.

In vast tracts of France and Italy, where the people are not carried off by violent attacks, the whole population exposed to this disease, under its endless types and varieties, drag on a life of perpetual sickness; often of incurable intermittents, or a low constantly febrile state, with visceral affections ending in dropsy, or some other fatal termination. "The countenances of these people are sallow, sometimes livid, and so emaciated as to give them the appearance of walking spectres." Nor are the effects on their mental condition less remarkable. "Apathy, recklessness, indolence, and melancholy," extinguish even the natural desire of improving their condition, or of prolonging their lives. The chronic forms into which this intractable fever runs, vary in intensity, with varying climates. In the temperate regions, such as England, and the United States, as far south as the 40°th of N. lat. they appear in dyspepsia, low spirits, loss of appetite, languor, hypochondria, catarrh, innumerable nervous diseases, and consumption.

II. If the fact is satisfactorily established, that the foregoing diseases are produced by pestiferous marsh exhalations, or malaria, it is of importance to ascertain what are its properties, and in what situations, soils, winds, or other phenomena, it has its origin.

As this destructive influence is not cognizable by our senses, we must rest content in the present state of evidence, with such a conception of it as results from weighing probabilities after an attentive examination, and comparison of facts.—If I have quoted, or do hereafter quote, extreme cases in support of probabilities, it is because they are conclusive to my mind in *settling principles*, from which, by analogical induction, parallels may be discovered in different climates, by making due allowance for the difference in quality and amount of materials, and of intensity and duration, in the degrees of heat.

Chemical analysis has failed to discover malaria in any visible or tangible form, either when escaping, or acting with its greatest malignancy. There is an agent, or there are agents developed or created by the joint action of heat and moisture, aided perhaps by electricity or other subtle powers, upon decaying vegetables, which produce malaria. That these agents are aërial cannot be doubted, because the atmosphere is the medium through which they act. Chemistry, although it has made us acquainted with several deadly gases, which are evolved during vegetable decomposition, e. g. the carbonic acid, the carburetted hydrogen gases, carbonic oxide, &c. has not yet put us in possession of that form of matter of whose real existence we cannot entertain a doubt, but which is more subtle than the rarest of the gases; an attenuated poison, which has not yet been imprisoned and separately exhibited in our chemical vessels; *causa latet—vis est notissima.* But when we consider what has been done in pneumatic chemistry, in the last half century, we need not despair that even the winged poison of malaria may be yet detected, indentified, isolated, and even neutralized. If there be a vapor as subtle and poisonous as that of prussic acid, created or evolved by vegetable decay, nothing more would be necessary to produce all the effects that are now so painfully notorious. The fact that trees and fresh vegetables render atmospheric air salubrious by restoring the necessary supply of oxygen, when it is exhausted by animal respiration, proves that in a living or growing state they do not contribute to such a result: but decomposing vegetable materials, to a greater or less amount, being found in every spot, from which this poison is known to proceed, the inference seems to be almost inevitable, that they supply the unknown pestilential agent, during the process of decomposition.

It does not appear that one class of vegetables more than another gives out the malarious poison, but it will be seen hereafter, that rank herbage, such as juicy weeds, and subaquatic plants, decay more rapidly, give off more moisture, and yield more effluvia in the same time and space, than those of more ligneous fibre.

That this noxious material is innocent by itself, or perhaps not separable without the aid of water, from its original combination with vegetable matter, is also obvious; for in a dry state, the constituent parts of every species of vegetation are harmless; and the vapor given off in hay making, when no decomposing process is going on, is not only innocent, but salubrious.

It is presumed that animal matter furnishes no constituent part of malaria, for although insects, and other animal remains, are daily perishing in those places where these pestiferous exhalations arise, sufficient to modify, and perhaps to characterize them, yet it is believed that animal decomposition does not produce fever; because, the manufacturers who use various animal substances when in their most offensive state, are not subject to fevers, nor has any endemic fever been known to occur in such situations.* Another proof, and it is deemed sufficient, is the fact, that when the bodies of the *Cimetière des Innocens*, which were in every stage from incipient putrefaction to complete decomposition, were disinterred and reinhumed, not a case of fever appeared during the whole operation, which occupied two years.

I cannot see any reason to deny that some deleterious exhalation may originate in the materials which form the mud of marshes, and which every where support vegetation, except, that it is unascertainable by chemical analysis; and further, that the pestilential agent is subdued by frost. There is no evidence that mineral or earthy substances contribute in any degree to malaria, except clay, which, by preventing the subsidence of water, remotely causes the maceration of plants, and a consequent disengagement of malarious effluvia; but this being purely a mechanical cause, the quality of the effluvia cannot in any degree be referred to the clay.

It must be inferred that some foreign principles are evolved by the moisture in these pestiferous exhalations, because pure water produces no deleterious effects.† The spray of cataracts is not unhealthy, and sea fogs,‡ the mists which occur in thaws, or on high mountains, or in high northern latitudes, are never followed with unfavorable consequences. But whatever it is, whether a combination of agents, or a single agent, it appears to have a vegetable origin, and by its chemical union with water, or its elements, a new entity is produced, which is a poison, and which, being exhaled, constitutes the marsh miasmata, or malaria.

Some naturalists have conjectured that electricity has an agency in this specific poison; "but nature accomplishes her wonders, not by employing a multitude of agents, but by merely varying the combination of a few simple means," and from what we know of electrical phenomena, it might be expected to exercise a salutary influence, by agitating the atmosphere, and dispersing the mephitic vapors.

That *heat* is essential to its extrication, is proved by the increased virulence of the miasma after the hot season, and the greater vio-

---

* Many examples might be adduced, such as various processes in making leather, manufacturing glue, catgut, &c. and above all, in Paris, the occupation of the *Knackers*, a set of men who apply dead horses to useful purposes, but among whom no endemic fever has been known to occur.

† I think Dr. Fordyce maintains erroneously that it is the *dampness alone* of marshes, which causes fever.

‡ Witness the fogs on Rhode Island and Newfoundland. The former place is distinguished for salubrity, and is resorted to by strangers for a summer residence.

lence of its effects as we advance towards warmer and tropical climates. The degree of heat in Calcutta, during the prevalence of malignant intermittents was from 86° to 76°, Fahr. In Syria it was 86°, and increasing.* At Bassora in 1780, previous to a most frightful and malignant intermittent, the thermometer rose from 115° to 156° in the shade.† On Long Island 1828, in August, just before the remitting fever became epidemic, it was from 91° to 73°.‡

But in temperate climates it is not during the actual presence of the heat that the pestilential power is most injurious. The Italian peasant takes a siesta upon the ground at noon and escapes unhurt.§ The poisonous gases and vapors at that hour, are so rarefied, or diffused, or in common phrase, so dried up, that they are harmless; but when the air is cooled sufficiently to condense the aqueous vapors, and they descend in dews, imparting a delightful freshness, then it is that the insidious and baneful poison is abroad. Those peasants "to whom the earth serves as a bed, after the cold dews have descended upon it, and who pass the night on the moist turf," seldom, if ever, escape; and laborers who incautiously sit upon the ground, are sometimes struck with apoplexy, or even with death. On this principle it is easy to see, why the diseases proceeding from this cause, are more aggravated in autumn. During the summer, it is not generally dangerous, except in the evening and morning; but the heat of summer having

---

* Bancroft on fevers. † Tytler on plague.

‡ I am indebted to Mr. Kellogg, Principal of the Academy at Erasmus Hall, Flatbush, Long Island, for the following accurate table, which shows the effect of heat and drought in eliciting and concentrating malaria in our own climate. It includes the amount of rain which fell in June, July, and August, and the summer temperature of four consecutive years.

Rain during the months of

	June,	*July,*	*August.*		
Years.	In.	In.	In.	Total.	
1826	8.60	3.79	7.95	20.32	
1827	3.68	3.58	5.47	12.73	
1828	2.55	3.73	1.97	8.25	And none after the 5th of Aug. 1828.
1829	3.38	2.35	4.84	10.57	

Temperature.

	June,		*July,*		*August.*	
	Highest.	Mean.	Highest.	Mean.	Highest.	Mean.
1826	91.		89.		89.	71.90
1827	86.	65.80	94.	72.10	96.	70.51
1828	84.	70.12	91.	71.88	91.	73.45
1829	85.	66.45	87.	69.62	87.	70.65

§ Chateauvieux's Agricultural Travels.

daily added to the quantity and concentration of the miasmata, the cooler atmosphere of autumn keeps it perpetually condensed, and it is not only more virulent, but the exposure to it is continual throughout the day.

Neither does the sickly season except in tropical regions commence during the prevalence of rain. Vegetation is then flourishing, the rain absorbs and dilutes any poison which may be exhaled, and when the clouds subside, the sun dries up the moisture. *As the season advances* the quantity of water diminishes, the herbage which had been macerated is then exposed to the heat, the poison increases in deadly energy by concentration, and the exhalations hover nearer the surface. Hence another reason why fevers and epidemic sickness prevail after the heats and rains of summer are past.

Another distinctive property of malaria is its *specific gravity*,* which being greater than atmospheric air, prevents its effects from being felt above a certain altitude. Dr. Ferguson states that "a hill in Antigua, six hundred feet high, is exempt from its effects, while the country is replete with it at its base." M. de Rigaud de Lisle "establishes the height of safety near Rome, at from six hundred and eighty two, to one thousand feet." Sezza, nine hundred feet above the Pontine marsh, is free from disease. "Erceero, nine hundred yards above La Vera Cruz, is exempt from the fevers of the lower land."†

It is difficult to ascertain satisfactorily why it sometimes attacks one side of a street, and leaves the other unhurt; sometimes cuts off a family or a neighborhood, while those in the immediate vicinity escape; and even, when transported from a distance, invades certain places perennially through successive years, and avoids others which appear equally exposed. A remarkable instance cited by Dr. McCulloch is "on the road between Chatham and Brighton in England, where the ague affects every town and single house on the left hand side of the turnpike, and does not touch the right side, though the road itself forms the only line of separation." It seems probable however, that there being an attraction between the miasma, and the identical moisture with which it is exhaled, it does not equally pervade the atmosphere, but is winged about in flaws and

* This would appear to be generally but not universally true. We are credibly informed, that in the marshy regions of Maryland and of some other portions of the Southern States, those who live at the very edge of the marshes escape, while those on the higher grounds are assailed by fever.—*Ed.*

† Humboldt.

veins; but what it is, which intercepts its passage across a garden or an open street; whether it is limited by some meteorological phenomenon; or whatever the cause is, it has hitherto eluded discovery. Its movements cannot generally be anticipated with certainty, for it is only in a few cases that it is so strangely exact. Several circumstances must concur in common instances in conveying it to greater or less distances. These are, its greater or less concentration, the favor of the wind which should not be too strong, and the precise amount of fog or moisture. If there is too much water, it will be diluted; if the wind is too strong, it will be dispersed; if the sun is too hot, it will be dried up, and will separate from moisture, which alone unfolds its existence. This occult property is doubtless innoxious, as it certainly is unknown. It is to such unseen counteracting forces that those differences are owing in successive seasons, for which we can assign no cause; such as a healthy year succeeding to one of great mortality, a healthy place becoming sickly, and the reverse: That the laws which control the phenomena of malaria are uniform, cannot be doubted, although our powers of observation are not always sufficient to discover the causes, or to reconcile apparant disagreements; but if we can arrive at data which will enable us to remedy, or will teach us to shun the evil, we need not repine if the ambition of science is checked in its endeavors to fathom all its mysteries.

The occurrence of intermittents in hill countries has led some to imagine that the causes were as various as the localities; or perhaps not chargeable to external agencies, but inherent in certain conditions of the human constitution. The debility or predisposition of individuals, is undoubtedly the reason why some are seized while others escape, but this does not impugn the argument, that this form of disease, viz. intermitting *fever*, is owing to an external and material agency, although modified by an endless variety of circumstances. One among many ways of accounting for this seeming anomaly, is that already remarked, that it is conveyed in currents by the winds. Volney states that "high grounds in Bengal, with the most promising appearances of upland scenery, are infested with wasting intermittents, called *hill fever*, from the poisonous effluvia wafted by the monsoons from the distant marshy plain." The same writer adds "that there are high lands in Corsica and Italy wholly uninhabitable, because, though far remote from damp and boggy places, the malady of low lands and bogs is brought thither by the winds which blow over them at certain seasons of the year."* The possible *origin* of this noxious principle on hills will be noticed hereafter.

If I have given a probable conjecture of the material existence of malaria, I may now proceed to show where it has been found to reside.

Morasses and jungle thickets, contain the materials for this pestilential emanation in greater amount, than any other situations. Vegetable matters macerated in water, in every stage of existence, from the incipient bud to the last point of decomposition, are here always prepared to send forth such exhalations as the heat may disengage. These are more virulent, as has been already said, in dry than in wet seasons, from the concentration of the poison in a smaller volume of water; and more abundant from the greater amount of substances exposed, which when submerged are inert. During great rains the air has been found wholesome, where in succeeding drought the sickness has been severe, and the mortality frightful. Upon corresponding principles, countries are healthy during inundations. This is strikingly exemplified in some of the departments in France, where the lands are flooded every second or third year, when the water is drained off for tillage. The laborers enter upon the land as soon as the waters are off, but not one half ever survive the cultivation of the crop, and the lands are uninhabitable. Ponds, when full to the brim, are not injurious, unless they form a marsh on their borders; but when a drought exposes their muddy margins and bottoms, replete with herbage and aquatic plants, the exhalations are winged with malignant diseases. That this poison becomes sublimated by drought and heat, appears on the melancholy record of the sufferings of the British army in Spain. After the battle of Talavera, when they retreated in the hottest weather upon the course of the Guadiana, the country was so dry, that the river had ceased to be a continuous stream, but stood in detached pools. "The soldiers then suffered from remittent fevers of such destructive malignity, that the enemy, and all Europe believed that the British host was lost."

The causes which operate on ponds have a like effect upon *canals.* Heat and moisture render the herbage on their edges tangled and luxuriant, the brooding dampness hovering over the half macerated foliage, facilitates its decomposition; then appear fever and ague and lingering complaints, heat and drought as the summer wanes, disen-

* Volney's View.

gage and concentrate the miasmata, and these by the cooler air of the fall produce endemic and epidemic diseases.

Salt marsh, although less fruitful of malaria than fresh water bogs and marshes, has erroneously obtained a reputation for salubrity. The grass of a salt marsh is not pulpy and rank like fresh water weeds; consequently it is decomposed less rapidly than that which grows in stagnant fresh water, and the effluvia are diluted by the flow of the tide below high water mark; but with these qualifications, salt marshes are proportionably insalubrious with fresh water marshes, provided both are exposed to great degrees of heat. This is seen extensively in the Mediterranean, and near the outlets of rivers within the tropics. The rule holds in every climate, the pestilential effects being in the direct ratio of the degree of heat, commencing with the Oronoco and other tropical rivers.

"The soil on the tops or sides of hills may also contain materials suited to the formation of malaria, if there is clay sufficient in quality and proportions to retain the necessary moisture."* So on plains not marshy, a surface or subsoil of hard clay may so far hold the water after great rains, as to keep the surface nearly marshy; and in those peculiar seasons when great heat and drought ensue, the results upon the foregoing principles are obvious. In addition to these, the following local causes may be enumerated—wet meadows and pastures, coppices grown up with tangled underwood, plashy grounds, mill ponds, flax ponds, and agricultural ditches and drains.

A tract of undulating country which came under my own observation, exhibited these pernicious influences, as they affect mild climates, in the experience of 1828. I forbear to mention names, as in giving this or any other local illustration, I wish not to excite alarm, but to suggest the mode of correction; and the following particulars are stated with a view to aid our judgment as to other situations, and the best modes of reform. This tract, for forty or fifty miles margined on three sides by the sea, is a rolling country, the soil generally a stiff loam upon a substratum of clay, overlying sand at no great depths. The formation is fundamentally primitive, but contains many tracts of superficial alluvion. The hills are of no great elevation but rather abrupt, succeeding each other rapidly, sometimes forming wet, basin shaped valleys, and at others, ponds of similar outline, seldom admitting any outlet for the superfluous waters or the wash of the hills.

---

* Bancroft on Fevers.

The lands are productive and assiduously cultivated. Salt marshes occur on the sea shores frequently, and on the margins of small bays, which indent the coast. In June and July of 1828, the fall of rain was not far from the average of preceding summers, but much of it fell in showers, and the rapid alternations of rain and sunshine were followed by very luxuriant vegetation. In August, a little more than an inch of rain fell before the 5th, and to this succeeded a drought for the remainder of the month. The mean heat of the month was 73° 45′, though it was occasionally as high as 91° Fahr. The margins of ponds were soon laid bare, the rank and macerated herbage was every were exposed to the unclouded rays of the sun, and the salt marshes yielded their co-operation. Various forces conspired to increase the energy and extent of pestiferous influences. For example, the greater amount of surface and materials exposed, gave out a larger quantity of poison, and that more concentrated; the mitigating effect of rain was also needed to absorb or dilute the miasmata, or, by keeping the ponds full, to secure the surfaces and materials usually under water, from the chemical action of heat. Whether this theory is or is not correct, the event was, that in this month a remitting bilious fever endemic in many villages, became rapidly and extensively epidemic, including all the open country; sudden attacks seized the most healthy, and those who in the spring had been affected with fever and ague, found their relapses of a malignant character; and great mortality ensued. On the western verge of this tract is situated a town containing ten thousand inhabitants, and although the epidemic came almost to the doors, and the sick were in every house, and almost in every apartment in neighborhoods not half a mile distant, yet not a single case occurred in the town, excepting a few persons who had been in the country, and who after their return were visited with fever. The site of the town is on table land about eighty feet above the level of the sea, but not high enough to secure it from the winds blowing over the adjacent country. It seems probable that it owed its safety to the fires, smoke, and other counteracting, though unknown causes, which accumulate wherever there is a numerous and industrious population. The sickness did not abate until the commencement of frost, which is another proof of the truth of the position that frost extinguishes the malarious principle, and another reason for supposing it referable to a vegetable origin. But if malaria is subdued by frost, the question arises, why do complaints proceeding from it occur in winter? To this inquiry, Dr. Keate's report of those regiments which returned to England from Walcheren in 1809, appears to me a satisfactory answer. Dr. Keate states that after their arrival in England from that most disastrous campaign, where more lives were lost by disease than by the collisions of war, "Many of the men fell down suddenly after the fatigue of a short march with an attack of the identical fever, so fatal at Walcheren," and he has no doubt that the poison was imbibed *there*, and remained *latent* until after their return. This seems to me so conclusive on this point, that I need not take room to repeat other instances where the effect of marsh effluvia had remained latent for different periods, from six days to six weeks and more, and where the proximate cause of its developement was fatigue, or a luxurious meal, night watching or some other casual excitement.

It has been further suggested, that it is a mistake to attribute this class of maladies to a local cause, as the North American Indians were not affected in the same manner, although more exposed to varieties of soils and seasons than the present race of inhabitants. That the Indians were subject to epidemics, we are informed by Hutchinson, who in his "History of Massachusetts," remarks that "the Indians had been greatly weakened by an epidemic." In Belknap's Biography, "several periods of pestilence among the natives of New England are named." It is mentioned, in "Gookin's Historical Collections of the Indians in New England," that consumption and fever were among the diseases of the natives, and also, that they invoked invisible spirits in powows, "*to lay the latter distemper.*" These sicknesses might, or might not be owing to causes at present operating, but they could scarcely be as violent, because the swamps and low grounds were screened in a good degree from the sun by the almost impenetrable forests; and the amount of humid vapors would be proportionate to the degree of heat which exhaled them, although their character might be influenced by other causes.

The severe sickness, and the violent fevers, which assailed the early settlers of this country, are familiarly known; nor need we a record of the symptoms to convince us that they were analogous to those which appear in every new settlement west of our Atlantic border, where the *newly cleared lands*, are known to be sources of disease to the cultivators. When the deep accumulations of autumnal leaves and other vegetable remains, which have been gathering for ages, are broken up by the plough and exposed to the sun and rain, those elements are necessarily disengaged and exhaled, which, as has has already been shewn, are productive of disease; and this sufficiently accounts for the distresses often suffered by the pioneers in new settlements, while the disappearance of those endemic maladies after the country has changed its aspect by cultivation, proves that we have not mistaken the cause.*

Another source of malaria remarked by Dr. McCulloch, is *bilge water*, to which he charges a great proportion of the sickness experienced on shipboard since the disappearance of the scurvy. It is his opinion, that the noxious effluvia are generated in hot climates by the action of the bilge water upon the wood of the ship itself, often augmented by corn, coffee and sugar cargoes, and sometimes by the quality of the ballast. It is notorious that grain and sugar, by sifting through the seams, render the bilge water excessively offensive, and Dr. McCulloch instances the most destructive fevers, proceeding from that cause. Gravel and mud ballast are also conducive to similar results, while iron ballast is safe. The simple and easy remedies for this evil are ventilation, and washing the ship every day by the plug, until the water drawn by the pumps is as clear, as that in the sea outside of the ship. A most thorough attention to ventilating the hold is also essential, because *there* is the origin and residence of the evil. The efficacy of this practice has been tested by experiment in the British naval and merchant service.† Another exposure of ships to this class of diseases, is from communication with the harbors and shores of tropical climates. Although it is not practicable to bring this set of dangers under as positive regulations as the former, yet great perils may be avoided, which are now thoughtlessly or ignorantly incurred by ships' companies in tropical regions. It has been ascertained that malaria has been distinctly propagated to a ship at anchor, five miles distant, and that a fatal cholera occurred instantly three miles from the land, upon a shift of wind.‡ It is therefore extremely desirable that ships should not approach such shores

---

* "The *long fever*, one form of the bilious remittent, is nearly extinct in the maratime states, although eighty years ago, it was one of the most terrible diseases of this climate. Where the country has been cleared one hundred and fifty years, the *long fever* is unknown."—Webster on Pestilence.

† From what is known of the astonishing powers of *chlorine* in destroying poisons, it is not too much to hope, that it may prove an efficient auxiliary in extinguishing or counteracting the "malaria of ships," perhaps even of superseding the necessity of any other application, although it should never be substituted for thorough cleanliness.

‡ McCulloch on Malaria on shipboard.

for wood and water; but when it is unavoidable, the natives of such countries should be procured to perform the labor, and all communication with the shore in boats should be in the day time, at full water; as on the banks of rivers, or on the sea shore, at low water, the exhalations from the mud are of the most pestilential character. No man should go on shore after sun-set when in harbor, nor before breakfast, nor be on the decks at all in the night, and the watch should be limited to the smallest possible number of men, to whom "smoking constantly while in the open air," should be recommended. Whenever any part of a crew are necessitated to engage in the dangerous employment of wooding and watering, fires lighted at short distances would be of great value, and "ought to be a standing order during such service." No boat should, by any means, be out after sun-set.

The consequences of *inundation* after the waters retire, are seen in every climate, producing diseases, differing in the degrees of severity, from the mild tertian agues of cool climates, occasioned by a low meadow or a mill pond; to the sudden and terrific fevers on the deltas of the Nile and Oronoco, and other rivers of the tropics. In these regions the heat is continual for long periods; the effects are sometimes instant, and the mortality frightful.

It is on the rice plantations of our southern States, in Mobile, New Orleans, and the countries which form the deltas of the Mississippi and its tributaries, that malaria has raised its throne on this continent; and were it not for the mysterious ability of the negro to resist the influences which destroy the white or Caucasian race of men, those vast alluvial regions would, of necessity, be resigned to their original denizens. It is a question interesting to naturalists, whether this capability of resisting the effects of malaria resides in the texture of the negro's skin, or in some more latent peculiarity of structure or functions; and it is important to medical science, to ascertain whether it is resisted by the pores of the external and internal surfaces, or by respiration, as we may hence discover some clue to the mode of its attack.

I will detain you with but one other cause of malaria, which I am bound not to omit, as it is one of extreme danger, from its following closely upon a very extensively prevailing human propensity—and that is, *neglect*.

Were it not that I might injure the value of real estates in some parts of this country, I could point out by name several excellent farms, which, by changing hands, and falling into the possession of non-resident proprietors, have become dangerous as places of residence, and are sinking in value every day. This results from the neglect of ditches and low grounds, and the consequent encroachment of bogs and marshes upon the borders of meadows, as these increase the extent of plashy surface, and accumulate a mass of deadly materials in weeds and herbage; because tenants and hired laborers cultivate only such parts as yield a ready profit. But this practice will be found ruinous; for where point by point is yielded, and the inhabitants recede, the result will be as in Italy, a complete depopulation: for, as I shall further shew, its destructive influences are in the inverse ratio of the resistance made by cultivation, and the habits of civilized life.

Perhaps I cannot in any way so concisely illustrate this point, as by giving a history of its effects in Italy.

The *maremma* of Tuscany extends from the south border of the vale of the Arno, to the States of the Church, and from the Appenines to the sea shore on the west. It was anciently covered with a busy race of men, high in rank among heroes and sages: but although its soils and seasons were then the same as now, the insalubrious elements were probably kept in comparative subordination. Maremma signifies the region of malaria, and this maremma has been cited as a proof that marsh effluvia cannot be the source of malarious fevers, because this tract is nearly depopulated by the diseases attributed to that cause, although it is an undulating upland country, of volcanic origin. But perhaps it will be esteemed conclusive evidence that science has discovered the lurking places of this poison, and that it conceals itself at times in spots remote from the shaking morass and mangrove sea beach, although those are its legitimate places of abode. In the valleys of this deserted tract, there are a few scattered houses, and the inmates, pale and languid, appear to maintain but a feeble conflict with the destroyer. On the hills are seen occasionally ruins of mouldering towns and ancient towers; "above all the rest rises the eminence on which the aged walls of Volterra repose. Its inhabitants wander like shades among its majestic ruins, and do not attempt to preserve even their habitations; but abandon them to the elements, and await with resignation "the returns of the scourge which decimates them every year."

Sometime in the sixteenth century, a sweeping pestilence* cut off from this whole region a great part of the population; after which the price of property declined, and the lands fell into the possession of the great capitalists. "From this time all productive activity was banished," and although Leopold, Duke of Tuscany, made several attempts to plant colonies in the maremma, they were each unsuccessful, because the colonists died of the fever before a settlement could be established. Thus the remnants of a people, who were distinguished among the Volsci and Arretinii as warriors, and who improved upon the science and taste of Greece and Tyre in the arts of peace, have gradually wasted away before the ravages of the pestilence. The genial climate allows the progress of vegetation through the winter, when multitudes of shepherds and herdsmen descend from the Appenines with their flocks and cattle, to pasture on the spontaneous herbage: but during the summer, companies of wild horses, and herds of black cattle, sweep over these immense pastures, revelling at will in the produce of the fields. The voices or the footsteps of men never interrupt these solitudes except in the ruined cities, and an occasional hamlet in the valleys, which shelter a few manufacturers of alabaster and alum. Even these employments are not followed from March to November; all is resigned to the dominion of malaria, which "increases in proportion as the resistance of civilization diminishes."

But it is in the States of the Church that this pestilence exercises its most hideous sway, and spreads the darkest ruin. The lands are more fertile than the maremma of Tuscany; fig trees and aloes grow amongst the ruins; vegetation is too luxuriant to be employed in pasturage; "the eye cannot penetrate the depth of the majestic woods, and the imagination peoples their gloom with the Manes of that ancient people who formerly rendered these solitudes illustrious."

When the papal throne was established at Avignon in the beginning of the fourteenth century, Rome was given up to the most desperate factions. Nothing can surpass the misery occasioned by those civil wars. One ambitious family succeeded to another; one demagogue displaced another in such rapid succession, that when Gregory XI. returned to Rome in 1377, he found that the country was laid waste; that the suburbs had disappeared; that the walls, in many places, were broken down, and that the diminished and dis-

* I believe it was the plague, but am not certain.

couraged population had neither wish nor ability to return to the pursuits of industry: and from the period of this melancholy desolation, when the luxuriant gardens and fields, and the beautiful courts and pleasure grounds in the city, and contiguous to it, had been for some time *neglected*, malaria commenced its frightful and gloomy reign. As a consequence upon these political animosities, estates were wrested from their owners, and fell in vast domains into the possession of individual proprietors. Thus upon luxuriant soils, and in places that had been pampered with the utmost efforts of culture, lazy weeds, and thickets of herbage, accumulated, unthought of, sending forth pestilence, at once the "cause and the consequence of the insalubrity of the atmosphere, banishing the rural population from the fields." The sun shines here with the purest light; the softest airs woo the lingering and admiring passenger; the winds blow with the most exhilirating freshness; but all these advantages are turned to deadly agencies, for the want of an enterprising, vigorous, industrious, and persevering population. NEGLECT creates what is equivalent to a marsh in every thicket of herbage; and the evil increases, and will increase, while there are no effective laborers, and while only a few ignorant, half savage, and decrepid herdsmen roam over the lands, haggard, and trembling with the annual visitation of disease, "possessing hardly spirit enough to ask strength from heaven to resist the coming attack," or scarcely a wish to survive it.

