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. Geol. Soc., Paris; Mem. Roy. Min. Soc., Dresden; Nat. Hist. Soc., Halle; 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. XXVII.—JANUARY, 1835.

NEW HAVEN:

Published and Sold by HEZEKIAH HOWE & Co. and A. H. MALTBY. *Baltimore*, E. J. COALE & Co.—*Philadelphia*, J. S. LITTELL and CAREY & HART.—*New York*, G. & C. & H. CARVILL.—*Boston*, HILLIARD, GRAY & Co.

PRINTED BY HEZEKIAH HOWE & CO.

CONTENTS OF VOLUME XXVII.

NUMBER I.

MISCELLANIES.—DOMESTIC AND FOREIGN.

NUMBER II.

MISCELLANIES.—DOMESTIC AND FOREIGN.

ERRATA AND ALTERATIONS.

P. 7, l. 23 fr. top, for *Nascongo*, read *Naseongo;* l. 10 fr. bot. for *establishments*, read *establishment*.—p. 29, l. 6 fr. top, omit *it*.—p. 31, l. 8 fr. bot. after *valley*, add *of the;* l. 3 fr. bot. for *vein*, read *bed*.—p. 107, l. 3 fr. top, for *at*, read *down*.—Two letters are omitted on the plate fig. 3, p. 108, on the dykes marked *c* and *i*, at the point of their junction; *j* should be read on the dyke *i*, and *f* on the dyke *c*.—p. 298, l. 11 fr. top, for *nature which*, read *which nature;* l. 16 fr. top, for *size* read *sire*.

Vol. xxvi, p. 289, l. 10 fr. bot., for *probability* read *propriety*.—p. 296, l. 1 and 2 fr. top, for *as well as drunk*, read *when drank*.—p. 297, note, l. 4 fr. bot., for *diminutions*, read *elimination;* and a few other slight errors are left to the intelligent correction of the reader.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*Report on a projected Geological and Topograyhical Survey of the State of Maryland; by* JULIUS T. DUCATEL, M. D. Prof. of Chemistry, Univ. of Maryland, and JOHN H. ALEXANDER, Esq. Topo. Eng. Communicated for insertion in this Journal.

To His Excellency, JAMES THOMAS, *Governor of Maryland.*

THE undersigned, commissioned in pursuance of a resolution of the General Assembly, passed at its last session, to make the necessary examinations preliminary to a general survey of the territory of Maryland, beg leave respectfully to report:—

That upon communication to them of their having been selected to execute the provisions of the resolution before mentioned—on the 25th of May last: they immediately applied themselves to the discharge of the required duties. These duties were understood to be:

1. A general reconnoissance of the entire territory of the State, with a view to proper arrangements for subsequent topographical admeasurement and geological examination, and,

2. An inquiry after, and collection of all such authentic information, contained in maps or charts, as covered any part of the said territy of Maryland.

The first mentioned division of their duties—commenced on the 25th of May and occupied them, with two intervals of a few days each, until the 6th of September last. In that time they took occasion to pass over every known remarkable spot in our state; particularly, making it a point to visit every county and its chief town, and by especial inquiries among the inhabitants, to assure themselves that no place was overlooked, which, in such preliminary examinations, could or ought to have been attended to. These they were anxious should be known, in order that an opportunity might be afforded to persons interested (they hope under that title to include every citizen of Maryland) of ascertaining how far the parts passed over were capable of furnishing a correct general idea of the whole.

This general idea, the results of their examination—they beg leave now to present; premising, that by a geological investigation they conceive is meant, not only an inquiry into the *mineral* constitution of the different sections of the state, but a developement of all its resources, in so far as these are dependent upon the occurrence within its territory of such substances belonging to the soil, as have already been, or are capable of being applied to useful purposes, in agriculture, manufactures, and the arts; the collection likewise of facts relative to its hydrology, by which they understand, besides an inquiry into the nature and properties of the *mineral* waters that occur with in its limits, an examination of the peculiar circumstances under which the natural flow of its streams is determined, with a view, principally, to establish the amount of its *water power*, and, in a word, every point of information usually embraced under the head of the physical geography of a country.

Taking this view of the subject, they proceed to lay down the facts in the order in which they have presented themselves to their observation, adding such remarks concerning them, as may serve to illustrate their importance or the interest connected with them, whether of a general or local character.

Turning the attention, in the first place, to that portion of the state usually designated as the Eastern shore of Maryland, and overlooking all those subjects, in which it abounds, of a merely speculative interest in geology, the observer cannot fail to be struck with the immense advantages which its *agricultural* interests would derive from a minute investigation of the mineral constitution of its soil, and a careful research into the nature and extent of the resources which it offers within itself for improvement or amendment. If the observation be confined, for the present, to that portion of the Eastern shore which lies south of the river Elk, it is found to comprise an extensive and irregular deposite of gravel, sand and clay; supported, perhaps, in its whole extent, by a substratum of clay, enveloping innumerable reliquiæ of many genera of testaceous animals. This substratum, the value of which is to a certain extent known, is commonly denominated, and not improperly so, ***beds of shell marl;*** its utility for agricultural purposes—according to the species of shells which it encloses, the degree of decomposition of these shells, and the nature of the cement by which they are held together—being in some instances greater than, in most equal to that of the mineral species, described in systematic works as offering two varieties; namely, indurated or *stone marl* and *earthy marl.*

These beds of shell marl occur at variable depths. They are sometimes covered by a thick stratum of gravel or sand, measuring from ten to thirty feet and upwards in thickness. At other times they reach nearly to the surface of the soil, and their limits, under this latter circumstance, are marked by a line distinctly undulating; whilst elsewhere the line of separation from the superincumbent soil is horizontal, and in some localities slightly inclined. In some places, the fossils in the marl bed, are its principal constituent; that is to say, consisting of numerous genera and species of shells, they are bound together by a cement of their own nature, which offers an admixture of foreign ingredients, either argillaceous or siliceous, not exceeding a ratio of fifteen or twenty per cent. Such beds are characterized by the great predominance of that species of shells known in popular language as *clam shells.* Other beds consist principally of *scallop shells.* Some contain both scallop and oyster shells; others oyster shells alone. Some beds are composed principally of these shells thickly imbedded in clay; while in others, the shells, and more especially the *scallop shells,** are firmly agglutinated by an argillaceous and ferruginous cement. A portion of these beds of shell marl offers an inexhaustible supply of the best material that can be used for improving the soil, in an extensive circle around the spots on which they are deposited.

Notwithstanding the great diversity of soils, (according to localities,) which is observable on the Eastern shore of Maryland, it would be easy to shew, that, excluding the vegetable and animal matter, contained in them, they may all be arranged under two classes; namely, those containing a predominance of silicious ingredients, and such as contain a predominance of argillaceous ingredients; in other words, *sandy* soils, and *clayey* soils. It is presumed that the great characteristic of the soil, in this portion of the territory of Maryland, is an absence, or deficiency of calcareous ingredients.

---

* This introductory account being mainly popular, the scientific names of the shells are, for the present, omitted.

Taking this view, then of the constitution of the soil, in connexion with the well known fact, that to constitute a permanently good soil, there should necessarily be present in it a due proportion of silicious, argillaceous and calcareous particles; and, in connexion too with the fortunate circumstance of the existence of the immense deposites of shell marl, which have just been referred to, the undersigned remain persuaded, that the system of geological investigation, to be pursued for the Eastern shore of Maryland, in so far as its agricultural interests are concerned is a very simple one. It must consist—1st, in ascertaining and then delineating upon a map, the extent and limits of each class of soils; and 2dly, in discovering the position and ascertaining the extent and nature of the deposites of shell marl.

In reference to the latter subject of investigation, it must be borne in mind, that, as already stated, the value of this marl as an amendment to the soil will depend upon the species of shells which it encloses, the facility with which those shells are susceptible of disintegration, and the nature of the cement by which they are sometimes held together, or the nature of the mineral deposites with which they are associated. Thus it has been found, that those beds, which consist principally of *clam shells* usually associated with numerous varieties of other smaller bivalve and many univalve shells, and containing very little admixture of foreign ingredients, yield a marl which exhibits its beneficial effects upon the soil in a very short time; because the calcareous particles are derived from shells which are very prone to disintegrate when exposed to the atmosphere. Marl beds, composed entirely or principally of *oyster shells*, are much less valuable, because of the slow disintegration and decomposition of this species of shell. *Scallop shells*, which are a species nearly allied to the oyster, resist such decomposition still more obstinately than do oyster shells, and when they occur, as they have been observed to do, in extensive beds firmly agglutinated by an argillo-ferruginous cement, they are useless in all soils, and may be positively injurious to some. The undersigned have had abundant opportunities of ascertaining, that beds of shell marl, thus constituted, occur in various localities, on the Eastern shore of Maryland—sometimes as distinct uniform deposites, but more generally in alternating strata, which might be described as so many varieties of shell marl; the indiscriminate use of which has given occasion to some mortifying disappointments.

These general remarks, concerning the extent and nature of the shell marl deposites on the Eastern shore of Maryland, are predicated upon the facts contained in the following extracts from notes taken upon several spots which were carefully examined by the undersigned, or about which the information received was deemed satisfactory.

"At the Frederick ferry, on the Sassafras River, there is a partial formation of a ferruginous sand stone rock, with impressions of shells. This rock is covered by a deposite of sand and gravel, thirty feet thick.

"Three miles below Chestertown, on the Chester River, another similar bank occurs, elevated about twenty feet above tide, composed of a more indurated ferruginous sand and clay than that at the ferry on the Sassafras, and strongly characterized by numerous impressions of shells.

"These spots may perhaps, be indicated as the commencement of the fossiliferous deposites of the Eastern shore of Maryland.

"At Centreville, we obtained information of the existence of beds of shell marl on Corsica creek, which circumstances prevented us from visiting: but the specimens obtained from that locality enable us to state, that the deposites in that place furnish, what we would term, *two varieties* of shell marl, one composed principally of clam shells imbedded in clay; the other consisting of *pectens* (scallop shells) enveloped by an indurated ferruginous clay.

"Easton is situated upon a foundation of shell marl. Experiments made upon three samples of the waters used for the supply of the town, indicated a notable proportion of lime, held in solution by carbonic acid.

"Five miles from Easton, on the Choptank River, and thirty miles from its mouth, there is an extensive deposite of fossil shells, which is very conspicuous for about two miles up the river. This deposite which probably underlies nearly the whole of Talbot County, occasionally makes its appearance immediately beneath the soil, at the depth of only a few inches, in other places it is met with only at the depth of several feet.

"In the locality at present under examination, being one of the most remarkable, the bank on the river is elevated about twenty feet above tide. The shells occur therein in the following order:

1. Soil consisting of sand, ferruginous sand, and gravel, about - - - - - - 7 feet.

2. Pectens, (scallop shells,) upwards of - - 1 foot.
3. Clams and pectens, intermixed, - - 3 "
4. Pectens, - - - - - - 1 "
5. Clams, - - - - - - - 3 "
6. Oysters, not determined.

"Besides these shells which are the most prominent in the strata alluded to, there are numerous varieties of other marine shells.

"At the foot of the bank, and perhaps under the deposite of shells, (although the latter circumstance has not been satisfactorily ascertained,) it would seem that there is a formation of iron stone of the nature of a bog ore, and exhibiting numerous impressions of pectens (scallop,) and other shells.

"Shell marl deposites also occur in the immediate neighborhood of Easton. They are generally found at the head of the branches making up from the Third-haven creek. In one locality, the deposite, which is almost exclusively composed of oyster shells, is covered by a bed of gravel, four or five feet in depth.

"At a short distance from this, there is another deposite which consists of broken scallop and oyster shells. This deposite is undulated in its superior surface, and lies about seven feet beneath the soil which is sandy," &c. &c.

These notes, it will be perceived, refer principally to spots which have been visited by the undersigned. And although, from transient observation, they had been at first led to assign the commencement of the shell deposites to the Sassafras River, they have since been induced to think, that they occur on Bohemia River. At Oxford, on the Third-haven, these deposites are known to be extensive. There is also good authority for stating, that in Caroline County shell marl is found and has been used. On the south bank of the Choptank River, at Cambridge, in the digging of wells, thick beds of shells have been penetrated; but, from all accounts, these lie commonly very deep. It may be proper too, to remark here, that extensive accumulations of oyster shells, which must not be cofounded with fossil shells, are met with on many spots. This is particularly the case on Chester River; where the laudable enterprise of an intelligent citizen has rendered them subservient to a great good, by burning them for lime. Similar accumulations exist on the Western shore of the Chesapeake Bay, and are no doubt the work of the aboriginal inhabitants of the country.

From these considerations it follows, that the prominent features in a geological map of the Eastern shore of Maryland, will be an exhibition of the various kinds of soil, circumscribed by accurate limits for each county, and of the extent of the whole shell marl deposites, so far as this can be ascertained; and a designation of such special deposites, as from their more accessible position and the nature of their contents, are adopted to afford the greatest advantage to the greatest number. The utility of a representation, in this manner, of the actual condition of the soil, and of the means of improvement which it possesses within itself, must be apparent to every one: the application of these resources is within the competency of every intelligent farmer.

Another geological feature of interest belonging to the Eastern shore of Maryland, and one which should be made of great prominence, is its extensive deposites of *bog ore*.—These are found to embrace a portion of Caroline county, the eastern part of Dorchester county, and a great part of Somerset and Worcester counties. As this ore of iron is of daily formation, being deposited from stagnant waters containing the oxide of iron, its beds may be said to be inexhaustible. It commonly yields from thirty to thirty five per cent. of metal, which, although brittle, has nevertheless a great range of application.

The ore is extensively worked at the Nascongo furnace, in Worcester county. On Barren creek, in Somerset county, it occurs in great abundance; and, as it has been found to be advantageously used with other ores of iron, it is thence sent to Baltimore and other places to be thus employed. The Barren creek springs, which yield chalybeate waters are said to have been at one time much frequented. They are now quite neglected; but a careful inquiry into all the advantages which they may possess, might possibly lead to the foundation of some establishments that would diffuse benefits over a considerable vicinage.

The great agricultural resources, which the beds of shell marl supply to the Eastern shore of Maryland, are, in a considerable degree, possessed by the lower counties on the Western shore of the Chesapeake, and on the Potomac River. The fossiliferous deposites available in this way, for this section of country, occur principally at Indian point, in Prince George's county, at Maryland point, in Charles county, and on the Saint Mary River, in Saint Mary's county. There is also a deposite of fossil oyster shells at Hog point, on the Patuxent; and the cliffs, between Drum point and Cove point, in Calvert county, present a vertical section of about seventy feet, consisting in the descending order of: 1st. Gravel and sand, fifty feet in depth. 2d. A bed of marine shells, in the upper portion of which the shells are firmly bound together by a ferruginous cement, and in the lower portion are imbedded in a blue clay: this bed measures upwards of ten feet. 3d. A tough blue clay, rising ten feet above the level of the bay.

The localities at Indian point and Maryland point are stated upon the authority of intelligent gentlemen, who have asserted the existence of shell deposites on those spots; but the deposite on the Saint Mary River having been examined by the undersigned with some care, they are enabled to specify some circumstances connected with it, of great interest, (it is thought,) both in a scientific point of view, and in consequence of the practical application which naturally, in those circumstances, suggests itself.

The deposite referred to occurs at the mouth of Saint Inigoe's creek, on the western side. It is overlaid by a bed of ferruginous sand, soil and gravel, about twelve feet thick. The shells are very abundant, and present a great variety of genera and species. They occur in a blue clay, and are associated with groups of crystallized *selenite*, which project from the bank through the clay from one to two feet above tide; or after high tide, having been washed out of the bank, are loosely scattered over the beach. This bed of clay contains likewise small pieces of *lignite*, nodules of *iron pyrites*, (sulphuret of iron,) and, whenever exposed to the influence of atmospheric agents, becomes covered with an efflorescence of copperas, (sulphate of iron.)

The formation of the *selenite* (which is the name given to the purest variety of a well known mineral employed in agriculture and the arts, as *plaster of Paris*,) merits consideration in a two-fold respect, scientifically and practically.

It is not difficult to account for the formation of this variety of plaster of Paris, under the circumstances which have just been stated to be peculiar to the locality mentioned. Selenite is a compound of sulphuric acid and lime. In the language of chemistry, it is a *sulphate of lime.* Its constituents occur abundantly in the bed of clay which has just been described—the sulphuric acid being derived from the decomposition of the iron pyrites and copperas, and the lime from that of the shells. Their spontaneous union, under a variety of favorable circumstances belonging to this locality, is explicable by the first principles of chemical science. Wherever the same conditions shall be found to exist, the production of selenite may be confidently expected. Accordingly, at Hog point on the Patuxent River, where a bed of clay occurs similarly constituted to that on the St. Mary, a like formation of the same substance is found to take place. From the relative position of the two localities, it is presumed that the bed of clay extends across a great portion of the peninsula of St. Mary's county, and may be looked upon as a natural manufactory, upon a large scale, of a mineral substance which can be rendered valuable in many ways. It may be proper, however, to add the remark, that these masses of selenite cannot be expected to occur throughout the whole bed of clay. They will be found only at its outbreakings, where the concurrent action of the atmosphere and of water will bring about the conditions necessary for their production.

The occurrence of *plaster of Paris* on the Patuxent, accords with an old tradition in Maryland. It is known, too, that the stucco employed in the State house at Annapolis, is made with sulphate of lime obtained from St. Mary's county. This fact had induced an enterprising agriculturalist from a neighboring state to make arrangements for proceeding to the discovery of some continuous deposite of the mineral. The enterprise was afterwards abandoned, in consequence of a pretended subsequent discovery, that this supposed plaster of Paris had been landed from a wreck of a vessel, coming from Nova Scotia with a load of this article. But the fact of the existence of selenite on the Patuxent and St. Mary, explains the origin of the tradition; and its employment to make the stucco of the State house illustrates one of its useful applications.

The quantity of the material which may be obtained from the sources just designated, although not very great, is still sufficient to answer many valuable purposes. Many cart loads are stated to have been collected, loosely scattered upon the shore, after heavy swells of the river or the violent washings of its banks by an agitated sea. The conjecture is thought a plausible one, that by removing the masses of crystals as they become formed, they would be replaced by fresh crops; and thus almost an indefinite quantity would be obtained. At all events, this portion of the geology of St. Mary's county deserves a minute and careful investigation.

Besides these deposites of fossils, which have been referred to as occurring in the lower counties on the western shore of Maryland, there are others, as at upper Marlborough in Prince George's county, where the banks on the western branch of the Patuxent, consisting of gravel, sand and clay, envelope masses of a *siliceous* incrustation, containing casts of marine shells. These masses of silicified shells are observed to rest on a deposite of sand and broken shells, made up of oyster shells, scallop shells, &c. A similar deposite occurs in the neighborhood of Queen Anne, and another which has already acquired some celebrity in the annals of science, is that at Fort Washington on the Potomac. But as the products of this last deposite are more especially interesting to natural history than otherwise susceptible of any useful application, it is not thought necessary to give a particular description of them at present. The undersigned, however, feel themselves bound in this place to acknowledge, in the warmest terms of gratitude, the polite attentions which they have received from Major Mason, of the United States' army, the commanding officer on the station.

They have, likewise, to return their thanks to Dr. Brereton, surgeon, U. S. army, on the same station, for specimens of various kinds of *clay* obtained from that neighborhood. A partial examination of these clays, led to the expectation that they might be advantageously used in the manufacture of pottery ware; and the result obtained by an intelligent manufacturer in Baltimore, to whom they were submitted for further and more practical examination, proves them accordingly to be excellent materials, which are extensively used in a very important branch of our manufacturing industry. Of the three varieties submitted to experiment, one was found to be a very superior material for the manufacture of the better sorts of stone ware, as well as for the ordinary pottery or earthen ware: the other two were of fair quality, and applicable to the making of common pottery.

The clay deposites, in the whole of that portion of Maryland designated as belonging to the tertiary order of geological formations, offer a subject of investigation of the deepest interest to several branches of the manufacturing classes of the state. This formation may be described as extending, so far as this state is concerned, over the whole eastern shore of Maryland, south of a line drawn from east to west through Cecil county, commencing at the Delaware line, passing a few miles north of Elkton, and terminating a few miles below Port Deposit on the Susquehanna. If the same line be continued from a point a little above Havre de Grace, on the opposite side of the Susquehanna, through Harford and Baltimore counties, with very slight deviations along the main post road to Baltimore, nearly the whole of the site of which it embraces; thence along the line of the Baltimore and Ohio Rail Road, to where it reaches the Patapsco; from this a little west of the Washington turnpike road, passing behind that city and terminating at the confluence of Rock creek and the Potomac, it will form the N., N. W., and W. boundaries of the portion of Maryland, on the western side of the Chesapeake bay, in which these *clay deposites*, varying in extent, in nature, and consequently in their susceptibility of application to useful purposes, will be found to occur.

The value of these deposites is already fully appreciated by those engaged in the manufacture of their contents. The *stone ware* of Baltimore is celebrated and largely exported. The clay of which it is made, is sent in great quantities to Philadelphia. The Baltimore *glazed ware*, yellow and black, is a highly prized article of commercial exchange. Our *common* pottery is no less extensively used. An estimate of *fifty thousand dollars* rather falls short of than exceeds the annual value of products in this branch of domestic industry; of which from fifteen to twenty thousand dollars worth is yearly exported.* The *common bricks*, and the *pressed bricks* of Baltimore which are the best made in the U. States, are likewise products of the domestic industry of Maryland of great value as articles of export. The *fire bricks*, which, so far as regards the U. States, are made exclusively at Baltimore, have been pronounced by competent judges, after repeated trials, to be fully equal, if not superior to the far famed Stourbridge bricks of the same nature. *Puddling clays* too, of an excellent quality, occur in several localities around Baltimore. Our manufacturing industry calls now for the discovery of those varieties of fine soft clay, which are used as substitutes for *whiting* in the manufacture of paper hangings, and of that purest variety of potter's clay, called *pipe clay*, which is used for the pots of glass houses, and is largely imported from Germany to be sent in great quantities to the west. Surely, where nearly all the other known varieties of clay are already found to exist, it may reasonably be expected that the research after the only ones of value remaining to be discovered will be crowned with success.

---

* No account is taken in this place of the *porcelain clay*, which there is reason to believe occurs in abundance, in the upper parts both of Cecil and Harford counties, because this mineral belongs to another order of geological formations.

Another variety of clay, of at least paramount importance to those which have been thus far considered, and which Maryland possesses in great abundance, is that which has been called *alum earth.*

The principal deposite of this very valuable material is on the northern shore of the Magothy river, at Cape Sable, in Anne Arundel county. A minute and very able account of this locality has been furnished by one of its original proprietors, Dr. Gerard Troost, at present officially employed as geologist for the state of Tennessee. This account is published in Prof. Silliman's Journal.* The general features in the geological constitution of this spot, are the following, in a descending order:—

1.	Sand, from - - - - -	20 to 30 feet.
2.	Ferruginous sandstone, - - - -	1 to 2 "
3.	Copperas ore, (*iron pyrites,*) - -	1 to 2 "
4.	Alum earth—clay embracing iron pyrites and lignite, - - - - - - -	7 to 10 "
	This stratum is very irregular in its inferior line of separation. It rests upon	
5.	A stratum of ferruginous sandstone, - -	1 to 2 "

which, if accidentally penetrated, admits the flow of water from beneath in such abundance, as to put a stop to any further excavation.

The value of the *alum* obtained annually from this source is estimated at *seventy five thousand dollars,* and that of the quantity exported out of the limits of the state at *sixty five thousand dollars.*

As stated above, this alum earth is associated with a bed of *copperas ore*—the annual product of which has been ascertained to amount to *six thousand dollars*; of which one half is exported. This same ore of copperas, as it is termed, which chemists describe as a *bisulphuret of iron,* occurs in many other situations throughout the district of country which is now being reviewed. It has been found in Cecil county; it occurs on the shores of the Round bay, in Anne Arundel county; and at Oxen creek in Prince George's county, it was observed under circumstances leading to the suspicion that there may exist in that place a formation similar to the one at Cape Sable.

Associated, also, with the clay deposites, are found abundant formations of two varieties of iron ore, which, as they are but seldom used for the extraction of the metal, may be properly mentioned here.

---

* Vol. iii. p. 8.

These two varieties of iron ore, are the *ochrey red oxide of iron* (red ochre) and the *ochrey brown oxide of iron*, (yellow ochre.)

The estimate of the value of red and yellow ochres produced at Baltimore and exported, exceeds two thousand dollars a year. By the production of these articles within our own limits, the importation has been entirely excluded; and the domestic articles are now furnished at one half of their former prices.

But a still more valuable constituent of the tertiary formation of Maryland is the deposite of those ores of iron which are used for the extraction of the metal. Notice has alreade been taken of the *bog-ore* of the Eastern Shore. The same variety is found on the Western Shore, as in the neighborhood of Queen Anne, in Prince George's county, &c.

Those kinds of iron ore, which are the most valuble are described in systematic works under two specific heads; namely, *carbonate of iron* and *brown oxide of iron.* The varieties, included under these two heads, occur throughout a broad belt of country comprising the upper limits of the tertiary formation, where it is associated with a coarse gravel, ferruginous sand, transported boulders and blocks—constituting what in some systems of geology is termed the *Erratic block groupe*, and which with us is found to rest immediately upon the *primitive* or *primary rocks.* These ores of iron (usually but improperly classed among the *argillaceous oxides of iron*, that belong to another epoch) are found occurring in nodules of an oval or spherical form, sometimes kidney-shaped, and composed of concentric layers. The nodules frequently embrace a nucleus, differing in density and color from the exterior layer. The texture of this exterior layer is compact, but its density diminishes towards the centre, and while its color is commonly dark brown, that of the central portion is light approaching to yellow. The technological terms applied to these varieties of iron ore are *brown ores* and *hone ores*—names which have reference to their physical characters.

All these ores belong to the mineralogical species, *carbonate of iron.* But when the nodules contain cavities, as they frequently do, these are lined with minute crystals of a rich velvety aspect; which are *hydrated oxide of iron*, a variety of the species *brown oxide of iron.*

They are ranked among the best ores of iron—working easily and yielding an average of metal from forty to fifty per cent. A celebrated deposite of them is in Prince George's county at *Snowden's* *mine bank*, situated on the east side of the Washington Turnpike, near the twenty-first mile stone, and about half a mile from the road. The ore was formerly extracted from this bank in large quantities, as is evident from the excavation—but the mine is now totally abandoned and serves as a mere *lick*, to which the cattle of the neighboring country are attracted by a singular efflorescence within of *sulphate of magnesia*.

At the head of deep run, which empties into the Patapsco, seven miles from Baltimore, ore of a good quality is raised for the use of the Patapsco furnace. The furnace at Curtis's creek is fed with ore of the same nature, principally from its own neighborhood; and in the immediate vicinity of Baltimore, where it occurs in abundance, advantage is taken of the facilities of the rail road to convey it to the water side, whence it is exported to New Jersey, and there exchanged for bog-ore.

On the falls of the little gunpowder, at Joppa, and near Abingdon, in Harford county, there are extensive deposites principally of that variety called in the arts *brown ore*, which is of the best quality. Along Bush river in the same county, the best quality of *hone ore* is raised. This latter variety is a mixture of *carbonate* and *oxide of iron*, and is said to produce the best foundry iron. Hone-ore, generally yields a more valuable metal for castings; while the brown ores furnish the best forge-pigs. The furnace of Bush creek is in part fed with these ores. Others, with which it is supplied from the upper part of Harford county, will be described hereafter, but it may be proper to mention here, that associated with what is obtained from Bush river, there is a mineral, apparently a *ferruginous jasper*, which by some iron masters has been termed *flint ore*. This is not an ore of iron; but, on the contrary, is a pernicious article when suffered to go into the furnace.

Such are the principle known localities of iron ore in this section of the state of Maryland. There are doubtless others of equal extent and value; and it is known that ores of inferior quality, but answering admirably when mixed with the richer refractory ores, also abound. It is not deemed necessary to specify these at present.

Besides all of these, however, which have just been briefly described as belonging more immediately to the tertiary formation; there is found in its upper limits among the erratic material with which it is associated and occurring very often in very large masses, another variety described mineralogically as *hematitic brown oxide of* *iron.* The forged iron from this ore is commonly found to be hard, and very malleable, and has been used to furnish steel. It was formerly worked at the furnace known as Ridgely's furnace on the falls of the great gunpowder.

The whole amount of iron produced annually in the state of Maryland has been estimated at 5800 tons—valued at about $400,000; and it is thought that one half at least of this quantity is derived from the sources which have so far been enumerated.

From all these considerations, the undersigned are of opinion, that further researches into the mineral constitution of the portion of our state which they have so far passed in review, cannot fail to bring to light new sources of wealth as well as to extend the operation of those that are already known; whilst they remain persuaded that where so many important interests are subserved, great and lasting benefits must accure to the community at large.

The undersigned will now proceed to state the results of their observations on other parts of the state.

The second great division of Maryland, which may be made for the sake of convenience in its geological examination, will embrace that portion of territory lying between the line already defined, as limiting the upper part of the tertiary formation, and another drawn through the state from N. E. to S. W. passing along the summit of Parr's spring ridge, and coinciding nearly with the western limits of Baltimore, Anne Arundel, and Montgomery counties. This division will thus comprise the upper part of Cecil county, the greatest portion of Baltimore and Harford counties, the upper districts of Anne Arundel county, and the whole of Montgomery county. Its geological characters, are that it consists of stratified rocks, varying in mineral composition alternating with each other, and sometimes passing one into another, in such a way as to render it very difficult to affix definite names to their different mixtures. When any of these rocks are viewed singly, they will rarely be found to present a simple mineral substance, constituting a large tract of country. They are, on the contrary, admixtures of several minerals and earths; the principal of which are, quartz, felspar, mica, hornblende, lime, magnesia, talc, &c. and according to the nature of their aggregation, and the predominance of one or the other, the rocks themselves are described in the systems by different names, is granite, gneiss, mica slate, hornblende rock, limestone, magnesian limestone, serpentine, steatite (soapstone,) &c. These rocks are generally *metalliferous*, and, as a groupe, are usually called *primitive* or *primary* rocks.

If, first, we inquire into the nature of the *soil* by which these rocks are covered, it seems proper to base this inquiry upon the consideration that the soil (so far as its mineral constitution is concerned) is produced by the disintegration of the rock which immediately underlies it: whenever observed to be otherwise, it is presumed that it will always be found to have arisen, either from the circumstance of an encroachment of the tertiary formation upon the primary, or from partial transportations of soil from one spot to another by causes always appreciable. This view it is deemed important to take, as the only one calculated to lead to any general and positive results of value to agriculture. Thus every farmer in Baltimore county is aware of the higher estimate which is put upon the *red soil* of some districts, than upon the lighter colored soils of an adjoining one. Now, the *red soil*, as it is termed, is known to be produced by the decomposition of that variety of rocks, called *hornblende rock;* while the adjoining soil is derived from some other of the granitic aggregates. On the other hand, those portions of the same county that are designated as *barren*, are equally well known to occur principally among the *magnesian* and *talcose rocks.* Generally speaking, then, the mineral constituents of these soils will be found to correspond with those of the rocky strata beneath them. Although it is a remarkable fact in relation to the *limestone soil*, that its constituents do not indicate it to have been produced solely by the disintegration of the subjacent rock. Still however, the *limestone soil*, like the other soils that have been mentioned, is peculiar, and it is uniform, as regards superposition upon *limestone rock;* and as it shews no evidence of having been transported, must be classed among the primative or original soils, whatever may have been the circumstances, hereafter to be discovered, that have occasioned its production.

If this view of the original constitution of the soils lying over the primary rocks be a correct one, and it is confidently believed to be so, it follows, that the first step to be taken by which to serve the agricultural interest of this portion of our state, is to discover and to establish the nature of each geological formation within it.

It is also a matter of interest to the farmer to know the *limits* of these formations. It interests him for example, to be made acquainted with the nearest spot from which he can derive his material for obtaining *lime.* Yet, even as regards the *limestone formation*, its limits have not been satisfactorily determined. From this circumstance, much inconvenience and disappointment have already arisen. Thus, the search after limestone is, at this time, anxiously kept up in many places, where it is possible, but barely possible, that it may be found; and it is also pursued in other localities, where it is not at all likely to occur. The aid of science is therefore required to hasten the fruition of any well founded hopes of this kind, as well as to remove the injurious tendency of fallacious expectations that ought no longer to be cherished. Already, but only within a short time, limestone has been found near Bell-air in Harford county. The excavations for the Baltimore and Ohio rail-road have exposed it in some parts of Baltimore county, where previously its existence was only suspected; and in some portions of Anne-Arundel and Mountgomery counties, on the Patuxent, the inhabitants have lately enjoyed the means, by its discovery in their neighborhood, of supplying themselves with a subtance long earnestly desired, whose anticipated benefits they are now realizing. It is in this way, that by bringing to light new resources, new incentives to industry are created, the happy effects of which become in a short time apparent in the generally ameliorated condition of a large tract of surrounding country.

Before leaving this subject it may be stated, that the amount of lime, according to the inspections for the year 1832, which is annually brought to the city of Baltimore and applied to various purposes, is *one hundred and sixty one thousand and one hundred bushels*, to which, if there be added about an equal amount consumed in the country principally for the use of the soil, it may be made out, that this formation of limestone actually yields to the commercial and agricultural interests of Maryland, a yearly income of one hundred thousand dollars.

The other formations in this district would be found to yield, in proportion to their extent, perhaps larger returns. This is the case with the *granite formations*; whilst on the other hand, the *soapstone* formations, although not so extensively employed, are known to furnish a material of great value for the construction of hearths for furnaces and fire places, for the making of stoves, &c.

The next step in the progress of inquiry, which the undersigned beg leave to recommend, would be, to indicate the localities of mineral deposites that are already known, or which in the course of examination might be discovered, to furnish materials for our *manufactures*. It would be necessary also to indicate the *value* of these materials in reference not only to their comparaive qualities, but likewise to their precise nature. As an instance of the importance of the latter consideration it may be stated, that it has been found a matter of great moment to have ascertained the presence of a foreign metal in the rich iron ores of Deer creek, in Harford county. This ore which contains from eighteen to twenty per cent, of the metal Titanium, and is hence called *titaniferous iron ore*, was found, in consequence of this admixture, to be exceedingly refractory. It connot in fact, be smelted by itself; but requires to be mixed with some poorer ores before it can be made to yield its metal. Experiments directed by science have shown, that by mixing it, in the proportion of two parts to three, of an ore yielding thirty three per cent. of metal, it may be very readily worked. Similar considerations apply to those varieties of ore which, for the sake of distinction, might be called *calciferous iron ores*; and which for a long time were thought to require the addition of limestone, as a flux; these, likewise, experience has proved, not, however, until after considerable expenditure of time and money, to be perfectly manageable without it.

To be able to specify those different kinds of ore in the manner now indicated, it is evident that it will be frequently necessary to subject them to careful chemical analysis. The advantages, which those who have to use them will derive from such a specification, it is presumed, must be apparent. Nor do these considerations apply with less weight to the varieties of ores of iron which are not used for production of the metal. Among them, the chromiferous iron ores, which furnish a substance employed in a different branch of our manufacturing industry, require a separate mention. These, more usually called *chrome ores*, are known to be extensively employed for the production of several articles used as *pigments* and *dyes*. The value of the products annually obtained from this source is not less than fifty thousand dollars. The ore itself, too, is exported, and is understood to be in demand at the present time for the supply of foreign countries. The chief localities in Maryland are Harford county, Cooptown; Baltimore county, at the Bare hills, seven miles from the city of Baltimore, and at the Soldier's Delight, seventeen miles distant, and the northern part of Cecil county.

The *serpentine formation*, which encompasses the chromiferous iron ores, yields also another material for the preparation of a chemical product of great value. This is the *epsom salt*, the base of which is derived from a *magnesian* mineral, no where found in such abundance and purity as within the state of Maryland. The quantity produced annually, is eleven hundred thousand pounds; valued at forty five thousand dollars; the exports are valued at forty thousand dollars. It is believed that the production of this article in Baltimore has entirely superseded the necessity of its importation for any portion of the United States, and has also greatly reduced its former price.

Still another substance, doubtless about to prove, ere long, a source of considerable revenue to the counties where it occurs, has been already alluded to as having been found in Cecil and Harford counties. It is the mineral commonly called *porcelain clay* or *porcelain earth.* This material is regarded as proceeding principally from the natural decomposition of the coarse grained granite, a very common rock in the state of Maryland.