The celebrated plain which surrounds the city of Rome, extends from the promontory of Circe to the hills of Etruria, thirty leagues in length, by ten or twelve broad. The surface is uneven, but neither are the valleys deep, nor the hills precipitous. The plain seems an immeasurable extent of turf, spotted with thorns and briers; and a few solitary post houses, on this deserted tract, alone "reveal to the traveller that he is approaching the city of Rome." There is no example of so rapid a depopulation, as that which now wastes this imperial city, unless by siege, or by some elemental catastrophe. This is owing as well to political as to physical causes, but the proximate cause is malaria. So late as 1791, the city contained 166,000 inhabitants. "The streets," says M. Chateauvieux, "at that time were filled with sumptuous equipages and liveries, and decorated with magnificent palaces: in 1812 I entered the city by the same road, but instead of equipages, it was filled with droves of cattle, goats, and half wild horses, which a number of Tartar looking horsemen, armed with lances, and wrapped in cloaks, were driving before them. These seek an asylum within the walls of Rome, from the fate which awaits them in the fields." The population of the city has diminished more than sixty thousand in twenty years; and of the one hundred thousand who remain, ten thousand are vine dressers and herdsmen, who have fled before the pestilence from their habitations in the country. The deadly influence advances every year, invading some new section or square, and every year its terrible effects are augmented; for as it "increases in the inverse ratio of the resistance occasioned by the population, the fewer inhabitants, the more victims." Some parts of the city contain more dwellings than inhabitants, consequently, no repairs are made; stairs, doors, roofs and windows fall, but are not replaced; the occupants remove to other dwellings; abandoned palaces frown in gloomy grandeur, and multitudes of convents are uninhabitable, and left without even a porter to take care of them. It is here seen, that the pestilence walks in the footsteps of receding industry, *wherever its effectual resistance is withdrawn, while the remains of civilization and culture, furnish aliment and stimulus to the insalubrious exhalations.* The deep weedy dells, and the rank herbage around the mouldering ruins, supply those pestilential materials, from which the suns and airs of Italy extract swift poisons, and from which every breeze comes freighted with the messengers of death.

These obviously proximate causes are in full operation over the Pontine marsh. The attempt to reclaim it does honor to the pontificate of Pius Sixth; but although twenty miles have been restored on the Appian way, where three feet of alluvial marsh had formed above the pavements; and although the reclaimed lands are more productive than those of almost any other country, yet so immense a tract (more than one hundred miles,) remains, that the enterprise will probably fail under the present nerveless government; especially as the disease is fatal to the workmen, except for a short time in the winter. So successful however were the efforts of the French engineers under the protection of Pius, that not a doubt remains, that the whole spongy morass, now covered with reeds, and the hoary water-willow, might be restored to cultivation, that the pestilential influences might be eradicated, and a healthful population be made to rise near its fertile valleys, like that which distinguished the days of the Republic. Those parts which have been but partially drained, are represented as more rich and beautiful than the Elysium of the poets: but the charms of a fragrant atmosphere, the effulgence of an unclouded sun moderated by bowers of foliage, the rich verdure chequered by flowers of every hue, the clustering vine and loaded fig-tree, invite the passenger to linger in the scene of enchantment, only that a deadly poison may insinuate itself into his veins. Near the sea, on the west of the Via Appia, is a garden of Prince Doria, the flowers and trees of which have so long grown wild, that the tangled shades form a receptacle of miasmata; and a deep fertile valley the property of Prince Chighi, shaded with elms, and possessing every variety of rural elegance and beauty, has long been abandoned to the dominion of nature and the seasons; deer and birds are the only objects of moving life, which disturb the frightful repose.

These will suffice for examples of *neglect*, and will shew how it is co-operating with natural causes, to depopulate one of the fairest portions of the globe: and as like causes produce like effects, Rome, while gathering up her glories, and her mighty deeds for the shroud, and passing to the silence, and solitude of Paestum, and Volterra, may alarm the inhabitants of other cities, and teach them to guard against the approach of similar dangers.

III. First among all measures for the purpose of subduing the causes of malaria, it is recommended to drain or fill up wet grounds, and to prevent the collection of pools, and standing water where vegetation flourishes. Next in importance, are cleanliness and ventilation. Upon a smaller scale are various local defences, when the pestiferous exhalations can neither be prevented nor extinguished. These are, groves of trees, walls, fences, fires, moderately warm clothing, uniformity of diet and exercise, and a most scrupulous guard against exposure to the evening air.

Treatises have been written, and many experiments have been made, to ascertain the best methods of reclaiming wet lands for tillage; and so generally are they understood on the ground of profit, that I need not occupy your pages in repeating many of them: but I hope the great additional motive for prosecuting such improvements, as that of preventing epidemic pestilence, will arrest the attention of every class of citizens.

As malaria employs its deadliest energies in Italy, from the united results of political, moral, and physical causes, so the beneficial effect of any remedy operating there, ought to be conclusive of its efficacy; and for this purpose I beg leave to quote the instance of reclaiming the Val de Chiana, to shew that *physical causes may be controlled, by the skillful application of human industry.*

Near the city of Crotona was a lake, of no very great dimensions, but surrounded with marshes which diffused the most pestilential exhalations. The Tuscan genius and spirit, at that time in its zenith, suggested and executed a plan for draining the lake and its marshes. A canal leading to the Arno carried off the water, and three thousand acres were brought into cultivation. It was not thrown into a vast domain, and consigned to some individual proprietor, in whose hands the neglected parts would soon have run down the remainder, but was divided into seventy farms, which were separated by roads, and bordered with canals. On each farm a rural dwelling was erected; every inch of ground was cultivated; the crops, consisting of corn, wine, vegetables and silks were gathered in season, and not a foot of land was left to run waste. "The plain of Crotona in 1813 displayed one of the noblest triumphs of human industry;"* fertile fields where had been a pestilential morass, a salubrious atmosphere, and an industrious and happy population. Volney states that he "witnessed the drying up of a small pool and rivulet in Holland completely, to free a family from the annual visits of intermittent fevers." I might illustrate this part of the subject with many examples from foreign countries, in proof of the salutary effects of draining; particularly the benefit produced to the health of the inhabitants, by reclaiming large tracts of fens and bogs in the eastern counties of England, a benefit felt even in the metropolis; and a few cases nearly analogous in the United States might be cited; but I am not aware that the experiment has been thoroughly tested in this country.

In order to make the draining effectual, ditches should be broad and deep enough to convey off the superfluous water of the rains; and cross cuts or sluices should lead from hollows to the main outlet. *No weeds should be allowed to grow on the banks*, and the bottoms should be scraped annually, to clear them from mud and aquatic plants. It is of particular service to cut the weeds, grasses and shrubs, after the coming of frost, and to burn them upon the marsh; as the materials, which would be injurious in the following hot season, are thus changed into a species of manure, that hastens the progress of the

---

* Chateauvieux's Travels.

soil to the condition of upland. Ditching, clearing ditches, and mowing willows, stubble, and brush for burning, should be done when the weather is frosty or immediately after frost; nor should reclaimed lands be tilled, in summer, until the marshy character has been entirely subdued, and the surface has become firm and dry; but when that is once achieved, no assiduity or labor should be omitted to prevent the slightest approach to the former condition. *Ponds* with grassy margins, and little coves indenting the edges, or having shallow basins and pools with grass, weeds and bushes growing around them and over their bottoms, are abundant sources of malaria, if exposed to the due degree of heat. When these do not admit of draining, there is no alternative but to fill them up, or to deepen them, so that their edges may not be infested with weeds. No insalubrity will arise from ponds if they are surrounded by a clean margin of earth, with an outlet sufficient to prevent the waters from rising to the surrounding grass, and if the bottoms are kept submerged or free from aquatic plants.

Canals and ditches, whether for agricultural or commercial purposes, should be kept clear from vegetation, by walls or clean banks of earth, nor can I omit to notice those little harbors or basins near the feeders, where the waters spread abroad to some adjacent elevation, making a grassy shallow on its verge.

Drowned lands, when free from trees, are more dangerous than when shaded by forests; whenever therefore, they are found to be productive of ill health, in any of the forms which have been stated, measures should be adopted to prevent their encroaching on the dry land; and if they cannot be effectually drained, whether they are salt marsh, bog meadows, or wet pastures, *groves of trees* should be planted on their margins, to attract their moisture, and to prevent the poison from being carried by the winds to adjacent roads, or fields, or dwellings. The Romans ordered trees to be planted on the shores of Latium, to check the currents from the Pontine marshes. They rendered those groves sacred, and enacted heavy penalties, and other laws for their protection. The entrance of malaria upon the southern side of Rome, has been attributed to the cutting down of those forest trees, which, for a succession of ages, had occupied the declivities of the hills, between the marshes and the city. If to plant trees on the principle of intercepting the insalubrious exhalations blowing from the marshes, or other malarious tracts, is useful, so to cut them off on the sea board, when on the seaward side of a marsh, is of equal efficacy, by opening a channel for a free current of land winds to carry off the exhalations. I scarcely need add, that when irreclaimable marshes are on the sea shore, at the outlet of narrow valleys, groves on the landward side should be planted, to prevent sea winds from passing over them into the interior.

Fires and smoke have been found of great utility, especially in military service, as was proved on a large scale, by Buonaparte, before Mantua; and in Africa, the experiment in a small way, has proved successful. Emigrants proceeding to Alabama and other southern regions, from the low countries of Carolina, find no injury from sleeping in the open air, as their custom at night is to build a large fire of logs, and lay themselves beside it, on some part of their baggage. The effect of fires in destroying malaria, is plain, if the fact of its existence depends upon the presence of moisture; for the moisture being evaporated by the heat, the poison is either dispersed with the vapor, or if separated from it, falls innoxious, and probably inert. It is on the same principle, that smoking segars on the decks of ships is salutary. The heat and smoke, keep a dry atmosphere about the uncovered face, and the air respired, being thus deprived of miasmata, is safe. This view of the subject suggests another ground of suspicion, that the *poison acts upon the surface;* which is supported by the fact, that a strong malarious breeze, often strikes seamen arriving on such coasts with instant cholera, apoplexy, and other suddenly fatal diseases, and this from the sympathy of the stomach with the skin, and of the brain with the stomach. I offer this as conjecture merely; but I may add in favor of the hypothesis, that it is during sleep in the open air, when the pores of the skin are peculiarly relaxed and sensitive, that the poison operates with the most fatal activity and certainty.

It is necessary for people in exposed situations, either from the vicinity of pestilential places, or the prevalence of endemic sickness, to beware of causes, which may render them obnoxious to its effects; and a due attention to the following suggestions will not be without use. Regular and sufficient sleep: exercise without fatigue: substantial food, equally removed from a low abstemious diet, or a luxurious stimulating aliment: moderately warm clothing: scrupulously avoiding the evening air: and as far as possible a quiet mind. To these may be added, fires lighted for an hour or two, morning and evening, in every apartment of a house; and if practicable, lime or brick kilns, or fires for manufacturing purposes, between pestilential places, and villages, or dwellings.

I forbear to extend this article by making even the apology which its length already demands; and am, with great respect,

Your obedient servant, ****

New York, Nov. 1829.

Art. VI.—*Tennessee Meteorite.*

The late Professor Bowen, of whom an obituary notice was inserted at the close of Vol. XVI. of this Journal, left the meteoric stone, of which an analysis by Mr. Seybert is subjoined, with directions that it should be forwarded to me. On its way to this place, it was detained in Philadelphia, at my request, to undergo an analysis by Mr. Seybert, a labor which that gentleman has been so kind as to perform. Mr. Seybert's valuable analyses in Vols. IV. V. and VI. of this work, interrupted by an absence of several years in Europe, have added to our knowledge and our reputation; and the friends of science will be happy to see him occupied again in a kind of investigation, which is peculiarly difficult, and for which few in any country are adequately qualified. The meteorite of Tennessee has not yet arrived here. Mr. Seybert's notice of its external and physical characters, is sufficient to shew its similarity to the meteorites that have fallen in other places.—B. S.

New Haven, Dec. 6.

Analysis of the Meteorite, which fell near Drake's Creek, eighteen miles from Nashville, Tennessee, in the year 1827.

This mineral consists of a friable granular mass, of a greyish color, in which metallic particles are easily discernible to the naked eye. It is coated externally, with a crust of a dark brown color, which shows evident marks of fusion. It is highly magnetic, and its specific gravity, by two trials, was ascertained to be 3.484, and 3.487. When thrown into muriatic acid, sulphuretted hydrogen is evolved. By preliminary essays, its constituents appeared to be, Silica, Alumina, Magnesia, Sulphur, Nickel, Chrome, and Iron.

ANALYSIS.

A. 3 grammes of the pulverized mineral were decomposed in the usual way, by calcination with 2 parts of nitre, and 2 parts of pure caustic potash; the product communicated a pale green color to the water used to detach it from the silver crucible, indicating the presence of a trace of manganese; it was acidulated with nitric acid in excess, and by evaporation of the solution to a dry gelatinous mass, and subsequent treatment with acidulated water, the silica was separated, which, after edulcoration and calcination, weighed 1.20 gr. on 3 gr. or 40. per 100.

B. The solution (A), from which the silica had been separated, was of a pale green color. Submitted to ebullition with an excess of sub-carbonate of soda, it afforded a dark reddish brown precipitate, which, treated in the gelatinous state with oxalic acid, according to the process of Laugier, and then digested in ammonia, proved to be free from cobalt, and yielded 0.065 gr. of protoxide of nickel on 3 gr., or 2.166 per 100.

C. The residue insoluble in ammonia, was dissolved in muriatic acid, and tested with oxalate of potash, it proved to be free from lime. By phosphate of soda and ammonia, it yielded a precipitate of ammoniacal phosphate of magnesia, which, together with that subsequently obtained from the oxalic solution, amounted to 1.94 gr., equivalent to 0.715 gr. of magnesia on 3 gr. or 23.833 per 100.

D. The oxalic solution (B), was boiled with an excess of sub-carbonate of soda; the reddish brown precipitate which ensued when calcined with caustic potash, and treated with water, gave a solution of a lemon yellow color, which shewed that it had carried down with it some chrome; the alkaline solution was exactly neutralized, with muriatic acid, by which means the alumina was ascertained to be accurately separated; when washed and calcined, it weighed 0.074 gr. on 3 gr. or 2.466 per 100.

E. The solution from which the alumina was separated, was concentrated and boiled with muriatic acid, when chlorine was evolved: when ammonia was added, there was produced a precipitate of proto-hydrate of chrome, which, by calcination, yielded 0.025 gr. of protoxide of chrome on 3 gr. or 0.833 per 100.

F. The residue insoluble in potash (D), was dissolved in muriatic acid, and after the addition of sub-carbonate of ammonia, a precipitate ensued, which, when calcined, afforded 0.885 gr. of per oxide of iron.

On testing 3 grammes of the pulverized mineral with a magnet, there were separated 0.36 gr. of metallic grains, which, owing to the small quantity of sulphur, nickel, and chrome, may, without committing any important error, be regarded as the quantity of metallic iron contained in the substance, amounting to 12. per 100. There will then remain 0.366 gr. of per oxide of iron on 3 gr. or 12.20 per 100. The magnesia, precipitated by phosphate of soda and ammonia, is included in (C.)

G. The solution (B), after the separation of the precipitate by the sub-carbonate of soda, was boiled with an excess of nitric acid, and on the addition of the nitrate of barytes, there was obtained a precipitate of sulphate of barytes, weighing 0.535 gr. equivalent to 0.073 gr. of sulphur, on 3 gr. or 2.433 per 100.

After the separation of the sulphate of barytes, the excess of acid was neutralized with ammonia, and after the addition of more nitrate of barytes, no chromate of barytes was precipitated, notwithstanding the liquor had a yellow hue. It was also ascertained that the precipitated sulphate was free from chrome.

According to the precedent results, the constituents of this meteorite are—

	Per 100 Parts,	
A. Silica, - -	40.	
B. Protoxide of Nickel,	2.166	=Metallic Nickel, 1.704
C. Magnesia, - -	23.833	
D. Alumina, - -	2.466	
E. Protoxide of Chrome,	0.833	=Metallic Chrome, 0.584
F. Metallic Iron, -	12.000	
F. Per oxide of Iron,	12.200	
G. Sulphur, - -	2.433	
	95.931	
	100.000	
	4.069	Loss and Hygrometrical Moisture.

The above loss is somewhat considerable, but the principal results having been verified approximately by different trials, the precedent analysis is deemed sufficiently accurate, to shew the close analogy between this and other aërolites.

ART. VII.—*Solution of a Problem in Fluxions; by* Prof. THEODORE STRONG.

(Continued from p. 73 of this Volume.)

TO PROFESSOR SILLIMAN.

New Brunswick, Nov. 9, 1829.

Dear Sir—I send you the following continuation of my paper.
Yours respectfully, T. STRONG.

The same notation being retained; the form $F=-\frac{c'^2}{2}\frac{d\left(\frac{1}{p^2}\right)}{dr}$ applies easily to the case in which the particle describes an ellipse, the centre of force being at the centre. Let a, p', be the same as at the 72d page of the last Journal: then by what was there found, (since p=half the sum of the perpendiculars from the foci to the tangent at the place of the particle; the distance of its foot from the point of contact being half the difference of their distances from the same point); I have $a^2+ap'-\frac{a^3p'}{p^2}=r^2$ (1); $\therefore F=\frac{c'^2r}{a^3p'}$ (2); or F as r. By changing (1) into $a^2-ap'+\frac{a^3p'}{p^2}=r^2$; the ellipse becomes an hyperbola, the centre of force at the centre; and F as $-r$; hence it is repulsive. Substitute in (2) for c'^2, its equal $\frac{r^4dv^2}{dt^2}$; change the ellipse into a parabola by removing its centre to an infinite distance; which makes r parallel to a; $\frac{r^3}{a^3}=1$; put $\frac{rdv}{dt}=V$ the velocity parallel to the ordinates to the axis =const. and (2) becomes in the parabola $F=\frac{V^2}{p'}$=const. (Prin. B. 1. sec. 2. prop 10. and sch.) The form (I) of the Journal (for July) is easily adapted to the case of the particle describing a curve, when acted on by a force parallel to the ordinates (y) which are perpendicular to the abscisses (x). For (I) can be changed to $\frac{c'^2\,\text{cosec.}^2\psi}{r^3}-\frac{c'^2}{r^2}\frac{d(\text{cot.}^2\psi)}{dr}=F$ (3); since the force acts in parallel lines, its centre is removed to an infinite distance; $\therefore r$ being infinite, the term $\frac{c'^2 \text{cosec.}^2 \psi}{r^3}$ becomes a quantity of the first order relatively to the other terms, and is hence to be neglected; and $\frac{c'^2}{r^2}=\text{const.}$; $dr=dy$; $\cot.\psi=\frac{dy}{dx}$; hence F as $-\frac{d\left(\frac{dy}{dx}\right)^2}{dy}$ (4). Let the equation of the curve be $y^2=\frac{b^2}{a^2}\times(2ax-x^2)$ (5); then $\left(\frac{dy}{dx}\right)^2=\frac{b^2}{a^2}\times\left(\frac{b^2}{y^2}-1\right)$; hence $-\frac{d\left(\frac{dy}{dx}\right)^2}{dy}=\frac{2b^4}{a^2y^3}$; or F as $\frac{1}{y^3}$. (5) is the equation of an ellipse; make $a=b$, and it is a circle; change the sign of x^2 and it becomes an hyperbola; neglect x^2 and it is a parabola; but the solution which I have given comprehends all these cases. (Prin. B. 1. sec. 2. prop. 8. and sch.) By (b) of the Journal (for July) when the motion of the particle is wholly in the plane, (x, y) $F=-\frac{xd^2x+yd^2y}{rdt^2}$; if the force is directed to the origin of x and y, $d^2x=\frac{xd^2y}{y}\therefore F=-\frac{rd^2y}{ydt^2}$ (6). Let y be changed in any given ratio; or let its inclination to the abscisses (x) be changed from a right angle to any other given angle φ. Then y becomes ny ($n=$ any given number; or $=\sin.\varphi$); let F, r, become F′, r', in the changed curve; $\therefore$ (6) becomes $F'=-\frac{r'd^2y}{ydt^2}$ (7). Hence if two particles of matter are supposed to describe these curves so as simultaneously to be at the extremities of corresponding ordinates, I have by (6) and (7), $F : F' :: r : r'$ (Prin. B. 1. prop. 10. latter part of the scholium.) By (M) of the last Journal, I have $-\frac{c'^2}{2}\frac{d\left(\left(\frac{1}{r}\right)^2+\left(d\frac{1}{r}\right)^2\right)}{dv^2}=$ $=Fdr$ (8); put $\frac{1}{r}=R$, suppose $dv=\text{const.}$ reduce, and there results $\frac{d^2R}{dv^2}+R-\frac{F}{c'^2R^2}=0$ (9); which is a form of F, very useful in physical astronomy.

I will now notice some things which readily follow from what has been done. Let a, p', be the same as before; $P=3.14159$, etc. $=$ semicircumference of a circle rad. (1); $T=$ the time of revolution of the particle in an ellipse around a centre of force at the focus; $T'=do$, around a centre of force at the centre; the arbitrary constant $\frac{c'}{2}$ being (as heretofore) so assumed as to $=$ the area described by (r), the radius vector around each centre of force in the assumed unit of time. At the seventy-third page of the last Journal I found $F=\frac{c'^2}{r^2p'}=$ the force to the focus of any conic section; suppose $F\times r^2=$const. then $\frac{c'^2}{p'}=$const.; or p' as c'^2; (Prin. B. 1. sec. 3. prop. 14.) Suppose again that $F\times r^2=$const. then $\frac{c'^2}{p'}=$ const. as before; but in the ellipse $\frac{c'T}{2}=P\sqrt{a^3p'}=$ the area; hence $\frac{a^3}{T^2}=$ $=\frac{c'^2}{4p'P^2}=$ const.; or T as $a^{\frac{3}{2}}$; (P. B. 1. prop. 15.) By (2) of this paper, $F=\frac{c'^2r}{a^3p'}$ the force to the centre of an ellipse; suppose $\frac{F}{r}=$const., then $\frac{c'T'}{2}=P\sqrt{a^3p'}$, or $c'^2=\frac{4P^2a^3p'}{T'^2}\therefore\frac{F}{r}=$ const. $=$ $=\frac{4P^2}{T'^2}\because T'=$const. $\therefore$ in different ellipses, if $\frac{F}{r}=$ const. $T'=$ const. the circle is here considered as an ellipse; (P. prop. 10. cor. 2.) Again, if $F\times r^2=$ const. in different conic sections, (as above), $\frac{c'^2}{p'}=$const. but $\frac{c'}{p}=V$ the velocity $\because V$ is as $\sqrt{\frac{p'}{p}}$; (P. prop. 16). By (8) of the last Journal, $\frac{1}{p^2}=\frac{2}{rp'}\because V^2=\frac{2c'^2}{rp'}$, or V as $\sqrt{\frac{1}{r}}$. (P. prop. 16. cor. 6.) By (7)..(8)..(9) I have in any conic section $\frac{dp}{p^3}=\frac{dr}{r^2p'}$, but by (3) of last Journal, $V:V'::\sqrt{\frac{dr}{r}}:\sqrt{\frac{dp}{p}}\therefore V:V'::\sqrt{rp'}:p$; (P. prop. 16. cor. 9.) Again, $p^2=\frac{ap'r}{2a\mp r}$; hence, $V:V'::\sqrt{2a\mp r}:\sqrt{a}$ (10); the sign $-$ being used in the case of the ellipse, and $+$ in the hyperbola, and r is to be neglected in the parabola, which gives $V : V' :: \sqrt{2} : 1$ (11); (P. prop. 16. cor. 7.) Since (10) and (11) are independent of the parameter of the conic section, by supposing the parameter to vanish the sections become right lines, and the particle describes a right line, as stated by Newton, B. 1. sec. 7. propositions 33 ·· 34, and $V : V' :: \sqrt{AC} : \sqrt{\frac{AB}{2}}$ as in prop. 33, for in his fig. (1) $2a-r=AC$, in fig. (2) $2a+r=AC$, in both $a=\frac{AB}{2}$; but in prop. 34 $V : V' :: \sqrt{2} : 1$.

I will conclude this paper with some remarks on (b) which presented itself in the differentiation of (1) of the Journal (for July). It may be changed to $\left(\frac{d^2x}{dt^2}+\frac{xF}{r}\right)x+\left(\frac{d^2y}{dt^2}+\frac{yF}{r}\right)y+ +\left(\frac{d^2z}{dt^2}+\frac{zF}{r}\right)z=0$ (a). If the particle is free, that is, if it is not supposed to move on any given line, or surface; then x, y, z, are independent of each other; and their coefficients, or the quantities in (a) within the parentheses must each $=0$, in order that (a) may be indefinitely trne. Hence $\frac{d^2x}{dt^2}=-\frac{xF}{r}$, $\frac{d^2y}{dt^2}=-\frac{yF}{r}$, $\frac{d^2z}{dt^2}=-\frac{zF}{r}$; which are the equations (g) assumed at page 69, of the last Journal, from the ordinary methods of decomposing forces. Again (b) can be changed to $\frac{xd^2z+yd^2y+zd^2z}{dt^2}+Fr=0$ (c); similarly I shall have $\frac{x'd^2x'+y'd^2y'+z'd^2z'}{dt^2}+F'r'=0$ (c') should the particle be acted on by any other force, F′, analagous to F; x', y', z', being respectively parallel to x, y, z; their origin being at the centre of F′; also r' is the distance of the centre of F′ to the particle. Also I shall have for another force F″, an equation of the same form by accenting x, y, &c. twice; &c. for F‴ to any number of forces whatever. In order to obtain the combined effect of F, F′, F″, &c. on the particle, I take the sum of the equations (c) &c. then I suppose the position of the particle to be varied infinitely little, but so as not to affect F, F′, &c. $\frac{d^2x}{dt^2}$, $\frac{d^2x''}{dt^2}$ &c.; $\frac{d^2y}{dt^2}$, $\frac{d^2y'}{dt^2}$ &c.; $\frac{d^2z}{dt^2}$, $\frac{d^2z'}{dt^2}$ &c.; in other words, I regard these quantities as constant in taking the variation of the sum of the equations. Hence I have $\left(\frac{d^2x+d^2x'+\&c.}{dt^2}\right)\delta x+$

$+\left(\frac{d^2y+d^2y'+\&c.}{dt^2}\right)\delta y+\left(\frac{d^2z+d^2z'+\&c.}{dt^2}\right)\delta z+F\delta r+F'\delta r'+$ &c. $=0$(A); since δx, $\delta x'$, &c. are evidently equal to each other, as also $\delta y=\delta y'=\delta y''=$&c. the same may be said of δz, $\delta z'$, &c. I now suppose the motion of the particle to be referred to three rectangular axes having their origin at any given point in space, these co-ordinates which I shall denote by the small capitals X, Y, Z, being respectively parallel to x, y, z; then $\frac{d^2x+d^2x'+\&c.}{dt^2}=$ the acceleration in the direction of X may be denoted by $\frac{d^2\text{X}}{dt^2}$ and $\frac{d^2y+d^2y'+\&c.}{dt^2}=\frac{d^2\text{Y}}{dt^2}$, $\frac{d^2z+d^2z'+\&c.}{dt^2}=\frac{d^2\text{Z}}{dt^2}$, and $\delta\text{X}=\delta x$, $\delta\text{Y}=\delta y$, $\delta\text{Z}=\delta z$; by substituting these values (A) becomes $\frac{d^2\text{X}\delta\text{X}+d^2\text{Y}\delta\text{Y}+d^2\text{Z}\delta\text{Z}}{dt^2}+$ $+F\delta r+F'\delta r'+$&c.$=0$(B). I have supposed F to tend to diminish r, F$'$ to diminish r', &c. but should any force act from its origin or tend to increase its distance from its origin, the variation of its distance must have the sign minus in (B), thus if F$''$ tends to increase r'' instead of $+F''\delta r''$ I shall have $-F''\delta r''$ in the formula. The formula (B) is the general formula of Dynamics in the case of the motion of one particle of matter. (See the Mec. Anal. of La Grange, vol. I. page 251.) (B) can be changed to $\left(\frac{d^2\text{X}}{dt^2}+X\right)\delta\text{X}+$ $+\left(\frac{d^2\text{Y}}{dt^2}+Y\right)\delta\text{Y}+\left(\frac{d^2\text{Z}}{dt^2}+Z\right)\delta\text{Z}=0$ (C); by taking the variation of r, expressed in terms of x, y, z, and of $r'=\sqrt{x'^2+y'^2+z'^2}$ &c. then putting the large capitals $X=\frac{xF}{r}+\frac{x'F'}{r'}+$&c. $Y=\frac{yF}{r}+\frac{y'F'}{r'}+$ &c. $Z=\frac{zF}{r}+\frac{z'F'}{r'}$&c. The formula (C) agrees with (f) given by La Place, (Mec. Cel. vol. 1, page 21.) If the particle is free, the coefficients of δx, δy, δz, must each $=0$, which gives $\frac{d^2\text{X}}{dt^2}+X=0$, $\frac{d^2\text{Y}}{dt^2}+Y=0$, $\frac{d^2\text{Z}}{dt^2}+Z=0$. But if the particle is supposed to move on any given line or surface, then by means of the equations of the line or surface, we are to eliminate so many of the variations δx, δy, δz, as there are equations, and to put each of the coefficients of the remaining variations =0, and there will arise equations, which together with the equations of condition, will be sufficient to find the place of the particle at any given time.