For the porcelain works at Philadelphia, it is derived, almost exclusively, from the neighborhood of Wilmington in Delaware; but an analogous formation was observed in Cecil county, eastward of the Big Elk, in the vicinity of the stopping place known as Dysart's. The mineral, called by mineralogists *Kaolin,* is here well characterized, and is believed to occur in quantity; and as the undersigned know that demands for it have lately been made in Baltimore, they would indicate this locality as one likely to afford a supply. To the inhabitants of the county, it is well known as what is not unfrequently mistaken for limestone. Specimens of *Kaolin* have been sent from Harford county also; but the exact locality has not been ascertained. The undersigned have likewise noted its occurrence on the route of the Baltimore and Ohio Rail Road, between Ellicott's Mills and Mariottsville.

Resuming now the consideration of the most prominent circumstances in the geology of that section of our state, which comprehends the primitive or primary rocks, and specifying the share of interest which belongs to each county within it; it will be seen that,—

Cecil county possesses in her porcelain earth, an article of exchange likely to become soon of considerable value. The magnesian earths, and chrome ores abound towards her north western limits. The granite formation at Port deposit is well known not to yield in value and importance to any in the state. To complete her advantages, and to supply proper mnterials for the industry of the agriculturists of the upper portion of the county, there seems to be wanting only a discovery of limestone, if not within her boundaries, at least at a more accessible distance than it is now known to exist.

Harford county possesses *limestone rocks;* but it is very necessary that their extent and comparative value in the production of *lime* for agriculture, be determined correctly. She has *soap stones;* and her limits extend to the *slate formation* on the Susquehanna. Her iron ores are of very rich quality. The *chrome ores* and *magnesian earths* exist in abundance; and *pyritous copper*, occurring with the chromiferous iron ores, has been found near Cooptown.

Baltimore county presents nearly the same mineralogical constitution as Harford county. Her limestone formation furnishes the greatest proportion of the lime embraced in the estimate given on a preceding page, of the quantity annually inspected and consumed; while it is likewise extensively quarried for marble, which is obtained of a fine quality for most architectural purposes, and is used also for the more ordinary kinds of statuary. The mineral called *graphite*, which is a mixture of carbon and iron, but is better known under the improper name of *black lead*, has been observed on the gunpowder. *Sulphuret of molybdenum*, also, which yields an acid that in combination with the oxides of some other metals produces salts of lively and permanent colors and capable of being applied in the art of dyeing and of painting on porcelain, occurs in this county, but to what extent has not yet been determined. The same uncertainty rests on the occurrence of *lead* and of *zinc*, which has been by some confidently asserted.

Anne-Arundel county supplies the porphyroidal granite, now so generally employed for the embellishment of Baltimore city. Several localities of other varieties of this rock, which it would be superfluous to mention at present, have been observed on the line of the Rail Road, along the Western branch of the Patapsco, and the decomposition of that variety of the same rock known to mineralogists as *graphic granite* offers, as was already stated, situations where the material for the manufacture of *porcelain ware* may be confidently expected to occur. The limestone formation has been also ascertained to extend through a portion of this county: and much of the *soap stone* used in Baltimore is derived from Elk Ridge.

Montgomery county might supply the latter article, of better quality, from the Patuxent; and finally, this county, possesses, besides the more usual concomitants of the primary rocks, a formation of *Manganese* ore, occurring, so far as known, principally in the neighborhood of Mechanicsville.—It has been thought, too, that a portion of this county, between Sandy spring and Rockville, presents some analogies in mineral constitution with the gold districts of Virginia. The undersigned can only say, that in the rapid reconnoissance which they were enabled to make of this part of our state, they have not seen the least indication of the presence of this highly prized metal.—Three miles westward of Rockville, there is a serpentine formation, which in a systematic plan of examination, it would be necessary accurately to define. Beyond this the geological character of the country changes. *Slate rocks* make their appearance, and at the mouth of Seneca creek, the quarries of beautiful *freestone*, which the facilities of the Chesapeake and Ohio canal permit to be brought to such profitable account as a building material, exhibit the mineral connection of this portion of Montgomery county with another geological division of the state of Maryland.

This division, the third in the order of this Report, will coincide with the limits of Frederick county. In its mineralogical and geological relations, it is intimately associated with the preceding division, which has been previously stated to consist of primary rocks. At its eastern boundary it commences with the *clay slates* and *chlorite slates*, usually classed among the primary rocks. With these it passes insensibly into that series of rocks described in systematic works under the head of the grauwacke groupe and from these again to the red sandstone, and carboniferous groupes.

In a scientific point of view it would be a matter of great interest to assign the precise line of demarcation between these different groupes of rocks: while the practical application of the result would also prove of importance. The task however, is not an easy one, owing to the fact already mentioned, of the very gradual passage of one series into the other; nor for present purposes is it required.

This division, then, viewed generally, may be described as consisting of large stratified masses of arenaceous and slaty rocks, intermixed with deposites of limestone and conglomerates of considerable extent. Many of the rocks embraced within it are *metalliferous.*

Among the arenaceous rocks which it comprehends, there is an abundant supply of excellent building materials—rendered now available in the facility of transportation by the Chesapeake and Ohio canal. It is not necessary to indicate more than a few localities.

The quarries of white and colored *sandstone*, at the foot of the south western slope of the Sugarloaf mountain, may be said to rival, in the beauty of their materials, those already mentioned, as occurring near the mouth of the Seneca. The splendid aqueduct over the Monocacy is constructed of the freestone, quarried at the foot of the Sugarloaf mountain.

The conglomerate, so well known as the *Potomac breccia marble,* occurs along the river side, commencing a short distance above the mouth of the Monocacy and reaching nearly to the point of rocks. This formation extends along the valley on the eastern side of the Catoctin mountain, to within two miles westward of Frederick town. It is there contiguous to the *red sandstone* and *blue limestone,* by which it is displaced; but it re-appears in a distance of fifteen miles, near Mechanicsburg.

The slaty rocks of the present division, which occur east of the Monocacy within the limits of transition from the primary to the groupe of arenaceous rocks, cannot, under existing circumstances, be said to offer any consideration of much moment. Quarries of roofing slate, however, have been opened in several spots—on Bush creek adjoining the line of the Baltimore and Ohio Rail Road; in the neighborhood of Unionville, &c. &c.

The results of a minute geological examination should, no doubt, exhibit every circumstance of any consequence growing out of the mineral constitution of the country, but there are particular spots giving rise to considerations of such superior interest, that, in a general reconnoissance, the attention is forcibly directed towards them. This is the case with that portion of Frederick county, which may for distinction's sake be called its *metalliferous region,* lying east of the Monocacy and extending between Bush creek and Piney run. The metals that occur within it are copper, iron, lead and manganese.

Veins of copper ore had, from a very early period in the settlement of our state, been traced through many portions of the country. Upon our oldest maps is found indicated the existence of a copper mine near the Monocacy, between Piney run and Pipe creek. And more recently, the ore has been largely extracted between Liberty-Town and Woodsborough. In fact, it has been observed in all directions, and may be said to exist throughout this region. It occurs in the neighborhood of New Market, associated with an ore of *manganese;* on the Linganore in various places; and in the vicinity of New London on the New Market and Liberty road. But its principal deposites appear to be between Woodsborough and Liberty Town.

The more important veins of the ore, so far discovered in the last named locality, are in limestone. They consist principally of that variety called the *sulphuret of copper*, which is known to be the best of copper ores; for it requires but two simple operations to reduce it to the metallic state; whereas the English and South American ores require from eighteen to twenty distinct meltings. The veins have been pursued with great industry to a considerable extent, and ore to the amount of several hundreds of tons has been extracted from them. But, notwithstanding the judgment displayed by the proprietors of the mine so long as the works were in operation, the undersigned are of opinion, from a careful examination of the spot and of the surrounding country, that operations have thus far been carried on in straggling veins only; while the main body of the ore, whose existence is hardly to be doubted, has not yet been reached.

The only application, at present, made of the mineral resources of this spot is to produce a *sulphate of copper*. This salt, the blue vitriol of commerce, is obtained from a material known in the country by the name of *black earth*. It contains from 5 to 20 per cent. of copper mixed with iron, manganese, and earthy matter in very variable proportions. It has been observed in several spots around Liberty, appearing on the surface of the soil. The quantity of blue vitriol annually manufactured from it in Baltimore, has been ascertained to exceed fifty thousand pounds.

Should subsequent researches however, as there is every reason to expect, open for use the larger and more convenient deposites of *copper ore* than those already worked, another object of application is already at hand from which almost incalculable wealth might be reasonably supposed to accrue to the state and to its citizens. This is in the manufacture of sheet copper. Made almost exclusively now of materials from South America, the Baltimore sheet copper has acquired reputation in foreign countries. The undersigned need not suggest how much more advantage might be realized through various classes of the community from a more economical material within our own limits.

As to the other metals that were named as occurring in this region of Frederick county, the *iron ore* observed in the vicinity of New London, has been found to be of that variety called *specular oxide of iron*, generally considered as a valuable and profitable ore, and yielding iron of excellent quality. The occurrence of *lead* was discovered some years back at Unionville, in a vein of galena running through limestone: but, although it is reported, to have been pursued for a short distance with very fair promises, it was not continued. The shaft having been filled up previous to the arrival of the undersigned upon this locality, they are not able to form any opinion as to the importance of the vein from actual observation; but they may venture to state, that it is very desirable it should undergo a careful examination. *Manganese*, as already stated, occurs near New Market.

In addition to these metallic ores, the same region might be made to furnish *marble* of great variety and beauty. Already, at New Market, a fine grained dove colored marble, capable of receiving a good polish, has been quarried; a red and white marble occurs near Liberty; and a similar variety was formerly quarried to some extent on Sam's creek.

Upon the whole then, the undersigned have no hesitation in expressing their opinion that in the event of a geological examination of Maryland, the district of country which they have just briefly described, would be found not to yield in interest and in importance to any other part of the state.

Fredericktown valley, so beautiful in its position, and so rich in agricultural resources, is thus bounded, on its eastern limits, by a country full of interest in a mineralogical and geological respect. Its western limits will be found to include a full share of the same kind of interest.

Commencing at the extreme northern end of the Catoctin range of mountains, there is observed in the first place, a recurrence of those mineral aggregates more commonly described as belonging to the primary groupe of rocks. They consist of *epidote*, *chlorite*, *amygdaloids*, *serpentine*, and granular *limestone*. The summit of the ridge is, in a great portion of its extent, crowned with a *sandstone*, characterized as very compact, exhibiting occasional small cavities lined with drusy crystals of quartz, and crossed by siliceous veins, which indicate the age of the formation, as among the oldest in the transition groupe at least. It is found, not unfrequently, to form the gangue in which are imbedded various metallic substances, such as *native copper*, *pyritous copper*, *specular oxide of iron*, *&c.* This sandstone is exceedingly well adapted for use as a building material: it might also be employed for mill stones; and ere long will doubtless render a full amount of service in these ways.

The geology of the Catoctin range, in a scientific respect, will require a very special investigation. The existence of a serpentine rock at its base, as observed at the foot of Mount Saint Mary's, must be regarded, to say the least of it, as a very unexpected occurrence. This serpentine rock, which from the peculiar nature of the country, covered as it is with a heavy growth of forest trees and with loose materials detached from the superincumbent rocks, could have been discovered only by accident, has been exposed to view by the sinking of a shaft, the work of some vissionary in search of the precious metals. It is traversed by veins of specular oxide of iron associated with quartz, and in some places by thin veins of *calcareous spar*. Pieces picked up among the materials raised from the shaft, exhibited perfect specimens of *verd antique*. Should the pieces of granular limestone, which were shown as occurring in the same vicinity, belong to some continuous formation of this rock, there is very little doubt, that at its junction with the serpentine, a quarry of the highly prized and very ornamental marble just named might be opened with success. But the only mineral production of the Catoctin Mountains, that has so far been put to any profitable use, is the *iron ore*, which may be said to occur along the whole length of the mountain range towards the foot of the eastern slope. By its mineralogical character, it is referable to the variety *hematitic brown oxide of iron*. On Hunting-creek, at the Catoctin furnace, where it is extensively worked, it is associated with *phosphate of iron;* yet it yields a metal exceedingly well adapted to the casting of hollow ware, to which use it is principally applied by the intelligent proprietor of that extensive establishment. A similar ore is found, and was formerly abundantly raised, in the vicinity of the Point of Rocks.

Much anxiety has been felt and great interest excited about the possible occurrence of *coal*, either of a bituminous character, or as *anthracite*, in the Fredericktown valley. Search has been made after this substance in various places, some of which the undersigned have had an opportunity of visiting; but so far as it can at any time be deemed prudent to come at positive conclusions from observations which were necessarily only superficial, they must report that they have not been so fortunate as to perceive the least evidence of the certain existence of this very desirable mineral in any plaee within the valley of Fredericktown.

At the Yellow Springs, on the head waters of the Tuscarora, there are appearances which would justify a more thorough examination of the spot, than it is known to have already received. But even here, the occurrence of coal is a bare possibility, predicated solely upon the presence of a deposite of *shale* containing vegetable matter, and overlaid by a conformable deposite of grey sandstone, (*psammite* of Brongniart; *gres houiller* of the French,) in horizontal strata. These are doubtless usual accompaniments of coal, but it does not necessarily follow that where they occur, coal will always be found.

Anthracite has certainly been discovered on the Monocacy, not far from Pipe creek, in a vein running through the red sandstone. The vein is represented, however, as not exceeding one or two inches in thickness. In the sandstones at the mouth of the Seneca, the undersigned detected, also very slender veins of the same mineral, together with a few vegetable impressions. But these indications only prove that the formations in which they are observed, are not uncongenial to the existence of that variety of coal.

The only part of the third geological division of Maryland that remains to be mentioned, is the valley of Middletown, in the fork of the Catoctin and South mountains. In the beauty of its position and the value of its agricultural resources, it rivals the valley of Fredericktown. In its geological constitution, is is found to consist of the slaty and arenaceous rocks. The undersigned regret that they have as yet had no opportunity of examining its mineral resources. *Pyritous copper* is said to occur near Middletown; but under what circumstances, and to what extent, there has been no means of ascertaining.

The fourth geological division of Maryland falls now to be considered. It will be made to embrace the whole of Washington county, and a part of Allegany county, as far as Cumberland. In its geological structure, it consists chiefly of the slaty and arenaceous rocks of the transition series, and of the limestone so well characterized by the occurrence of *caverns*, and hence called cavernous limestone. There are however found occasionally, other rocks containing the impressions of shells, which afford evidence of a more recent origin. The whole system of formation in a word, gradually, but more evidently than in the preceding division, approximates to the *carboniferous groupe*. The soil which covers these formations, is remarked to be not so deep as in the neighboring vallies, but is very productive; and the basin of which Hagerstown is the centre, between the South and North mountains, together with the smaller vallies beyond, as far as Hancock, are decidedly among the most fertile portions of the state. But to return to its mineralogical constitution.

On the western slope of the South mountain, the *epidote* rocks and *amygdaloids*, are again met with; but in descending into Pleasant valley, which lies between the mountain and a more limited range of hills, known as the Elk ridge, there is observed a formation of limestone, from which *statuary marble* of superior quality, has been obtained. The principal quarries of this marble, are in the vicinity of Boonsborough. At the debouche of this valley, there is an extensive deposite of *iron ore*, which in its chemical composition is analogous to that described as occurring on the eastern slope of the Catoctin, but it is free from *phosphate of iron*. It is technologically termed *pipe ore*, and sometimes *limestone ore*, from the circumstance of its usually occurring in that rock. The metal obtained from it is of excellent quality, and well adapted to the making of bar iron. The Antietam Furnace is in part supplied with this ore from a place two miles above Harper's Ferry on the Potomac and Maryland side of the river, and from a similar deposite on the Virginia shore, about six miles above the ferry. The same ore again occurs in the northern portions of the West slope of the South mountain.

The other notable localities of *iron ore* within the limits of this division, are on the eastern slope of Sideling hill, beyond the Conoloway. It is there associated with manganese.

Williamsport, situated near the confluence of the Conocoheague and the Potomac, has been frequently indicated as the centre of a district, in which *anthracite coal* might confidently be expected to occur. The undersigned are not aware of the grounds upon which this assertion has been made. As was stated in regard to certain parts of Frederick county, there is nothing which absolutely forbids it, but neither is there any thing which in their knowledge indicates it. The known region of anthracite, supposing it necessarily to extend from Pennsylvania through Maryland, would not be found to correspond with this portion of our state; it would rather strike farther west, between Hancock and Sideling hill. The undersigned have not been wanting in endeavors to impress this view upon the minds of those of their fellow citizens, who seemed to take especial interest in the subject; and a confirmation of their opinion, they think, may be found in the recently reported discoveries of coal on Sleepy creek, in Virginia.

It has been said that the line of the Pennsylvania anthracite deposites would, if continued, strike in this division near Hancock. No such continuation has been observed; but yet the geological interest of this part is fully kept up, amid the more evident indications of an advance upon the carboniferous groupe. The slaty, arenaceous and limestone rocks of this region, contain also numerous impressions of testaceous and crustaceous animals. But between these indications merely, and the coal formations properly speaking, there intervenes a mountainous district, which from its peculiar circumstances, and the shortness of the time allowed for the examination, the undersigned have not yet been able to examine. The only subject of interest which fell under their notice, is the occurrence of *mineral springs.* There can be little doubt, considering the healthfulness of the country in which they are situated, with the grandeur of the mountain scenery around them, that very soon they will induce near them, with advantages that cannot be excelled, the establishment of places of public resort, during the heats of summer, similar to those already successfully founded in neighboring states. Most of the springs being strongly impregnated with *sulphuretted hydrogen*, are of the kind known as *sulphur waters.* They have been met with in several places, but the only one which has as yet been brought into extensive use is that at the foot of the Warrior mountain on the Flintstone. This spot has moreover other attractions. It is a richly cultivated basin-shaped valley of moderate extent, through which flows the small stream, called the Flintstone. A portion of its waters run along the base of the Warrior mountain; but much the larger part passes through the mountain and issues from its opposite side. There is no doubt from this, of the existence of a large cavern under the mountain, which is composed of that variety of limestone already designated as cavernous.

Warm springs occur on the south side of the mountain; but in consequence of their present neglected state, their natural temperature could not be ascertained.

The fifth and last geological division, which it is deemed expedient to make, comprehends the remaining portion of Allegany county westward of Willis' creek. Some general remarks concerning this very interesting part of the state, comprising its deposites of *bituminous coal*, and the *iron ores* frequently associated with them, will conclude what the undersigned have to report on the geology of Maryland.

The carboniferous groupe of rocks, forming the most prominent geological feature of Allegany county, consists principally of beds of *sandstone, slate, shale,* and *coal,* irregularly interstratified; besides which, it embraces formations of *red sandstone*, *whinstone* and *carboniferous limestone;* and, what is of more importance, considerable deposites of *iron ore.*

In reference to the agricultural resources of the coal districts, which may be described as hilly, it is found that the soil upon them being a mixture of decomposed slate and limestone with sand, it is in general very fertile, and yields abundant crops of grain, principally *oats*, of a very superior quality. Within a few years, the cultivation of the tobacco plant has been commenced, and in the newly cleared lands, is produced the bright leaf staple, which always commands a high price.

The more mountainous districts, above the level of the coal formation, present broad vallies bearing every evidence of having formerly been the beds of extensive lakes now dried up or drained; the waters of which have left behind them, deep deposites of clayey loam. These beautiful tracts of country, have received the name of *glades.* From their elevated position and their constant moist condition, they form very productive meadows and the most luxuriant pastures. The mineral resources of the coal districts, it would be folly to attempt to estimate. That district alone of which Frostburg may be assumed to be the centre, is represented as "bounded by the Savage mountain on the west, extending from the west branch of Will's creek to the Savage river, and by the same mountain, continued south west to the head branch of the Potomac: and on the east by the little Allegany, Piney mountain, Dan's mountain and the same mountain continued into Virginia to the upper branches of the Potomac. The space between the two ranges of mountains, is from five to seven miles, and sixty miles long; making a surface of near four hundred square miles, over a great part of which coal is known to abound."

The thickness of these beds of coal, varies from three feet to fifteen feet. The following account of three coal deposites, two at Westernport, and one on the Potomac a little above the mouth of Savage, will exhibit the more striking appearances of these coal strata: preference having been given to these localities over those near Frostburg, because it is believed they have not been elsewhere described.

The first deposite at Westernport, known by the name of Murphy's bed, is situated on the eastern side of George's creek and northwestern slope of Dan's mountain; its elevation above the Potomac is one hundred feet; the thickness of the bed is three feet, and it is overlaid by sandstone. The second deposite, also at Westernport, called Paris's bed, is on the western side of the creek and eastern slope of Savage mountain, its elevation above the river is one hundred and thirty feet; the thickness of the bed five feet, and this is covered by shale and slate.

The third and most extensive deposite is that at Brant's mine. There are in this place five distinct beds: the lowest corresponding, it is thought, with Murphy's bed; it is covered by sandstone: the second, which is thirty feet higher, is covered by shale; it probably corresponds with Paris's: the depth and elevation of the fourth bed could not be ascertained: and the fifth bed which is at an elevation of nine hundred feet above the river, is fifteen feet thick. This important deposite is on the Virginia side of the Potomac, and forms the north slope of what is termed the New creek ridge. The precipitous nature of the mountain slope, allows the discharge of the coal, by means of a slide, from each successive stratum into the very bed of the river below.

A very satisfactory account of the coal mines in the immediate vicinity of Frostburgh, is furnished in the collection of reports and letters of the engineers of the Chesapeake and Ohio Canal Company, from which the extract above, referring to the extent of this deposite, was also taken.

"In the hills and valley, three distinct beds of rich bituminous coal are frequently opened. The first or lowest is near the base of the hills, and is from two and a half to three and a half feet thick. This was first discovered, and opened about twenty years ago by Mr. Rizor, and the coal was held in high estimation for many years, until the richer beds were discovered. The second bed is from eighty to one hundred feet higher in the hills; and is from four to six feet thick. The third and most valuable mass is found nearer the summit of the hills and the upper parts of the deep vallies. This bed is from eight to ten feet thick and like those below, is between strata of rock. The bed on which the coal rests, and the roof which covers it, are of slate with a great mixture of coal: but the coal diminishes and the slate prevails for three or four feet in thickness. This often gives the mine an appearance of uncommon depth until it is thoroughly opened. But in those mines which are worked to any great extent, the bed of pure coal is about eight feet thick, subdivided horizontally by three or four very thin veins of slate, seldom more than half an inch thick. Next above the slate roof is sandstone in thick layers and often of a quality suitable for the various purposes of freestone in building. A preference is given to those mines that lie deep, which are in a moist situation, and have a considerable height of hill over them: the coal from such mines, being more pure and solid, is quarried in much larger blocks, and is much less liable to crumble and waste in handling, than that from mines situated so near the top of the hills as to be too dry and to have but little depth of earth over them."—pp. 93, 94.

The analysis of a specimen of the coal from the large bed, known as Frost's mine, about half a mile southwest from Frostburg, gave the following results:—

Carbon,	70.
Bitumen,	20.5
Earthy matter,	6.
Water,	3.5
	100.

It is thus shewn to be of that variety distinguished mineralogically as *slaty coal*; which is ranked among the best, as it burns easily, with a bright and durable flame, swells and agglutinates, or *cakes* as it is termed, and leaves little residue.

From this view of the extent and condition of the coal deposites in this district it will be seen, that should the projected schemes of communication between the Chesapeake bay and the western waters, by means of canals and rail roads, be effected no further even than Cumberland—and there is but little doubt that the communication will soon extend thus far, there will be furnished a convenient outlet for an amount of coal which can be estimated only by hundreds of millions of bushels.

But this is not the sole district in which the coal deposites occur. Another, probably of equal extent, lies beyond the Great Back-bone ridge, along the valley Yohogany, and extending as far as the most southern limits of Maryland; which by way of distinction, may be called the *Yohogany coal district.* It has been remarked of this western coal region, that the beds within it are generally thicker than those of the Frostburg district. That bed, for example, which seems to correspond with the fifteen feet vein in Brant's mine, is found near the heads of the Potomac to exceed twenty feet in thickness. Time, no doubt may be expected to elapse, before these mineral riches will be brought into operation. Far removed from any convenient outlet, the mineral for fuel cannot come into competition with the coal from the more accessible districts; and the employment of it for the purpose of *coking*, applied to the smelting of iron, will not be required so long as our native forests supply in such abundance the means of obtaining the charcoal, by use of which, metal of a better quality is obtained. It is nevertheless advisable to determine, at once, the extent and nature of this second coal formation, the greatest portion of which lies within our own limits; and the more so, on account of several of its accessories, whose importance has not been perhaps hitherto fully appreciated.

One of these is the *iron ore*, with which it abounds. The occurrence of iron ore, associated with coal, has been considered the most prolific source of commercial prosperity possessed by Great Britain. Her political economists have long been accustomed to ascribe the extent of her manufactures to the abundance and cheapness of both these substances; by which are furnished, not only fuel for working the steam engines which put into operation their machinery, but the material, also, for the construction of this machinery. The time will come when a similar ascription shall apply to the United States, and when the western county of Maryland shall be looked upon as the Wales of North America.

On the Yohogany, the iron ore exists of the best quality and in the greatest abundance. It is of the variety described by mineralogists under the specific head of *argillaceous oxide of iron*. The following extracts taken from notes made on the spot, will give an idea of the circumstances under which it is found to eccur.

"1st. Iron ore bank, on the western shore of the Yohogany.—*Argillaceous iron ore* lying under sandstone; above which, at an elevation of about thirty feet, there is a bed of coal three feet thick, overlaid by a stratum of slate ten feet thick; and above this again, a deposite of clay, with nodules of iron ore. The coal in the upper part of this bed is much mixed with shale, and this with iron pyrites.

"2d. *Nodular argillaceous iron ore*, at the mouth of Bear creek; occurring in a bed the depth of which has not been ascertained, and lying under a mixed deposite of debris of *clay slate* and *sandstone*; the whole covered by a heavy superstratum of ferruginous sand, and a deep vegetable soil.

3d. *Extensive deposite of clay*, on the slope of Winding ridge, east shore of Yohogany. This deposite contains nodules of *argillaceous* iron ore. It rests upon the sandstone, and is covered by a continuous stratum of *calcareous marl.*—The ore, promiscuously extracted from the bed, has been found to smelt itself."

Associated with the deposites, there has been observed in the stratum of ferruginous clay, overlying the coal, (as remarked in note 1st; above,) nodules of a mineral substance, consisting of lime, clay and oxide of iron, answering very nearly the description of what by English writers is termed *Parker's cement*, but better known in this country under the name of *Roman cement.* This article will probably hereafter prove susceptible of most useful application.

Manganese, some of which is of very good quality, has been found on Bear creek. It occurs also on Keyser's ridge, five miles south of the national road.

The Yohogany furnace, on Bear creek, is situated in the midst of these resources. With an immense amount of water power at command, and under an active and intelligent management, it requires nothing but greater facilities for sending its valuable products to market.

Finally, another object which has excited some degree of interest in this portion of Allegany county, is the existence of a cave towards the head waters of the Yohogany, reported to be of great extent and to have furnished a considerable quantity of *crude saltpetre.* A similar cave was observed near Hancock, Washington county, which is also said to have yielded this salt. There is a similar one at the foot of the South mountain. An exploration of these caves might bring to light something of interest; although it is presumed to be a subject of but secondary importance.

In the commencement of this report, the undersigned have alluded to the circumstance of embracing in their examination an inquiry into the *hydrology* of the state. They have not lost sight of the importance of this object; but have to regret that the short time allowed them for investigating so many subjects of interest has not permitted them, so far, to collect a sufficient number of facts to arrive at any but a very partial result.

The undersigned will now close the remarks, which for the present they have to make on the geology of Maryland. They hope it will be perceived that their main object in ascertaining upon scientific principles the true mineral constitution of the State, has been to make this information applicable to useful purposes and subservient to the various interests of their fellow citizens. Opportunities have also been afforded of observing many objects of purely scientific interest; but a distinct account in the body of the report did not seem to be required. They have, however, carefully collected such articles as might serve to illustrate the facts that have been mentioned; or to which it might be desirable to refer, as specimens of the geological constitution and mineral resources of the different sections of the State. The disposal of these is left to your excellency.

They beg leave further, in conclusion of this part of their report, to acknowledge to your excellency, the great advantage which they have themselves derived from the assistance of their fellow citizen, Philip Thomas Tyson, of Baltimore, whose extensive practical information and whose familiar acquaintance with the sciences connected with the present examination, have rendered his services extremely valuable. They entertain a hope that corresponding advantages have resulted to the public interest; as without the assistance so zealously and devotedly given by this gentleman, it would not have been in their power to have extended their researches over so wide a field of investigation, nor with the same satisfactory results, which they flatter themselves they have in a measure obtained.

Submitting what has been already said in relation to the first division of their duties, the undersigned will only add, with reference to the second, a few words explanatory of the mode of execution, and of the map which they have the honor herewith to present.

A catalogue, which they have been careful to arrange and prepare, and which will be found to accompany this report, exhibits the sources from which this information was drawn. Where materials were so scarce, it is hardly to be expected that there should be much clashing or contradiction, yet the full allowance of difference and incertitude which must always attend independent observations, made arbitrarily and without reference to an unit of any sort, was found to attach to this work also. In having reconciled as far as they were able these discrepancies, and in stating the elements of examination and proof, they conceive there is no room for expressing an opinion as to the authority of any, it is left for every reader to make up his own judgment. Only they must be permitted to add, that their labor would have been longer and more wearisome without the assistance furnished by the work and public spirit of a citizen, whose name appears in the catalogue as having furnished them with a map of the entire territory of Maryland.

The basis of the map itself has been founded on observations of the latitude and longitude of Baltimore and Washington; made in each case under circumstances which are pledges of accuracy. The portion of territory, eastward of the meridian, passing between these places, has been laid down from Mr. Lucas' chart; a work published not very long since, upon data and calculations, which are near approximations to those used in the present instance. Westward of this meridian, the course of the Potomac was found in map No. 63 of the table; an actual survey of the board of Internal Improvement. This line, in default of astronomical observations, has been used for defining the western boundary of the state. Still farther west, the map of Virginia has furnished the geography of the country adjacent to the south branch of the Potomac.

It has been thought important that in a territory—whose situation is like that of Maryland—embracing the great marine outlet of an immense district, as much as possible of this adjoining district should be given in one view; and that the positions and relations of *natural* boundaries should be regarded; however much or widely separated by civil or municipal distinctions. Hence, besides the extreme verge of the Delaware Peninsula, is included also a part of the Susquehanna; and while the facilities for foreign communication and commercial enterprize are exhibited on the one hand, a glance on the other takes in the riches and resources, the growth and prospects of the inland country of the west. The object was to shew how completely it is in the power of Maryland to secure whatever benefits may be connected with so rich a carrying trade, as that which may be made—which *must* be made to exist between the positions. This has been, as far as possible, gained by a few additional square feet of canvas; while the hazard of making the map inconveniently large, was more than compensated, it was thought, in the advantage of having obtained this object.

The *extent* of the map having been determined upon, it remained to ascertain the most proper projection and the most convenient scale. Admitting the defects attributed to *flat maps*, in which the meridians as well as the lines of latitude are strictly parallel with one another, in so comparatively small a portion of territory these defects have been hardly operative; while the facility in securing accuracy in reducing the original maps, compensated, it was thought, for whatever defect there might exist of this kind. The difference, too, between the area afforded by this projection and that derived from the calculations of the Rhumbs is so minute as to prevent any distortion from taking place or the formation of any false ideas as to the relative positions of different places.

The proportion of the map to the actual extent of country included in its limits is as 1-200,000; that is to say that every measurement on the map is intended to be the 1-200,000th part of a similar actual measurement.

These proportions and projections had been adopted before any thing definite was known of the progress of the coast survey of the United States, which is now proceeding under the direction of M. Hassler; several considerations however would now dictate the adoption of a projection uniform with whatever may be decided on for the larger survey. With regard to the proportion it is a matter of smaller importance; since the detailed surveys hereafter to be entered upon, will exhibit results the 1-2000th of actual dimensions in length, and it will be practicable to reduce with the greatest accuracy, whatever part may be desired, to any given scale. The defect, too, in the present map, of minuteness of scale, will be remedied in the Atlas, which it is proposed to arrange, of the counties, upon a proportion of 1-50,000th, or four times the present dimensions.

With regard to the profiles, which are given on the face of the map, and whose horizontal and vertical proportions could not be made the same, while the scale of miles is the same as on the map, the vertical measurements are the 1-4000th part of the real elevations. A solitary exception will be found in the case of the Chesapeake and Ohio Canal, which for convenience was reduced to one half in the horizontal proportions. It has been endeavored to apply the results of these profiles to the horizontal face of the map; and the *dotted lines* which are already familiar to every reader of nautical charts, as denoting elevations of reefs or depths of soundings, have been transferred to indicate similar circumstances on land. The lines, for the sake of avoiding confusion, represent planes which are supposed to lie each *one hundred feet* above the other; a nearer approximate elevation of any point, is obtained by noticing its distance from the level line nearest it. The elevation always bears to one hundred feet the same proportion that the distance observed does to the entire distance between the two dotted lines enclosing the place whose elevation is sought.

In arranging the columns of the statistical tables which occupy a place upon the map, more regard, it will be seen, was paid to the designation of information considered to be useful, than what was in possession. The object, however, was to shew the results contemplated to be arrived at in the survey.

The undersigned beg leave, then, in conclusion, to present this map, as a document containing all the information that can be collected from authentic sources and indicating, to a certain extent, the sort of knowledge desirable to be embodied in a map for popular use. Whether *all* that is desirable has been indicated or not, is not now a matter of much moment, since it may be expected that the progress of the survey, which will bring to light a great variety of information, will also suggest the most appropriate mode of exhibiting it.

The topographical examination for which opportunities have been afforded, has necessarily been, as yet, very general; but enough has been done to exhibit and establish the principles of future operations, and to reduce to a small compass the time which must be devoted to the continuance of the examination, and which must elapse before the detailed surveys specified in the resolution can be entered upon.

Arrangements are already in progress for facilitating the immediate execution of these surveys, which are proposed to be connected and executed in strict accordance with the geodesical operations of the coast survey. In endeavoring to make this connection, the undersigned have consulted their own feelings of propriety—and while the interest of both works would seem to be subserved by it, that of Maryland in particular will have been attended to, in assuring greater accuracy in the results and materially diminishing the attendant expenses.

The undersigned defer any specification of the mode in which the detailed surveys will be conducted—of the means to be employed and the minute circumstances attending them, until all the contemplated arrangements shall have been completed, at which time they will beg leave to present another detailed report.

But they cannot permit themselves to terminate this without the expression of their especial thanks to the gentlemen of the United States' Topographical Corps, and the Engineers of the several works of Internal Improvement, whose liberality has been experienced in facilitating the collection of desirable information. To their fellow citizens throughout the state, they will always feel grateful for the kindness and hospitality with which they have every where been received.

They await, now, only the approval of your Excellency as to what has been already commenced, to set themselves assiduously at work to effect its completion: and in the mean time beg leave to offer the assurance of their entire respect.

Annapolis, Dec. 27th, 1833.

REMARKS.

The above report, being intended to excite the people and government of Maryland, to authorize a thorough survey of the State, it may not be superfluous to add, that in our view, the subject is well worthy of their attention. The facts stated in this introductory account are highly important to the agricultural, manufacturing and commercial interests of the State; they evince, that it has great physical resources, which need only to be brought to light, in order to produce very important results to public and individual wealth; the relation of the facts to science, is also very interesting, and the gentlemen charged with the execution of this important trust, have proved themselves to be entirely equal to the undertaking. Although their account is designed for popular use, they have happily united scientific accuracy with perspicuity. We trust, that the enlightened state of Maryland, having made so happy a beginning, will also make the necessary provision to carry this noble undertaking to a complete and happy conclusion.

The example set by Massachusetts, as exhibited in the able report on the Geology, &c. of that State, by Prof. Hitchcock;—the movement in the Legislature of Pennsylvania, as evinced by a report on the project of a survey of that very important State; the progress made, almost to completion, of a geological survey of Tennessee, by Dr. Troost; and the increasing interest of the same kind, which, as we are informed, is exhibited in Virginia, will, we trust, furnish additional motives to the government of Maryland, to proceed to the completion of this good work, on a scale fully commensurate to the magnitude of the object, and in accordance with the dignity and honor of the State.—*Ed.*

ART. II.—*Experimental Enquiry into some of the Laws of the Elementary Voltaic Battery;* by WILLIAM B. ROGERS, Prof. Nat. Philosophy and Chemistry in William and Mary College, and HENRY D. ROGERS, F. G. S. of Lond. &c.

WE send for publication in your valuable Journal, a series of experiments made upon the voltaic battery for the purpose of investigating the circumstances which principally modify its action. They all have a direct reference to the most efficient construction and mode of employing this powerful engine of research, while some of them, moreover, lead immediately to conclusions respecting its laws, very different from those of Ritchie and other celebrated experimenters on the subject. In the hope therefore that the observations which we are about to record, will be found sufficiently new and important to provoke a more thorough investigation of this portion of the field of electrical science, we beg leave to present our experiments in the order in which they were made, with some brief remarks upon the conclusions to which they lead.