Art. VIII.—*All primitive general strata, below granular quartz, are cotemporaneous and schistose; by* Prof. A. Eaton.

PROF. SILLIMAN.

I have received letters from several eminent geologists, since you published my Geological Prodromus, all of which, express full satisfaction on the subject of my five carboniferous formations, excepting the primitive. The generous sentiments expressed on this subject, especially by Dr. Morton, who is pleased to call it a reformation in geology, with which he seems to be *generally* pleased,* induces me to trouble you with a concise statement of facts relative to primitive *general* strata.

As consistency may be considered important, I will state, that in the year 1818, I wrote an article, which is recorded in the MS. transactions of the Troy Lyceum, in which I attempted to prove, that there is not in New England, and probably not in North America, a general stratum of Werner's crystalline granite. This being a question in "matter of fact," no proof can be urged but that which is derived from simple inspection. I have carefully examined most of the territory of the Northern States, and have not been able to discover crystalline granite, granitic hornblende rock, or any other rock, *geologically* below granular quartz, which is not schistose and carboniferous. The ranges of Spencer, and of Southampton, Mass. and of the Highlands, N. Y. contain the most extensive alternating layers or beds in the Northern States, of what has been called *granite* by those who call the slaty kind *gneiss*. In all these localities I can see nothing more than subordinate strata, or beds, at most.

Deducting crystalline granite and granitic hornblende rock including porphyry, nothing is left but schistose (slaty,) rocks, containing plumbago. The primitive slates are the *gneiss*, (slaty granite,) *the mica slate, the hornblende slate*, and *the talcose slate*. Plumbago (carburet of iron,) is found in all these rocks. It is true, that some of

---

* Dr. Morton objects to my tertiary formation

these rocks in some localities contain but little plumbago. The same remark will apply to transition and secondary coal formations. For example, the gneiss of Sturbridge, Mass. contains immense beds of plumbago,—also the gneiss of the west side of Lake Champlain; though the gneiss of the same ranges contains little or none as we proceed northerly or southerly. So the second graywacke of Pennsylvania contains beds of coal of vast extent; while the same continuous stratum contains minute beds only in Catskill Mountain.

That all the primitive schistose rocks are cotemporaneous, appears from their extensive alternations and intermixtures. The following series will be sufficient, at least to promote enquiry, if they do not induce conviction.

These alternations were carefully examined by Mr. Cortlandt Van Rensselaer and myself, while on a geological tour from Manchester in Vermont, obliquely over to Boston, (a distance of about one hundred and thirty miles,) in the month of June, 1829.

1. Slaty granite—2. Talcose slate—3. Hornblende rock—4. Mica-slate—5. Hornblende rock—6. Mica-slate, (transition argillite,)—7. Talcose slate—8. Slaty granite—9. Hornblende rock—10. Talcose slate—11. Hornblende rock—12. Mica-slate—13. Slaty granite—14. Hornblende rock—15. Talcose slate—16. Hornblende rock—17. Talcose slate, (transition argillite)—18. Talcose slate—19. Slaty granite—20. Talcose slate—21. Hornblende rock, (transition argillite.)

Dr. E. Emmons mentions a remarkable locality, in proof of the cotemporaneous character of these primitive rocks, in the town of Chester, Mass. Here one of the general ranges of hornblende rock seems to be subdivided, so as to alternate with mica-slate more than twenty times within the distance of half a mile.

It is true that other rocks alternate at their approximating sides; but such extensive alternations are never observed among them. When rocks alternate so extensively, we are bound to consider them cotemporaneous; consequently, "according to the sound logic" of geology, each stratum is a constituent of the same formation. I believe the expression, *same formation*, is applied to all strata which appear to have been produced by the same cotemporaneously operating causes.

I hope to have the 2d part of the reports in readiness, together with the map, for the April number of the Journal.

Most respectfully yours. A. E.

Rensselaer School, Troy, Nov. 2d, 1829.

Art. IX.—*On the Origin of Springs and Fountains; by* Geo. W. Long.

TO THE EDITOR.

West Point, October 29th, 1829.

Sir—I submit to you, for the Journal of Science and Arts, a few ideas on the subject of springs, and the discharge of water at the earth's surface by boring; although it has often been discussed by able philosophers; still some additional explanations may perhaps be given by others.

Springs that flow spontaneously, are generally found on the sides of hills, or in the neighborhood of them; and often in such situations, as not to be easily accounted for, and to be, at the same time, objects of great curiosity. The flow of water from the bowels of the earth, by boring, excites still more wonder, as the cause appears more hidden from our comprehension. In all these cases, the hydrostatic principle which causes the discharge of the water, must be the same; that is, the pressure of a column of water superior to the pressure of the water raised; and in the absence of any other active force to cause this pressure, it follows that it must arise from a superior fountain head. To account for these circumstances, which seem to involve the whole subject of springs, will be the object of this paper.

The enquiry first leads the attention to the great amount of exhalation, in the form of vapor, that is constantly going on from the interior of the earth towards its surface, and which is dissipated in the atmosphere. This can be shewn experimentally, by placing a board or platform horizontally on the ground, when the bottom surface will soon become moist with the vapor that rises, and which would otherwise escape into the atmosphere. A still more striking example may be cited, to prove the amount of vapor that escapes from the earth into the atmosphere. Springs that have their sources near the surface of the ground, in periods of drought sometimes fail, and are observed to flow again just before a storm. This circumstance is accounted for by the supposition that the change of the atmosphere from a dry to a moist state, so far retards the escape of the vapor from the earth, as to cause its collection, and to renew the supply of water for the spring. From these facts it may be demonstrated that springs in deep places and wells, receive their supply of water from the condensation of the vapor exhaled under the surface, and no farther from rains, than just to allow of the interposition of strata, sufficient to form an impediment to the escape of the vapor through the moist surface of the ground. It may also be observed that the heaviest rains seldom penetrate more than a few inches into the earth, especially on the sides of hills, where springs are the most numerous; and that therefore the rains cannot supply them with water.

The force of capillary attraction may be thought to be the cause of the supply of water in high lands; but if that is the case, it would follow that wells or springs from the interior would not be affected by droughts, the reverse of which is by sad experience yearly demonstrated in different parts of the country. In the foregoing examples, to prove the reality of the subterranean exhalation and condensation of vapor, it is evident that hydrostatic principles have no application; but if capillary attraction has the power usually attributed to it, of raising water through the pores of the earth, many appearances would be expected that do not exist. Small islands and banks of rivers would be saturated with water, and the earth would be much more equally supplied in all its parts, than it now is. The second object is, to show how the vapor exhalations are actually collected, to give a supply of water for springs; which is explained, from the structure of the *crust* of the earth, as it is found in strata of rocks and various kinds of earths, some of which are porous, and others, like the rocks, impenetrable to the rising vapor. The mountains and hills have their regular formation of inclined strata, which appear to be generally a continuation of those in the low countries adjoining them. These impenetrable strata are sufficient to oppose the escape of the vapor, and convert it into water, which falls into cavities, or saturates the confined strata of porous earth underneath, where it may exist under a pressure, according to the difference of level of the highest part of the stratum, and the parts below. This accounts for the fact, that when a stratum of rock is penetrated, the water sometimes rises in wells, to some feet above the rock. The strata in hilly lands are irregular, and often so broken as to form numerous cavities, opening outwards, in which water is collected as above, and is discharged in springs. The interior of the hills may also have extensive cavities, and strata of porous earth, into which the greatest part of the water collected may pass, and form connexions with distant places in low lands; thus affording a fountain head higher than the surface of the ground in an extensive surrounding country. Hence by sinking a shaft that may penetrate this stratum, a flow of water would be obtained at the surface of the ground.

Another observation may be made with regard to the vapor exhalations from the earth. In the winter,* the earth receives no water by rains, yet the surface of the ground, in cold latitudes, obtains moisture sufficient to be frozen into a solid crust; and all springs and wells give a full discharge of water. Rivers that are supplied by springs, are also found to contain more water in winter than summer, although nothing is received from the surface of the ground.

Art. X.—*The science of Mechanics as applied to the present improvements in the useful arts in Europe, and in the United States: adapted as a Manual for Mechanics and Manufacturers; by* Zachariah Allen. Providence, R. I. 1829.

(Communicated.)

This is the first work of the kind, of domestic origin, that has been put into the hands of our practical mechanics and manufacturers. Some of the subjects contained in it, have appeared in separate treatises and in periodical journals, but no American book has hitherto been published, calculated to afford instruction in so many departments of a manufactory and workshop, as the one before us. Robinson's Mechanical Philosophy, and Brewster's edition of Ferguson's Mechanics, published in England, can seldom be procured in this country. Nicholson's Operative Mechanic, and Gregory's Mechanics, republished in Philadelphia, have served as books of reference to our millwrights and machinists, and in connexion with the Encyclopæpia, have been their principal sources of information. These works, however, contain a great amount of matter totally irrelevant to the

---

* The writer doubtless intends the winter of polar regions, as in the winters of the temperate latitudes, rain is not an uncommon occurrence. A question will of course arise as to the origin of the subterranean water, which affords the exhalations; and the writer intimates no opinion, whether it is ultimately derived from percolation, from rains and waters upon the surface, which are thus ultimately, although, it may be, variously and unequally distributed through the interior of the earth, or whether, as some geologists suppose, there may be great subterranean reservoirs of water. This, however, will not militate against the author's hypothesis, for from whatever sources the water may be derived, it is fair to reason upon the formation and condensation of its vapor.—*Ed.*

wants of American manufacturers, which enhances their price so much, that the information wanted from them is not conveniently available to most persons who need it. To the above list of authors, may be added, "Buchanan on Millwork and other Machinery," recently republished in this country, which, though valuable so far as it goes, is not sufficiently comprehensive. A work was, therefore, much wanted, from the pen of an experienced American manufacturer, competent to the undertaking, who would avail himself of whatever is applicable from the above, and other similar publications, and enrich it with his own reflexions and observations, and adapt the whole to the wants and circumstances of our own establishments, and to the capacities of those who are employed in them.

Among the advantages of a work of this kind, may be mentioned the saving of expense it may occasion from abortive experiments. No people employed in the useful arts are so liable to engage in these, as the mechanics and manufacturers of this country; and although the result has, on the whole, been highly favorable to our general prosperity at home, and to our reputation abroad, yet it must be conceded that an immense amount of property has been squandered in unavailing experiments, by individuals "possessing zeal without knowledge," who were either ignorant of the theory of mechanical powers, or destitute of experience in the application. We have authority for saying, that of all the inventions that have been patented in this country, "one third only are considered as either useful, or directly applicable to some practical purpose; another third of them are merely exhibitions of ingenuity, useful only, as displays of the inventive faculties of our countrymen, and the remaining third are useless;"* and yet the expense of all these collectively is small, compared with what has been lavished by individuals upon useless experiments, that have never been made known to the public. "There is probably," as Mr. Allen justly remarks, "no mode in which a greater amount of property may be more rapidly dissipated and wasted, except perhaps at the gaming table, than in the construction and management of mills and machinery, by those incompetent to the task, from a want of proper practical knowledge. Every false calculation is attended with costly expenditures, and loss of labor in manufacturing operations. At some of the American mills, which have been erected only a few years, various kinds of machinery,

* Journal of the Patent Office.

abandoned after a course of unsuccessful experiments, may be found collected as rubbish, forming a sort of museum of injudicious and abortive contrivances." A book like the one before us, is calculated to prevent the waste of property in this manner, by pointing out the practical modes of success, and the common sources of failure.

The first hundred pages are occupied with a consideration of matter as acted upon or modified by certain natural powers, as gravitation, cohesion, magnetism, electricity, galvanism and heat, which appear to have most important effects upon all solid bodies, producing changes in their gravity, strength, hardness, fluidity and forms. In discussing these subjects, the author keeps constantly in view the design and object of his book, to wit, the application of science to the arts, in a manner adapted to the capacities of manufacturers and mechanics, avoiding a pedantic display of technical terms and ostentatious speculations, too often to be found in works of this kind, and which embarrass the inquiries of those who are deficient in scientific education. After a brief explanation of *gravitation,* he gives tables and calculations for estimating the specific gravity of the substances manufactured or used in manufactories, with directions for doing it by admeasurement, by which the weight of sheets of malleable and cast iron, of copper and lead, also, of square or round bars, of ropes, and of iron and lead pipes, can be ascertained, without the use of a balance of any kind, and even while these articles make a component part of machinery. After an explanation of *cohesion,* there is exhibited the comparative strength of materials to resist compression, or being crushed, as the stiffness of beams, bars, &c. longitudinal strength to resist being pulled asunder in the direction of their lengths; as cables, chains and anchors, bars, &c.; also, power to resist twisting or torsion, as gudgeons, journals of shafts, &c. with rules for calculating the strength of the same, and of wheels, revolving shafts, and other parts of machinery.

The next thirty pages treat of matter geometrically defined, and contain rules and calculations for determining the solid contents and superficies of walls, timber and other like substances of every form. This is followed by numerous practical remarks on friction, and other kinds of resistance to motion, with rules for estimating their amount and influence upon various kinds of machinery. "From the resistance of friction alone," it has been observed by Mr. Ferguson, "there are few compound machines that do not require a third part more power to work them when loaded, than is sufficient to constitute an equilibrium between the weight and power." Galileo too, observes, "that what appears very firm and succeeds very well in models, may be very weak and infirm, or may even fall to pieces by its own weight, when it comes to be executed in large dimensions, according to the model." It must be obvious then to every one, that rules and directions for calculating the amount of friction and other impediments to motion with precision, must be all important to the machinist.

The subject of heat occupies about fifty pages, upon which, the author has been at pains to consult the most approved works recently offered to the public, and has added the result of his own experience. Here, as on other subjects, are given an elementary treatise, and then the effects of heat upon machinery, and in carrying on the useful arts, as distillation; and in generating steam for working engines, with rules and calculations of its power, and of the comparative value for this purpose, of different kinds of fuel. His remarks on the domestic use of fuel, though somewhat of a departure from mechanics, are interesting to all persons. From the calculations exhibited, we learn, that Lehigh coal is actually cheaper, when used for heating rooms by means of close stoves, than English coal, by 150 per cent;—that when R. Island coal costs five dollars fifty cents per ton, and Lehigh eight dollars, the same quantity of heat may be obtained from the same cost of fuel; or that a ton of R. Island coal is actually worth a little less than three fourths of a ton of Lehigh coal.

From a table inserted page 96, it appears, that it costs ten times as much to heat rooms by means of ordinary open fire-places, as by close stoves with long pipes or funnels; and that an open parlour grate requires five times the expense for fuel, and an open Franklin stove nearly three times the expense, to produce an equal degree of heat to the air of an apartment.

On the quality of the heat thus imparted he observes, that

"The principal objection urged against the use of close stoves, is the confined dry air produced by them. It is well known that air, which passes over iron or bricks heated red hot, acquires a disagreeable odor, and produces a harsh sensation upon the lungs, accompanied by a tendency to cough. The clay or fire bricks, with which anthracite coal-stoves are lined, being slow conductors of heat, are peculiarly well adapted for keeping the external part of the stove at a temperature which will not have the disagreeable effect upon the air abovementioned. Whenever the heat of a stove does not exceed

300°, the air is not rendered unpleasant for respiration. On this account steam pipes produce a temperature at once mild and agreeable."—*p.* 97.

The consideration of heat concludes with some valuable remarks and suggestions on the structure of flues of chimnies, stovepipes, and different kinds of stoves, which all persons will take more or less interest in reading.

Thus far the book relates to *matter*, as forming the compound parts of machines, or as subject to their action, and to the effects of the principal natural agents or powers upon material substances. The subjects next treated upon, and which may more appropriately than the foregoing, be termed mechanics, are 1. *Power*, whether derived from wind, water, steam or animals, with rules for calculating the same.—2. *Motion*, under which several interesting topics are discussed.—3. *Mechanical powers*, as defined and explained in other elementary works.—4. *Hydrodynamics*, which includes among other things, pressure of fluid substances,—hydrostatic press, which is one of the most simple and beautiful machines for producing vast mechanical effects by means of a fluid, and illustrates most perfectly the axiom that what is gained in power is lost in velocity,—aqueducts, water level, levelling instruments, rules for levelling, floating power of fluids, hydrometer, rules for calculating the pressure of fluids upon the bottom and sides of vessels and upon flood-gates, embankments, pipes, &c. and for proving their strength; most of which subjects are to be found in elementary works on mechanics, but are explained here in a manner adapted to the comprehension of common readers. —5. *Hydraulics.*—6. *Water wheels*, under which heads, the mill wright, engineer, and all persons concerned in the management of water power, will find a rich fund of information, elementary and practical, and in which the author has furnished more suggestions from his own experience and observations, made in this country and in Europe, than in other parts of the book. If these were duly observed, we should not so often hear of miscalculations in the power of mill streams, the construction of dams, embankments, trenches, and in the structure of different kinds of water wheels, that have in many instances within our knowledge, been attended with great loss of property to the owners. A description is here given of the value of reservoirs of water connected with ponds, with calculations and directions for forming them; a subject rarely to be found in treatises of the kind. There are two or three minor things omitted under this head, which will be noticed hereafter.—7. *Pneumatics*, including the structure and operation of windmills—8. *Elements of machinery* and the contrivances used in the composition of machines.—9. *Wheelwork.*—10. *Method of disengaging and re-engaging machinery.*—11. *Methods of regulating the motion of machinery.*—12. *Mechanical action of moving bodies and mechanical resistance of reaction.*—13. *Mechanism for producing changes of motion.* The limits prescribed to this notice, prevent our dwelling upon any of the foregoing topics, or even mentioning all the particular subjects embraced under each head. They fill about seventy pages, and form a neat compendium of what is necessary to be known in a work intended for the manufactory and workshop, and references to them will be often found convenient, if not necessary, for illustration of mechanical principles and forms of construction. The work concludes with a faithful and very intelligible account of the various steam engines, illustrated with plates, and tables, and calculations.

It would be too much to expect the first edition of a work of this kind to exhibit no imperfections, or that it would embrace every particular proper to be introduced. The author has however made a valuable storehouse of choice materials, well arranged in appropriate compartments, in which accidental omissions, as well as future discoveries, may, in succeeding editions, find their appropriate places. On the subject of backwater, it would have been well to have inserted a description, and view of the means of getting rid of it in times of freshets, invented by Mr. Perkins of this country, and Mr. Burns, of Scotland, which is particularly applicable to overshot and breast wheels.

A new work, published by Dr. Bigelow, entitled, "Elements of Technology," contains the following remarks respecting the buckets of overshot and breast wheels: "The pressure of the atmosphere occasions sometimes a serious obstruction to the motion of overshot wheels, by causing a quantity of backwater to be lifted, or sucked up, by the ascending inverted bucket, when it first leaves the water. This difficulty is remedied, by making a few small holes near the base of the bucket, and communicating with the next bucket. Through these the air will enter, and prevent the suction. It is true, that when on the descending side, these holes will allow the escape of some water, but as this water only flows from one bucket to the next, its effect is inconsiderable, when compared with the advantage gained. Air, as Professor Robinson observes, will escape through the holes about thirty times faster than water, under the same pressure." As this evil, from suction of water by the ascending buckets, is also mentioned by Mr. Allen, without the suggestion of any remedy, perhaps the one proposed by Dr. Bigelow, may be deemed worthy of notice in a future edition. The process of bleaching cotton fabrics, which follows so closely upon the weaving of them, and is performed in immediate connexion with some manufactories, may perhaps be thought worthy of a place in a work like this. The process for making starch, so much used in sizing cottons, might be advantageously introduced.

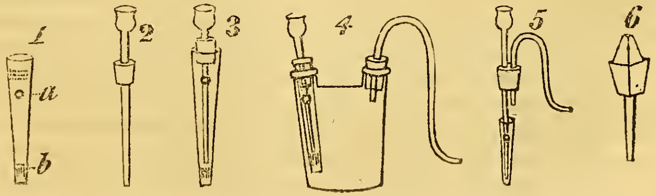
We have one fault to find, and that is, with the appearance of the book. The author has shown a better knowledge of the subjects treated, than of the art of book making. The work wears a dress inferior to its merits; the paper is of an inferior quality; the pages are more crowded than is pleasing to the eye of most readers; and the numerous cuts distributed throughout the work, although accurately drawn, and answering the purpose intended, are executed in a clumsy style. All this, however, is in some measure compensated for, in the reduction of the price of the book, which is much lower, considering the value of the materials, and the amount of labor bestowed in preparing them, than that of almost any other book we have seen.

In conclusion, we may observe, that every one must be struck with astonishment, when he reflects, that the mechanical powers, amounting to only six, should be susceptible of applications, so numerous and varied, as that all mechanical effects, however intricate, should originate from, and be reducible to, one or more of these powers. The extent and variety of application of these powers, are beautifully displayed and illustrated, in the interior of a cotton manufactory, where innumerable instruments and operative parts are to be seen, moving in concert in every direction, with every degree of velocity; and reciprocating with each other, in such perfect harmony, that complex operations are performed by them with the greatest precision, and with apparently as much self-directed skill, as is exhibited in the manual labor of intelligent beings.

Art. XI.—*On a Substitute for Welther's Tube of Safety, with Notices of other subjects; by* E. Mitchell, Professor of Chemistry, Mineralogy, &c. University of North Carolina.

Welther's tube of safety, including under this title the three-branched tube, with an uniform bore, as well as that furnished with a bulb, is a convenient piece of apparatus in many operations, but is not without its defects. 1. The three parallel branches make the upper part too heavy for the slender stem that is to support it. 2. From its form it cannot be attached to the apparatus with which it is to be connected, without considerable danger of fracture. 3. When the fluid is once set a running through it, the lower part sometimes acts as a syphon, and carries over more of the acid or other substance we are introducing, than was intended. 4. Unless the upper leg be made most inconveniently long, its insulating power is feeble. 5. For its size and simplicity it is a costly article.

The remoteness of my situation from glass-houses and other manufacturing establishments, makes it quite impossible for me to get any thing, that may have failed in the course of my experiments, replaced within a moderate time; and it is therefore important for me to contrive such modifications of apparatus, as shall render me less dependent on distant artists. On an emergency of this kind, I fell upon the following substitute for Welther's tube of safety, which I propose to such of the chemists, as may be placed in circumstances similar to my own. It has this at least to recommend it, that it requires only the beak of a broken retort, a few inches of straight tube, a little emery, and such other articles, as are found in every laboratory, for its construction; and in regard to convenience, I have found it so much superior, in many cases, to Welther's tube, that I should retain it in any situation. The mode of constructing it, will perhaps be best understood, from an account of the method of fitting up a two-necked bottle, for making hydrogen, nitric oxide, carbonic acid, and sulphuretted hydrogen gases.



The beak of a broken retort, of a suitable size, is ground with emery into one of the necks, till it is found to be perfectly air tight, and reaches very nearly to the bottom of the bottle. The part projecting above, is cut off with a hot iron, at a small distance above the nozle.* The lower end is then closed by means of the blow-pipe; or when it is so thick as to render this method inconvenient, it is filled with a glass plug; the lower or round part of the stopper of a tincture bottle or retort, (and such articles are apt to accumulate in every laboratory) of a suitable size, is cemented with sealing wax to the end of a glass or wooden rod, and ground into the tube with emery, till it fits it accurately, and is nearly at its lower extremity, (*b*, fig. 1.) the grinding being from the larger towards the smaller part, that there may be no danger of its falling out. A hole is now cut with a round file in its side, (an operation that is soon finished; and if the file be kept wet during the process, it will answer a great number of times) so as to be just within the bottle, when the tube is put into its place, (*a*, fig. 1.) All that is now necessary, is to pass the stem of a small funnel—the stem itself being five or six inches long, through a cork: insert the cork into the upper end of the tube, and introduce the tube into the nozle of the bottle.† The funnel itself may

---

* Mr. Faraday has devoted four pages of his recent work on chemical manipulation, to an account of the methods of cutting glass with a hot iron. His directions are valuable to the young chemist, because they are drawn out into that minuteness of detail, which alone can make them of any use; and yet he has omitted one precaution, which I have found important in cutting large tubes, vials, etc.—that of not making the iron too hot. It should be heated to *a redness barely visible in day light.* If in this state, it be caused to vibrate a few times around the tube, along the track where the division is to be made, and a drop of water put upon the spot, a simple fracture, *without side flaws*, will be obtained. By pursuing this method, especially if a trace be made beforehand, with a file, a long tube may be cut up into sound, well defined, and narrow rings, without a single instance of failure.

† Instead of making the cork apply itself directly to the side of the orifice that is to be closed, I have found it of advantage, not only in this case, but in many other similar ones—in fitting in the tube that is to convey away the gas from the other nozle; for instance, to cut a glass jacket for the cork which is made to enter by grinding.

A large tapering glass tube, such as the beak of a retort, is cut with a hot iron, at a point where it is not greater—where it is perhaps a little less, than the orifice to

be closed; and the larger part is cut a second time, at the distance of two or three inches from its smaller end; forming, in fact, a tapering tube, two or three inches in length, and having the diameter of its larger end a little greater than that of the orifice. This is easily ground into the opening, so as to fit it accurately, and make it perfectly tight. A cork, considerably shorter than the tube, is fit-either be manufactured by grinding two or three glass rings together, so that they will fit accurately one within the other, or obtained from the glass-house.

The mode of operation is obvious. We have a quantity of granulated zinc in the bottle. The dilute-acid is poured into the funnel, passes down, and rises in the tube, till it reaches the orifice (*a.*); when it flows over into the interior of the bottle. The gas can escape through this nozle only by depressing the fluid in the tube quite to its bottom, and thus creating a column in the stem of the funnel five or six inches in height.

The advantages of this construction are, 1. Its cheapness and simplicity; it is what every chemist can make for himself. 2. There is

---

ted into it, so as to occupy its middle part, and leave a vacant space at both ends; is bored, and has the conducting tube passed through it, in the usual way. There is then on each side of the cork, a vacant chamber, into which any kind of lute or cement, such as the fat lute, made by beating fine clay and drying oil together, may be introduced under such circumstances, as to retain its place with great firmness, and at the same time be perfectly impervious to any gas or vapor.