For the sake of greater accuracy, all our experiments were made upon the battery in its most elementary form, consisting of a single pair of zinc and copper plates in the shape of long slips an inch wide, and from four to twelve inches long. The slips were graduated by transverse lines into inches and parts. To the upper end of each slip a copper wire, always of the same length, was carefully soldered, the other extremity of the wire being amalgamated and dipped into the cup of the galvanometer. The slips were placed parallel to each other, and generally an inch and a quarter apart. To secure them in this position, and at the same time to be enabled to immerse them to the various depths required, they were supported in two parallel slits in the cover of the vessel containing the acid solution, and adjusted by sliding up or down to the degree of immersion desired.

The galvanometer, which was one of extreme delicacy, was constructed on a large scale, and with some modifications of the original invention, which we believe to add to its accuracy as an instrument of research. Being moreover simple in its parts, it can readily be constructed by any experimenter, and we therefore subjoin a brief description and drawing.

Fig. 1, represents the instrument adjusted for use. A and B are circles of well seasoned wood, 12 inches in diameter, connected by two pillars 36 inches high. A strong tube of ½ inch diameter, is secured at its upper extremity in the center of the circle A, passes through the brace D, and terminates an inch and a half above the lower circle B. The coil, consisting of 100 feet of fine copper wire wrapped with silk, rests partly above, partly in a groove beneath the circle B, passing through two holes immediately at the base of the pillars. The tube extends just through the coil, and assists to support it.

Fig. 1.

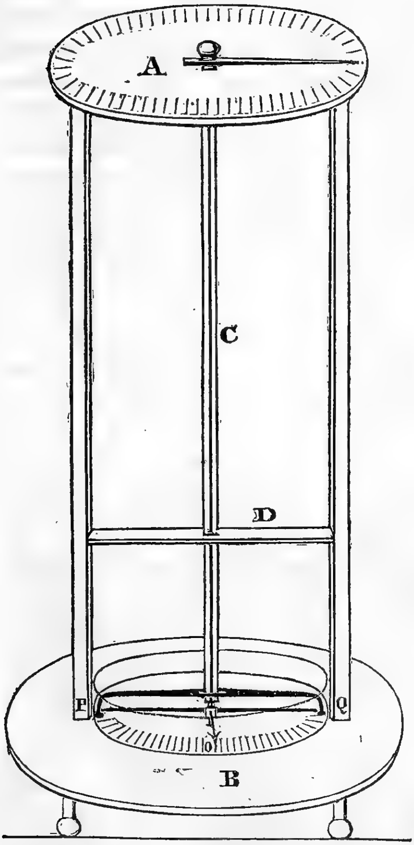
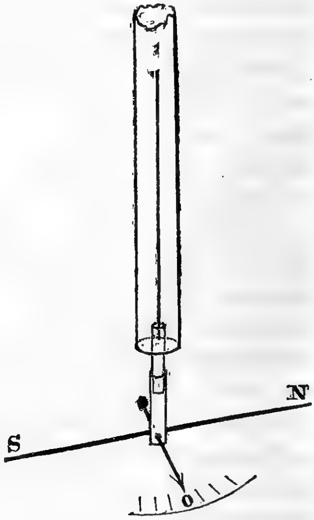


Fig. 2.



The needle is suspended by a torsion filament of glass, represented more fully in Fig. 2. The upper extremity of the tube receives a glass stopper, formed of a portion of thick capillary tube, filed into a shoulder, and made to fit easily into it. The upper end of the glass filament is made fast in the capillary bore, while the lower end is cemented into a short piece of fine straw. The needle (a fine knitting needle) is passed through another piece of straw, of rather greater diameter, to allow the former to fit into it. By this construction, the needle can readily be detached from the filament when the instrument is not in use. The same straw which carries the needle is also perforated by an index at right angles to it, consisting of a fine rigid straw about five inches long, and having on its shorter end a little counterpoise. This index moves over a short graduated arch in the circle B at a very small distance above it. It is intended, when using the instrument, to bring this index to zero, by means of the torsion key above. There being no obstruction to the view of the index in this arrangement, the adjustment can be more accurately and speedily made. A pin projects from the center of the circle B, and enters a little way the straw, to steady the motion of the needle. A rim of pasteboard two inches high rises above the circle B, and the whole, both needle and coil, are covered by two semicircular plates of glass. The torsion key moving over the upper circle, which is minutely graduated, denotes the amount of deflection when the index below is brought to zero.

I. On the relative influences severally possessed by the zinc and copper in the elementary battery.

Our first experiments on this point were made with a pair of short plates graduated to the ¼th of an inch. The quantities of surface immersed are expressed at the top of each column of observations. The numbers in the columns indicate the angular deflexion of the needle observed at intervals of one minute; the first observation being made a minute after the plunge. After completing the first column of observations, the slips were removed for a new adjustment; and so on for the succeeding columns. No particular attention was as yet paid to the length of interval during which the plates were out of the action of the solution. The solution in nearly all our experiments contained one part of sulphuric acid in about 100 of water.

1. Copper 2½ in. zinc dipped to

	¼ in.	½ in.	¾ in.	1 in.	
1.	37°	34°	27°	26½°	Fresh solution 24.*
2.	33	30	27	23	
3.	31½	29	27	21	
4.	31	29	27	21	
5.	31	29	26½	21	

* In this and some of the following experiments, the plates were transferred after the completion of the series to a vessel containing fresh liquid of the proper strength.

	1¼ in.		1½ in.		1¾ in.		2 in.		2½ in.	
1.	21½°	-	40°	-	27½°	-	27°	-	27°	Fresh sol. 21½
2.	20	-	37	-	24	-	24	-	23	
3.	20	-	33	-	24	-	23	-	21	
4.	20	-	33	-	24	-	23	-	21	
5.		-		-		-		-	21	

In the experiment where the zinc was dipped to 1½ in. it will be remarked that the numbers are greatly higher than in the preceding. This arose from our having allowed the plates to remain out of the solution for about an hour. When compared with the first column, when the plates were fresh, and therefore nearly in the same condition, although the zinc was then only ¼ inch, we find the deflection to be no greater.

The above results show that no increase of effect is produced by an increase of the zinc surface exposed to the acid, the copper surface remaining constant. Indeed, the whole tenor of the experiments shews that in proportion as the zinc surface increases, the effect diminishes.

2. With the view of bringing these two extremes together, the two following experiments were performed; the zinc being well dried before each immersion.

Copper as before 2½ in., zinc dipped to

	z. ½ in.		z. 2½ in.
1.	27°	-	18½°
2.	25½	-	18
3.	23	-	15

3. In order to vary the experiments the slips were not removed from the liquid, but were slid through the slits which hold them, to each succeeding depth required.

Copper constant at 4 inches.

	½ in. z.		1 in. z.		1½ in. z.		2 in. z.		2½ in. z.		3 in. z.		3½ in. z.		4 in. z.
1.	173°	-	88°	-	86°	-	86°	-	86°	-	86°	-	84°	-	81°
2.	147	-	85	-	84	-	83½	-	85	-	84	-	82	-	80
3.	114	-	84	-	84	-	83	-	82	-	84	-	81	-	80

In this experiment although less strikingly than in that previously described, a tendency to diminished action is observable as the zinc surface increases.

This was done with the view of ascertaining whether the declining action was in any degree owing to the gradual weakening of the solution.

The slips being new, as fresh surface was successively plunged, an increased action generally took place, which however soon declined; and each column of observations shews a general tendency to declension.

4. To make the comparison at shorter intervals of time, and thus avoid any declension which might arise from a long period of exposure,—the following were made.

Zinc 4 in. cop. dipped to,	Copper 4 in. zinc dipped to,
1 in. 52°	1 in. 50°
2 in. 68	2 in. 55
3 in. 70	3 in. 58
4 in. 82	4 in. 60
Diff. 52 and 82=30	Diff. 50 and 60=10

The same repeated gave the following.

Z. 4 in. cop.	Cop. 4 in. zinc.
1 in. 25°	1 in. 45°
2 in. 47	2 in. 51
3 in. 52	3 in. 53
4 in. 57	4 in. 54
57 – 25=32	54 – 45=9

Thus it would appear that when the copper surface is increased from 1 to 4 inches, the zinc remaining constant at 4 inches, the increase of activity in the battery is between three and four times as great as when the zinc surface is increased in the same proportion.

Subsequent experiments will shew that the above mode of comparing the effects of the two metals is less correct than that adopted afterwards, since the successive immersions of *fresh* portions of the plate produces an effect greater than the normal power of the surface immersed when long in action. We should here observe that throughout our experiments, whenever any portion of the plates was drawn out of the solution the moistened part was carefully wiped dry;—otherwise a slight action in the surface newly exposed would have made all the smaller deflections somewhat too great, and would thus have modified the series by an error which would have tended against the law.

5. In all the foregoing experiments one of the surfaces is made to increase until it *equals* the other, but never to *exceed* it. It was thought however of importance, to examine the case where the va-

riable plate increased to twice the surface of the other. With this view two new plates, similar to the former were prepared. Two inches of one and variable proportions of the other were plunged and between each set of immersions an interval of five minutes was allowed.

Copper, 2.

z. ¼.		z. 1.	z. 2.	z. 3.	z. 4.
	1.	62°	69°	73°	72°
	2.	62	69	72	72
	3.	62	69	70	70
	4.	62	69	70	69

Zinc, 2.

	Cop. 1.	Cop. 2.	Cop. 3.	Cop. 4.
1.	53°	65°	77°	127°
2.	50	64	72	120
3.	47	63	72	90
4.	44	62	72	89

From an inspection of the first four columns, namely, when the copper is constant and the zinc variable, it appears although contrary to the former observations, (2.) that the deflexion slowly augments as the zinc surface is increased. This was not observed to occur in any previous or subsequent experiments made under similar circumstances, it being found that with an increase of zinc surface, the deflexion *diminished* or else remained nearly stationary. We are inclined to attribute the discrepancy in this single instance to some peculiarity in the surface of zinc plate, having obtained it from a different mass.

II. Experiments shewing the distinction between the first momentary, and subsequent more permanent deflections.

6. It will be remarked that in the experiments hitherto recorded, no observation of the needle was made until the plates had been exposed one minute to the solution. The *momentary* effects, measured on the instant of immersion, would of course have been much greater. We were anxious to observe the relation of the momentary and permanent deflections, as also the influence upon both of these, produced by various intervals between immersion, and various periods of exposure to the solution. In most of the experiments hitherto performed by others on the elementary battery, attention has not been directed to separating the momentary from the permanent effects, nor indeed to estimate the momentary effects themselves with

any thing like precision. The proper permanent effects have not, as far as we are informed, been the subject of any observation at all, inasmuch as it has been usual to get the deflection as early as possible without regard to the interval between the plunge and the instant of observation.

It is this omission to distinguish these two effects, that has led the able and ingenious contriver of the torsion galvanometer, in his experiments with it, upon the elementary battery, to erroneous conclusions regarding the law which expresses the connexion between the degree of deflection and the quantity of surface immersed.—It is made apparent from the following experiments that the momentary and permanent deflections obey different laws, and that in many cases when the momentary deflections augment in successive immersions of the plates, the degree of deflection measured one or two minutes after immersion is unchanged. Nothing could be more striking during these observations than the prodigious velocity with which the deflecting energy declined, making it impossible often even with the most adroit movement of the torsion key, to follow it; nor on the other hand can any thing surpass the remarkable steadiness of the deflection when one or two minutes have elapsed. All the attempts, therefore, at determining the momentary deflections are attended with more or less of uncertainty from this great rapidity with which the electrical action, or at least so much of it as is measured by deflection, decreases for the first few instants. Hence, in the experiments which follow, nothing more than an approximation to the two first actions is aimed at. It is this uncertainty as we believe, which renders of no value, all determinations which are not based on the subsequent or permanent deflections, as a measure.

7. In the first set of experiments the momentary effects have been measured as nearly as practicable, by taking an observation immediately upon immersion; leaving the plates one minute in the liquid; then removing them for some time, and immersing them a second time, and at the instant of immersion, taking another obsevation.

At the end of each plunge, that is, after one minute of action—the effect was also observed. The following results indicate that the *first effect* augments as the interval between the plunges is increased. —They also go to prove that the permanent deflection very slowly declines.

The plates having first been immersed for some time in the solution, were removed for 5 minutes, and then plunged twice in succession at an interval of 5 minutes.

The 1st plunge gave	+220°	In both these cases the deflection settled in 1 minute at 57°.
" 2nd " "	−230	

Removed from the solution for 4 minutes, they were dipped twice in succession at an interval of 4 minutes.

1st plunge gave	+200°	Permanent deflection,	57°
2nd " "	+230		

3 minute intervals.

1st. plunge gave	−200°	Permanent deflection,	55°
2nd. " "	+180		

2 minute intervals.

1st. plunge gave	−180°	Permanent deflection,	54°
2nd. " "	+170		

1 minute intervals.

1st. plunge gave	−170°	Permanent deflection,	54°
2nd. " "	−160		
3rd. " "	+150		

10 minute intervals.

1st. plunge gave	270° ?	Permanent deflection,	55°
2nd, " "	+270		

20 minute intervals.

1st. plunge gave	+310°	Permanent deflection,	55°
2nd. " "	−320		

30 minute intervals.

1st. plunge gave	+320°	Permanent deflection,	55°
2nd. " "	−330		

45 minute intervals.

1st. plunge gave	+330°	Permanent deflection,	55°
2nd. " "	−340		

120 minute intervals.

1st. plunge gave	+340°	Permanent deflection,	55°
2nd. " "	=360		

8. As the accurate observation of momentary effects in the preceding experiments depended upon the dexterity with which the key of the galvanometer was adjusted to the deflection, and as it is impossible to obtain with the desirable accuracy the first effects of immersion by turning the torsion key at, or immediately after the moment of immersion, in consequence of the instantaneous and very great decline of the force, another and more perfect mode of observation was devised and a new series of experiments performed. We now set the torsion key previous to immersion, at such an angle as was thought from preceding observations to approach the expected ef-

fect, the needle being retained at zero by a light trigger placed against the index. The immersion being then made as instantaneously as posible, the observer stationed at the needle marked whether the index receded from its lateral support, this of course indicating that the deflecting force was more than a balance for the torsion. In this case the number of degrees of torsion read off the upper circle was recorded + (Plus). If no movement of the needle occurred, the number was recorded — (Minus). Experiments were thus successively made, always setting the torsion key previous to immersion at some number either less or greater than the former number according as this had been found plus or minus. In this way after repeated observations, a close approximation to the momentary effect was procured.

Having observed that the momentary effect was influenced to some extent both by the period of exposure to the liquid and by the interval of repose between the immersions, two distinct sets of experiments were made, in order as far as possible to separate these two influences. In the first set, the intervals of repose in the air were varied, as follows,—1 min. for 1st result, 2 min. for 2nd, 4 min. for 3d. The period of exposure to the solution was constant, namely, minute after each dip.

In the second set, the periods of exposure to the solution were 1 min., 2 min., 4 min., 8 min., and the interval of repose out of the solution was constant. In each observation besides the momentary action, the permanent deflection was noticed.

1st set.—Period of exposure to solution 1 min. in all the observations.—Interval of repose 1 min.

1st. obs.	momentary	def.	−360°	Perm.	def.	104°
2nd. "	"	"	−340	"	"	104
3rd. "	"	"	+300	"	"	104
4th. "	"	"	+320	"	"	103
5th. "	"	"	−340	"	"	103

Result, $\frac{320+340}{2}=330$ of mom. def. and between 103 and 104 perm. def.

Interval of repose, 2 minutes.

1st. obs.	momentary	def.	+340°	Perm.	def.	104°
2nd. "	"	"	+360	"	"	104
3rd. "	"	"	+380	"	"	103
4th. "	"	"	−400	"	"	103

Result, $\frac{380+400}{2}=390$ of mom. def. and as before of perm. def.

Interval of repose, 4 minutes.

1st. obs. momentary def.	– 450°	Perm. def.	103°
2nd. " " "	– 400 ?	" "	102
3rd. " " "	+390	" "	102
4th. " " "	=400	" "	102

Result, 400 mom. def. and 102 perm. def.

2nd. set.—Interval of repose, 1 min. between immersions in all the observations. Period of exposure in solution, 1 min.

1st. obs. momentary def.	+330°	Perm. def.	100°
2nd. " " "	–340	" "	100

Result, 336 mom. def. and 100 perm. def.

Period of exposure in solution, 2 min.

1st. obs. momentary def.	–300°	Perm. def.	99°
2nd. " " "	–260	" "	98
3rd. " " "	+240	" "	96

Result, 250 mom. def. and 97 perm. def.

Period in solution, 4 min.

1st. obs. momentary def.	+200°	Perm. def.	95°
2nd. " " "	–230	" "	94
3rd. " " "	–220	" "	93

Result, 210 mom. def. and 94 perm. def.

Period in solution, 8 min.

1st. obs. momentary def.	–180°	Perm. def.	91°
2nd. " " "	+160	" "	90
2rd. " " "	=170	" "	90

Result, 170 mom. def. and 90 perm. def.

III. Relative influence of the zinc and copper.

9. The effect of repose out of the solution to exalt the activity of voltaic plates, although a fact generally observed, does not appear hitherto to have been made the subject of systematic examination. From the foregoing experiments, it is evident that the electrical energy of the plates as measured by the momentary deflection, continued to augment as the interval of repose out of the solution was increased, until this interval was extended to 2 hours, with which the experiments (7), were terminated. A single observation, made the following day, with the same plates and liquid, as were used in the experiments (7), gave a deflection very little greater than in the experiments with an interval of 2 hours. It would therefore, appear, that plates which have been subjected to the action of the solution for some time, do not recover their power of producing momentary deflection, until they have been out of the liquid two or three hours.

But while there is this marked dependence of the momentary effects upon the interval of repose, it is particularly worthy of observation, that what we have denominated the permanent deflections, observes an almost steady uniformity or decline, in an agreeable and very gradual manner. The stability and regularity of the permanent deflections, are strikingly apparent, in the two last sets of observations, for while in the first of these, (8) the momentary deflections are increasing and in the last rapidly diminishing, the permanent effects are seen throughout, both very steadily and slowly to decline.

Satisfied therefore, with the accuracy of the mode of measuring the action of the battery previously adopted, that is, by permanent effects, we determined to repeat our experiments upon the relative action of the two metals, with larger plates so as to admit of varying to a greater extent the relative proportion of the two surfaces. We likewise in nearly all the subsequent experiments, observed the momentary deflections. In these and most of the succeeding experiments, the plates were allowed 5 minutes, repose out of the solution, for we had uniformly observed that a very short interval accelerated the decline of the permanent effects.

10. New series of experiments upon the relative influence of the two metals. Slips 1 inch wide, 12 inches long, and 1¼ inches distant. Solution, sulphuric acid 1 to 94; quantity 1½ gallon.

Zinc 1 inch, copper dipped to

	1 inch.	2 inch.	3 inch.	4 inch.	5 inch.
1st. effect,	00°	+90°	+180°	+180°	−360°
1′	62	70	74	76	80
2′	59	67	72	70	72
3′	56	71	67	68	70
4′	54	59	64	68	

	6 inch.	7 inch.	8 inch.	9 inch.	10 inch.
1st. effect,	−360°	+360°	−380°	+380°	−400°
1′	81	81	81	82	85
2′	74	74	74	74	75
3′	72	72	70	72	73

Copper 1 inch, zinc dipped to

	1 inch.	2 inch.	3 inch.	4 inch.	5 inch.
1st. effect,	+90°	+180°	−220°	−220°	−180°
1′	48	40	35	30	34
2′	42	36	30	26	23
3′	36	36	27	24	22

	6 inch.	7 inch.	8 inch.	9 inch.	10 inch.
1st. effect,	=140°	−140°	+90°	=90°	−90°
1′	23	22	21	19	19
2′	21	20	19	19	19
3′	19	19	18	18	18

11. Another set was now made, by immersing one of the plates 5 inches, and varying the surface immersed of the other from 1 inch to 10 inches. Five minutes were allowed between the immersions as before.

Zinc 5 inches, copper dipped to

	1 inch.	2 inch.	3 inch.	4 inch.	5 inch.
1st. effect,	−220°	+120°	+200°	+300°	+400°
1′	34	63	66	70	74
2′	31	51	60	63	66
3′	29	48	55	59	61
	6 inch.	7 inch.	8 inch.	9 inch.	10 inch.
1st. effect,	+450°	−500°	−500°	−490°	00°
1′	74	77	78	79	82
2′	70	72	74	74	76
3′	64	68	69	69	74

Copper 5 inches, zinc dipped to

	1 inch.	2 inch.	3 inch.	4 inch.	5 inch.
1st. effect,	360°	+360°	+360°	−400°	360°
1′	48	47	44	43	40
2′	45	44	38	38	37
3′	42	38	37	36	34
	6 inch.	7 inch.	8 inch.	9 inch.	10 inch.
1st. effect,	360°	360°	−380°	−380°	370°
1′	38	38	38	38	38
2′	36	35	35	35	35
3′	34	35	35	34	34

12. In the following experiments the plates were not removed from the solution between the immersions. One of the plates being plunged to 5 inches; the other was immersed by a sliding movement to 1 inch, 3 inches, &c. up to 11 inches. After finishing with one metal, the plates were removed for 5 minutes, and then adjusted for another set.

Zinc 5 inches, copper dipped to

	1 inch.	3 inch.	5 inch.	7 inch.	9 inch.	11 inch.*
1′	28°	50°	61°	76°	80°	90°
2′	27	47	59	70	73	90
3′	25	45	56	67	70	87

* The last inch was perfectly fresh metal, which probably accounts for the *great* increase of action.

Copper 5 inches, zinc dipped to

	1 inch.	3 inch.	5 inch.	7 inch.	9 inch.	11 inch.
1′	43°	37°	33°	31°	30°	29°
2′	40	35	32	31	30	29
3′	38	35	32	31	30	29

13. In the preceding experiments, the solution used, was always composed of sulphuric acid and water. A solution containing one part nitric acid, (specific gravity, 1.333) to 66 water, was now prepared and employed in a similar set of observations, of which the following are the details.

Experiments with nitric acid solutions, 1 to 66. 1½ galls.; slips, 10 inches long, 1 inch broad and 2½ apart. Intervals between the immersions, 3 minutes.

1st. set.—Zinc immersed 2 inches, copper dipped to

	2 inch.	4 inch.	6 inch.	8 inch.	10 inch.
1st. effect,	−300°	+250°	−300°	−250°	
1′	98	130	132	140	160°
2′	88	125	119	128	154
3′	82	120	118	124	148
4′	78	113	116	124	144
5′	74	111	115	124	144
6′	74	111	115	124	138
7′	74				

2nd. set.—Copper immersed 2 inches, zinc dipped to

	2 inch.	4 inch.	6 inch.	8 inch.	10 inch.
1st. effect,	−250°	−180°	=150°	+150°	−180°
1′	90	87	63	75	85
2′	85	72	44	54	65
3′	76	60	41	46	54
4′	66	57	40	42	46
5′	64	56	40	38	38
6′	62	55	40	38	38

14. We now made a number of observations by sliding the plates alternately, and through great distances at each time. Columns Z and C, represent the inches of zinc and copper immersed. The deflection was noted 1 minute after each change.

No.	Z.	C.	def.	No.	Z.	C.	def.
1.	10	10	255°	8.	10	1	28°
2.	5	10	170	9.	1	1	30
3.	1	10	170	10.	10	1	25
4.	10	10	240	11.	1	1	27
5.	5	10	170	12.	1	10	168
6.	10	1	28	13.	10	10	250
7.	1	1	30	14.	10	1	25

The above results exhibit, very beautifully, the great relative efficiency of the copper in galvanic arrangements. Comparing Nos. 2 and 5 with Nos. 3 and 12, it appears, consistently with nearly all our former results, that the increase of zinc produces no increase of action, although compared with Nos. 1, 4, and 13, some increase is shewn. Comparing Nos. 3 and 12 with Nos. 6, 8, 10, and 14, we perceive a vast disparity in the amount of galvanic action; 170° to 30°. This mode of experiment, furnishes an easy and impressive class room illustration.

15. In all the preceding experiments, the increase of action became very slow, when the copper surface was a large multiple of the zinc, so that in fact, after a certain point, no additional effect was produced by the addition of more copper surface. Attributing this to the great distance of the lower portions of the copper slip from the small immersed surface of Zinc, we inferred, that by placing the copper in two portions on opposite sides of the zinc, still preserving the same distance from it, a much greater action would take place. This inference moreover, was favored by the consideration, that in Dr. Wollaston's construction of the battery, the plates are thus arranged. We determined, however, to put the matter to the test of experiment.

Plates similar to those formerly used, were arranged with a view to this new series of observations—the two exterior plates, whether of copper or zinc, being connected by an arched wire carefully soldered to both, to the middle and highest point of which another wire was soldered, reaching to one of the cups of the galvanometer. By this means, two outside plates acted electrically as one. The letters Z and C, will sufficiently indicate the arrangement of the plates.

	C. Z. C.		C. Z.		Z. C. Z.		Z. C.
	2 in. 2 in. 2 in.		4 in. 2 in.		2 in. 2 in. 2. in.		4. in. 2 in.
1′	82°	-	106°	-	73°	-	76°
2′	82	-	106	-	72	-	72
3′	82	-	106	-	72	-	72

These rather unexpected results, lead directly to the inference, that Wollaston's plan of enclosing the zinc on both sides with copper, is really less advantageous than allowing the copper to extend to a double length on one side of the zinc plate. The fact of the copper being presented to both zinc surfaces, being, in contradiction of all our theoretical notions, of no advantage whatever.

16. An examination of Ritchie's Law of Surface.

Reasoning from some of the foregoing experiments where a diminution of action accompanied an increase of the zinc surface, and where also, the increase of power from augmentation of the copper surface, still fell far short of being proportional to the quantity of that metal immersed, we were naturally induced to doubt, whether the law announced by Dr. Ritchie, that the deflexion increases exactly in the ratio in which the surfaces of the two metals are increased, could be true.*

The slips were of the same kind as before. Both were immersed to equal depths. Intervals of five minutes were allowed between the immersions, to permit the plates to regain their greatest energy.

	Both 1 inch.	2 inch.	4 inch.
1st. effect,	+200°	+300°	−400°
1′	60	85	170
2′	61	82	115
3′	61	82	115

Repeated after an interval of 5 minutes; beginning with 4 inches, and diminishing to 1 inch.

---

* In Vol. I. p. 33 of the Journal of the Royal Institution, Dr. Ritchie describes his experiment and views in regard to this point in the following words. "Take two rectangular slips of copper and zinc, an inch broad and eight or ten inches long, and divide them into square inches by narrow bands of wax or cement. Solder copper wires to their extremities, and fix them into a small frame so that they may always be placed at the same distance from each other. Immerse them in a small vessel of water, containing a small quantity of sulphuric acid, to the first horizontal division; turn round the torsion key till the untwisting force of the glass thread, balances the deflecting power of the electric current, and note the number of degrees of torsion. Immerse them to the second division, turn round the torsion key as before, and the degrees of torsion necessary to balance the deflecting force of the current, from two square inches, will be found *double* of those for one square inch. Repeat the experiment wlth three, four, &c., square inches, and the degrees of torsion will be found proportional to the surface of the plates immersed.

"Having thus shewn experimentally the accuracy of the instrument"—&c.

From the last sentence it would appear that the truth of this law was already admitted, and that the experiments quoted above were made not so much to establish it as to test the accuracy of the galvanometer by it. Now no one who reflects upon the beautiful principle of torsion used in this instrument can doubt the correctness of its indications when employed with the requisite precautions; we do not think however that in the case above cited, it could be regarded as furnishing proof of the truth of the law in question, for, as we have proved in our experiments upon *first effects*, the adequate precautions were overlooked.

The investigations which follow, go we think to establish, that no such law prevails.

	4 inch.	2 inch.	1 inch.
1st. effect,	−400°	+220°	+150°
1′	115	84	60
2′	114	83	60
3′	114	82	60

2nd. set.—	1 inch.	2 inch.	4 inch.
1st. effect.	+150°	=300°	=400°
1′	61	81	112
2′	60	80	112
3′	60	80	111

	4 inch.	2 inch.	1 inch.
1st. effect,	−420°	−310°	−180°
1′	112	81	60

17. With the view of obtaining a wider range of comparison, two new slips were prepared, 10 inches long, 1 inch wide, and 1¼ distant. These were immersed, successively, to 10, 8, 6, &c. inches in the solution of 1 to 94. After the first minute of action, the deflection was permanent, or nearly so. These observations, at intervals of a minute, were taken while the slips were exposed to the solution. The slips, being then removed, were allowed to repose without wiping for 5 minutes. The adjustment for immersion being made, at the end of the 5th minute, the slips were again immersed. The following are the results.

In new plates we have always observed a very violent action on the first immersion, we therefore commenced by a preparatory immersion, to their full depth 10 inches, to bring them to their stable condition.

1st. effect,	−720°
½′	500
1′	400
1½′	240
2′	135
3′	132
4′	132
5′	132

After an interval of five minutes from the last observation above recorded, the series was begun, always noting as near as practicable, the instantaneous effects.—

	10 inch.	8 inch.	6 inch.	4 inch.	2 inch.	1 inch.
1st. effect,	−600°	+400°	+400°	+400°	=360°	−300°
1′	132	124	112	100	82	68
1′	132	124	112	100	80	65
3′	132	124	112	100	79	62

The observations were now repeated in the reverse order, after the same interval. The order was reversed, because the action of the liquid in the earlier immersions is tending continually to depress the permanent deflection in the succeeding ones, independently of the lessened surface and must cause the final deflections to be a little too low.

By inverting the order the error is counterbalanced, the larger deflections now suffering the reduction, as we see on comparing the final deflection 118, with the first permanent one 132.

It will be seen that in nearly all our other experiments, we began by immersing the slips to the greatest depth to which they were to go, for the sake of making the error lean in favor of the law which our investigations were opposing.

	1 inch.	2 inch.	4 inch.	6 inch.	8 inch.	10 inch.
1st. effect,	00°	+300°	+300°	+400°	−500°	−500°
1′	62	72	95	106	113	123
2′	60	71	94	103	113	118
3′	60	71	93	103	112	118

The results here obtained, so far from agreeing with the law in question, which for a ten-fold surface should have produced a ten-fold deflection, are throughout at variance with it, in as much as ten times the surface displayed, gives us only twice the deflection, or 118° to 60°.

18. So striking a departure from the supposed law, induced us to investigate it by new modifications of the experiments. An old pair of slips, the same which we had used before in our experiments with the nitric acid solution, was therefore next employed, and using the sulphuric acid solution of 1 to 94, we obtained the following. Intervals 5 minutes.

	8 inch.	6 inch.	4 inch.	2 inch.
1st. effect,	−500°	−300°	+200°	00°
1′	95	64	49	25
2′	84	61	49	23
3′	84	56	44	22

The solution was now strengthened so as to be 1 to 60, when we obtained the following deflections.

	8 inch.	6 inch.	4 inch.	2 inch.
1st. effect,	+300°	+250°	+250°	−250°
1′	85	72	60	40
2′	80	67	53	33
3′	80	66	53	30

In both these sets of results there is evidently a nearer approach to Dr. Ritchie's law, than in any of the former, on the same subject. In the last set, the deviation is more marked than in the first. The partial accordance with the law in the first set, is most probably attributable to some accidental peculiarity in the condition of the plates, perhaps induced by the previous exposure to the nitric acid. The same results have never been obtained with new slips, or with any of those which had been immersed in sulphuric acid.

19. A fresh pair of plates, gave results which so far from agreeing with our first set above, are in perfect accordance with our former ones.—New slips.—Sulp. ac. sol. 1 to 66.—Intervals 3 minutes.

1st. set.—8 inch.		4 inch.	2 inch.	1 inch.
1st. effect,	+500°	+400°	+300°	+150°
1′	160	103	77	56
2′	128	103	76	55
3′	126	103	75	54
4′	126	102	75	54

The plates were now slid down to 8 inches, without removing them from the solution, and afterwards slid up to the succeeding stages. The deflections were,

	8 inch.	4 inch.	2 inch.	1 inch.
1′	120°	96°	67°	48°
2′	118	95	66	47
3′	117	94	65	46

20. After an interval of 16 hours, the same series was repeated. First, however, the plates were dipped to 4 inches, in order to compare the deflection with that from 8 inches immersion, the first time they were used.—(See 19, 1st. set.) The deflections were,

	4 inch.
1st. effect,	−500°
1′ - - - - - -	92
2′ - - - - - -	92
3′ - - - - - -	88
4′ - - - - - -	84
5′ - - - - - -	84

After 4 minutes exposure to the air, the regular series was begun. Intervals between the dips 4 minutes.

	8 inch.	4 inch.	2 inch.	1 inch.	8 inch.
1st. effect,	−500°	00°	+300°	00°	000°
1′	104	83	57	42	104
2′	97	80	56	40	100
3′	96	80	54	39	95
4′	94	80	54	39	93
5′	94	80	54	39	93

It is only necessary to compare the final numbers in the columns of any of the foregoing sets of observations, with the numbers above the columns, expressing the number of inches immersed to discover the entire absence of the proportionality assumed in the law. Had the deflections been announced, to conform to the *square roots* of the surfaces, a much closer approximation would in many cases be witnessed, but this cannot be laid down without doing equal violence to experiment. All that we venture at present to establish, is the important practical fact, that the power of the battery increases much more slowly than the quantity of metallic surface, and that, as far at least, as deflection and the other properties of which this is a measure, are concerned, there will be a very useless expenditure of metal by increasing beyond a certain point the dimensions of the plates.

IV. On the influence of temperature to exalt the energy of the battery.

21. It has been mentioned by Dr. Ritchie, and has been known, we believe, to electricians for some time, that heating the solution tends to augment the activity of the battery. Seeing ourselves in possession of an instrument which enabled us to measure numerically, exceedingly minute augmentations of force, it became an enquiry of some interest to ascertain the amount of influence exerted by temperature.

A glass vessel with wide mouth was nearly filled with some of the solution of the ordinary strength. The usual cover with slits to receive the plates, was then adapted to the top, and the whole supported on a stand, and a spirit lamp applied beneath. The slips were 4 inches long, $\frac{3}{4}$ of an inch distant, and plunged 2 inches in the liquid. Before heating the solution, the temperature was 66°. Temp. rising from 110° to 150°.

Deflection was	1′	32°	Deflection was	1′	53°
"	2′	30	"	2′	52
"	3′	30	"	3′	55
"	4′	30	"	4′	56
"	5′	30	"	5′	59
			"	6′	62

Temp. descending from 140° to 130°.

Def.	1′	60°
"	2′	57
"	3′	55
"	4′	55
"	5′	55
"	6′	54

In the first experiment with the heated solution, the average temperature was 130°, and the average deflection corresponding was 56°. In the next experiment, the mean temp. was 135°, and def. 56°.

22. After removing the plates, and allowing the solution to cool down to 70°, which took place in about three hours, the plates were again plunged, and the lamp reapplied. The following are the results of the deflections for each minute, until the solution reached the boiling point.

Minutes.	*Def.*	*Minutes.*	*Def.*
1	46°	10	94°
2	49	11	98
3	52	12	105
4	58	13	110
5	64	14	116
6	72	15	120
7	78	16	126
8	83	17	135
9	88	Boiling, 18	145

From this series it appears, that in the circumstances of our experiment the effect of boiling solution is about $3\frac{1}{6}$ as great as that of the same solution at 70°. From the time which the plates are immersed, in these experiments, the decline of permanent action must be considerable, and therefore the full effect of the elevated temperature is not perceived. It is probable, that had the solution remained at 70° for the same period of 18 minutes, it would have fallen at least 3 or 4 degrees from 46, in which case the energy of the battery at the boiling point would be three and a half times its power at 70°.

23. As it was desirable to obtain several observations at each stage of temperature, a small spirit lamp was now applied to maintain the temperature constant at each point where the observations were made. The solution in this case was 1 sulphuric acid to 60 water. In making the first column of observations, the lamp was withdrawn and reapplied, to ascertain if the deflections were constant at the same temperatures. This they seem to be, and the fact would appear to have an important bearing, as pointing to some law which may possibly be found to connect the increase of the deflection with some co-efficient of the temperature.

It being important, for obvious reasons, to expedite the cooling of the solution, artificial means were employed.

Our object in the present experiments being merely to establish the remarkable gain of power, with the view to recommend its more frequent use in experiment, rather than its precise rate of effect, no great regularity was observed in the intervals between the successive stages of temperature.

The slips, as before, were ¾ of an inch apart, and were plunged two inches into the solution.