I am thus minute, because I do not recollect to have seen this mode of fitting up gas-bottles, noticed in any of the books, and I have found it very convenient. Indeed, for making the four gases specified above, hydrogen, nitric oxide, carbonic acid, and sulphuretted hydrogen, I do not believe it possible to contrive any arrangement better than that here proposed. A two-necked bottle, standing upon a shelf made to receive it, by the side of the pneumatic cistern, with the substitute for Welther's tube, here described, in one of the nozles, and the glass jacket, holding the cork and conducting tube, ground into the other. The solid materials are readily introduced, and the resulting liquid as easily withdrawn: the acid is added as there is occasion for it: not a particle of gas can escape, except along the conducting tube; and finally, the apparatus is not one which we shall be likely to break. If there be occasion to shew the absorption of the gas by a liquid; as of the nitric oxide by the green sulphate of iron, there may be two tubes, with their corks and glass jackets fitting the same orifice; one for delivering the gas at the pneumatic cistern, and the other bent twice at right angles, for passing it through the liquid; one of which may be exchanged for the other in a moment. The stem of the funnel of the safety tube, must however be made a little longer in this case, than where the object is merely to collect the gas in jars. It will require the labor of half a day to fit up a bottle in this way, but when once finished, it may be used for any length of time.

The method of grinding, which is involved in this mode of fitting up apparatus, has so many advantages, that it seems strange it is not more strongly recommended in the books, and more frequently employed. We can in many cases make a close joint in this way, in as little time as it would take to fit in a cork, and where the surfaces in contact are not wide enough to resist a considerable pressure of a gas that is endeavoring to escape; a very minute quantity of lute pressed down between them, will make all perfectly close and secure.

little or no danger of breaking it, when connecting it with other pieces of apparatus. 3. That whereas Welther's tube projects far *above* the apparatus to which it is attached, and is constantly in the way, and in danger of being broken on that account: *this is included within*, without however at all interfering with, or preventing the success of the process that is going on ; or contaminating the substances that are there. In the case of hydrogen, it is not necessary that the funnel should rise at all above the nozle of the bottle. It has also an advantage in procuring the gases, over a simple funnel with a long stem, reaching very nearly to the bottom of the bottle, and dipping into the fluid that is introduced, such as is recommended by Orfila, and figured in his chemistry—because with that some of the gas generated will escape into the room. If any chemist should dislike the trouble of making the instrument here proposed, himself, it is obvious that the glass blower may take the business off his hands; that the tube may in fact be made so as to constitute but a single piece, and ground into the bottle, before it comes to the laboratory.

When a two necked bottle is not at hand, a common gas bottle with an orifice an inch across, will answer the purpose very well. Two tubes pass through the same cork as is represented in Fig. 5, (the cork itself being inclosed in a glass jacket that is ground into the bottle, after the manner described in the note,) one for the conveyance of the gas that is generated—the other receiving a small funnel into its top, and entering itself through a cork into a test tube, having a hole cut in its side and performing the office of a tube of safety.

A tube of the kind here proposed, the funnel only being omitted, may be ground into the middle orifice of a set of Woulfe's bottles, or into the tubulure of the retort, when the gas that is passing through them is generated and answers every purpose of Welther's tube of safety, besides having some advantages over it. For it is evident that it need not project at all above the apparatus with which it is connected, and that if the diameter of the interior tube be small with regard to that of the exterior, (and it is quite unnecessary that it should be large,) the included gas may be safely kept under a pressure of some half dozen inches of mercury, and the absorption in this way promoted. Of its other applications I will notice but a single one. Dr. Marcet's fine instrument for experiments on high steam, figured in the supplementary volume of the Philadelphia edition of Henry's chemistry, and in Brande, is now very well made in New York, and upon the plan there exhibited, except that instead of two hemispherical shells bound together by flanches, it is a hollow sphere in a single piece. The only defect attaching to it seems to be that the mercury is applied directly to the surface of the brass, and although that surface is not of such a nature that any *great* action between the two is to be apprehended, there is danger that there will be some, and that the screw or some other part of the instrument that is brought into contact with the mercury will be corroded. Instead then of pouring the mercury directly upon the brass, a neater and better way will evidently be to put it into a tube of glass, or iron, having a hole cut in its side. The long ascending tube will dip into this, the elastic force of the steam be exerted through the opening, and the usual results obtained.

On the preparation of the substance commonly called phosphuret of lime.

Three or four different methods of procuring phosphuretted hydrogen are given in the books. 1. By means of phosphuret of lime which is to be thrown in small lumps into water acidulated with muriatic acid. 2. By pouring sulphuric acid into water containing phosphorus, cut into small pieces and finely granulated zinc. 3. By dropping phosphorus into a retort previously filled with a hot solution of pure potassa. To secure the retort from fracture, Dr. Coxe recommends that it be fastened to a triangular block of wood. It appears impossible that any one who has tried the three methods and compared them, should consent to employ either of the two last, if he has any tolerable means of supplying himself with the phosphuret of lime. Unless other persons have succeeded better than myself in regard to scalding their fingers with the hot liquid—breaking their retorts, and especially as to the quality of the gas procured by the method of Dr. Coxe, it must give them little satisfaction. That it should have been adhered to so long, is I presume to be attributed to the want of some good method of procuring the phosphuret.

We are directed to take a green glass or porcelain tube closed at one end, eighteen inches long, and an inch in diameter; to cover it carefully with clay lute containing a little borax; put an ounce of phosphorus into its lower end; fill it with small pieces of quicklime; place it in a furnace, with the end containing the phosphorus protruding; heat it to redness, and then draw the cool part into the fire so that the phosphorus may be volatilized, and pass over the heated lime. Instead of the tube I employ two Hessian crucibles, some of the inner members of a nest. The larger of the two has a hole bored through its bottom, and a test tube of a suitable size luted in with clay. The phosphorus is put into the test tube; the top of which is loosely covered with a piece of broken crucible to prevent the small pieces of quicklime from running down into it.* The lime is then put in so as to fill this crucible and partly fill the upper smaller one, which serves as a cover to it, and is luted on with some fine clay a little moistened, (fig. 6.) The cover has also a small hole in its top to afford an outlet for the air or volatilized phosphorus if there should be any occasion for it. The whole is now placed upon the grate of a furnace, with the test tube projecting through and appearing below, and a charcoal fire kindled around it. The phosphorus may be kept cool if it should be thought necessary, by making the tube dip into the water, contained in a tin cup attached to the end of a stick. When the crucibles and their contents are thoroughly red hot, a chafing dish is substituted for the tin cup, and the phosphorus rising in vapor produces the desired change. The phosphuret should be preserved in a *sealed* vial. The same crucibles may be used a number of times.

The only purpose for which phosphuretted hydrogen is prepared is for the exhibition of its property of spontaneous combustion. A pleasing mode of exhibiting this is to immerse wholly the retort or gas bottle in which it is generated in the water of the pneumatic cistern. The gas rising at a distance from any object from which it may be supposed to have been derived, and taking fire at the surface of the water, presents a miniature representation of what the appearance may have been when the Azores or Sandwich Islands were about to emerge from the bottom of the ocean.

It is the business of the chemist to ascertain the proper method of preparing this gas; its composition; upon what its extreme combustibility depends, etc. Will some one of the mathematical correspondents of the Journal, investigate the nature of the forces exerted during its combustion, and show how they result in the production of the beautiful coronet which succeeds; and why a rotatory motion around the axis of the coronet is impressed upon the filaments of watery vapor, and phosphoric acid of which it is composed?

---

* The crystalline limestones do not answer well for the preparation of the quicklime that is to be used, there is nothing better for this purpose than a piece of chalk.

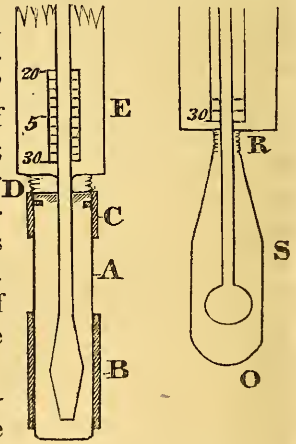
ART. XII.—*On a Portable Hygrometer;* by A. A. HAYES.

BY presenting the meteorologist and chemist, with his beautiful and truly philosophical instrument, Mr. Daniell has left little chance for improvement, so far as delicacy and accuracy of indication are concerned; and were it less fragile, perhaps no other would be desired, by those who experiment on aqueous vapor. As it is in mountainous countries, or on the tops of mountains, that the results of experiments on aqueous vapor, are of most value; from the phenomena being presented in a more simple form, and divested in part, of the attendant circumstances which modify them; an instrument adapted to such purposes, should be as portable as is consistent with delicacy. The simple apparatus devised Mr. Dalton, and used in those decisive experiments, which have so intimately connected his name with the history of meteorological science, is sufficient to enable us to determine the temperature of the aqueous vapor in the atmosphere, and by a reduction in the size, and a slight modification of form, an instrument is obtained, which is well fitted for general meteorological purposes. Instead of the cylindrical jar used by Mr. Dalton, I substitute a thin brass tube, the diameter of which, is one half greater than that of the cylindrical, or spherical bulb of the thermometer, which forms a part of the instrument; its length is one inch and a half; it is closed at one end, the other having a screw cut on the inside, to receive a screw cap and a rim, or projection below, to allow the disk of caoutchouc which precedes the cap, to be compressed, forming a convenient and efficient "stuffing box." At that end of the tube which fits the cap, a narrow ferule of polished platina, or steel is soldered to the outside of the tube, and one half of its length from the other end, is covered with soft cotton thread. The scale of the thermometer, graduated from 120° to —30°, terminates about one inch from the bulb. At this extremity, a screw cap, and disk of caoutchouc, both pierced for the tube of the thermometer, are firmly attached. When not in use, the tube is closed by a cork, and packs in the case, by the side of the thermometer and phial for containing ether.

In all aerological experiments, the thermometer is used for determing the temperature of the atmosphere, carefully avoiding those sources of error, which render this a delicate operation. For determining the dew point, so much alcohol is put into the tube, as is necessary to nearly fill it when the bulb occupies its axis; this quantity once adjusted, serves for many subsequent experiments; the tube is then screwed to the cap, and the instrument being held in an inclined position, the thread on the inferior part of the tube is wetted with ether; in a few moments dew is deposited on the platina ferule,—the instrument is then agitated, to ensure an uniform distribution of heat within the tube; the dew begins to disappear,—the temperature then indicated by the thermometer is carefully noted. In the sectional representation of the instrument, A is the brass tube with its cotton envelope, B C the platina or steel ferule, D disk of caoutchouc and screw cap, E the thermometer.

Another form of the instrument, more elegant and costly, and fitted only for determining the temperature of vapor of low tension, has been used. S No. 2, represents a black glass tube, of the same capacity compared with the bulb as the brass tube; it is attached by fusion to the stem at R, and after being filled in part with alcohol, is hermetically sealed at O. The upper part of the black tube is the depositing surface, the lower being covered with thread; the same mode of experimenting as in the former case.

No. 1. No. 2.



For making corrections in barometrical experiments, this instrument is peculiarly fitted, the "Detached Thermometer" serving to determine the temperature of the air and tension of atmospheric vapor; the experimental result is substituted for that deduced by calculation from the general formula of LaPlace. Some results recently obtained by my friend, Dr. Ed. E. Phelps, show the great importance of making the experimental, rather than the calculated correction.

The small size of the instrument, enables us to use a thermometer with large divisions, the dew point can be found to a fraction of a degree; the quantity of matter to be refrigerated being small, a reduction of temperature is speedily effected, and only an inconsiderable quantity of ether is required.

Roxbury Laboratory, 30th Nov. 1829.

Art. XIII.—*Mineralogical Journey in the northern parts of New England, by* Charles Upham Shepard; Assistant to the Professor of Chemistry and Mineralogy, and Lecturer on Botany in Yale College.

In the months of September and October last, Dr. Heermann of New Orleans, and myself, made an excursion into Vermont, New Hampshire, and Maine, in company with Prof. Hitchcock of Amherst College, and Mr. Edward Emerson of Boston; the two latter gentlemen were with us only as far north as Acworth, N. H. At the request of Prof. H. and Dr. Heermann, I shall give in the succeeding pages some account of those minerals which gave us particular interest upon the route.

1. *Marlborough and New Fane Minerals.*

At Marlborough, Vt. under the guidance of Rev. Mr. Newton, we visited the soapstone quarry, which affords such remarkably *distinct crystals of Bitter spar*, and *Octahedral Iron ore in Chlorite;* and the localities of Chrysoprase and Actynolite in the border of New Fane. The *Chrysoprase* of this spot, discovered by Gen. Field, has been known for many years. It exists in narrow and frequently interrupted seams traversing Serpentine, accompanied by delicate *druses* of *Quartz*, and small quantities of *Pimelite* and *Asbestus.* It is considerably inferior to the Chrysoprase of Silesia, in the beauty of its fracture and translucency, though sometimes vying with it in color. We were more interested in the small *crystals of Quartz, tinged throughout of a deep apple green color*, by the same coloring matter that tinges the chalcedony in the Chrysoprase, and the clay in the Pimelite. These, regularly terminated at both extremities, like the Compostella Hyacinths, were often found variously attached to each other, filling up small seams and cavities in the Asbestus and Serpentine, which when broken open, presented surfaces of several square inches of unusual beauty. This is the only known locality, furnishing this variety of Quartz. The Actynolite, which is situated at a distance of four or five miles from the Chrysoprase, is easily obtained, and closely resembles the same mineral from many other places. It is the more beautiful from the nearly white color of the Talc in which it is imbedded.

We did not visit the deposit of *Garnets in Chlorite slate* a little north of the village of New Fane. But we had an opportunity of observing some fine crystals, remarkable for their dimensions and perfection of form, in the cabinet of Gen. Field. We were informed that they are quite abundant and easily procured.

On our road from New Fane to Bellows Falls, we stopped at the lime-kiln between Townsend and Athens, to procure specimens of the *granular Actynolite* and *Epidote*, which occur here intermingled with the limestone. The former substance differs but slightly from the variety of Hornblende, called Pargasite, which exists at Boxborough, Mass. The crystals, which are of a bottle green color, are more minute and less rounded in their shape. The Epidote is but imperfectly crystallized, and at first view, from its color, is liable to be mistaken for Idocrase, on which account, merely, is it worthy of the attention of the mineralogist.

2. *Acworth Minerals.*

In approaching the locality of Beryls in Acworth, N. H. from the west, the mineralogist recognizes for some distance, those peculiar features in the scenery which indicate to him the neighborhood of interesting minerals. The shape of the hills becomes less rounded and heavy ; vegetation begins to be interrupted upon their surfaces ; and large masses of a lighter colored rock are seen breaking through their sides, and sometimes crowning their summits. In fine, he discovers at a glance, that the gneiss which before has been the prevailing rock, is here greatly interrupted and broken by the shooting up of powerful veins of granite.

The mountain, as it is called, upon which the Beryls occur, is comparatively isolated, and rises very abruptly to the elevation of, perhaps, 300 feet.* Its western side, from its steepness, presents much uncovered rock, which toward the base consists of gneiss, interrupted by granite veins, and is strewed over in several places with large blocks of these rocks, piled in confusion upon each other. A road passes directly along at the base of the mountain, upon this side. Leaving the road as we approached the northern extremity of the elevation, we ascended gradually by a circuitous path through the

---

* The locality in question is situated upon the land of Mr. Williams, who lives near by. As there is no public house in the neighborhood, persons visiting this spot may be recommended to take up their residence, while there, with Mr. W. whom they will find very willing to afford them every accommodation in his power. The mineralogist will do well also, if he approaches the place by the road from Bellows Falls, to call upon Mr. Marsh Chase, and Mr. Francis G. Drew, at Drewsville, as both these gentlemen are cultivators of mineralogy, and will be able to furnish some further directions which may prove useful, in exploring the minerals of their vicinity.

edge of a wood to the distance of forty or fifty rods, when we began to encounter the principal granite vein of the mountain. At first, it is bare only in patches of a few square feet, and consists mostly of Quartz, of a rose colored tinge; a few rods farther, we came to a mural front, formed by the sudden uprising of the vein, in the side of which, covering an area of perhaps ten or twelve square feet, we discovered the deposit of Beryls, of which we were in search. From this, to the top of the mountain, (one hundred and fifty feet, perhaps, higher up,) and some distance down its southern declivity, the vein continues for the most part uncovered by soil, and several rods in width. It is protruded quite free from the intersected strata, which it overhangs, in some places towards the west, in a manner highly picturesque. The geological relations of the rocks are here exceedingly interesting; but as they were particularly studied by Prof. Hitchcock with the express view of connecting them with a series of similar observations upon granite veins elsewhere, and which it is to be hoped, he will ere long give to the public, I shall take no further notice of them on the present occasion. The granite is coarse grained in the highest sense of the expression; the Quartz often constituting many square yards without any foreign intermixture; while the Feldspar exists in ill-defined crystals of extraordinary dimensions, and the Mica, also, in very large plates. The Quartz is of a rose color in numerous spots throughout the vein, and the Beryls, though mostly confined to the spot indicated above, are yet to be met with, occasionally, the whole way up the mountain.

To return to the cluster of Beryls first mentioned, we here found a number still in view, and impressions in the Quartz from whence others had been detached. The principal part of a crystal of great size, situated high up in the ledge, we were at the pains of measuring, though from its mutilated condition, we were prevented from attempting its disengagement. The horizontal diameter of one of its lateral planes was eight and a half inches, and the length of the crystal, inferring from the portion still-remaining and the cavity formed by the part removed, was twenty two inches. It is possessed of a considerable degree of translucency, and is of a bluish green color, free from stains. The first blast we caused to be made, however, developed a crystal still more remarkable in point of size and general perfection of figure. It occupied a vertical position, and was uncovered upon its upper terminal, and three of its lateral planes; the breadth of its lateral faces was five and a half inches, and their length four feet. Its color was a clean, bluish green for the upper three feet of its length, passing into a dull green and yellow at the lower extremity. The faces possessed a considerable polish, and were quite free from longitudinal striae. A slight irregularity was observed on a near inspection. The prism had suffered from those accidents which, among strata, are denominated *slips;* the effect of which had been to give its axis a slightly curvilinear direction. Between the sections which had thus been made across the crystal, thin films or layers of quartz had been interposed. This peculiarity of structure, it deserves to be mentioned, is common to the larger beryls of this locality; and it may be attributed, possibly, to the circumstances under which the rock forming their bed came into its present situation. Unfortunately, in attempting to free the sides still engaged, by means of a charge of powder in the neighborhood, the concussion produced was so great, as to shiver this noble crystal into fragments, so small as not to allow of its being afterwards set up again. One foot of the base, however, came out nearly entire, which is in my possession. Its weight is fifty nine and a half pounds, thus giving for the entire crystal the weight of *two hundred and thirty eight pounds.** I have been the more minute in my account of the above crystal, from the belief that it is the largest hitherto noticed, notwithstanding the testimony of Theophrastus, who mentions having seen one in a temple in Egypt, measuring four cubits in length by three in breadth, and an obelisk of the same gem, forty feet high: both of which are justly conceived, at the present time, to have been masses either of Verd Antique or Porphyry; since the early Greek writers are known to have called almost every green stone by the name of Emerald.

Two other Beryls, of large dimensions, were also brought to light by the blast which threw down the one just described; and there can be no doubt that other crystals of a similar size are distributed through the rock, at pretty uniform distances, as the Feldspar here, seems to be replaced almost entirely by Beryl; which becomes, so to speak, the *equivalent* of that mineral, in the composition of the granite. A few feet below the spot, affording the larger crystals, Feldspar begins to preponderate as an ingredient in the rock, the Beryls diminish in size as well as regularity, and present for the most part a yellowish tinge, sometimes passing into a deep

* Allowing 14 p. c. for the proportion in which the glucine exists in the Beryl, we have 33 pounds of that rare earth in this crystal.

wax yellow color. The smallest of these crystals, which are less than an inch in diameter, are occasionally regular, and nearly transparent; while the larger ones are extremely irregular, consisting of interlaced and contorted prisms, with but one or two polished faces, and these much channelled.

We were scarcely less interested with a *crystallized Mica*, which we found here, than with the Beryls. It exists in considerable abundance in the immediate neighborhood of the Beryls, and the same blasts which serve to lay open the one, will also develope the other. The form of the crystals is that of the six-sided table, the *Mica prismatique* of Haüy. They occur thickly implanted upon veins of a white, massive, and nearly compact Feldspar, adhering by one or two sides of the prism, and shooting into the Quartz. The greater portion of the enveloping Quartz, is easily removed by means of a light hammer and pick, leaving the Mica firmly attached to the Feldspar, with its smooth and polished crystals pointing outwards. The tables are seldom much above one-eighth of an inch in thickness, and vary in width from half an inch to an inch and a half. They are less transparent in the direction of the axis, than in a line perpendicular to it; and possess the curious property of presenting different colors when viewed in these directions, being liver-brown in the first, and olive-green in the second. The well defined characters of these crystals, and the elegant manner in which they are disposed upon the feldspar, give this locality a decided superiority over any other hitherto discovered in the United States; and will, I have no doubt, cause it to be much frequented by mineralogists.

The *Rose Quartz*, though exceedingly abundant, we did not cause to be explored to any extent. The rose tint is delicate, though not intense. It has however too much of the fracture of common quartz, to render it deserving of much attention.

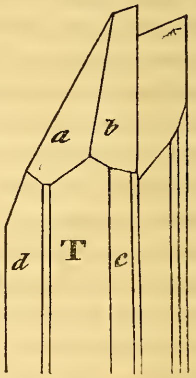
I shall conclude my account of the Acworth minerals, by the notice of *Columbite*. In the cabinet of Mr. Gallup, of Woodstock, Vt. we had the pleasure of being presented with a very unusual crystal of this mineral, still rare, though found in several places. It had been in the possession of Mr. G. for some time; and was discovered by him along with two other similar crystals, one of which also, he showed us afterwards at Hanover, and the other he informed us was in the hands of Prof. Hale, of Dartmouth College. Unfortunately, Mr. G. could recollect nothing precise, either with regard to the particular place where he procured them, or, as to the abundance or scarcity in which they exist. From the accompanying minerals, (which were black Tourmaline and Mica,) I was led to infer that they might have come from one of the high ledges, situated not far from the Beryl mountain, in a south-easterly direction, as I there observed several veins of black Tourmaline. The most perfect of the two crystals which I saw, Mr. G. was obliging enough to permit me to take along with me to New Haven, for the purpose of submitting its angles to goniometrical admeasurement.

It is a *double crystal*, the prisms coinciding upon the broad lateral planes, parallel to the prismatic axis, and presenting the re-entering and salient angles, as usual in such crystals. In color, lustre, &c. it resembles other crystals of the same substance. Its form, so far as it is perfect, will be perceived from the subjoined figure. It weighs 2035 grs. Troy, equal to 4¼ oz. of this standard. As respects dimensions, therefore, it is in full keeping with the beryls above described. The other crystal which I saw, was but little inferior in size, though less perfect as a crystal. It is much to be desired, that a knowledge of the locality may be recovered, as it promises from these specimens, to furnish us with an abundant supply of this hitherto scarce substance.

Inclination of

T on *c*	160°
T on *d*	131 30′
T on *a*	135 30′
T on *b*	140
a on *b*	142
a on *d*	128
b on *c*	150

Fig. 1.



3. *Vermont Zircon.*

The very interesting mineral I am now about to describe was not procured upon our journey; but as its locality is not very remote from the region we visited, it will not, I am persuaded, be misplaced to connect my account of it with the present memoir.

The specimens described, were forwarded last autumn in a case of Vermont minerals from Prof. W. C. Fowler of Middlebury college to Prof. Silliman and myself. It did not, however, receive particular attention until recently; when we had the pleasure of finding it to contain, along with other things, two or three pieces of an apparently sienitic rock, filled with beautifully distinct and nearly transparent crystals of Zircon, together with a small box containing a number of loose crystals of the same substance. The majority of them are regularly terminated at one or both extremities. In size, they vary from one inch in length down to a quarter of an inch, and in diameter, from one eighth to one sixteenth of an inch. Their faces are nearly all equally perfect as respects their evenness, and are possessed of a brilliant and somewhat adamantine lustre. In color, they are uniformly of a reddish brown, not sufficiently bright to bring them under the denomination of Hyacinths, from which they differ, moreover, in the character of their modifications, as will be seen from a view of the annexed figures. They approach in their general aspect, nearer to the variety of this mineral from Frederiksvärn in Norway; though they are not precisely identical with the crystals from that place as respects their form. Fig. 2 is the *Zircon plagièdre* of Haüy, and fig. 3, the *Z. binotriunitaire*, of the same mineralogist. These are the only forms I could observe among the specimens in my hands. The former of them is said to exist among the crystals of Ceylon, while the latter has not before been known to occur except at Trenton, N. J. where it was formerly found in a granite approaching in character to gneiss.

I said that the gangue of the Zircon was apparently a sienitic rock: such I am sure it would be pronounced in hand specimens seen at a little distance. When viewed nearer by, however, the black lamellar particles interspersed among the Feldspar and Quartz, are discovered to be Magnetic Iron ore. Notwithstanding the absence of Hornblende which exists in the Norway rock, I am disposed to call it the true zircon sienite. The Feldspar is of a greyish color often tinged by the oxide of iron, and exists in small angular masses in nearly equal proportion with the Quartz.

As there were no tickets accompanying the specimens, I immediately addressed a letter to Prof. Fowler, from whom I learned the following facts. The specimens forwarded were detached from a bowlder weighing about one hundred pounds, found one mile north of Middlebury college, Vt. This mass is now in the possession of Prof. F. The same rock occurs scattered over the surface in the vicinity; but "its proper geological position is upon the opposite side of Lake Champlain." The foregoing is all the information we are at present in possession of, as respects the locality and geological relations of the rock in question. From the known transition character of that neighborhood, it is very possible that this zircon sienite may repose upon transition limestone; in the same manner as the analogous rock does in Norway, according to the observations of MM. Hausmann and Léopold de Buch.

The following measurements were obtained by the aid of the Reflective Goniometer.

Fig. 2.

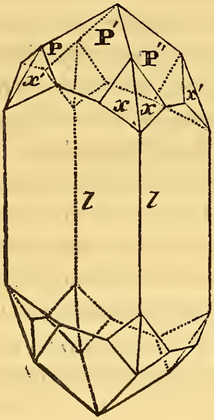
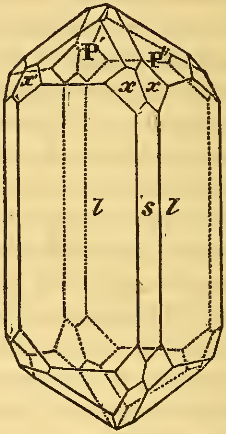


Fig. 3.



Inclination of

P′ on P″ over the summit . .	123° 25′
P′ on P″	95 45
P′ or P″ on l	132 30
P′ or P″ on x	150 15
x on x	147 12
x on x'	133 4
l on l	90
l on x	143 30
l on s	135 4
s on x	148 15

(*To be continued.*)

Art. XIV.—*Philosophical Transactions of the Royal Society of London, for the year* 1829 : Part 1st, London, R. Taylor, 1829, 4to. pp. 238.

The Royal Society of London, has lost within a short period, three of its most distinguished members. These are Dr. Hyde Wollaston, Sir Humphry Davy, and Dr. Young. The first unquestionably held the highest place among the scientific men of England; the second, who was for several years President of the Society, is too well known for his important chemical discoveries, to require more than the mention of his name, to recall all his merits to the recollection of our readers; while the third was long the only person whom Great Britain could hold up by the side of the continental school of mathematicians, and who, if perhaps eclipsed of late by younger men in this department of science, is still worthy of remembrance, in consequence of his having kept up the succession of the pure sciences, at a time when the narrow policy of Banks has almost caused their total oblivion. The mathematical attainments of Young, were not, however, his sole merits; literature is indebted to him for the first important step in the study of hieroglyphics, and from him Champollion was led to that instrument of discovery by which he promises to throw the most important light upon the history of our race.

Wollaston and Davy have occupied a great space in many previous volumes of the Philosophical Transactions, and the part which is before us, contains several papers of the former, that, from their date of publication, may be called posthumous, together with one by the latter. It has been urged as a reproach against men of science, that they seldom apply their knowledge to the advancement of valuable practical ends, but content with the simple pleasure of their researches, leave their uses out of view, and abandon the profit of their discoveries to be reaped by those of less knowledge, but of more perseverance. Such was not the case with Wollaston, who not only made many important discoveries in science, but in its application to the arts accumulated what, even in England, was an ample competence, and in our country would be considered a large fortune.