	Temp.	Def.	1st eff. +500°.
1′	210°	166°	
2	206	160	
3	208	163	
4	210	165	
5	205	158	
6	203	153	
7	200	150	

The plates were now removed, and the solution cooled down to 190°; this and the succeeding intervals of cooling occupied each about four minutes.

Temp.	190° Def.	180°	170°	160°
1′	152	145	134	131
2′	146	139	132	129
3′	146	138	132	126

	140°	120°	100°	80°	56°
1′	121	106	90	75	61
2′	119	104	88	69	54
3′	119	103	86	69	46
4′					46

24. Similar experiments were now made with nitric acid, 1 to 50.

Temp.	210°	200°	170°	140°
1′	385	355	320	293
2′	385	348	320	291
3′	385	346	320	290
4′	385	346	320	285
5′	385	346	320	285
6′	385			

	120°	100°	80°	70°	60°
1′	261	247	230	210	194
2′	253	242	226	209	192
3′	252	239	225	209	190
4′	252	234	224	209	190
5′		234	224	209	190

25. In order to expose the plates a less time to the solution for reasons before assigned, the following were made, in which the deflections were noted at the end of each minute.

Thirty minutes were consumed in heating the solution to boiling, which took place at 210°. The ebullition was gentle, to avoid agitation of the liquid, which would have brought into play a portion of the surface above the parts immersed. It will be observed in comparing these results with the former in which a more rapid change of temperature was effected, namely, in 18 minutes, that the increased effect arising from temperature is somewhat less than before.

	Temp.	*Def.*		*Temp.*	*Def.*
1′	75°	70°	16′	142°	109°
2	80	73	17	145	111
3	84	76	18	150	113
4	90	78	19	154	114
5	94	80	20	157	115
6	100	84	21	160	116
7	104	87	22	166	117
8	108	90	23	170	118
9	113	92	24	176	120
10	116	96	25	182	123
11	120	98	26	186	128
12	124	100	27	194	131
13	130	103	28	200	135
14	134	105	29	206	141
15	137	107	30	210	147

As we are now prosecuting these investigations upon the powers of the battery in its various modifications of form, &c., we shall reserve for a future paper the more practical applications of the facts we have been developing. It is apparent from what we have already shown, that the efficiency of the present galvanic arrangement is capable of being greatly increased, and the experiments we are now making with the compound battery may enable us to show, we hope, to *what extent.*

If the experiments detailed, throughout the foregoing paper be correct, and we have not been able, on a careful revision, to discover any thing in the mode of making them which ought to invalidate their results, we have arrived at some conclusions which have an important bearing on the theoretical question of the source of the electricity in the battery. Why, if the chemical theory of the battery be true, should the first instant of immersion be attended by a deflecting energy so much greater than at any period after; when it is obvious to the eye that, at this moment, the chemical action has scarcely as yet commenced. For the first few seconds indeed, little or no hydrogen can be seen escaping from the zinc plate, although by the time the power has *declined* to a more stationary condition, the discharge of gas, and consequently the accompanying chemical action upon the zinc, have increased to many times their former quantity. Again, by the chemical hypothesis, the oxidation of the zinc is held to be the cause which here first disturbs the electric equilibrium; but why then is it, that the activity of the battery does not augment with the quantity of *zinc*, in place of obeying, as we have shown, very opposite laws, decreasing with the zinc, and augmenting with the *copper*. So intimate has the connection always seemed between this theory, and the law of the power being as the surfaces acted on, that those who receive the theory, generally take for granted the law, as an *a priori* fact. Our experiments go far, we think, to show that neither the *law* nor the *theory* are true in nature.

The other theory, that of Volta, is obviously incompetent to explain many of the results we have obtained; for instance, that above alluded to, which proves an increase of zinc plate to be injurious, while the same increase of copper is so highly beneficial.

We therefore dismiss this subject of the theory of the battery, in the hope that some gifted individual, Faraday perhaps, in following up his present brilliant discoveries in electricity, may penetrate the obscurity which now conceals the internal movements of this mighty and wonderful instrument.

Art. III.—*Some Encomiums upon the excellent Treatise of Chemistry, by Berzelius; also objections to his Nomenclature, and suggestions respecting a Substitute, deemed preferable, in a letter to Professor Silliman; by* Robert Hare, M.D., Prof. of Chemistry in the University of Pennsylvania.

Philadelphia, June, 1834.

Dear Sir,—I have already apprized you, that last year I had the honor to receive from the celebrated Berzelius, six volumes of his admirable treatise of Chemistry; to which, during the last summer, I gave much time, in order to avail myself of the vast fund of useful practical knowledge which it contains. I am of opinion that to adepts in the science, this treatise is the most interesting and instructive compilation of chemical knowledge which has ever issued from the press. It comprises much matter for which Chemistry is indebted entirely to the genius, skill, and industry, of the author, while scarcely any subject in it, is so treated, as not to create a renovated interest in the reader, however previously familiar with the science.

Sweden may with reason be proud of her Scheele, her Bergman, and her Berzelius. The last, but not the least, of these great chemists, aided by an Herculean intellect, and commencing at the point at which his predecessors terminated their glorious career, may be considered as possessing attainments which have never been excelled. Yet the sun is not without spots, nor is Berzelius without errors; unless indeed, those which I have ascribed to him, are phantoms of my own intellectual vision.

I concur with those chemists who consider the relation ascertained by Berzelius, between the quantities of oxygen in oxybases, and in oxacids, as a necessary consequence of the laws of combination, on which the Daltonian theory has been founded. I conceive also that the interesting facts which demonstrate the existence of the relation alluded to, would be more easily understood and remembered, if referred to the theory of atoms, than when made the basis of his doctrine of capacities for saturation, and of the numbers by which those capacities are expressed.

Moreover, I do not approve of his nomenclature. This is a subject highly interesting to me at this time. The last edition of my text book is exhausted, and in publishing a new edition I shall be obliged either to adopt the nomenclature of Berzelius, or to adhere to that now generally used, with such improvements as may seem to me consistent with its principles.

I will proceed to state my objections to the Berzelian nomenclature, and to suggest the language which I would prefer. I should be glad if the promulgation of my opinions should call forth remarks, which may enable me to correct, in due season, any errors into which I may have fallen. I regret the necessity of making a final election, before submitting my objections to Berzelius himself, whose disapprobation it would grieve me much to incur.

My apology will be found in the adage—"Amicus Plato, sed magis amica veritas." Besides, if my opinions are incorrect, they will only react upon their author. The productions of Berzelius stand deservedly too high in public favor to be reached by ill founded criticism.

The most striking feature in the nomenclature of Berzelius, is the formation of two classes of bodies; one class called "*halogene*," or salt producing, because they are conceived to produce salts directly; the other called "*amphigene*," or both producing, being productive both of acids and bases, and of course indirectly of salts. To render this division eligible, it appears to me that the terms acid, base, and salt, should, in the first place, be strictly defined. Unfortunately there are no terms in use, more broad, vague, and unsettled in their meaning. Agreeably to the common acceptation, chloride of sodium is pre-eminently entitled to be called a salt; since in common parlance, when no distinguishing term is annexed, salt is the name of that chloride. This is quite reasonable, as it is well known that it was from this compound, that the genus received its name. Other substances, having in their obvious qualities some analogy with chloride of sodium, were, at an early period, readily admitted to be species of the same genus; as, for instance, Glauber's salt, Epsom salt, sal ammoniac. Yet founding their pretensions upon similitude in obvious qualities, few of the substances called salts, in the broader sense of the name, could have been admitted into the class. *Insoluble* chlorides have evidently, on the score of properties, as little claim to be considered as salts, as *insoluble* oxides. Luna cornea, plumbum corneum, butter of antimony, and the fuming liquor of Libavius, are the appellations given respectively to chlorides of silver, lead, antimony, and tin, which are quite as deficient of the saline character as the corresponding compounds of the same metal with oxygen. Fluoride of calcium (fluor spar) is as unlike a salt as lime, the oxide of the same metal. No saline quality can be perceived in the soluble "haloid salts," so called by Berzelius, while free from water; and when a compound of this kind is moistened, even by contact with the tongue, it may be considered as a salt formed of an hydracid and an oxybase, produced by a union of the hydrogen of the water with the halogene element, and of the oxygen with the radical. It is admitted by Berzelius, vol. iii, p. 330, that it cannot be demonstrated that the elements of the water, and those of an haloid salt, dissolved in that liquid, do not exist in the state of an hydracid and an oxybase, forming a salt by their obvious union.

On the other hand, if, instead of qualities, we resort to composition as the criterion of a salt; if, as in some of the most respectable chemical treatises, we assume that the word salt is to be employed only to designate compounds consisting of a base united with an acid, we exclude from the class chloride of sodium, and all other "haloid salts," and thus overset the basis of the distinction between "*halogene*" and "*amphigene*" elements.

Moreover, while thus excluding from the class of salts, substances which the mass of mankind will still consider as belonging to it, we assemble under one name combinations opposite in their properties, and destitute of the qualities usually deemed indispensable to the class. Thus under the definition that every compound of an acid and a base, is a salt, we must attach this name to marble, gypsum, felspar, glass, and porcelain, in common with Epsom salt, Glauber's salt, vitriolated tartar, pearlash, &c. But admitting that these objections are not sufficient to demonstrate the absurdity of defining a salt, as a compound of an acid and a base, of what use could such a definition be, when, as I have premised, it is quite uncertain what is an acid, or what is a base. To the word acid, different meanings have been attached at different periods. The original characteristic sourness, is no longer deemed essential! Nor is the effect upon vegetable colors treated as an indispensable characteristic. And as respects obvious properties, can there be a greater discordancy, than that which exists between sulphuric acid, and rock crystal; between vinegar, and tannin; or between the volatile, odoriferous, liquid, poison, which we call prussic acid, and the inodorous, inert, concrete, material for candles called margaric acid?

While an acid is defined to be a compound capable of forming a salt with a base, a base is defined to be a compound, that will form a salt with an acid. Yet a salt is to be recognised as such, by being a compound of the acid and base, of which, as I have stated, it is made an essential mean of recognition.

An attempt to reconcile the definitions of acidity given by Berzelius, with the sense in which he uses the word acid, will in my apprehension, increase the perplexity.

It is alleged in his Treatise, p. 1, Vol. II, "*that the name of acid is given to silica, and other feeble acids, because they are susceptible of combining with the oxides of the electropositive metals, that is to say, with salifiable bases, and thus to produce salts, which is precisely the principal character of acids.*" Again, Vol. I, p. 308, speaking of the *halogene* elements, he declares that "their combinations with hydrogen, are not only acids, but belong to a series the most puissant that we can employ in Chemistry; and in this respect they rank as equals with the strongest of the acids, into which oxygen enters as a constituent principle." And again, Vol. II, p. 162, when treating of hydracids formed with the halogene class, he alleges, "*The former are very powerful acids, truly acids, and perfectly like the oxacids; but they do not combine with salifiable bases; on the contrary, they decompose them, and produce haloid salts.*"

In this paragraph, the acids in question are represented as preeminently endowed with the attributes of acidity, while at the same time they are alleged to be destitute of his "*principal character of acids,*" the property of combining with salifiable bases.

In page 41, (same volume) treating of the acid consisting of two volumes of oxygen and one of nitrogen, considered by chemists generally as a distinct acid, Berzelius uses the following language. "If I have not coincided in their view, it is because, judging by what we know at present, the acid in question cannot combine with any base, either directly or indirectly, that consequently it does not give salts, and that salifiable bases decompose it always into nitrous acid,* and nitric oxide gas. It is not then a distinct acid, and as such, ought not to be admitted in the nomenclature." Viewing these passages with all that deference which I feel for the productions of the author, I am unable to understand upon what principle the exclusion of nitrous acid from the class of acids, can be rendered consistent with the retention, in that class, of the compounds formed by hydrogen with "*halogene*" elements.

Having thus endeavored to show that the words acid, salt, and base, have not been so defined as to justify their employment as a basis of the Berzelian nomenclature, I will, with great deference, proceed to state my objections to the superstructure, erected upon this questionable foundation. Consistently with the French nomenclature, the combinations formed by electronegative principles, with other elements, have been distinguished as *acids*, or characterized by a termination in "*ide*," or in "*ure*," which last monosyllable, when there has been no intention of altering the meaning, has, by the British chemists, been translated into *uret*. The termination in ide,

* Hyponitrous acid of other chemists.

which is common to both languages, is, by Thenard, and other eminent French authors, restricted to the binary compounds of oxygen, which are not acid. Analogous compounds formed with the "*halogene*" elements, chlorine, bromine, fluorine, iodine, cyanogen, &c., have by the same writer been designated by the termination in ure. Thus we have in his work, chlorures, bromures, fluorures, iodures, cyanures. Some of the most eminent chemists in Great Britain, have distinguished the elements called halogene, by Berzelius, together with oxygen, as supporters of combustion; and have designated the binary compounds made with them, when not acid, by the same termination as the analogous compounds of oxygen. Accordingly in their writings, instead of the names above mentioned, we have chlorides, bromides, fluorides, iodides. In Henry's Chemistry, cyanure is represented by cyanide; in Thomson's, by cyanodide, and in Brande's and Turner's, by cyanuret.

The term *uret*, equivalent as above mentioned to the French *ure*, is restricted by the English chemists to the compounds formed by non-metallic combustibles, either with each other, or with metals. Hence we have in English, sulphurets, phosphurets, carburets, borurets, for sulphures, phosphures, carbures, borures, in French.

Berzelius classes as electronegative, all those substances which go to the positive pole when isolated, or *when in union with oxygen*, while all substances are by him treated as electropositive which go to the negative pole, either when isolated, or when in union with oxygen.* (See Vol. 1st, page 201.)

According to his nomenclature, when both the ingredients in a binary compound belong to the class of bodies by him designated as electronegative, the termination in ide, is to be applied to the more electronegative ingredient; but where one of the ingredients belongs to his list of electropositive bodies, the termination in ure, (uret, in

---

* The term isolated is employed to convey an idea of the state in which the elements of water are, when after having been separated by the voltaic wires, they are severally on their way to their appropriate poles, that is, the oxygen proceeding to the positive pole, and the hydrogen to the negative pole. Each element is, in that case, isolated, and obedient to the attractive influence of one of the poles. When a salt containing an oxacid and an oxybase, is decomposed, the acid will go to the positive, and the base to the negative pole. The radical of the acid, in consequence of its not counteracting the propensity of the oxygen for the positive pole, is deemed electronegative; while the radical of the base overcoming that propensity, is deemed electropositive.

English) is to be applied to the electronegative ingredient. As, agreeably to the prevailing nomenclature, which in this respect the great Swedish chemist has not deemed it expedient to change, the electropositive compounds of oxygen with radicals, forming electropositive bases, have each a termination in ide, it seems that consistency requires us, conformably with the English practice, to designate in like manner analogous electropositive compounds of the electronegative elements called by him "*halogene*." But especially it would be inconsistent not to put the same mark upon the compounds of substances which from their analogy with oxygen are placed in the same "*amphigenc*" class. If there were insuperable reasons for retaining the term oxide, as a generic name for the electropositive compounds of oxygen, it seems to me inexpedient not to employ the words sulphide, selenide, and telluride, to designate the electropositive compounds of sulphur, selenium, and tellurium. And since the three last mentioned elements when united with hydrogen, form electronegative compounds which act as acids, why not treat them as such, under appellations corresponding with those heretofore used for that purpose?

I conceive the following definitions to be justified by the practice of modern chemists in general, as established in the case of oxacids and oxibases. *When two compounds capable of combining with each other to form a tertium quid, have an ingredient common to both, and one of the compounds prefers the positive, the other the negative pole of the voltaic series, we must deem the former an acid, the latter a base.* And again, all compounds having a sour taste, or which redden litmus, should be deemed acids in obedience to usage.

I should think it preferable, if in adopting these definitions, the termination in ide was considered as applicable to all compounds of electronegative principles with other substances, whether producing electronegative or electropositive combinations, and that the terms acid, and base, should be considered as severally indicating the subordinate electronegative, and electropositive compounds. In that case oxybase, chloribase, fluobase, bromibase, iodobase, cyanobase, sulphobase, telluribase, selenibase, would stand in opposition to oxacid, chloracid, fluacid, bromacid, iodacid, cyanacid, sulphacid, selenacid, telluracid; yet for convenience, the generic termination ide might be used without any misunderstanding; and so far, the prevailing practice might remain unchanged. Resort to either appellation would not, agreeably to custom, be necessary in speaking of salts or other compounds analogous to them; since it is deemed sufficient to mention the radical as if it existed in the compound in its metallic state. Ordinarily we say, sulphate of lead, not sulphate of the oxide of lead. This last mentioned expression is resorted to, only where great precision is desirable. In such cases, it might be better to say sulphate of the oxybase of lead. So long however as the electronegative combinations of oxygen are designated as oxacids, and the electropositive as oxides, it seems to be incorrect, not to use analogical terms in the case of analogous compounds, formed by other pre-eminently electronegative principles; and assuming the definition above stated, to be justified by modern practice, it follows, that in order to entitle the electronegative and electropositive ingredients of the double salts of Berzelius, to be classed, the latter as bases, and the former as acids, it is not necessary to appeal to the highly interesting and important experiments of Bonsdorf, confirmed in some instances by the testimony of Berzelius himself, proving that the attributes of acidity (as heretofore defined) exist in the one case, and those of alkalinity in the other. My definition is founded upon the conviction that these characteristics have not latterly been deemed necessary to acids, and that in bases, they never were required; having, as respects them, only served as a means of subdivision, between alkaline oxides and other bases.

Chemistry owes to Berzelius much valuable information respecting the compounds formed by the substances which he calls "*halogene;*" especially respecting the combination formed by fluorine, with boron, and silicon, and the "*double salts,*" as he considers them, formed by the union of two "*halogene salts,*" &c. While in the highest degree interested in the facts which he has ascertained, it will be inferred from the premises, that I do not perceive that any adequate line of distinction can be drawn in this respect between the simple salts formed by oxacids and oxybases; and the *double* salts formed by his "*halogene*" elements.—Agreeably to the definition which I have ventured to propose, in a combination of this kind, the electronegative salt would play the part of an acid, while the electropositive salt would perform that of a base.