The first paper in the half volume before us contains a complete account of Wollaston's method of rendering Platina malleable, a process founded on the most nice and delicate chemical investigations, and which not only secured a fortune to the inventor, but has redounded in innumerable ways to the interests of science.

The second paper is also by the same author, and contains an account of a microscopic doublet. Adopting the principle employed in the form of the eye piece used in telescopes, and called Huygenian, he forms his magnifier of two plano-convex lenses. This plan he inferred would obviate both the spheric and chromatic aberration, and produce a much more distinct image than has yet been attained in any other manner. These anticipated advantages were fully realized in practice, and he states that he was enabled, by the aid of a microscope constructed upon this principle, to view the most minute objects, with " a degree of delicate perspicuity he had in vain sought in any other microscope with which he was acquainted."

The next of Wollaston's papers contains an account of a method of comparing the light of the sun with that of the fixed stars. It is founded upon a suggestion of the Rev. John Mitchell, published as long since as towards the close of the last century, but which was rude and imperfect in the hands of the inventor, and has not been since used by any other person. The distance of the fixed stars is a problem the solution of which has escaped the ordinary direct modes of investigation. The search after their annual parallax led at first to the discovery of other and far more important irregularities by which it is cloaked; and the best instruments, that the present state of the arts has supplied, have left the question, whether it is of such magnitude as to be detected or not, unsettled. Pond, observing with the two magnificent murals of the Greenwich observatory, conceives that this parallax is imperceptible, while Brinkley, an astronomer not less active and zealous, but furnished with less perfect instruments, thinks that he has detected it. In the absence of this direct method, the proportion which the light, afforded to us separately by each of the fixed stars, bears to the light of the sun, furnishes the best, and perhaps the only method within our reach, of obtaining a probable estimate of their distances. The manner in which this principle was applied by Wollaston, will be best explained by quoting his own words:

" From a comparison which I made in the year 1799, of the light of the sun with that of the moon, I should estimate the direct light of the sun, as being nearly one million times greater than that of the moon; and consequently, the direct light of the sun as very many million times greater than that afforded by all the fixed stars collectively. Such then being, to our visual organs, the vast disproportion in radiance between the sun and the whole starry firmament, it is not to be expected that we should assign very accurately how much greater the light of the sun is than that exceedingly minute quantity of it, that shines upon us from any one, even the most brilliant, of the fixed stars.

"It may be remembered, that on a former occasion, in examining the performance of a good telescope, I found that the sun's image, reflected from the surface of a small sphere, (such as that of a thermometer bulb, filled with mercury,) and viewed at a proper distance through a telescope, is, to all appearance, extremely like a fixed star, and forms in such experiments, an admirable substitute for one, in being really fixed, and therefore well adapted for deliberate observation. It occurred to me, while engaged in this examination, that by comparing such an image with one of the larger stars, I might be able to obtain some grounds for estimating the light of the star.

"It would be desirable, though extremely difficult, in conducting such an experiment, to make a direct comparison between the star and the sun's image; since in that case we should be enabled to avoid the uncertainties arising from an indirect comparison, the consequence of observing at times so distant, that the atmosphere has in the interval undergone considerable changes. As, however, the only practicable mode of observing is the indirect one, by comparing the two objects with some common standard at different times, we must endeavor to remove these uncertainties from our results, by repeating each series of comparisons so frequently, that the average of each series may be affected by atmospheric vicissitudes, or may fairly be presumed to be so, in an equal degree.

"The common standard of comparison I chose, was the image of a candle, reflected from a small thermometer bulb, (in most trials, about one quarter of an inch in diameter) filled with mercury, and seen by one eye through a lens of about two inches focus, at the same time that the sun's image, (reflected in a similar manner,) from a thermometer bulb, placed at a distance, was viewed by the other eye through a telescope."

The precautions used, and the detail of the observations, would exceed our limits; we shall therefore pass to the results. These are: that the light of the brightest of the stars, *Sirius*, does not exceed a 20,000,000,000th part of the sun's light; and that of Lyra is about the 180,000,000,000th part of the same, or one-ninth part of the light that reaches us from Sirius.

The fourth paper of Wollaston is stated by him, to be communicated for the purpose of doing justice to the memory of Dr. Marcet, by recording one of his latest efforts in the cause of science. It is well known that a current, at the surface, is continually setting through the straits of Gibraltar into the Mediterranean. This is in some measure counteracted by an under current, setting in an opposite direction, as has been inferred from wrecks that had sunk in the Mediterranean, having risen again in the Atlantic. But it also appears to have been proved, that the evaporation from the Mediterranean exceeds the supply from rivers; and hence the under current must be less in quantity than the upper. Now, although this great evaporation would account for the loss of much of the water that runs Eastward through the straits, yet the salt which that water holds in solution, must remain in the basin of the Mediterranean, or escape by some hitherto unexplained means of exit.

To settle this point, Dr. Marcet planned a set of experiments on the density of the water at different depths, and obtained the aid of Capt. W. H. Smith, R. N. to carry them into effect. The experiments were made, but Dr. Marcet died, before the specimens collected at the different depths had reached England. A part of them were unluckily given by Capt. Smith, to persons seeking them from no other motive than simple curiosity, but a few were left to fall into the hands of Dr. Wollaston, who completed, by their aid, the investigation commenced by Dr. Marcet. The comparison of these specimens shews, that the water, at great depths, in the Mediterranean, contains four times as much salt as that in the main ocean; while that at the surface, and at depths not greater than four hundred and fifty fathoms, is identical in its composition with the water of the latter. Hence an under current, of a fourth part of the velocity and equal area, or of a fourth part of the area and equal velocity, would carry back to the ocean all the salt brought in by the upper current.

We find but one paper of Sir H. Davy in this half volume. It is entitled, "*An Account of some Experiments on the Torpedo.*" The inference, drawn from these by the author, is, that the electricity of this animal is, *sui generis*, and neither identical with common, or with Galvanic, electricity.

The remainder of the papers are by living men of science. Among these, Capt. Edward Sabine, of the British Royal Artillery, one of the present secretaries of the Royal Society, stands most conspicuous; his contributions are three in number, viz.—

On the dip of the Magnetic needle in London, in August, 1828.

Experiments to determine the difference in the number of vibrations, made by an Invariable Pendulum, in the Royal Observatory at Greenwich, and in the house in London in which Capt. Kater's *experiments were made.*

On the Reduction to a vacuum of the vibrations of an invariable pendulum.

The first of these contains a set of experiments, made for the purpose of determining the change in the dip at London, between the date of a former set, made by the author in 1821, and the year 1828. This change is still in diminution, but the decrease is less rapid than it formerly was. By comparing the most authentic observations, made during the century preceding 1821, the annual decrease in the dip appears to have been between 3″.2 and 2″.9, while in the seven years between 1821 and 1828, it does not exceed 2″.5.

In pursuing the investigations with the pendulum in various parts of the world, an account of which he has published in a separate form, Sabine had come to the conclusion that its vibrations are influenced, not merely by the general law of gravitation on the surface of a revolving spheroid, but by local circumstances. The paper before us affords conclusive evidence, that this opinion was correct. The difference of latitude between the house of Mr. Browne, in which Kater's experiments were made, and the Observatory at Greenwich, ought to cause a retardation of 0″.15 per day, and the difference of level, computing by the method of Dr. Young, a further retardation of 0″.12 per day. Instead of this, an acceleration was found to exist, by observation, of 0″.48, making a result, which differs from what would have been anticipated, had no anomalies been known to exist, of 0″.75. The most important bearing of these experiments, is upon the subject of weights and measures. The British parliament has taken as the national standard, the Pendulum of the *Latitude* of London; assuming, that the experiments of Kater, in Captain Brown's house, gave its length in all other places under the same parallel. These experiments of Sabine shew, that this is premature, and that the law ought to have prescribed as the standard the pendulum of some particular place. This has been done by the revisers of the laws of the State of New York, who have taken as their standard, the length of the seconds pendulum, determined in Columbia College, by Captain Sabine and Professor Renwick.

Among the reductions employed in calculating the length of the seconds pendulum from observation, one of the most essential is that which depends upon the resistance of the air. All experiments being made in the open atmosphere, this resistance is a retarding force, whose influence is important. All philosophers have hitherto been of opinion, that when a body falls through the atmosphere, the force which acts upon it may be represented, by dividing the excess of the mass of the body over that of an equal bulk of air, by the mass of the body itself, and all the reductions of a pendulum's motion in air, to that which would take place in a vacuum, are made upon the same principle. Bessel, the celebrated astronomer of Konigsberg, was the first to suspect the truth of this principle, which allows for simple buoyancy alone, without taking into view the force necessary to communicate motion to the particles of the air that are successively displaced. He established conclusively, that his suspicion was correct, and found that, when the oscillations of a pendulum take place in rare media, such as the air of our atmosphere, this retarding force, which has hitherto been neglected, is at least equal in amount to the simple buoyancy. The apparatus of Bessel, was a modification of that by which he had determined the length of the pendulum. It differs from the methods of Borda and Kater, and approaches more nearly than they do to the more ancient plan used by Whitehurst. The pendulum is composed of a sphere, suspended by a wire of steel, in such a manner that it may be made to vibrate either, from the upper or lower end of a scale, of known length. There are thus in fact two pendulums, the difference of whose lengths is a known quantity, and hence when their respective times of oscillation are known, the absolute length may be calculated. To apply this apparatus to the investigation of the air's resistance, the bulbs are made of materials of very different densities, but of the same size and shape. Sabine, on the other hand, employed an invariable pendulum, made upon Kater's plan, and the investigation of the resistance of the air was made directly, by causing the pendulum to vibrate alternately in air, and in the exhausted receiver of an air pump. The experiments of Sabine have fully confirmed those of Bessel, and a similar result has been found, by causing the pendulum to vibrate in hydrogen. In this gas, as well as in common air, a resistance, growing out of the necessity of displacing the particles, has been detected. This result is the more important, in as much as it shews, that the method of Kater is liable to an objection, in consequence of the pendulum with convertible axes being unequally affected by the fluid resistance.

It seems that every new improvement in the apparatus, by which the length of the second pendulum is ascertained, tends to the discovery of new, although slight, causes of disturbance, and although for all mere practical purposes the measures of Kater and Biot may be taken as sufficient, corrections never before employed, must now be introduced, whenever strict scientific accuracy is desired.

We shall mention but one of the remaining papers in this half volume. It is that of Barlow on a refracting telescope, the achromatism of which is produced by a lens of a liquid substance. Mr. Barlow has in the Philosophical Transactions of the Royal Society for 1828, given an account of his preliminary experiments. It appears that in experiments upon the construction of aplanatic object glasses, he had become sensible of the great difficulty of obtaining flint glass of sufficient size and purity for astronomic telescopes. He was therefore led to consider the practicability of substituting a fluid instead of a flint glass lens. Fluid object lenses had been long before constructed by Dr. Blair, but the object was different; Blair had no other pretension than to lessen a practical difficulty in the construction of a compound lens, of which both flint and crown glass still formed essential portions; while our author sought to dispense with flint glass altogether. After an examination of the refractive and dispersive powers of various substances, he at last fixed upon sulphuret of carbon as best suited to his purpose. This appeared to him, to possess every requisite he could desire; "having a refractive index about equal to that of the best flint glass, with a dispersive power more than double, perfectly colorless, beautifully transparent, and, although very expansible, possesing the same, or very nearly the same optical properties when hermetically sealed, under all temperatures to which it is likely to be exposed for astronomical purposes.

"Its high dispersive power also gives it an advantage which no glass ever made or likely to be made can possess; although the fixed nature of the latter material may probably always give it a preference in the construction of telescopes; and I wish clearly to be understood, not as proposing to supplant the use of flint glass in these instruments, but simply to supply its place by a valuable substitute, in cases where it cannot be obtained sufficiently large and pure; or where it can be obtained only at an expense which must always limit the possession of a powerful astronomical telescope to a small number of individuals, and to public bodies."

* * * * * * *

"In the usual construction of achromatic telescopes, the two or three lenses composing the object glass are brought into immediate contact; and in the fluid telescope proposed by Dr. Blair, the construction was the same, the fluid having been inclosed in the object glass itself. Nor could any change in this arrangement in either case be introduced with advantage, because the dispersive ratio between the glasses in the former instance, and between the glass and the fluid in the latter, is too close to admit of bringing the concave correcting medium far enough back to be of any sensible advantage. The case however is widely different with sulphuret of carbon. The dispersive ratio here varies (according to the glass employed,) between the limits 299 and 334; which circumstance has enabled me to place the fluid correcting lens at a distance from the plate lens equal to half its focal length; and I might carry it still farther back, and yet possess sufficient dispersive power to render the object glass achromatic. Moreover, by this means the fluid lens, which is the most difficult part of the construction, is reduced to one half, or to less than one half of the plate lens; consequently, to construct a telescope of ten or twelve inches aperture, involves no greater difficulty in the manipulation than in making a telescope of the usual description of five or six inches aperture, except in the simple plate lens itself. And what will be thought of greater importance, a telescope of this kind of ten or twelve feet in length will be equivalent in its focal power to one of sixteen or twenty feet. We may therefore, by this means shorten the tube several feet, and yet possess a focal power more considerable than could be conveniently given it on the usual principle of construction."

Having established the correctness of his views by the application of these principles to the construction of smaller instruments, he obtained the aid of the Board of Longitude to enable him to construct one of great dimensions. This is described in the paper before us. It has an aperture of 7.8 inches, exceeding by an inch that of the largest refracting telescope previously existing in England. Its tube is eleven feet in length, which, with the eye piece makes a total length of twelve feet; but its effective focal distance upon the principle just referred to is eighteen feet; it has a power of 700.

Of the performance of this instrument, the account is most satisfactory, and there is little doubt that the construction is likely to realize all the anticipations of its ingenious author.

In the mean time however, Mr. Faraday has been engaged in experiments on the manufacture of a glass, intended as a substitute for flint glass in optical instruments. In this he is said by the latest advices to have been completely successful. Many of the difficulties attending the construction of solid object lenses for refracting telescopes will be obviated by this discovery, and the plan of Barlow rendered of less importance, inasmuch as it now appears probable, that glass of any desirable dimensions can henceforth be obtained without much difficulty.

I. R.

Art. XIV.—*Chemical Observations and Experiments on Tobacco; by* C. C. Conwell, M. D.

The subsequent paragraphs embrace a brief account of a series of analytical investigations, as carefully conducted as they were difficult in execution, on an article, the commercial and medical importance of which, as well as its almost universal consumption as a luxury, is too generally appreciated to require comment. It may be readily inferred, that a knowledge of its constituent principles cannot fail to be desirable. No complete analysis of tobacco, so far as I have read, has ever appeared before the public, excepting that of Vauquelin, who makes mention of only a few principles, one of which, viz. starch, I do not find in that plant.

The following principles, complex and multiplied as they are, all enter into the tissue of the Tobacco leaf.

1. Gum.

2. Mucus, or a substance soluble in water, as well as in spirit, and precipitable from either menstruum by subacetate of lead.

3. Tannin.

4. Gallic acid.

5. Chlorophyllin.

6. A green pulverulent matter, soluble in boiling water, and subsiding on refrigeration.

7. A yellow oil, evolving in a concentrated degree the peculiar odor, and possessing the taste of Tobacco; it is the poisonous principle of the leaf.

8. A large quantity of light yellowish resin.

9. Nicotin.

When Tobacco leaves are treated, according to the popular formula for the developement of Piperin, traces of a crystalline structure may be observed; it is this substance alone, which, according to the received technology of English chemistry, should be called Nicotin.

10. Tobacco, treated like opium in Sertuerner's process for obtaining morphia, yields a white substance, soluble in hot, but nearly insoluble in cold alcohol: whether this substance be strictly analogous to morphia, I am not immediately prepared to assert.

11. A fine orange red coloring matter, soluble in the acids alone: this substance, when obtained in a solid form, possesses a bright red

hue; decrepitates before the fire, and seems to enjoy neutral properties.

12. Nicotia.

There is not a more delusive term in modern chemistry, than Lignin: an analyst might be induced by this term, to abandon his researches on vegetables, after alcohol, ether and water, at all temperatures, had acted on them; for, after digestion in these substances, plants are supposed to be exhausted of their principles; yet nothing can be more gratuitously asserted. Quercia was obtained from oak bark thus depurated by ether, spirit and water, and Tobacco leaves similarly treated, and forming what chemists would call Lignin, afforded a new alkali more strictly approximating to quercia in chemical habitudes than to any other known salifiable base.

Still Nicotia exists in a small quantity in the infusion and decoction of the leaves; but it may be more readily developed by treating with sulphuric acid the Tobacco, well edulcorated with ether, alcohol and water, and evaporating nearly to dryness.

The crystals of the sulphate being carefully washed, may be decomposed by aqua ammoniæ, which, combining with the acid, precipitates Nicotia.

This substance does not appear to be susceptible of a crystalline form; it is of a dull yellowish white color, tasteless, inodorous, plastic, and pulverulent; insoluble in ether, alcohol and water; soluble in excess of acids, and decomposed by heat; all its salts are tasteless, and insoluble, unless acid predominate, and may be readily decomposed by ammonia. Sulphate of nicotia crystallizes in asteroid needles, which, under the microscope, assume the form of quadrangular prisms. It is soluble in water, and contains a slight excess of acid, a circumstance which may serve to distinguish it from quercia.

Hydro-chlorate (muriate) of Nicotia is aggregated in stars, usually formed of from five to six crystals.

Borate of Nicotia is white, insoluble, and uncrystallizable.

The most diagnostic property of Nicotia, is perhaps its entering into solution with the vegetable acids, without forming with them any crystalline compound.

Philadelphia, Aug. 24th, 1829, No. 8 Lombard street.

SCIENTIFIC INTELLIGENCE.

Translated and Extracted by Prof. G. Griscom.

CHEMISTRY.

1. *On the Setting of Plaster, by M. Gay Lussac.*—The property which plaster of Paris possesses, when deprived of its water by heat, of setting into a firm mass by combining with additional water, is well known to most persons. The consistency which it acquires is very variable, and it is the purest plaster that acquires the least. The solidification has been attributed to the presence of some hundredth parts of carbonate of lime; but doubtless erroneously, for the heat necessary to bake plaster, and which in the small way does not rise to 150° cent. is not sufficient to decompose carbonate of lime. Besides, baked plaster does not ordinarily contain quick lime, and the addition of this base to plasters of feeble consistency does not sensibly improve them. I think that the difference observable in the consistency of baked plasters, is to be ascribed to their hardness in a crude state. I conceive that hard stone plaster, after losing its water, will resume a firmer consistency, in returning to its former condition than that which is more tender. The primitive molecular arrangement is in some sort regained. On the same principle, it is, that good cast steel, the carbon of which has been removed by cementing it with oxide of iron, produces by a fresh cementation with carbon, a steel much more homogeneous and perfect than that obtained under the same circumstances, by the cementation of iron.—*Quar. Jour. July—Sept.* 1829.

2. *Braconnot's Indelible Ink.*—The inventor acknowledges, that in ascribing indelibility to this ink, he was much too hasty, (beaucoup trop empressé.) For, having subjected it, recently, to fresh trial, he has convinced himself that it does not deserve the title of indelible, since its characters disappear by successive macerations in chlorine and potash.—*Idem.*

Admitting the *correctness* as well as candor of this retraction, we have assured ourselves by a *hasty* trial of Braconnot's ink, that though not absolutely *indelible*, it is much more *durable*, or much less easily destroyed, than common ink.—*Trans.*

3. *The Diamond.*—It is evident to geologists, that the diamond has not been formed in the places where it is found. It is obtained from alluvial situations, consisting of rolled stones cemented by a ferruginous or sandy clay, mixed with oxide of iron, quartz, petrified wood, &c.

The mines of Brazil furnish annually from twenty five to thirty thousand carats, that is, from ten to thirteen pounds of rough diamond, of which eight or nine hundred carats only can be cut.

The expense of exploring the diamond mines is estimated at 38 francs, 20 cent. per carat. A slave who finds a diamond of more than seventy grains obtains his freedom.

Diamonds not susceptible of being cut, are sold at from thirty to thirty six francs the carat.

The term carat, formerly employed to designate the quantity of gold, originated in the country of Shangallas, in Africa, where the natives in weighing gold used as weights the grain of a plant, called *kuara*. These grains, transported to India, were employed in weighing diamonds. The weight of the carat is exactly two hundred and five milligrammes, or nearly four grains.

A rough diamond which can be cut and which weighs less than a carat, sells for forty eight francs per carat. When they surpass a carat in weight, the price is obtained by squaring the weight and multiplying by forty eight francs.

The cutting of diamonds is the invention of Louis Berquin of Bruges, in 1476. It is effected by means of diamond powder on a horizontal wheel of soft steel. All the diamonds found in ancient armor are natural crystals.

Diamonds are cut either in *rose* or in *brilliant*. The *brilliant* produces the most *varied* effect of color and light,—the *rose* corruscates more vividly, but its play is less fine. At present the *brilliant* obtains the preference.

The price of cut diamonds varies much with their form, purity and color, as well as weight. From $\frac{1}{40}$ to a carat, the mean price is from sixty to two hundred and fifty francs per carat. Above a carat, the square of the weight is multiplied by one hundred and ninety two,—or by a price per carat according to the defects or beauty of the diamond. We perceive in the diamond, more remarkably than in any other substance, the wonderful effects of crystallization in altering the consistency and appearances of matter. Calcareous spar and rock crystal also afford remarkable examples.

Since the discovery that the diamond consists of pure crystallized carbon, chemists have reflected on the possibility of determining their crystallizations artificially. No means, however, have yet been discovered of rendering charcoal, or pure carbon, fluid. The action of the Voltaic Battery on charcoal points seems to afford traces of incipient fusion, but the effect probably arises from the ashes of the combustion, which containing silex and potash, furnish a kind of glass which is sometimes very hard, but which has none of the properties of diamond. If the heating power of the battery be very great, the charcoal is scattered in impalpaple powder over the adjacent apparatus.* Some Savans have proposed to unite a high temperature with strong compression. On the 11th of November last, Cagniard de la Tour presented to the Academy of Sciences, tubes containing, as he supposed, crystallized carbon, but they were ascertained by the committee appointed to examine them, to be earthy silicates of a remarkable composition. M. Gannal on the 3d of November, informed the Academy of another method which he had employed, viz. treating carburet of sulphur, with phosphorus and water. The phosphorus combines with the sulphur, and the carbon is supposed to form crystals on the surface. More attempts of M. Gannal, though not publicly announced before, have been long known to some of his friends. One of his associates, a jeweller, who has been two years at Geneva, presented one of these crystals to the museum. Its weight is about $\frac{1}{16}$ of a carat. But before any thing decisive can be pronounced relative to this discovery, the experiment must be reiterated, and a scrupulous examination made of all the facts. We may add that the employment of weak electric forces, long continued, may, perhaps, effect this crystallization, M. Becqueul having already succeeded upon bodies which appear as difficult to manage as carbon.—*Bib. Univ. Jan.* 1829.

4. *Of the influence of air on the crystallization of salts, by M. Graham.* (Trans. Roy. Soc. of Edinburgh.)—The well known fact of the sudden crystallization of a saturated solution of sulphate of soda, from which the air has been excluded by ebullition on the readmission of air, appears still to defy every attempt at accurate explanation. Gay Lussac has shewn, that it is not the pressure of the at-

* This is incorrect; the deflagrator of Dr. Hare volatilizes and fuses the charcoal point, and the higher its power the more readily and effectually is it accomplished.—*Ed.*

mosphere, for the phenomenon is retarded as well by covering the solution with spirits of turpentine, which preserves it from contact with the air, as by keeping it in a vacuum; and he has proved also, that the solvent powers of water are quite independent of pressure on its surface. Likewise when crystallization fails, as is sometimes the case when the atmosphere is admitted, no advantage is gained by adding to its pressure. This distinguished chemist was inclined to the opinion, that the crystallization might be owing to the diminution of solvent power, occasioned by the absorption of air. This opinion is strengthened by the experiments of Mr. Graham. By placing the hot solution of sulphate of soda in a tube, and inverting it in the mercurial bath, having previously heated the mercury, to prevent crystallization from a rapid cooling of the solution, he ascertained, by throwing up bubbles of air of different kinds, that their influence in determining crystallization, is precisely proportional to their degree of solubility in water, and in saline solutions: Thus a bubble of carbonic acid is more powerful than common air, and a bubble of ammoniacal gas or sulphurous acid, has more effect than carbonic acid. With ammoniacal gas, the crystallization follows the ascent of the bubble so rapidly, that the latter sometimes becomes imprisoned among the crystals before it reaches the top of the tube. Hydrogen, on the other hand, and other gases less soluble in water than common air, have decidedly less effect. A very small quantity of a liquid, soluble in water, causes the solution immediately to crystallize, as may be evinced by using alcohol: now, it is well known that alcohol precipitates sulphate of soda dissolved in water, and the soluble gases appear to possess a similar property.

The enlargement of volume, which ensues upon the sudden crystallization of sulphate of soda, the author ascribes altogether to the expansive effect of the heat thus developed.

The various influence of the different gases is an important fact, not before remarked; but is it sufficient to demonstrate completely the explanation advanced by Mr. Graham? We think not, and we are of opinion that the phenomenon which sulphate of soda presents, belongs to that class of facts, which, though still small, is constantly increasing, and which, isolated thus far in the partial explanation which each one of them has received, constitute, in their totality, that molecular philosophy, still so very imperfectly understood, and so difficult to investigate.—A. D. L. R. *Bib. Univ. Juin*, 1829.

5. *Combination of Mercury with metallic wires, by M. Kemp* (Edinb. Phil. Jour. Apr. 1829.)—When an amalgam of zinc and mercury, containing thirty or fifty times as much mercury as zinc, is covered with a strong solution of muriatic acid, and wires are made to dip into the amalgam, passing through the acid, the quicksilver immediately begins to ascend the wires, and having reached the surface of the acid, there stops. It ascends different metals with different velocities. Wires of platina, copper, iron and zinc, each four inches long, were made to touch the amalgam at the same time;—the mercury reached the top of the zinc wire in eight minutes, that of the copper in fourteen, and in a little while after, that of the platina and iron. In whatever manner the wire may be contorted, the mercury follows its sinuosities, until it attains the level of the muriatic acid, which it never surpasses.

If sufficient time be allowed, the quicksilver not only ascends the wire, but penetrates its substance. There appear no limits to the height to which it may rise, as long as the presence of the acid solution favors its ascension. A stratum of fixed or volatile oil, on the surface of the acid, does not cause the mercury to rise higher.

The zinc contained in the mercury becomes oxidized, dissolves in the liquid, and in time appears in fine crystals on the surface of the wire. When the action has entirely ceased, the mercury which remains at the bottom of the vessel has resumed its primitive purity.

The cause of this singular phenomenon appears to reside in the opposite electrical states of the amalgam, and the wire in contact with it, the first being positive in relation to the second, but it is difficult to explain in this manner the rapid ascension of the mercury on the zinc wire, which is in the same electrical state as the amalgam, *or which at least cannot be negative in relation to it, like the other wires.*

Note of the Editor, Bib. Univ.—The phrase above in italics, which we have just added to the remark of the author, shews that the phenomenon cannot be attributed to ordinary chemical decomposition, arising from Voltaic electricity. The greater rapidity with which the mercury ascends the zinc and copper wires, proves that the facility which metals possess in forming amalgams, favors this ascension; nevertheless, the fact cannot be explained by a simple chemical action of mercury on metallic wires, nor by a physical adhesion, or a sort of capillary attraction. For if so, why should not the mercury ascend the other wires, which have not the property of forming amalgams, unless with extreme slowness? The electric current developed in the experiment doubtless then co-operates, but probably in a different manner from what the author seems to insinuate. Is it not evident that there is a relation between the ascent of the mercury along the wires, and the singular motions which an electric current, however feeble, imprints on this metal? We may be easily satisfied of the reality of this connection, by consulting the works of Erman, Serullas, Herschel, and especially the phenomena recently described by M. Nobili, which appear to have a more immediate relation to the facts above stated.—*Bib. Univ. Juin*, 1829.

6. *Colored Steel Plates.*—M. Nobili, in passing through Geneva some time since, shewed to several persons some steel plates, on which he had succeeded in impressing perfectly regular figures, which presented all the colors of the rainbow, blending with each other, and shaded in a thousand different modes. The inventor has not made known the details of his process. He had previously shewn, that if one of the poles of a battery is made to communicate with a very smooth metallic plate; and the other with a platina wire, ending in a point, and placed in a direction perpendicular to the plate and very near it, (about half a line) a portion of the elements of the liquid, interposed between the point of the wire and the plate, deposits an extremely thin stratum on the latter, which determines a succession of colored rings. The number, size, and nature of these rings, exactly similar in their appearance and origin, to those which are produced by thin plates, appear to depend on many circumstances,—among which are the nature of the plate on which the deposits are made, and that of the decomposed fluid. But what the fluids are which M. Nobili employs to color his steel plates, how he disposes his apparatus to produce this variety of forms and shades, is what he has not made manifest:—it is a secret which must be held in respect, and which we shall endeavor not to pry into until its author shall have made it public.—*Idem.*

7. *Chemical action of light.*—The following facts are cited by M. Fischer, as proper to be added to those which demonstrate the chemical action of light upon organic matter. If a solution of ferro-prussiate of potash be precipitated by alcohol, and the precipitate be quickly collected and dissolved in water, the solution, exposed to light, will pass rapidly from yellow to green, and at length prussian blue will be deposited. The solution becomes at the same time al-

kaline; and, if the experiment is made in a close vessel, on examining the liquid, the odor of hydro-cyanic acid will be perceived. The salt is indeed partly decomposed in this action. Prussian blue, sometimes with excess of oxide of iron, is formed and deposited, and the hydrocyanate of potash remains in solution. The same modifications may take place in a common solution of ferro-prussiate, but time is in that case necessary. It cannot take place without the presence of light. In darkness this salt (the ferro-prussiate of potash) crystallizes in large quadrangular plates, but exposed to a vivid light, it loses gradually the power of assuming this figure, and becomes pulverulent, and is deposited in dendritic forms.

The presence of organic matters, such as gum, starch, sugar, alcohol, &c. greatly increases the action of light on solutions of gold and silver.—*Idem.*

8. *A new Ether.*—Professor Liebig, of the university of Giessen, in examining the action of chlorine upon a number of salts, found, that by distilling one part of sulpho-cyanuret of potassium, two parts of sulphuric acid, and three of alcohol at 80 per cent. and mixing the distilled product with water, an oleaginous substance separated from it, whose weight is about three-fourths of that of the sulpho-cyanuret of potassium. It collects at first on the surface of the water, but in removing by repeated washings, the alcohol and ether which adhere to its surface, it falls to the bottom in the form of an oil, either colorless or slightly yellow.

This ether has very strongly the odor of assafœtida, or cochlearia off. and which odor adheres with great obstinacy to every thing that the ether touches. It is insoluble in water, but communicates to it its odor in a high degree. Its taste is not rough, but rather sweet, with an after-taste of peppermint. It dissolves easily in spirit of wine and in sulphuric ether; it inflames easily, and in burning produces sulphurous acid. It begins to boil at 66° to 72° cent.; its alcoholic solution is not acid, nor is it decomposed either by a strong solution of potash or by ammonia.

This ether appears to be distinguished from all the known bodies of this kind, by its containing sulphur and azote, but probably no oxygen.

Potassium, placed in contact with this substance, previously rectified on chloride of calcium, preserves its splendor, at least for some time; but if heated, it becomes covered with a yellow crust, easily soluble in water; and this solution colors the chloride of iron of a deep red, a proof that it is formed of sulpho-cyanuret of potassium. Fuming nitric acid decomposes this ether rapidly, producing a heat which extends to incandescence. In treating it with diluted acid, much nitrous acid is disengaged, and the liquid which remains precipitates the salts of barytes. Mixed with concentrated sulphuric acid, it loses its transparency; and when the mixture is warmed, sulphurous acid is disengaged, and the liquid becomes black.

Sulpho-cyanic ether absorbs chlorine in great quantity, without changing its form. If a little water be added, and chlorine be still introduced, a fresh quantity is absorbed; the odor of chloride of sulphur disappears, and a strong and penetrating odor of chloride of cyanogen ensues; the liquor then has a very acid taste, which finally becomes caustic; it precipitates barytic salts.

Iodine dissolves without difficulty in this ether, giving it a deep brownish red color, but does not decompose it; for water agitated with the solution, does not redden litmus; caustic potash removes the iodine immediately, and the ether separates with a white color, and with its peculiar odor.

Sulphur is equally soluble, and even in all proportions, at an elevated temperature; but the solution scarcely begins to cool, when a part of the sulphur separates, in the form of a yellow oil. When entirely cold, it sets into a radiated mass, which, in a few days is converted into large crystals, which are no other than sulphur. Phosphorus can, with the aid of heat, be made to dissolve in it in considerable proportion, and when cool it becomes crystalline.

From the properties above described, it may be inferred that this ether is a compound of sulphuret of cyanogen, with carburetted hydrogen; an opinion which is strengthened by the fact, that in preparing it, sulphurous acid is constantly formed. It is not then at the expense of the water of the alcohol, that the potassium of the sulpho-cyanuret of potassium become oxidized, but at the expense of the sulphurous acid.—*Ann. de Chim. Juin*, 1829.

9. *Pure Milk.*—In a valuable essay on the milk sold in Paris, by M. Barreul, the following facts are stated:

By the extension of the use of coffee, (café au lait) the quantity of milk now consumed is at least double that which was used eighteen or twenty years ago.

But the number of milch cows in the vicinity of the city has not increased in any thing like the same proportion.

Much of the milk sold by certain milk men at the corners of streets, has none of the properties common with milk, except the whiteness.

The quantity of the milk which proceeds from the same cow, is very different at different times; and that of different cows varies also in quality.

Some of the more wealthy inhabitants who obtain their milk directly from the dairies, at a good price, have it pure;—but the mass of milk sold in Paris is always more or less altered.

The most common adulteration is that of water. But as this can be detected by the taste and color, brown sugar is added to restore the sweetness, and wheat or some other kind of flour, the whiteness and consistency.

Hence the areometre which merely determines the specific gravity of the fluid, is of no use in detecting these impurities;—and besides, milk which is rich in butyraceous matters is much lighter than that which is less rich in butter, but more rich in caseous ingredients.

To prevent the flour which is used in thickening the skimmed and watered milk, from settling to the bottom, it is previously mixed with water and boiled, which renders it when cold, soluble in the milk.

Thus flour is easily detected by the tincture of iodine, which gives it a wine or violet color.

More especially, if this floured milk be heated with a little sulphuric acid, the coagulum separated by a filter, the serum acquires a fine blue color by the tincture of iodine.

Thus detected, the milk sellers sought for some substance which would not produce the blue color with iodine, in which they doubtless obtained the aid of some chemists. They resorted to an emulsion of sweet almonds, with which, for the cost of about one franc, they can give a milk white to thirty pints of water, and communicate no unpleasant taste.

Some of these pretended milk dealers, less scrupulous, employ hemp-seed in lieu of almonds, because of its greater cheapness. They thus dilute the milk of cows to almost any extent they please, without altering its color or opacity, and correct its taste by a little coarse sugar.

This factitious milk may be detected, however, by the oily nature of its curd. When the latter is pressed between the fingers, or on paper, the oil exudes from it, which is not the case with the curd of pure milk.

That portion or part of milk which is least influenced by variations of food, &c. in the cow is the caseous portion or curd.

Four specimens of milk were obtained by the author from dairies on different sides of Paris, and one other was taken from a cow and brought immediately to him. Three hundred grammes of each of these were warmed and treated with equal quantities of vinegar. The curd of each being drained, and equally pressed between folds of soft paper, furnished, namely, those from the dairies, each twenty nine grammes of cheese, and that from the cow, thirty grammes.

A second experiment, gave within a small fraction, the same result.

Taking the quantity of this caseous matter as a type of the purity of milk, other equal portions of milk were mixed, each with an equal weight of water, and treated in the same manner, when it was found that the quantity of cheese was exactly one half.

In a third experiment, the milk was diluted with twice its weight of water, and the cheese was precisely one third.

The last experiment was repeated, with the addition of sugar to the milk and water; when the cheese was extracted, the whey cautiously evaporated to the consistency of extract, treated with boiling alcohol, filtered and evaporated, the sugar which had been added was recovered.

To distinguish the milk which is adulterated with emulsion of almonds or of hemp-seed, one hundred and fifty grammes of pure milk were united with one hundred and fifty grammes of emulsion of sweet almonds, and the curd was separated by vinegar with the aid of heat. Being well pressed, it weighed sixteen grammes $\frac{5}{10}$. Then another mixture was made, in the proportion of one hundred grains of milk to two hundred of emulsion, and this furnished ten grammes and eighteen decigrammes of curd, which it will be observed is proportionate to the prior quantity.

Besides, the curd or caseum of pure milk can be easily distinguished from that with the emulsion, by its consistency, and by the grease which the latter yields when exposed for sometime to white paper.

To prevent the milk from turning sour and curdling, as it is so apt to do in the heat of summer, the milk men add a small quantity of sub-carbonate of potash or soda, which saturating the acetic acid as it forms, prevents the coagulation or separation of curd; and some of them practice this with so much success as to gain the reputation of selling milk that *never turns*. Often when coagulation *has* taken place, they restore the fluidity by a greater or less addition of one or the other of the fixed alkalies. The acetate which is thus formed has no injurious effects,—and, besides milk contains naturally a small quantity of acetate of potash, but not an atom of free or carbonated alkali.

It is proposed, from the result of these investigations, that the authorities should ordain, 1st. that no milk should be sold except in sealed measures, and 2d, that in each quarter of the city, one or two pharmaceutists should be charged with the duty of examining from time to time the quality of the milk offered for sale, and that penalties should be exacted for every fraudulent alteration of quantity or quality.—*Annales D'Hygiène Publique et de Médecine Legale, Juillet*, 1829.

10. *Discovery of a new metal named Thorium.*—M. Dulong communicated to the Academy of Sciences at Paris, on the 20th of July last, in a letter from M. Berzelius, the discovery of a new earth. "I have just discovered," says the Swedish savant, "a new earth, which possesses almost all the properties of that which bore the name of *Thorina*, and which has been ascertained to be only a phosphate of yttria. It is in consequence of this striking analogy, that I have retained the name of Thorina for this new substance. This earth is white, and irreducible by charcoal and potassium. After being strongly calcined, it is attacked by none of the acids, except concentrated sulphuric, even after being treated with caustic alkalies.

The sulphate of Thorina is very soluble in cold water, and almost insoluble in boiling water, so that it may be freed from many other salts, by washing the mixture with boiling water. Thorina dissolves easily in carbonate of Ammonia. An elevation of temperature occasions a precipitation of a part of the earth, but on cooling, the precipitate disappears. All the salts of Thorina have a very pure astringent taste, very similar to that of tannin. The chloride of Thorium treated with potassium is decomposed with a triple deflagration. There results a grey metallic powder, which does not decompose water, but which raised above a red heat, burns with a splendor, almost equal to that of phosphorus in oxygen gas. Nevertheless, Thorium is feebly attacked by nitric and sulphuric acids. The hydrochloric, on the contrary, dissolves it with a brisk effervescence. Thorina, or the oxide of Thorium, contains 11.8 oxygen. Its specific gravity is 9.4. Thorina exists in a new mineral which has been found in very small quantity at Brevig, in Norway.—*Bib. Univ. Juillet*, 1829.

11. *Action of Potash on Organic Materials.*—The success of Vauquelin in converting pectic acid to oxalate of potash, by heating the former in a crucible with potash, induced Gay Lussac to attempt the conversion of other organic matters to oxalic acid by a similar process.

Five grains of cotton, were put into a platina crucible with twenty five grains of alcoholic potash, and a little water, and the mixture heated over an alcoholic lamp. The cotton resisted the action for some time, but at length yielded, softened, swelled, and evolved hydrogen. It was necessary to stir the mass continually. When the action is over, the mass is dissolved in a little water and slightly supersaturated with nitric acid; it then gives with nitrate of lead, an abundant precipitate, which treated by hydro-sulphuric acid, produces beautiful crystals of oxalic acid. With the nitrate of lime, a voluminous precipitate is had of oxalate of lime.

Wood saw dust gave a similar result.

Sugar, starch, gum, and sugar of milk, treated with potash, furnished in like manner oxalate of potash.

Tartaric acid also underwent this remarkable transformation, without tumescence, blackening or giving out any considerable portion of hydrogen.

Citric and mucic acid produced much oxalic acid.

Silk, treated with potash, afforded oxalic acid, with a disengagement of hydrogen.

Uric acid and gelatine also furnished it. Indigo did not.—*Ann. de Chimie. Aout*, 1829.

12. *Composition of the Atmosphere.*—M. Kupffer, in a letter to Arago, states, that in Civilized Europe it might be foreseen that any slight difference of composition in the air would be soon destroyed by the winds, as those countries are but a few hundred leagues apart; but Kazan, which is bounded on one side by an uncultivated country, and on the other by the immense steppes and forests of Siberia, where there is no vegetation during the greater part of the year, might be imagined to have an atmosphere somewhat different from the rest of Europe. Employing the Eudiometer of Volta, 198 parts of atmospheric air, mingled with 99 of hydrogen, gave constantly 171 to 172 parts after detonation, which gives 20. to 21.2 of oxygen in 100 parts of air. The greatest care was observed with regard to temperature and pressure.—*Idem.*

13. *Combinations and Crystallizations, effected by the action of weak electrical forces.*—Let the owners of diamonds be comforted: chemistry and physics do not yet furnish the means of making them. It was thought that by the decomposition of carburet of sulphur, the carbon might be obtained in a crystallized state, that is, in the state of diamond. M. Becquerel has just communicated to the Academy of sciences, in its session of 27th of July, the result of several experiments, in which he effected the decomposition of carburet of sulphur by electric action of a low power; but instead of diamond, he obtained only carbon in thin plates, very pure it is true, but of an aspect altogether metallic.

M. B. disposes his apparatus in two different modes; sometimes a bent tube, like the letter U, at the bottom of which is placed a wad of amianthus, or preferably of fine sand or argil, to prevent, or at least greatly to retard the mixture of the two different liquids, placed in each branch, and which are united by a homogeneous metallic arc. Sometimes it is a tube closed at one end, at the bottom of which is placed an oxide, or some powdered charcoal, and which is then filled with a conducting fluid, and through which passes a metallic rod, touching the substance at the bottom. In either case, an electric current is established. If a solution of sulphate or nitrate of copper be put into one branch of the bent tube, and a solution of common salt into the other, and the connection effected at the top by a bent wire or strip of copper, there will in the course of a long time be found crystals of a double chloride of copper and sodium deposited on the end of the copper which dips into the alkaline solution, while the other extremity is covered by degrees with copper. The first extremity is positive, the second negative. In changing the liquid and the strip of metal, new products are obtained; and in this way M. Becquerel has enriched chemistry with several new products, such as double chlorides, and double sulphurets, &c., the crystalline forms and chemical composition of which he carefully describes.

It is by the second apparatus that he obtains metallic oxides in a crystalline form. Protoxide of copper for example, in crystals, is procured by placing in the bottom of the tube, deutoxide of copper, filling the tube with a saturated solution of nitrate of copper, and placing a strip of copper in it so as to touch the deutoxide, and then closing the tube hermetically. In ten days, there are visible on the copper, small cubic crystals of metallic brilliancy, which prove to be protoxide of copper.

By an analogous process, crystals of oxide of lead, of zinc, &c. may be formed.

To decompose carburet of sulphur, M. B. puts it in at the bottom of a tube, covers it with nitrate of copper of a lighter specific gravity, and makes the strip of copper pass into both fluids; the carburet is decomposed, as well as part of the nitrate; crystals of protoxide of copper are deposited on the strip, and carbon in very thin plates, of a metallic appearance on the sides of the tubes. A. D.

Bib. Univ. Aout. 1829.

MEDICAL CHEMISTRY.

1. *Preparation of Morphia, without the use of Alcohol.*—Having observed that it was easy to separate morphia from narcotine, by the use of very weak muriatic acid added to perfect neutralization, MM. Henri and Plisson founded upon it the following process. Five hundred parts of opium are to be divided into small strips, and infused thrice, each time in 500 parts of water, at 80° or 100° Fahr. with 20 parts of muriatic acid. The residue is to be pressed, all the liquor put together, and a very slight excess of weak solution of ammonia or caustic soda added. This deposit is to be collected and carefully washed. The mother liquors are to be acidulated, concentrated, and decomposed in the same manner. Potash, soda, and ammonia retain a large quantity of morphia in solution when the liquors are diluted, but much of it is obtained by concentration.

The deposit occasioned by the caustic alkalies is yellowish, and composed principally of resin, caoutchouc, morphia, and narcotine, colored by a brown matter. It is to be frequently washed with water, slightly acidulated, and assisted by a moderate heat until the liquor ceases to be saturated; a slight excess is to be allowed. The liquor is then to be filtered and evaporated; it contains a little resin and extractive matter, and much muriate of morphia, (the part which remains unacted upon, contains with the resin much narcotine;) it is to be concentrated considerably, and when brown crystals have been formed, they are to be slightly washed, and then purified twice by animal charcoal, and recrystallizations from water. The muriate of morphia thus purified, is to be dissolved in a small quantity of water slightly acidulated, and decomposed by a slight excess of ammonia; after which it is to be put upon a filter, washed and dried. Four hundred parts of opium gave from 26 to 27 parts of morphia, free from narcotine. It is yellowish, but solution in alcohol and crystallization gives very white crystals.—(*Jour. de pharmacie, Bull. Univ.* A. xi. 382.) *Quar. Jour. Jul.—Sept.* 1829.

2. *Plumbagine, a new vegetable substance,* (Jour. de Phar.)—M. Dulong has obtained a particular vegeto-principle from the roots of the Plumbago Europœa, Lin. This substance crystallizes readily from alcohol, ether, or water, in the form of numerous yellow needles. On the tongue it first produces a sweet taste, followed by a sharp acrid effect, extending to the throat. Its aqueous solution becomes cherry red by alkalies, subacetate of lead, permuriate of iron, &c.; but acids restore the yellow color, and the plumbagine remains unaltered. Besides this principle, the root contains a black fatty matter, and gallic acid. As this root has been used in cases of itch, tooth-ache, &c., and is proposed to be administered as an emetic, it is supposed that its active virtues will be found in the plumbagine, to ascertain which experiments are in progress.—*Quar. Jour. Jul.—Sep.* 1829.

3. *Analysis of Ipecacuanha Branca, Root of the Viola Ipecacuanha; by M. Vauquelin.* (Jour. de Phar.)—The root of the Ipecacuanha branca, is of a pale white, divided into many branches, of the thickness of a writing pen, much twisted and contracted at unequal intervals. Its fracture is short, the odor of it disagreeable, the taste acrid and nauseous; the ligneous part is thicker than the bark. The substances which compose this root are as follows by weight: Emetine, 1.50; Resin, 0.60; Gum, 0.20; Albumen, 0.30; Starch, 3.20; matter crystallized in scales, 0.85; ligneous matter, 7.00; fatty matter and wax, an indeterminate quantity: Total, 15.95; loss, 0.05.—*Idem.*

4. *Decomposition of Corrosive Sublimate by Vegetable Bodies.*—According to the experiments of M. Fabian, the mucilage of quince seed, (*semence de coing*) and that of salop, decomposes corrosive sublimate the instant it is mixed with its solution; but the decoction of marshmallow does not produce the same effect, and the extract of liquorice only partially.—*Idem.*

5. *Rosaic Acid in Human Urine.* (Jour. de Phar. XV. 228.)—M. Henry has observed in certain cases of acute rheumatism, accompanied by nervous fever, that the urine has been of a very red color, and produced an abundant deposit on cooling. On analyzing

the secretion in such cases, he found that it was very acid, that phosphoric acid and phosphate of lime were very abundant, and that the uric acid had almost entirely disappeared, and been replaced by rosaic acid in large quantities.—*Idem.*

NATURAL HISTORY.

1. *Natural History of the Mole.*—Observations relating to the natural history of this animal, have lately been made and published in the Mém. du Muséum d'Histoire Naturelle, XVII. 193, by M. Flourens, from which the following facts have been abstracted. Two moles were put into a vessel with earth at the bottom, and with roots of carrot and horse radish for food. The next morning only one mole was visible, the roots were not eaten, and on searching the earth, the skin alone of the other was found. It was opened throughout its length, beginning at the belly, and the bones and flesh were eaten.

The other mole was put into an empty vessel; it was excessively agitated and active, and appeared to be very hungry. A sparrow without its wing feathers was put to it, which at first pecked at the nose of the mole when the latter approached it, but after two or three times, the mole darted on to the sparrow, thrust its nose into the entrails of the bird, and detached the skin, at the same time devouring the flesh with a degree of fury. Putting a glass with water into the vessel, the mole drank abundantly once, and again during its meal on the sparrow. The presence of the observer did not appear to interfere, in the least, with the motions of the animal.

The remains of the sparrow being removed, the mole was left to itself; an hour after, it was lying quiet; in five or six hours it was very much agitated, and appeared exceedingly weak, its belly pressed inwards, its sides depressed, its appearance breathless, its snout in continual motion—it appeared starved and ready to die. Another live sparrow was put towards the animal, who this time instantly jumped at it, and began to devour it as before at the entrails. After eating a little, it drank, became of its usual size, and remained quiet. Next morning all but the skin of the sparrow had disappeared, but still the mole seemed hungry and agitated; a frog was put in, the mole instantly fell upon and devoured it, beginning at the entrails as before. The mole was then left until it was very hungry, after which a toad was put to it: the mole instantly perceived it, but each time that it approached the toad, the latter swelled up, and the former turned away his snout as if disgusted. Roots of carrot, cabbage, lettuce, and nothing else, were then put in and left with the mole all night. Next morning the mole was dead, the roots scarely touched, the bitten fragments still remaining. The mole, therefore, is not an herbivorous animal, and only destroys roots to get at the worms, insects, and larvæ within.

Three other moles were put separately, with vegetable food, as leaves, roots, &c. One died without at all touching the food, the other two also died, after slightly attacking the leaves, &c. only in their search for animal food. On the contrary, moles were preserved for a long time, by giving them sparrows and frogs, or even butcher's meat, and sometimes worms, snails, and wood-lice.

Two moles having been put into a room without food, some hours after, they were found the one pursuing the other, not a moment's cessation occurring; by the next morning, the stronger had eaten the weaker.

With regard to the time during which a mole can fast, from ten to twelve hours appear to be the maximum; at the end of that time they die. In three or four hours, they become very hungry, and in five or six hours exceedingly weak. Eating always seems to refresh them perfectly, and, as happens with all carnivorous animals, they are very desirous of drinking when they eat: the contrary is observed with herbivorous animals. It is doubtful whether any other animal exists, which is obliged to eat at such short intervals as this.

From what precedes, it is evident that the mole is essentially a carnivorous animal. A new instance of the admirable relation which connects organization with manners, and functions with organs; and a new proof, that whenever there appears to be a contradiction between one of these things and the other, it is because in the one or the other, the organization or the habits, have been badly observed.

M. Flourens remarks, that it will be interesting to observe in what degree the other *insectivious*, all classed in fact by M. Cuvier in the great family of *Camassicus*, are really carnivorous; and especially what determinate modifications of their digestive organs correspond to the various modifications of their regimen: that of the hedgehog, for instance, which can eat fruits as well as insects, and that of the shrewmouse, which ought to live entirely on prey, if we judge by the shortness of their intestinal canal, which, as in true carnivorous animals, like the tiger, lion, &c., is only about three times the length of the body.—*Idem.*

2. *On the different Genera and Species confounded with Cinchona.* (Bib. Univ. XLI. 144.)—M. De Candolle has published a short notice on the different genera and species of bark, which have been confounded under the name of Cinchona; the following are his conclusions:

1. It results from the enumeration made, that the forty six species of trees or shrubs, until now more or less confounded in books, compose eight distinct genera, namely, Cinchona, Buena, Remigia, Exostemma, Pinkneya, Hymenodyctron, Luculia, Danáis.

2. What is known of the bark of these eight groups appears to indicate a decided connexion between the external forms and the medical virtues, and in particular, that although all these barks may be usefully administered in intermitting fevers as bitter or astringent, it appears that the barks of Cinchona only contain quinia, and that they probably are those which only are endowed with anti-intermitting properties.

3. The yellow bark of medical men is produced from the Cinchona pubescens, and probably also in part from *C. purpurea* and *Humboldtiana.* The orange bark from the *C. lancifolia;* the red bark from the *C. scrobiculata* and the *C. magnifolia;* and the pale bark of best quality from the *C. condaminia,* whilst that of inferior quality comes from a mixture of many species.

4. The eight genera obtained by the dismemberment of the old genus Cinchona, are sensibly in the relation of the geographical distribution of these vegetables, over the globe *Luculia,* and *Hymenodyctron* in the East Indies, *Danais* in the southern isles of Africa, (Bourbon and France,) *Pinkneya* in Carolina and Georgia, *Remigia* in Brazil, *Buena* and *Cinchona* in Peru and the Andes of Bogota. The genus *Exostemma* is an exception to this regularity; but it may be observed that true Exostemma lives in the Antilles, Pseudostemma in Brazil; and the Brachyanthes are divided between America and the Phillippine Islands, with this circumstance, that the species of the Phillippines form perhaps a distinct genus.—*Idem.*

3. *Influence of Chemical Solutions on Plants.* (Bull. Univ. XVII. 372.)—This subject has been taken up experimentally by M. Wiegmann, whose object was to ascertain the influence of chemical solutions when applied to the roots of the plants, and taken in by absorption. His method was to put the liquid into vessels, into which were also then immersed the pots in which the plants were growing, the

earth having been previously allowed to dry freely. In this manner it was found that the neutral solutions of acetate of mercury, acetate of lead, sulphate of copper, muriate of tin, muriate of manganese, nitrate of cobalt, nitrate of bismuth, tartrate of antimony, muriate of baryta, muriate of strontia, and solutions of white arsenic and dilute prussic acid, destroyed plants previously full of vigor, either in the course of a few days, or a week. On the contrary, solutions of the sulphate of iron and zinc, muriates of titanium, iron and lime, and sulphates of alumina and magnesia, produce no prejudicial action.

When sought for, all the substances used were found in the plants, so that in opposition to what Mr. Murray has said, absorption had taken place by the roots.

Solutions of opium, hemlock, henbane, digitalis, and vomica nut, in the proportion of twenty grains of extract in two ounces of distilled water, poured into pots containing young plants of the family Chénopodus, caused death in from four to eight days.

Phillips' experiment of watering a plant with sulphate of copper, and killing it, was repeated, also, the absorption of copper and its precipitation on a knife verified. Solution of four ounces of acetate of lead applied to a young willow did not kill it, probably because the carbonic acid disengaged by the roots precipitated the metal. A similar experiment with two ounces of white arsenic, only made the tree to which it was applied grow more rapidly, M. Weigmann thinks that because the arsenic was in too small a quantity, and acted only as a stimulant.—*Idem.*

MECHANICAL PHILOSOPHY.

1. *Resistance in Space to the Motion of Heavenly Bodies.* (Bib. Univ. XLI. 3.)—In an account of the last appearance of Encke's Comet in 1828, M. Gautier states, that the results then obtained, accorded with those which Encke had previously procured, and which induced him, in 1823, to suppose the existence of a medium or etherial fluid in space, of which the resistance, acting as a tangential force against the motion of the comet, would augment the power of the sun, and shorten the period of revolution. The most celebrated geometers, and even Newton himself, had already calculated the influence which such a resisting medium could exercise on the motions of comets and planets. They had found that its effects would be to diminish continually the eccentricity of their orbits, and to shorten the longer axes and the periods of their revolutions; that the length of the

perehelium would suffer only a periodical change; and that the nodes and the inclination of the orbit would not be altered. In the case of Encke's comet, the first two effects have been decidedly produced, and there are two circumstances to facilitate the calculation; the first is, that this comet is always seen in the same point of its orbit, and near to its perehelium; and the second, that its orbit is subjected only to very slow alterations. Both these circumstances permit the supposition that the times of revolution (at least for some periods) diminish by an equal quantity, so that their diminution may be considered as proportional to the square of the times; the periodical variation of the perehelium may also be neglected without inconvenience. M. Encke supposes, with Newton, that the ether or resisting medium, is diffused through all space; that its density diminishes in the inverse ratio of the square of the sun's distance, and that the resisting force is always proportional to the square of the actual linear velocity of the comet.—*Quar. Jour. Jul.—Sep.* 1829.

2. *Brown's Active Molecules.*—Mr. Holland, the inventor of a microscope, sold by Carey of the Strand, has inclosed some of the particles described by Mr. Brown, as active molecules, between glass and talc, closing the whole hermetically, so as to exclude, as much as care could do, all interference of external causes. Notwithstanding this, the motion continued equally vivid even after ten days. The lens used had a focus of the thirtieth of an inch; and the particles were obtained, as we understand, from gamboge.—*Idem.*

3. *Destruction of Vermin in ships, by steam.*—By letters from India, it appears that the application of steam has been found wonderfully efficacious in cleansing ships from vermin, and especially the white ant. A steam-boat (*the Comet*) was placed alongside a merchant vessel, and steam from its boiler conveyed by a very simple system of pipes, into the hold of the latter, the apertures to which were closed as well as they could be. The operation was continued for several hours, and there is no reason to believe that it was not effectual, and will prove a valuable process in the navy. Besides the direct object of cleansing the ship, another advantage accrued, from the discovery of every leaky place existing, by the oozing of the water through them, in which way leaks were made manifest, that could not be found out otherwise. The expense is said to be very moderate; and it is further stated to be the only process at present known,

not even excepting sinking, which effectually destroys the white ant. —*Idem.*

4. *Electricity of the Solar Rays.* (Letter from Sig. Carlo Mattrucci, of Forli, to Professor Gazzeri.)—" I hasten, Sir, to communicate to you some experiments which appear to me to deserve the attention of philosophers. Having been for a long time persuaded of the existence of electricity in the solar rays, I wished to ascertain the fact by experiments. Having for the purpose exposed to the sun a delicate condensing electrometer of gold leaf, I soon perceived the leaves diverge and open themselves also on that side of the glass case which was directly exposed to the solar action, as if they had been attracted by it. Being induced from this first fact to suspect glass in this situation electrified, I was anxious to know if this were the case: wherefore, having left some plates of it in the sun, in a few moments I touched them in different places with the ball electrometer, when a very perceptible divergence ensued, which, however, was much more apparent when I touched the plates, although lightly, with a flat surface, since the effects of the friction and the pressure did not afford a doubtful result. I concluded, then, that the solar rays had the power of electrifying glass, and it only remained for me to ascertain if this effect were owing to the real existence of electricity in these rays, or rather to the increased temperature of thé glass, which I could easily determine by heating a plate of glass, and trying it with the electrometer. This I did several times, but never discovered any signs of electricity. I observed, also, that the glass plate exposed to the rays of the sun, never became electric if placed beneath another glass plate, or if the face of the sun was obscured by the intervention of a cloud. These few experiments which I have been induced to perform, seem to me sufficient to prove the existence of electricity in the solar rays. The influence of such a fact on the meteorological phenomena of nature, will, I hope, induce yourself and other philosophers to pursue the subject farther." (Antologia, No. 100. Forli April 25, 1829.)—*Idem.*

Professor Saverio Barlocci, of Rome, in a Memoir on the influence of Solar Light, in the Production of Electric and Magnetic Phenomena, inserted in Vol. XLI. of the Giornale Arcadico, relates the following experiments which he had performed, to ascertain the electric power of the solar light. Having decomposed it with a prism, he made the red ray and the violet ray fall upon two discs of blackened copper, each of which was attached to a copper wire. Two nuts of the same metal, sliding upon a vertical glass rod, and to which the two wires were attached, permitted their being brought near together, or removed at pleasure. Having suspended a prepared frog by the body to the upper wire, the legs were placed upon the lower one. The apparatus being thus arranged, whenever (the discs being respectively covered with the red and violet rays) a contact was formed between the extreme parts of the two wires, evident signs of contractions were observed in the frog.—Note by Prof. Gazzeri.

Having experimented two summers since, upon the solar spectrum, in exactly the same way, except that a very delicate galvanometer was used instead of a frog, no electricity could be obtained by means of an English sun. M. F.—*Idem.*

5. *Leech Bites.*—Dr. Lowendhart mentions a method of checking the profuse bleeding from leech bites, which is simple and effectual. The edges of the little wounds are drawn together with a fine needle and thread. The thread being drawn through the cuticle only, gives no pain, and the bleeding is at once suppressed. (Jour. de Chir. Med. Jour. VI. 86.)—*Idem.*

6. *Professor Hanstein.—Terrestrial Magnetism.*—Letters have been received from Professor Hanstein and his companions, to the 19th of February. On the 12th of September they left Tobolsk, and travelled on sledges, the cold being at $-40°$ R., so that the frozen quicksilver could be cut with a knife. On the 31st they arrived at Tornsk; on the 21st of January, 1829, at Krasnojarsk, and on the 7th of February, at Irkutsk, which is about 4000 versts from Tobolsk. They afterwards visited Kiachta, and crossed the frontier of China; but the most agreeable result is, that the desired object of the journey is accomplished, as the observations have proved perfectly satisfactory, and the magnetic pole is found. Centuries will perhaps elapse before Siberia will be again so thoroughly observed. When the letters were dispatched, it was resolved that the journey should be extended to Nertschink; from which place Professor Hanstein would return to Krasnojarsk. His companion, Lieutenant Due, was to go alone to Jakutzk, 2700 versts N. E. of Irkutzk, and perhaps proceed down the river Lena to the Frozen Ocean, and they intended to meet again at Jeniseisk in September or October. (New Mon. Mag. XXVII. 359.)—*Idem.*

STATISTICS.

1. *Foundling Hospitals.*—A prospectus has been published in Paris, of a work, in three volumes, on the history of Foundling Hospitals, on the manner in which they are conducted in all parts of the world, furnishing the statistics of all the principal establishments of this nature in Europe; and on their tendency, moral, political and eleemosynary, by M. De Gouroff, Rector of the University of St. Petersburg, Counsellor of State, &c.: Dedicated to the Emperor Nicholas. The author has travelled over the greater part of Europe, in the collection of materials for this work.

"In Catholic countries," he remarks, "numerous asylums have been opened to all new-born children, legitimate or illegitimate, which it may please the public to abandon, or to place in them. Austria has many such institutions: Spain reckons 67; Tuscany 12; Belgium 18; but France in this respect excels other countries: she has no less than 362. Protestant countries, on the contrary, have suppressed the greater part of those which had been specially founded for this purpose."

To form an idea of the advantage of the Protestant system over that of Catholic countries, the author states, "that in London, the population of which amounts to 1,250,000, there were in the five years from 1819 to 1823, only 151 children exposed; and that the number of illegitimate children received in the 44 work-houses of that city, of which he visited a large number in 1825, amounted, during the same period, to 4,668, or 933 per annum; and that about one-fifth of these are supported at the expense of their fathers. By a striking contrast, Paris, which has but two thirds of the population of London, enumerated in the same five years, 25,277 enfants trouvés, all supported at the expense of the state."

To ascertain the contagious influence of these houses on the abandonment of new-born children,—Mayence had no establishment of this kind, and from 1799 to 1811, there were exposed there thirty children. Napoleon, who imagined that in multiplying foundling hospitals, he would multiply soldiers and sailors, opened one in that town on the 7th of November, 1811, which remained until March, 1815, when it was suppressed by the Grand Duke of Hesse-Darmstadt. During this period of three years and four months, the house received five hundred and sixteen foundlings. Once suppressed, as the habit of exposure had not become rooted in the people, order was again restored, and in the nine succeeding years, but seven children were exposed.

2. *Progress of Mutual Instruction in Denmark.*—The monitorial system of instruction was first introduced into Denmark in 1819, and although opposed with great zeal by the clergy in its early stages, it was supported by a few of them, and having early received the sanction and support of the king, it made rapid progress. The Chevalier Abrahamson is regarded as the true founder of the system, and its most efficient promoter in that kingdom. The following is a statement of the number of schools, progressively, established on that system.

In the beginning of 1819,	1	school.
end of 1819,	7	"
1820,	11	"
1821,	15	"
1822,	35	"
1823,	244	"
1824,	605	"
1825,	1143	"
1826,	1545	"
1827,	2003	"
1828,	2302	"

At the latter period, the organization of 344 other schools had been commenced, which it was hoped would be in activity at the end of the present year. The total number of schools of mutual instruction would then be 2646, that is nearly two thirds of the whole number in the kingdom.—*Rev. Ency. Sept.* 1829.

3. *Educational Beneficence.*—It appears from a recent discourse pronounced by Ch. Dupin, at the conclusion of his course of "*Geometry and Mechanics applied to the Arts*," that one of the most enlightened magistrates of Paris, M. Cochin, Mayor of the 12th Arrondissement, has established in his district, which contains near eighty thousand inhabitants, schools for the benefit of the poorer classes of all ages. The subscriptions by which they are maintained, he has liberally aided by his own resources. In a retired and healthy situation, he has constructed an infant school, for children from three to seven years of age, where the children of the laboring classes may remain from morning till night, well taken care of and instructed. Four hundred children are to be admitted during the present year.

Another school of mutual instruction, for three hundred boys, from seven to fourteen years of age, will be provided, in which they will be taught reading, writing, arithmetic, linear drawing, and various useful precepts on industry and the arts. A school for three hundred girls, of a similar age, will be added for instruction in literature and needle work. To these are to be added, an adult school for two hundred and fifty of each sex, who have not enjoyed the benefit of early or primary instruction. Finally, on the Sabbath, a school is to be opened for those who are occupied during the week in manual labor.

In this quarter of Paris, there is a greater proportion of poor than in any other, and it has been found, that among these suffering classes, the mortality is much greater than in other parts of the city. In the rich quarters of Faubourg St. Honoré, and La Chaussée d'Antin, the deaths annually are one in forty four of the whole number of inhabitants, while in the faubourgs Saint-Jacques and Saint-Marceau, the deaths are one in twenty four. The only means of arresting these misfortunes thus indicated by the ravages of death, is to endeavor to enable those who gain their livelihood by the sweat of their brow, to do it more efficaciously. Their labors must be rendered more intelligent, easy and appropriate to their destination, and thereby susceptible of being better paid and more abundant.—*Rev. Ency. Sept.* 1829.

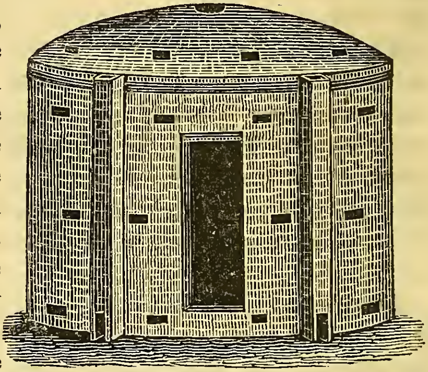
* * * * * *

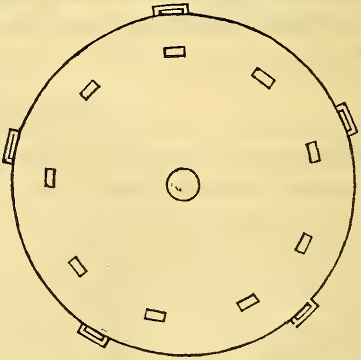
A much more copious digest of foreign scentific intelligence was received from Professor Griscom, but the advanced state of this Number when the MS. was received, has permitted us to make only a selection from its different topics and the remainder, with additions, will be given in our next.—*Ed.*

MISCELLANIES.

1. *Notice of a new method of charring wood, in a letter to the Editor, from* Mr. Isaac Doolittle.

My Dear Sir—My occupations for the last seven years, have led to pretty extensive and close observations on the manner in which charcoal is made in our woods and mountains; and which I always considered as an exceedingly laborious, wasteful and *slovenly* operation—but one which I knew not how to improve upon, until about a year since, when my attention was called to examine a small charring kiln at the works of the West Point Foundry Association. This kiln was made on the same principle, and nearly of the same size as one described by M. de la Chabeaussière, (Bulletin de la Sociètè d'Encouragement pour l'Industrie Nationale, Vol. XX. p. 295.) This was a pit dug in the ground, filled with wood, and covered with an iron cap—which cap must be removed at each successive emptying and filling of the pit—some tubes leading from the top of the ground to the bottom of the pit served as vents. From the nature of this construction, it is evident that the size must necessarily be limited to a very few cords of wood—say five or six at most.—This size might answer very well for the extraction of pyroligneous acid, to which purpose M. de la Chabeaussière applied his kiln—or for a blacksmith who consumes but a small quantity of coals; but would be no more than a plaything in works where the daily consumption is from one thousand to fifteen hundred bushels or more.





It occurred to me that, by building kilns above ground, so that all the vents could be come at with facility, and arching the top over in the form of a dome, leaving one or more openings in the side for the admission of wood and the extraction of coals, (which are closed during the operation of charring,) they might be constructed of almost any size that might be desirable. The result of the experiment justified my most sanguine expectations. A kiln of thirty feet diameter, and nine feet high to the spring of the arch, and which holds fifty cords of wood, has been several times filled and charred, and has uniformly yielded from fifty five to sixty bushels of coals to the cord,* of a quality, far, very far superior to coals made in the ordinary way. From the manner of making these coals, they must be entirely free from stones and dirt,

* Colliers, in the woods, usually compute the yield of coals at the rate of one hundred bushels to two and a half cords of wood, or forty bushels to the cord—but I believe that, as a general average, one hundred bushels to three cords of wood, would be nearer the truth.

which are highly detrimental in most uses to which charcoal is usually applied—and of which it is almost impossible to avoid raking more or less among coals made in pits covered with earth.

In addition to the economy of wood, and the improvement in the quality of coals—there is also an immense saving of labor in the use of the kilns, which, moreover, possess the advantage of operating at all seasons of the year, and in any weather.

In short, except the discovery of a bed of bituminous coal, which would afford coke, proper for the different operations of iron making, or of a method of using anthracite for this purpose, I know of nothing that could promise so great and decided advantages to this important branch of the arts as this system of coaling.

I have deemed this improvement of sufficient importance to others, to think it ought to be productive of some trifling benefit to myself, and have, therefore, applied to government for a patent, which I expect to receive in a short time, when, if you desire it, I will forward to you a copy of my specification for your Journal.

I am Sir, with high respect, your ob't. serv't.

I. Doolittle.

Bennington, Vt. Nov. 22, 1829.

2. *Origin of Bituminous Coal.*

(From the Rev. Sayrs Gazlay.)

Oxford, Dec. 9th, 1829.

To the Editor.—A fact, with which I have recently become acquainted, has satisfied me that bituminous coal is of vegetable origin.

Col. Scott, of Monongalia County, Va. who resides about eight or ten miles West of Laurel-Hill, and consequently in the great Valley of the Mississippi, in digging a well, on a level piece of ground, half a mile from the Monongahela river, and about two hundred feet above its waters, at the depth of thirty-four feet, dug through a stratum of bituminous coal, and about five feet lower, came upon another stratum of coal, in which he found a supply of water. Between these strata of coal, and one and a half feet below the first, he found a piece of wood the size of a man's arm, in a good state of preservation, perfectly sound, and entirely natural, except its being a little charred. It lay imbedded, in a kind of marle, which I judged to be calcareous, and which may have prevented the wood from being mineralized. Having conversed with one of the men who dug the well, and having been at the spot, and obtained of Col. Scott, some of the fossil wood, a specimen of which I herewith present you, I can assure you of the truth of the facts above stated.

That wood should be found at such a depth in the earth, in the valley of the Mississippi, excites no surprize, as the thing has frequently occurred; but that it should be found between two strata of coal, is an interesting fact, and settled my opinion, which before was wavering, respecting the origin of that mineral.

Your obt. servant, SAYRS GAZLAY.

(From the same.)

3. *Inhumed Wood.*—Mr. Samuel Hall, about 1817, was digging a well in Palmyra, Warren Co. Ohio, twenty miles from the Ohio river, where the land is almost a dead level for miles, and not in the vicinity of any stream of water, it being high table land. At the depth of forty feet, he came upon the body of a pine tree, fifteen inches diameter, lying horizontally, in a natural and perfectly sound state. He was obliged to chop off the log at each side of the well; and Judge Lowe, who lives within two miles of the spot, was there within a few minutes after the log was drawn out, and assured me of the fact.

That much of the land in the valley of the Mississippi, is "made-land," to the depth of forty feet or more, need not be doubted.

4. *A village lighted by natural gas.*—(Communicated.)—The village of Fredonia in the western part of the state of New York presents this singular phenomenon. I was detained there a day in October of last year, and had an opportunity of examining it at leisure. The village is forty miles from Buffalo, and about two from Lake Erie; a small but rapid stream called the Canadaway passes through it, and after turning several mills discharges itself into the lake below; near the mouth is a small harbor with a light house. While removing an old mill which stood partly over this stream in Fredonia, three years since, some bubbles were observed to break frequently from the water, and on trial were found to be inflammable. A company was formed, and a hole, an inch and a half in diameter, being bored through the rock, a soft fetid limestone, the gas left its natural channel and ascended through this. A gazometer was then constructed, with a small house for its protection, and pipes being laid, the gas is conveyed through the whole village. One hundred lights are fed from

it more or less, at an expense of one dollar and a half yearly for each. The flame is large, but not so strong, or brilliant as that from gas in our cities: it is however in high favor with the inhabitants. The gazometer I found on measurement, collected eighty eight cubic feet in twelve hours during the day: but the man who has charge of it told me that more might be procured with a larger apparatus. About a mile from the village, and in the same stream, it comes up in quantities four or five times as great. The contractor for the light house purchased the right to it and laid pipes to the lake, but found it impossible to make it descend, the difference in elevation being very great. It preferred its old natural channels, and bubbled up beyond the reach of his gazometer. The gas is carburetted hydrogen, and is supposed to come from beds of bituminous coal: the only rock visible, however, both here, and to a great extent on both sides, along the southern shore of the lake, is fetid limestone.

5. *Sheet Caoutchouc.*—A specimen of sheet caoutchouc has been sent to the Editor, by Dr. I. K. Mitchell of Philadelphia.

Dr. Mitchell's process is as follows. Steep a bag of caoutchouc in sulphuric ether until quite soft, say from four to twelve hours, or any longer term. Take it out and quickly attach to its neck, by a flat string a stop cock, and inflate with the mouth. This process succeds best in a cold room. When well prepared the balloon will rise with hydrogen, by means of which it should, for such a purpose, be inflated.

Cake caoutchouc soaked in ether until soft, is easily cut with a wet knife, or under water, and may thus be made as thin as required. By soaking in ether for some days, massive caoutchouc may be moulded by hand into any shape whatever, and is nearly as manageable as dough.

Dr. Mitchell has also discovered that essential oil of sassafras will dissolve caoutchouc readily after being softened in ether, and that after evaporation of the solvent the caoutchouc remains unaltered.

The very various uses to which both discoveries may be applied need not be insisted on.

When two pieces are laid together and cut with scissors, they unite at the line of section.

We are happy to see this interesting art introduced into this country. The specimen forwarded by Dr. Mitchell is very perfect, and there can be no doubt, that the interests of both science and the arts will be seriously promoted by the facilities which this substance will in many ways afford.—*Ed.*

6. *Geology of the Gold Region of North Carolina.*

(Note from Prof. Mitchell.)

A letter from Mr. Reinhardt of Lincolnston in this state, is published in the 16th volume of the Journal, with notes by Prof. Olmsted appended, and amongst others the following. "The account here given by a gentlemen, not at all interested in the theories of the formations, appears to favor the opinion that they are deposits from water and not merely as Prof. Mitchell has maintained in a late volume of this work, the result of the decomposition of the associated rocks." I could point out some small errors in Mr. Reinhardt's letter. The mines he mentions were not discovered as he says in the summer of 1828, but as early at least, as the spring of 1827. They were visited by me in the summer, and described in the fall of that year. But I am willing to allow the account to be strictly accurate and impartial, although I object to Prof. Olmsted's inferences. This gold is found in the *beds of small streams* where it lies mixed with rounded pebbles of quartz. (See Mr. Reinhardt's letter.) It is exactly under these circumstances that it should be found if my views are correct. Every one knows, that the bed of a stream contains rounded pebbles—the gold that accompanies them in Rutherford, once lay imbedded in the rocks of the neighboring hills, it was liberated from its matrix as these rocks underwent decomposition, and carried down during the prevalence of violent rains into the bed it now occupies, as is fully stated in my communication, to which Mr. Olmsted refers. When he shall produce *a single instance* of a collection of rounded pebbles associated with gold upon a rising ground, remote from a stream, he will have advanced something, adverse to the correctness of the views advocated by me, and favorable to his own.

University of North Carolina, Oct. 26th, 1829.

7. *German Collections of Rocks, Minerals, &c. communicated by Prof. Hitchcock, of Amherst.*

(To the Editor of the Journal of Science, &c.)

Sir—You gave some time ago an account of the terms, on which a Mr. Moldenhauer, of Heidelberg, in Germany, wished to sell, or exchange minerals; and mentioned a catalogue of his collection you had received. The successors of Mr. Moldenhauer are David and Adolph Zimmern; and their establishment seems to be connected with the University in that city, as a Mineralogical Institute. In a box of minerals recently received from them, came enclosed a new edition of their Catalogue of Minerals, and a list of rock specimens and petrifactions, which they are preparing for sale. As these gentlemen appear to be honorable dealers, (of which several others, as well as myself, have had conclusive proof, in valuable returns from them,) and as I know of no other place where such a collection of fossils can be obtained, I thought your readers might be gratified by a translation of their prospectus, which I give below.

Collections of Rocks and Petrifactions by parcels, at the Mineral Store in Heidelberg.

In December, 1826, we informed the public of our project, to furnish by parcels, collections of rocks and petrifactions at a moderate price; thus enabling the lovers of the science to possess the most important varieties of rocks, as well as a certain number of petrifactions, which are so important in their relations to the rocks.

We then calculated upon the success of an enterprize, in which we had more respect to a love of the science, than to a lucrative speculation. We thought ourselves sure of a demand for sixty collections, to cover the considerable expense of that undertaking. The success has much surpassed our expectation. The first two parcels, of which the greater part of the specimens were already obtained, were with difficulty got ready for delivery in December, 1827; at which time we had received orders from establishments in Holland, Italy and Russia, and from a great number of amateurs, both in Germany and abroad. These first parcels proved that we had spared no pains to keep our promise; and ever since, the specimens which remained, have met with a ready sale. Encouraged by the satisfaction which was generally expressed, and by the new orders which we could not supply, we have determined to announce a second edition of collections of rocks and petrifactions by parcels. The conditions of this new undertaking are essentially the same as the first; we recapitulate them here.

1. It is known how difficult it is to furnish collections of rocks, nearly complete, in the expectation that they will afford an object for pecuniary speculation.

2. Even to the present time, almost insurmountable difficulties exist to the acquisition of characteristic petrifactions, which, in the actual state of the science, have become indispensable in a collection of rocks, destined for study and teaching.

3. To lessen these obstacles and supply this need, we will furnish collections of rocks and petrifactions, which shall be distinguished by their selectness, and the variety of pieces which compose them.

4. To facilitate their acquisition, they shall be forwarded by parcels every six months—*et par le roulage.*

5. Each parcel shall contain from 50 to 60 specimens of rocks and petrifactions.

6. The specimens of rocks shall be from 9 to 12 inches square, according to the wish of the subscribers: all shall be well characterized, fresh, and selected with care. That the most important points in each formation may be presented, the specimens shall not come from one country, but will exhibit a very great variety in a geographical respect. Duplicates and useless varieties will be rejected: the subscribers shall receive only those specimens which exhibit the essential characters.

7. As to petrifactions, we propose a double object; a knowledge of their forms, and that of their geological relations; consequently we will furnish them either isolated, or remaining in the rock. We conceive that the first cannot be exhibited but in their natural condition, and that it is not always possible to bring the last into a determinate form, without depriving them of a part of their characters.

8. Each specimen shall be accompanied by a printed ticket, exhibiting the German, French and English names. They will indicate, moreover, with more or less of detail, the known position of the object, and its localities. Lest the tickets should be too long, the most obvious characters will not be described. The labels of the rocks will be prepared under the direction of Counsellor and Professor Leonhard; those of the petrifactions will be the work of Professor Bronn.

9. As far as possible, each parcel shall present examples of all the principal formations and petrifactions, so that they can be immediately arranged according to the systems of Humboldt, Boué or Referstein. The last parcel will be accompanied by an accurate catalogue of the entire collection, which will consist of eight or ten parcels.

10. The price of the subscription for each parcel is $8,88, (22 *florins, ou* 48 *francs Argent de France.**) Two months after sending each parcel, we shall expect to receive this sum from the subscribers. The subscription will remain open to the end of the year.

Those amateurs who may not yet be able to appreciate the plan and execution of our enterprise, will see the opinion of Prof. Leonhard, expressed upon the publication of our first proposals. (*Zeitschrift für Mineralogie, Fevrier* 1828, pp. 162.)

"I expect much," says he, "from this enterprise of the Mineralogical Institute. It will furnish the means of understanding in future with more precision and facility, the objects and their names: it will put an end to vague determinations and doubtful arrangements; a thing of no small importance in respect to petrifactions. From the considerable number of subscribers, in all countries, of which a list has been shown me, it is presumed that these collections will be generally received. Hence, in a few years they will doubtless be met with in all public cabinets, and in many private collections. It will therefore be possible hereafter to refer to specimens in these collections in geological works, and it will be easy from thence to make comparisons."

Heidelberg, May, 1829.

Although the subscription for these rocks and petrifactions is not promised to continue open longer than to the close of the year 1829, yet probably it will not be too late to make application after that period: and it is earnestly hoped that so good an opportunity for enriching the public and private cabinets of this country, will not be lost. A letter put into the post office in any part of our country, with the postage paid as far as New York, will reach Heidelberg safely, and expeditiously, if the following address be put upon it: *Au Comptoir de Mineraux de Messieurs David and Adolph Zimmern, Heidelberg, sur le Neckar, Allemagne—via New York et Havre.* It may be well, also, to put on the opposite side of the letter, the following direction in English: *Messrs. David and Adolph Zimmern, at the Mineral Magazine, Heidelberg, Germany, via New York and Havre.*

---

* Reckoning the franc at 18 1-2 cents, dividing 8,88 by 22, we get 40 cents and four tenths as the value of the florin, and this value I have used in all the subsequent reductions of the prices of the collections: judging it more safe to trust to this than to any tables of exchange within my reach.

In addition to the above, I have received a summary view of the various collections that are put up at this mineral store, a translation of which I subjoin to be used by you at your pleasure.

1. *Oryctognostic Collections*, arranged according to the Manual of Oryctognosy, by M. Leonhard:

a. In fine boxes of pasteboard with four drawers; 100 specimens, $4,44, (11 florins.)

b. Do. in five drawers; 150 specimens, $8,88, (22 florins.)

c. Without boxes and of larger size, 300 specimens, $26,67, (66 florins.)

d. Do. 400 specimens, 4 inches square, $44,44, (110 florins.)

2. *Collections of Precious Stones:*

a. In neat boxes of pasteboard, 50 specimens, the greater part of which are polished, $26,67, (66 florins.)

b. Do. a greater number of specimens and of larger size, according to any price that may be agreed on.

3. *Geological Collections*, according to the Characteristics of Rocks, by M. Leonhard.

a. In pasteboard boxes, 100 specimens, 4 inches square, $4,44, (11 florins.)

b. Do. 150 specimens, $8,88, (22 florins.)

c. Without boxes, 150 specimens, 9 inches square, $13,33, (33 florins.)

d. Do. 200 specimens, 9 inches square, $22,22, (55 florins.)

4. *Collections for the use of Apothecaries*, according to the system of M. Geiger:—the number of specimens and their price, corresponding to No. 1 above.

5. *Collections in Economical Mineralogy*, for the use of public schools and Polytechnic Institutes, according to M. Blumof, or M. Brard.

a. 300 specimens of 6 inches square, $31,11, (77 florins.)

b. 400 do. of do. $48,88.

6. *Collections of Petrifactions*, according to the system of M. Bronn.

a. 100 specimens, $13,33, (33 florins.)

b. 200 do. $31,11, (77 florins.)

7. *A Suite of Crystal Models*, made of pasteboard and covered with neat varnish.

a. 23 models, exhibiting the primitive forms, $1,62, (4 florins.)

b. 100 models; the same as above, with 77 secondary forms, $6,66, (16½ florins.)

All the specimens of the different collections are well selected and fresh, so as to be perfectly adapted for studying as well as teaching. Each specimen is accompanied by a ticket, indicating the name of the substance and the place where it is found. In case it is desired, the labels will be given both in French and English. The collections, also, if it is wished, will be arranged according to any other convenient system. We can furnish, also, collections of every species in greater numbers, larger size, and more rich in rare and precious minerals and crystals, at any other prices that may be agreed on. Accurate catalogues of our Magazine of Minerals of rocks and petrifactions are distributed gratis. For accommodating the public, we have made an arrangement, by which all the objects above mentioned may be obtained through any of the booksellers in Germany, who, on their part, must draw their orders upon the bookstore of M. J. B. Mohr, in this city.

Le Comptoir de Minéraux á Heidelberg.

Heidelberg, Feb. 28, 1828.

I will only add, that I have a few copies of the catalogues of minerals and petrifactions, (particularly of the latter) in this "*Comptoir*," and should be happy to loan them to any gentleman desirous of examing them. Respectfully, &c. E. Hitchcock.

Prof. of Chem. Min. &c.

Amherst, Oct. 19th, 1829.

8. *Baron Humboldt's Expedition.*—At a meeting of the Academy of Sciences, on the 12th of October, M. Gay Lussac communicated a letter, addressed to M. Arago by Baron Humboldt, dated August 18, 1829. "This celebrated naturalist," says the Courier des Electeurs, from which we translate the account, "having arrived at the remotest frontiers of Siberia, has accomplished the objects of his scientific voyage in a manner which has exceeded all his expectations. He expresses the hope of returning to Berlin towards the end of November. The Emperor of Russia has seconded this great enterprize with a munificence truly royal. Not content with causing the travellers to be accompanied with an armed force, he added to them a mining engineer of distinguished merit. 'I cannot look upon these things,' says the illustrious traveller, 'as tokens of personal kindness and consideration. They are a public homage paid to the

sciences, a noble munificence displayed in favor of modern civilization.'

"Baron Humboldt, being, as is well known, charged with exploring the Ural Mountains, under a mineralogical point of view, gives his friend M. Arago some eminently curious particulars respecting this subject. It appears that the mines of this chain of mountains contain abundance of platina, and that the gold dust found there far surpasses in richness that discovered in the Cordilleras and other parts of America. An astonishing number of lumps of gold, of eighteen and twenty pounds, are found some inches below the turf, where they have hitherto remained unknown. Fossil elephants' teeth are met with, surrounded with alluvion of gold dust. The formation of these alluvions, the consequence of local destructions, is perhaps subsequent to the destruction of the great animals. Some of them are incredibly rich; and that of Wilkni, belonging to the Demendoff family, has already produced more than 2,800 pounds of gold.

"After having determined the height of the loftiest peaks, calculated the position of the strata, visited the *usines* of Siberia, and confirmed by experiments the magnetic observations of M. Freycinet, Baron Humboldt had the curiosity to push his researches to the Chinese outposts. The Chinese commandant, informed of his arrival, made no opposition to the investigations of the travellers, but only required as a condition that they should make him a preliminary visit, adding, that he would have made the first advances of politeness if he had taken a fancy to visit the Russian territories. Seated in his tent, dressed in a suit of silks, and wearing in his cap a long peacock's feather, he received them with a gravity altogether amusing, and sold them, for a bit of red velvet, a historical work written in the language of his country."

Another account of Baron Humboldt's expedition, mentions that it was observed by him that it was always on the Asiatic declivity of the Ural Mountains that the auriferous sands lie. They contain pieces of gold, platina, and chromate of iron united with platina. The annual produce of these new mines is 6000 kilograms of gold. Mines of osmium and iridium in separate beds were discovered by Baron Humboldt in these mountains. Crossing the Khirgeese *steppe*, he visited, near the frontiers of Chinese Tartary, the ruins of the ancient city of Bulgaride or Bolgari, formerly the capital of the Tartar Empire, and the residence of the family of Tamerlane.—*N. Y. Eve. Post.*

9. *Information desired respecting Mineral Waters.*—Dr. Daubeny, Professor of Chemistry, &c. in the University of Oxford, well known to the scientific world, especially by his excellent work on volcanoes, of which a full analysis was given in Vols. XIII. and XIV. of this Journal, is engaged in a general examination of mineral waters, and being desirous of obtaining information on that subject, from every part of the world, has forwarded to the Editor of this Journal the following queries, which, although addressed more immediately to the people of Great Britain, are not the less interesting in other countries.

The Editor of this Journal solicits communications on this subject from every part of this continent, and they will be given to the public and to Dr. Daubeny, if permitted by their writers, through this Journal.

Oxford, July 13th, 1827.

Sir,—Being desirous of investigating the properties of such of our Mineral Waters as appear as yet to be known but imperfectly, I take the liberty of soliciting information respecting those in your neighborhood, and of submitting to you for that purpose the following queries:—

1st. Are you aware of any springs in your county, or in those adjacent, the heat of which exceeds the medium temperature of our climate?

2nd. Is the temperature of such springs fixed or variable?

3rd. Do you know of any distinguished from ordinary water by certain peculiarities, either sensible or chemical?

4th. Are you acquainted with any to which medical virtues are or have been ascribed, or which, when taken, produce any remarkable effects on the animal functions?

5th. Do the springs above alluded to give out any gaseous products, and of what description?

6th. What is the geological character of the stratum from which they arise?

7th. What effect do they produce on the stones and other substances with which they come in contact, upon the contiguous soil, or upon animals?

8th. Are there any works in which a detailed and authentic account of such springs may be found?

In addition to answers to the above queries, I beg leave to request any further information relative to hot or mineral waters which you may have it in your power to afford me; and shall likewise feel obliged by receiving samples of the more remarkable ones, carefully corked and sealed on the spot, and in quantity not less than a pint. They may be addressed to the Chemical Laboratory, Broad-street, Oxford, for, Sir, your obedient humble servant.

CHARLES DAUBENY,
Professor of Chemistry, Oxford.

10. *Diluvial Furrows and Scratches.*

Extract of a letter from David Thomas, Esq. one of the chief Engineers of the Erie Canal to Professor J. Griscom, dated Greatfield, 9 mo. 20, 1829.

In a late number of the Journal of Science, there is a notice of information laid before the New York Lyceum, relative to the worn appearance of rocks *in situ*, with parallel scratches, (such as heavy harrows might make in soft slate,) and the writer speaks of them as being in a *southeasterly* direction.

Appearances precisely similar occurred in excavating the Erie Canal above Lockport, on hard limestone, with a direction of the lines about *north* 25° *east.*

Similar marks were found on uncovering hard sandstone in the Erie Canal not far from Brockport, and nearly eighty feet below the former level. At my request, Dr. Whippo, the resident engineer, ascertained the direction of the lines *north* 80° *east.*

Nearly on the same level with the last, on the east side of the Genesee river, and also on the line of the Erie Canal, similar scratches occurred on the hard limestone, but I know not the direction.

I have also found similar traces on the Montrose and Milford turnpike, south of the Great Bend of the Susquehanna, in Pennsylvania, probably 1000 feet above any of the before mentioned localities, and in all cases on hard rock *in situ.*

I see no difficulty in referring this attrition of the surface of rocky strata, to the Deluge,—a period when *all the loose matter* of the globe appears to have been in violent commotion; but on *the cause* of lines so regular and so deeply engraved, I have nothing to offer.

11. *Economical Process for Chlorate of Potash, by A. A. Hays.*— Add to a quantity of chloride of lime, or bleaching powder, four times its weight of rain water, and agitate it occasionally; after two hours, decant the clear liquor, and repeat the operation twice on the undissolved part, using one half the quantity of water; mix and measure the solutions. Prepare a solution of pearlash, by adding six parts of cold water, decanting the clear liquor, and washing the residue with

more water; mix and ascertain the bulk of the solution. To a measure of the solution from the chloride, add from a measure, some of the alkaline solution, till it ceases to produce a precipitate: note the quantity used, which may be called the equivalent decomposing quantity, for the sample of chloride used. Take for every like measure of chloride solution, one-sixth the quantity of the pearlash solution, that was found necessary for decomposing the powder. Mix the solutions, and when the precipitate has subsided, decant the clear liquor, and evaporate to dryness by rapid ebullition in glass or earthen vessels. Dissolve the soluble part of the mass, by boiling it in water; filter or concentrate till a pellicle appears; the solution, by cooling, and subsequent evaporation and cooling, deposits all the chlorate in crystals; wash them in cold water, redissolve them in the smallest quantity of boiling water: large crystals of the pure chlorate are obtained by slowly cooling the solution.

12. *Astronomical Observations, made at the Royal Observatory at Greenwich, in the months of April, May and June*, 1828: by John Pond, Astronomer Royal.—These observations, published by the President and Council of the Royal Society, "at the public expense, and in obedience to his Majesty's command," are a continuation of that series of astronomical labors by which the Observatory of Greenwich has contributed so largely to the perfection of modern astronomy. The present number comprises observations on the transits of the fixed stars and planets over the meridian, and on the north polar distances, and the altitudes of numerous stars. It affords, as well in the manner and form, as in the contents, a striking example of the finished style in which the business of this renowned Institution is at present conducted.

This document was transmitted by the Royal Society of London, through Wm. Vaughan, Esq. to the Library of Yale College.

13. *Register of the Thermometer at Brooklyn, (N. Y.)*—noted at 8 o'clock, A. M.—FOR 1829.

	October.	November.	December.
1,	46°	48°	42°
2,	44	43	40
3,	56	45	38
4,	42	42	20
5,	44	42	42

October.			November.			December.
6,	46°	- -	40°	- -	42°
7,	46	- -	48	- -	50
8,	56	- -	48	- -	50
9,	42	- -	44	- -	37
10,	42	- -	54	- -	27
11,	60	- -	34	- -	35
12,	56	- -	25	- -	50
13,	42	- -	25	- -	32
14,	46	- -	40	- -	32
15,	48	- -	34	- -	40
16,	50	- -	34	- -	38
17,	50	- -	54	- -	26
18,	56	- -	54		
19,	56	- -	44		
20,	45	- -	27		
21,	35	- -	44		
22,	30	- -	54		
23,	38	- -	60		
24,	48	- -	34		
25,	60	- -	28		
26,	64	- -	40		
27,	43	- -	32		
28,	40	- -	30		
29,	48	- -	40		
30,	56	- -	37		
31,	42	- -	..		

NOTICES OF RECENT AND FORTH-COMING SCIENTIFIC WORKS.

Foreign.

1. *Early Discovery of America by the Scandinavians.*—An interesting communication, dated at Copenhagen, has just been received by the Conn. Academy of Arts and Sciences, from Charles Christian Rafn, Knight of Dannebroge, R. Danish Professor, Dr. Philosophy, Secretary to the R. Society of Northern Antiquarians. We are permitted to make the following extract:

"It is known that the inhabitants of the North of Europe visited, long before Columbus' time, the countries on the coasts of North America. The greatest part of the information on this subject has not hitherto been published.

" At a time when the researches concerning the former times of America have gained a greater interest, I hope the effort to extend this information will meet the approbation of the American Antiquarians.

"I have now gone through all the old MSS. on this subject, and have made a complete collection of the several pieces, shewing the knowledge which the old Scandinavians had of America. I intend now to publish this collection with a Latin translation.

" The accounts of the voyage of the old Scandinavians to America, have lately gained a new confirmation, by a Runic Stone, which in the year 1824, was found under 73° N. lat. on the Western coast of Greenland. Translated, it is as follows: Erling Sigvalson, and Biorne Hordeson, and Endride Addson, Saturday before Gagnday, (the 25 April) erected these heaps of stone, and cleared the place in the year 1135."

2. *Use of the Blowpipe in Chemistry and Mineralogy.* [In German.] By Jacob Berzelius. Second edition, 8vô. pp. 282, Nurnberg.

3. *Library of Useful Knowledge—published under the superintendence of the Society for the Promotion of Useful Knowledge:* 8vo. London.—This is a work of great value : it is published semi-monthly, in Nos. of thirty two pages each, and may be had of our booksellers at $3.50 per year. The names of Brougham, chairman, and of Lord John Russel, M. P. vice-chairman of the Committee of the Society, are a sufficient warrant for the integrity of the work. On the first of August, it had reached 55 numbers. We give the following as specimens of the subjects. No. 20, Life of Cardinal Woolsey ; 21, Optical Instruments ; 22, Electricity ; 23, Physical Geology ; 24, Life of Sir Christopher Wren ; 25, Arithmetic and Algebra ; 26, Thermometer and Pyrometer ; 27, Outlines of General History.

4. *Library of Entertaining Knowledge:* London : a work just commenced under the superintendence of the same Society, and published monthly, in half volumes, 18mo. of about 200 pages each. It has less of a scientific, and more of a popular character than the other work, but still contains much valuable knowledge. The subjects proposed to be first treated of, are, The Menageries, Vegetable Substances used in the Arts and in Domestic Economy, Natural History of British Insects, Natural History of Birds, History and Description of Substances used in the Arts, History of Inventions and Discoveries, The Monuments of Architecture, Anecdotes of individuals remarkable for their ardent pursuit of knowledge under unfavorable circumstances, &c.—The bookstore price is 56 cents per number.

5. *Guy's Pocket Cyclopædia or Epitome of Universal Knowledge, designed for Senior Scholars in Schools, and for young persons in general;* by Joseph Guy. Ninth edition, enlarged and extensively improved: London, pp. 633, 12mo.

The Quebec Literary and Historical Society has just published the first volume of its transactions. This Society has grown up under the munificent patronage of the Earl of Dalhousie, and has ably commenced its career: it has a wide range for objects of inquiry and research, and we shall expect from it much useful information. The following is from the Quebec *Official Gazette.*

"The first volume of the 'Transactions of the Literary and Historical Society' is now published and for sale. They form a good sized octavo volume of 260 pages, exclusive of the Catalogue of the Mineralogical Collection belonging to the Society, which contains 72 pages, and of several maps and lithographic prints.

"The first article is the Inaugural Address, being an essay on the Juridical History of France, antecedent to the year 1663, when the Sovereign Council of Quebec was established, the Law, as it was then administered being the common Law of Lower Canada. This article was written by the Chief Justice, and is a luminous and classical digest of the legal system of the Province, ending with a strong recommendation of the necessity of some establishment of a public description, where Law might be taught as a science. The recent decision on the subject of M'Gill College affords ground for hoping that this *desideratum* may hereafter be supplied.

"The second article is from the pen of Captain Bayfield, R. N. and contains outlines of the Geology of Lake Superior. This paper would, from its intrinsic merit, have attracted observation in the mother country, rich as she is in every kind of literature. An article, by Mr. Green, follows, respecting coloring materials produced in Canada. This paper was communicated to the Society of Arts, London, with some specimens of the raw and the prepared materials, and that Society was pleased to award to the writer the gold Isis medal.

"The next is an account of some meteorological phenomena observed in Canada by Captain Bonnycastle, R. E. who has also supplied a second article on a few of the Rocks and Minerals of Upper Canada. Mr. A. Stewart has furnished two very interesting papers, the one containing notes on the Saguenay country, and the other a paper on the ancient Beruscans or Tyrrhenians.

"The exertions of Mr. Baddelay, R. E. are very conspicuous, combining in themselves matter sufficient to occupy nearly 100 pages of the book, chiefly on the Geognosy of the Saguenay country. We may mention the article on the country around the Montmorency—the article on Recent Shells found near Quebec, by Mrs. Sheppard of Woodfield—the Journey across the continent of North America by an Indian Chief—the observations on the plants described by Charlevoix, by Mr. W. Sheppard—on the Myrtus Cerifera or Myrtle wax-shrub—a very curious catalogue of coincidents, which induce the belief of the Asiatic origin of the North American tribes, by Major Mercer, R. A.—and also a catalogue of Canadian Plants, presented to the Society by the Countess of Dalhousie. The plates are in general well executed, and we hail with sincere pleasure the appearance of a volume, the first production of a Literary Society in this Province."

Domestic.

1. *Encyclopædia Americana—a popular Dictionary of Arts, Sciences, Literature, History, Politics and Biography, brought down to the present time, including a copious collection of Original Articles in American Biography; on the basis of the seventh edition of the German Conversations Lexicon;* Edited by Francis Lieber, assisted by E. Wigglesworth. Vol. I. 8vo. pp. 616: Philadelphia.—The high reputation of the contributors to this work, will not fail to ensure it a favorable reception among our countrymen; and its own merits will do the rest. Something of the kind has been greatly needed. The heavier Encyclopedias are too cumbersome for common reference, and too expensive for common use. We needed something that would condense the valuable information which they contain, and present it before us in a form accessible to all. This is the object in the Conversations-Lexicon, the first Vol. of which is now before the public: the name implies a Lexicon calculated to fit a person for sharing in the conversation of well informed circles, and is taken from the German work, on which this is to be modelled. The estimation in which the German Lexicon, now consisting of 12 Volumes, is held, may be learned from the fact, that since 1812, 80,000 copies have been published, besides two pirated editions. "There has been also a Danish translation, a Swedish, and likewise a Dutch. A French translation is also preparing at Brussels." The American work is partly a translation, and partly original. "Some of the departments of Science and Literature, which were but imperfectly treated in the original German work, have been entirely re-

written for this edition; for example, Zoology, (by Dr. Godman, of Philadelphia, author of the well known Am. Nat. History) Mineralogy and Chemistry. The departments of Political Economy and Geography have also been much enlarged. Numerous entire articles of American and English Law have been introduced. In general Biography, large additions have been made. The articles on *American Biography* are entirely original, and have been furnished by Mr. Robert Walsh, Jr., whose learning and taste are a sufficient pledge of their value. The contributions under Mineralogy and Chemistry, though perhaps not a complete system in themselves, include nearly every particular which relates to the common concerns of life; and the articles are ably and faithfully written. In the nomenclature of minerals, the following course appears to have been adopted. When the composition of a mineral is simple, consisting of a combustible and metal, as Sulphuret of Antimony, or of an acid and an earth, as Sulphuric Acid and Barytes, as in Heavy Spar,—it is treated of under the head of the principal ingredient, as *Antimony* in the first instance, and *Barytes* in the second. Thus, also, Gibbsite, which is an Hydrate of Alumine, is described under that earth. In such cases, it is no doubt intended, in the progress of the work, that reference shall be made from the mineralogical names of these substances to the chemical head under which they are mentioned. Where the composition is less simple, the mineral is noticed under one of its most popular names, as in the case of Axinite and Agalmatholite.

While we congratulate the public on the prospect of such a work, we must be allowed to ask a favor of the publishers—that in the future numbers we may be saved from such a constant use of the paper knife.

2. *Elements of Physics or Natural Philosophy, general and Medical;* by Neil Arnott, M. D. of the Royal College of Physicians. First American, from the third London edition; with additions, by Isaac Hays, A. M., M. D., &c. 8vo. pp. 532. Philadelphia.

3. *Familiar Introduction to the Study of Botany, by Mrs. Lincoln,* 12mo. pp. 335.—The intention of this work is expressed in the title page. "Familiar Lectures on Botany, including Practical and Elementary Botany, with Generic and Specific Descriptions of the most common native and foreign plants, and a Vocabulary of Botanical terms, for the use of higher Schools and Academies." Mrs. Lincoln, who is vice-principal of the Troy Female

Seminary, states in her preface, that having been for some time devoted in part to the study of Botany, with the charge of a large class, she experienced the want of a suitable book for beginners, and was led to prepare for the use of her pupils, a sketch, of which the present treatise is but the filling up. Among the sources of information, from which she has drawn, are mentioned the works of Mirbel, Rousseau, St. Pierre, Smith, Woodville, Eaton, Nuttall, and Torrey, the Encyclopedias, and various other approved treatises upon the subject. The book is neatly executed, and illustrated by a frontispiece, exhibiting the progress of vegetation at different heights, and several engravings from original designs; and cannot fail of answering the principal intention of its amiable authoress, of engaging persons of her own sex in a study, eminently calculated to interest and instruct them.

4. *Elements of Spherical Trigonometry; designed as an Introduction to the Study of Nautical Astronomy; by J. P. Rodriguez*, U. S. Navy Yard, Gosport. 8vo. pp. 24.—This little work is valuable in itself; and still more so from the promise it holds out, of something further from the same author. He is known to us as a young gentleman of high mathematical attainments. His object is to prepare for our Naval officers a work, in which the higher principles of Navigation shall be developed, but which at the same time will be suited to their contracted opportunities for study and improvement on this subject. Such a work is needed, and we wish Mr. Rodriguez success.

5. *Lyceums.*—This is a name given to numerous town associations now forming in the State of Massachusetts. Their object is, *to establish Libraries, to raise the character of district schools, to compile town histories, to prepare town Maps, to promote Agricultural and Geological Surveys, and to form collections of Minerals.* Some maps, of good execution, and surprising cheapness, have been sent to us, as the results of these efforts: the system promises much good, and, it is hoped, will extend to other States.

6. *Transactions of the Albany Institute for Dec.* 1829.—The present number contains Statistical Notices of some of the Lunatic Asylums in the United States, by T. Romeyn Beck; Observations on the great Greywacke Region of the State of New York, by James Morse; and a Topographical Sketch of the State of New York, designed chiefly to show the general elevations and depressions of its surface, illustrated by an engraving, by Joseph Henry.

7. *Elements of Geometry upon the inductive method; to which is added an introduction to Descriptive Geometry;* by James Hayward, A. M. lately college professor of Mathematics and Natural Philosophy in Harvard University. 12mo. pp. 172. Cambridge.

8. *The American Almanac and Repository of Useful Knowledge, for the year* 1830, *comprising a Calendar for the year; Astronomical Information, Miscellaneous Directions, Hints and Remarks; and Statistical and other particulars respecting foreign countries and the United States.* Vol. I. 12mo. pp. 308. Boston.

9. *A Map of the U. States' Lead Mines on the Upper Mississippi, by R. W. Chandler of Galena: engraved and published at Cincinnati.*—This appears to be a very valuable map, executed on a scale sufficient to exhibit all the necessary local details, and with a degree of neatness that makes it a handsome specimen of Western arts.—The map contains also on its margin, various statistical and other statements, which much enhance its value, and it cannot fail of being an acceptable offering to our country, and especially to the mining regions, which it exhibits.

10. *New Treatise on Mineralogy.—Preparing for Press;*—An Introduction to the study of Mineralogy, consisting of an Analytic Method for enabling the student to determine unknown Minerals, founded upon the natural properties of Minerals; and full descriptions of the species, treated of according to the arrangement of Haüy, with their chemical and economical characters, and an account of their geological and geographical distribution: to which will be added an appendix, containing a descriptive catalogue of several of the most interesting specimens in the Cabinet of Yale College. By Charles U. Shepard.

Corrections for the article on Malaria.

Page 311. line 10th from the top—read, "if the sun is too hot it will be dried up; and separate from moisture, *which alone unfolds its existence,* this occult property is doubtless innoxious, as it certainly is unknown."

Page 315. line 29th from the top—read, "and the humid vapors would differ in amount, *though not in character,* proportionate to the degree of heat which exhaled them."

Page 317. line 10th from the bottom, read, "and it is important to medical science, as giving a clue to its mode of attack, whether by the external and internal surfaces, or by respiration."

Page 323. line 17th from the top, read, "a pestilential morass transformed into fertile fields, with a salubrious atmosphere, and an industrious and happy population."

INDEX TO VOL. XVII.

A.

B.

C.

D.

E.

F.

G.

H.

I.

K.

L.

M.

N.

O.

P.

Q.

R.

S.

T.

U.

V.

W.

Z.

v 17 Calm

THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and For. Mem. Geol. Soc., London; Mem. Roy. Min. Soc., Dresden; Imp. Agric. Soc., Moscow; Hon. Mem. Lin. Soc., Paris; Nat. Hist. Soc. Belfast, Ire.; Phil. and Lit. Soc. Bristol, Eng.; Mem. of various Lit. and Scien. Soc. in America.

VOL. XVII.—No. 1.—OCTOBER, 1829.

FOR JULY, AUGUST, AND SEPTEMBER.

NEW HAVEN:

Published and Sold by HEZEKIAH HOWE and A. H. MALTBY. *Philadelphia*, E. LITTELL & BROTHER.—*New York*, G. & C. & H. CARVILL.—*Boston*, HILLIARD, GRAY, LITTLE & WILKINS.

PRINTED BY HEZEKIAH HOWE.

THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and For. Mem. Geol. Soc., London; Mem. Roy. Min. Soc., Dresden; Imp. Agric. Soc., Moscow; Hon. Mem. Lin. Soc., Paris; Nat. Hist. Soc. Belfast, Ire.; Phil. and Lit. Soc. Bristol, Eng.; Mem. of various Lit. and Scien. Soc. in America.

VOL. XVII.—No. 2.—JANUARY, 1830.

FOR OCTOBER, NOVEMBER, AND DECEMBER, 1829.

NEW HAVEN:

Published and Sold by HEZEKIAH HOWE and A. H. MALTBY. *Philadelphia*, E. LITTELL & BROTHER.—*New York*, G. & C. & H. CARVILL.—*Boston*, HILLIARD, GRAY, LITTLE & WILKINS.

PRINTED BY HEZEKIAH HOWE.

THE AMERICAN JOURNAL
OF
SCIENCE AND ARTS,
CONDUCTED BY
PROFESSOR SILLIMAN,
OF YALE COLLEGE.

AGENTS.

MAINE.
HALLOWELL, Glazier, Masters & Co.
PORTLAND, Samuel Coleman.
VERMONT.
BRATTLEBORO', Holbrook & Fessenden.
MASSACHUSETTS.
NEWBURYPORT, Charles Whipple.
SALEM, Whipple & Lawrence.
NORTHAMPTON, S. Butler.
RHODE ISLAND.
PROVIDENCE, Hutchins & Cory.
CONNECTICUT.
HARTFORD, H. & F. J. Huntington.
LITCHFIELD, Joshua Garritt.
MIDDLETOWN, Luke C Lyman.
NEW YORK.
NEW-YORK, A. T. Goodrich.
WEST POINT, John De Witt.
NEWBURGH, H. P. Benham.
ALBANY, Weare C. Little.
TROY, Wm. S. Parker.
CANANDAIGUA, Bemis, Morse & Ward.
UTICA, William Williams.
ROCHESTER, E. Peck & Co.
NEW JERSEY.
PATTERSON, David Burnett.
PRINCETON, W. D'Hart.
TRENTON, D. Fenton.
NEW BRUNSWICK, Terhune & Letson.
PENNSYLVANIA.
PITTSBURGH, Luke Loomis.
MARYLAND.
BALTIMORE, E. J. Coale.
DISTRICT OF COLUMBIA.
WASHINGTON, P. Thompson.
NORTH CAROLINA.
CHAPEL-HILL, Prof. E. Mitchell.
SOUTH CAROLINA.
COLUMBIA, B. D. Plant.
CHARLESTON, Ebenezer Thayer.
CAMDEN, Alexander Young.
VIRGINIA.
FREDERICKSBURGH, W. F. Gray.
KENTUCKY.
MOUNT STERLING, Silas W. Robbins.
GEORGIA.
SAVANNAH, Wm T. Williams.
MISSISSIPPI.
NATCHES, W. C. Grissam & Co.
LOUISIANA.
NEW ORLEANS, Mary Carroll.
CANADA.
QUEBEC, Neilson & Cowan.

TERMS.

Six dollars a year for two volumes, published in quarterly numbers; *payment in advance*, for one volume at a time; postage to be paid on orders and remittances.

☞Terms of credit to general agents, six months from the publication of No. 1, of each volume. *Complete sets* furnished to individuals, and to the trade, at a suitable discount.

TO CORRESPONDENTS.

Payment will be made for valuable communications, which if not appropriate, will be returned. Those on arts, manufactures, domestic economy and useful inventions, are particularly desired.

Communications to be in hand six weeks, or when long, and especially when with drawings, two months, before the publication day.

☞ Authors are requested to give their own titles and those of their pieces, *exactly*.

☞ It is requested that journals sent in exchange for this, may not be *doubled*, but covered flat—as the common mode of folding is as injurious as it is unnecessary.