In common with other eminent chemists, he has distinguished acids in which oxygen is the electronegative principle, as *oxacids,* and those in which hydrogen is a prominent ingredient as *hydracids.* If we look for the word radical, in the table of contents of his invaluable Treatise, we are referred to p. 218, vol. 1st., where we find the following definition, "*the combustible body contained in an acid, or in a salifiable base, is called the radical of the acid, or of the base.*" In the second vol. p. 163, he defines hydracids to be "those acids, which contain an electronegative body, combined with hydrogen;" and in the next page it is stated, that "hydracids are divided into those which have a simple radical, and those which have a compound radical. The second only comprises those formed with cyanogen and sulphocyanogen." Again, in the next paragraph, "no radical is known that gives more than one acid with hydrogen, although sulphur and iodine, are capable of combining with it in many proportions. If at any future day more numerous degrees of acidification with hydrogen, should be discovered, their denomination might be founded on the same principles as those of oxacids." Consistently with these quotations, all the electronegative elements forming acids with hydrogen, are radicals, and of course by his own definition, combustibles; while hydrogen is made to rank with oxygen as an acidifying principle, and consequently is neither a radical nor a combustible. Yet page 189, vol. 2d, in explaining the reaction of fluoboric acid with water, in which case, fluorine unites both with hydrogen and boron, it is mentioned as one instance among others in which fluorine combines with *two combustibles.*

I am of opinion that the employment of the word hydracid, as coordinate with oxacid, must tend to convey that erroneous idea, with which, in opposition to his own definition, the author seems to have been imbued, that hydrogen in the one class, plays the same part as oxygen in the other. But in reality, the former is eminently a combustible, and of course the radical, by his own definition.

Dr. Thomson, in his system, does not recognise any class of acids, under the appellation of hydracids; but with greater propriety, as I conceive, places them under names indicating their electronegative principles. Thus he arranges them as oxygen acids, chlorine acids, bromine acids, iodine acids, fluorine acids, cyanogen acids, sulphur acids, selenium acids, and tellurium acids.* Those appellations might, I think, be advantageously abbreviated into oxacids, chloracids, fluacids, bromacids, iodacids, cyanacids, sulphacids, selenacids, telluracids.

As respects the acids individually, I conceive that it would be preferable, if the syllable indicating the more electronegative element

---

* I had formed my opinions on this subject, before I was aware that Dr. Thomson had resorted to this classification.

had precedency in all, as it has in some cases. The word hydrofluoric does not harmonize with fluoboric, fluosilicic, fluochromic, fluomolybdic, &c. Fluorine being, in each compound, the electronegative principle, the syllables indicating its presence, should in each name occupy the same station. These remarks will apply, in the case of acids formed with hydrogen, by all principles which are more electronegative. Hence we should use the terms chlorohydric, fluohydric, bromohydric, iodohydric, cyanhydric, instead of hydrochloric, hydrofluoric, hydrobromic, hydriodic, hydrocyanic.

These opinions, conceived last summer, were published by me in the Journal of Pharmacy for October last. Since then, I find that in the late edition of his Traité, Thenard has actually employed the appellations above recommended.

As by the British chemists the objectionable words have not been definitively adopted; the appellations muriatic and prussic, being still much employed, it may not be inconvenient to them, to introduce those which are recommended by consistency. In accordance with the premises, the acids formed with hydrogen by sulphur, selenium, and tellurium, would be called severally sulphydric, selenhydric, and telluhydric acid. Compounds formed by the union of the acids thus designated, with the bases severally generated by the same electronegative principles, would be called sulphydrates, selenhydrates, and telluhydrates, which are the names given to these compounds in the Berzelian nomenclature. Influenced by the analogy, a student would expect the electronegative ingredient of a sulphydrate to be sulphydric acid, not a sulphide. The terminating syllable of this word, by its associations, can only convey the conception of an electropositive compound.

By adhering to the plan of designating each acid by its most electronegative ingredient, the compounds of hydrogen and silicon, or of hydrogen and boron with fluorine, would appear in a much more consistent dress. In the compound named hydrofluoboric acid, and that named hydrofluosilicic acid by Berzelius, fluorine is represented as acting as a radical with hydrogen, while with boron and silicon it acts as the electronegative principle. It has been shown that hydrogen, no less than boron and silicon, must be considered as a combustible, and of course a radical. This being admitted, if the compounds in question are really entitled to be considered as distinct acids, their names should respectively be fluohydroboric, or fluohydrosilicic acid. But as I have elsewhere observed an incapacity to combine with bases, or to react with them without decomposition, is made by Berzelius an adequate reason for expunging the compound formed by one atom of nitrogen with four atoms of oxygen from the list of the acids of nitrogen. I do not, therefore, understand how the compounds referred to, while equally incapable of combination, can be considered by him as acids. At first it struck me that the liquids consisting of fluohydric acid, either with fluoboric acid, or with fluosilicic acid, might be considered as merely united by their common attraction to water, since they separate when this liquid is abstracted by evaporation. Upon reflection, however, I retract that opinion, since it appears to me that if the compounds in question are to be considered as acids, they may be viewed satisfactorily as fluacids with a double radical; but I deem it more consistent to suppose that a fluobase of hydrogen in the one case unites with fluoboric acid, in the other, with fluosilicic acid; so that fluohydroboric acid, might be called fluoborate of the fluobase of hydrogen, or more briefly, fluoborate of hydrogen; and in like manner, fluohydrosilicic acid would be called fluosilicate of the fluobase of hydrogen, or briefly fluoscilicate of hydrogen.

There are instances in which compounds, usually called bases act as acids. Of course it is consistent that compounds, usually called acids, should in some instances act as bases. In this respect, a striking analogy may be observed between the union of the oxide of hydrogen (water) with the oxacids and oxybases; and that of fluoride of hydrogen with fluacids and fluobases. According to Berzelius, water, in the first case, acts as a base, in the second as an acid. So I conceive the fluoride of hydrogen acts as a base in the cases above noticed, while it acts as an acid in the compound of hydrogen, fluorine, and potassium, called by Berzelius "*fluorure potassique acide.*" This compound I would call a fluohydrate of the fluobase of potassium, or more briefly fluohydrate of potassium, as we say sulphate of copper, instead of the sulphate of the oxide (or oxybase) of copper. It appears from the inquiries of the author of the nomenclature under consideration, that each of the three acids above mentioned as formed by fluorine, with the three different radicals, hydrogen, boron, and silicon, is capable, with electropositive metallic fluorides, of forming the compounds treated of by him as double salts. These compounds, to which I have already alluded, might be called fluohydrates, fluoborates, or fluosilicates of the metallic ingredient. As for instance, the compound into which potassium enters, named by him "*fluorure* *borico potassique*," I would designate as a fluoborate of the fluoride (or fluobase) of potassium, or for the sake of brevity, fluoborate of potassium. "Fluorure silico potassique," would by the same rule, be called fluoscilicate of potassium.

The illustration thus given in the instance of potassium, renders it unnecessary to furnish other examples, as it would only require that the name of any other metal should be substituted for that of potassium, in order to modify these appellations, so as to suit every case.

Pursuant to my fundamental definition, ferroprussiate of potash, cyanure ferroso potassique in the Berzelian nomenclature, should be considered as a compound of cyanoferric acid, and a cyanide or cyanobase of potassium, and would of consequence be a cyanoferrate of potassium. Or if the iron be in two different degrees united with cyanogen, as the names cyanure ferroso potassique, and cyanure ferrico potassique indicate, we should have both a cyanoferrite and a cyanoferrate of potassium; and of course cyanoferrous and cyanoferric acid for their respective electronegative ingredients. "Cyanure ferrique acide" would be exchanged for cyanoferrate of hydrogen, being a case analogous to that of the "fluorure potassique acide" above considered and provided for.

If I am justified in my impression above stated, water, and the compound formed by fluorine with hydrogen ("hydrofluric acid" or fluohydric acid as I prefer to call it) should be severally designated as acids when they act as acids; as bases, when they act as bases. In other cases the one might be designated as an oxide, the other as a fluoride, of hydrogen. In the case of a compound so well known as water, I would adhere to the common name, resorting to the scientific names only as definitions. Thus water would be defined as an oxide of hydrogen, which in some combinations, acts as an oxybase of hydrogen, in others as hydric acid, or the oxacid of hydrogen.*

After designating as metalloids all non-metallic bodies, Berzelius alleges (page 203, vol. 1st,) that they are divided into oxygen, and bodies which are *combustible*, or *susceptible of combining with oxygen;* in which process, the greater part display the ordinary phe-

---

* The use which I have made of the terminations in ide, in fluoride of hydrogen, or oxide of hydrogen, to signify a compound of hydrogen with fluorine, or oxygen generally, without conveying the idea of its being either a base or an acid, illustrates the advantage which would result from the use of that termination in that broad sense.

nomena of combustion, or, in other words, of fire. Agreeably to this classification, susceptibility of union with oxygen and combustibility are confounded; to which I object, because oxidizement frequently ensues without combustion, and combustion occurs often without oxidizement.

Speaking of chlorine, (Treatise, p. 276, vol. I.) it is alleged that it supports the combustion of a great number of bodies, of which a majority ignite in it at ordinary temperatures. If oxidizement be identical with combustion, how can this word be employed with propriety in the case thus quoted, where oxygen is not present? If combustion in the case of chlorine is applied only to those instances in which reaction with other bodies is attended by the phenomena of fire, why is not the term equally restricted in its application in the case of oxygen?

Oxygen differs so far from the substances usually called combustibles, that they will produce fire with oxygen, and with but few, if any other substances; while oxygen will produce fire with many substances. But this characteristic of producing fire with many substances, applies to chlorine, and as chlorine does not produce fire with oxygen, it is devoid of the only characteristic which should entitle it to be treated as a combustible, if combustibility and susceptibility of union with oxygen be identical.

Hence, if it be deemed proper in the case of oxygen to place the bodies with which it enters into combustion in one class, designated as combustibles, while oxygen is distinguished as the common "*comburant*" of them all, there is equal reson for placing chlorine in a like predicament. The impropriety of designating the substances comprised in his halogene and amphigene classes, with the exception of oxygen as combustibles, upon the basis of their susceptibility of oxidizement, must be evident from the fact, that fluorine is not oxidizeable, while it is so perfectly analogous to the others, especially chlorine, in its properties, that it would be disadvantageous to class it apart.

Berzelius objects to the use of the word "*comburant*," (equivalent to the English word supporter) upon the ground that the same substance may alternately be a supporter and a combustible. I should, however, go farther, and likewise object to the use of both words, as tending to convey the erroneous impression, that in combustion, one of the ponderable agents concerned, performs a part more active than the other; whereas, in all such cases, the reaction must evidently be reciprocal and equal. I have repeatedly shown to my pupils, that a jet of oxygen burns in an atmosphere of hydrogen, as well as a jet of hydrogen similarly situated in oxygen.

I would recommend that all the bodies comprised in the halogene and amphigene classes of Berzelius, should be placed under one head, to be called the basacigen class; indicating their common and distinguishing quality agreeably to the premises, of producing both acids and bases. The electronegative compounds of these substances to be called acids, their electropositive compounds, bases, as already suggested.*

Art. IV.—*Miscellaneous Communications from an American Naval officer, travelling in Europe; forwarded from the Mediterranean, May,* 1834.

1. Medals.

Information for American Colleges.—As numismatics forms a useful branch of study, and as in our country, collections of original coins† are seldom to be procured, and when so, at great expense, I have thought our colleges might be interested by an account of an establishment, which I met with in London, a few months ago. The enclosed advertisement,‡ will inform you pretty well of its character.

---

* After the preceding letter was ready for the press, the following remark of Berzelius attracted my attention, as sanctioning indirectly the definition which I have proposed, page 66.

Treatise, Vol. 3, page 323, he alleges—" It follows from this that the property of playing the part of an acid, is attached neither to the substance, nor to the manner in which the combination takes place. *It only indicates a state contrary to the property of being a base.*

† The writer has himself a cabinet of coins, and has made numismatics a little the subject of study.

‡ J. Doubleday, 32, little Russel st., Museum st. (near the British Museum,) Lond., has on sale, casts in sulphur of nearly all the ancient seals, that have been engraved or described in the *Vetusta Monumenta, Archaeologia*, and other antiquarian and topographical works. Great seals of England from Edward the confessor: baronial, conventual, and corporate seals, from the conquest, taken from seals appended to deeds and charters in the various record depositories in the kingdom, or from original matrixes. Beautiful impressions of that extraordinary seal of Southwick Priory, Hants, described in the Archaeologia, vol. xxiii. A very extensive collection of the most beautiful and rare Greek and Roman coins, in sulphur and white metal. Casts of the rarest English and foreign medals, made to imitate the finest bronze, including the Paris mint series of Buonaparte complete. Impressions from ancient and modern gems, Etruscan pateræ, and other antiquities. Great seals from 1s. to 2s. 6d. Baronial, &c. 4d. each. Greek and Roman coins, 4d.; medals, 4d. to 1s. each.

I became acquainted with Mr. Doubleday, who is an American by birth, and a very ingenious and intelligent man; we visited, together, the cabinet of coins and gems in the British museum, and I found that he is permitted to copy any thing he may desire in that great collection, valued, I was informed at about a million of pounds sterling. He also visits, now and then, the collection in the *Bibliothéque Royale* at Paris, where also he is allowed the privilege of copying. He colors his sulphur, and the copies are often so well dòne, that it is impossible, by the sight alone, to distinguish them from the originals. The splendid Bonaparte medals by Denon, are here copied, so as to have all the boldness and extreme delicacy for which these rivals of the antique are distinguished. The London University has supplied itself entirely from Mr. Doubleday's collection of copies; the professors told him that they would answer all the pnrposes of study as well as the originals, while a vast saving of expense would be effected. He also has large orders from country gentlemen and Lyceums, in all parts of England. He also copies silver coins in white metal, but although the copies are as accurate as those in sulphur, the metal has the color rather of tin than of silver, and I did not like them so well; still they are very fair imitations of the originals. It is his custom, when copying silver and gold coins in sulphur, to distinguish them by different colors, making the gold a deep red, &c.—he also labels them. To my question, what variety he could readily furnish and at what (the lowest) price—he replied that he had casts for 6000 Greek coins, 1050 Roman large Bronze, 1000 medium do.; Roman gold 500, do. silver 1000—all these for 4*d.** each;—Roman medallions 300 6*d.* each, copies in metal from 1*s.* to 2*s.* 6*d.* each.—The charge for the Madrassis is 5*s.* thence down to the uncia from 1*s.* to 4*d.*; the high price of the Madrassis, arising from the difficulty of making a cast endure for more than one copy. He has also, copies of a suit of medals of the English Sovereigns, from the Conqueror to George II. 34 in all, struck by Dassiers, in the reign of the latter king; from Richard the III. down, they are said to offer correct likenesses; the charge for these is 6*d.* each.

From what I have seen of Mr. Doubleday's establishment, I have no hesitation in recommending it to the attention of our colleges; to the amateur collector, it also offers the means of providing at a trifling expense, fac-similes of medals not to be had, or if so, at ex-

* The penny in London is worth exactly two cents in our currency.

travagant cost. It is the only one of the kind, with which I am acquainted; Mon. Mionnet of the cabinet of Paris, formerly took copies in sulphur, (his prices were the same as Mr. Doubleday's,) but when I sent last spring to him for some, I was informed that he had discontinued the business some years since. I saw also for sale in Mr. Doubleday's collection, a copy of the celebrated Rosetta stone, now in the British Museum, done in sulphur or plaster, I do not recollect which: he appeared to have succeeded as well in this as in the medals.

Should any of our institutions, however, prefer the originals to copies, they can easily supply themselves at the house of Matthew Young, Esq., 41 Tavistock street, Covent Garden, London. He has constantly on hand, a large collection; when I visited him, it amounted to 100,000, including coins of all countries, but was particularly rich in those of England. I was informed that Mr. Young is so jealous as to the character of his cabinet, that if he happens to purchase a counterfeit, he immediately melts it down or destroys it in some other way. His prices are—Roman silver from 18*d.* to some guineas; do. large brass, 2*s.* 6*d.* the lowest; Greek coins from 10*s.* to 30*s.* and so on to several pounds. He has a large collection of *American coins and medals,* together with several, struck in Great Britain and France, relative to our country. Among them are full setts of the Annapolis medals, (cost high,) Lord Baltimore's, do., said to be rare; they are in silver and cost one guinea each. Medals of Washington from 2*s.* 6*d.* to 10*s.* 6*d.*—also of Franklin for the same price.

I will add a list of some American coins, &c. which I purchased from him, and which you can publish or not according to the interest you think they may have at home.

1. White metal, 1⅝ inch in diameter, obverse, three concentric circles—in the first belt the legend, *Continental currency,* 1776; in the second, a sun, legend, *fugio;* in the centre, a sun dial, legend, *mind your business,* reverse 13 circles joined, on each the name of a state; within this a circular band with rays, inscribed *American Congress;* in the centre, legend, *we are one.*

2. Copper, obverse, sun with 13 stars among its rays—legend, *Nova Constellatio;*—reverse, legend, *Libertas et Justitia,* 1785; within this, a laurel wreath encircling the letters *U. S.* Another nearly similar, dated 1783.

3. Obverse, an elephant; reverse, legend, *God preserve Carolina and the Lords Proprietors,* 1694.

4. Obverse, horse's head, beneath this, a plough, and 1786, legend, *Nova Caesarea;* reverse, *U. S.* coat of arms, legend, *E. pluribus unum.* Another like this, date, 1787.

5. Obv. head crowned with laurel, legend, *Nova Eborac;* reverse, a female figure seated; in dex. a flower, in sin. a spear with cap of liberty, legend, *virt. et lib.*

6. Obv. sun shining on a dial, legend, *fugio,* 1787, beneath all, *mind your business;* reverse, a chain of 13 plain circular links; within this, a circular band inscribed *United States;* centre, legend, *We are one.*

7. Obv. head of Washington; legend *Washington President,* 1791: rev. an eagle with arrows and laurel, and in mouth, legend *unum e pluribus* above, *one cent.*

8. Obv. a radiated triangle made by 15 stars, each having the initial of a state, legend *E pluribus unum*: rev. a hand holding a scroll on which is inscribed *our cause is just*; legend round *unanimity is the strength of society.* This is very neatly executed.

9. Obv. an Indian with bow and arrow; legend, *Commonwealth:* rev. eagle, with arrows and laurel, on breast inscribed *cent;* legend, *Massachusetts,* 1787.

10. Obv. a head, beneath it the legend *no stamps;* above, *The Restorer of Commerce,* 1766; rev. a ship under sail—in front of it the legend *America;* around, *Thanks to the friends of Liberty and Trade.*

The above after No. 1., are of copper and about an inch in diameter.

11. Copper, cast, 1⅝ in. in diameter. Obv. head of Washington; legend, *George Washington, born Virginia, Feb.* 11, 1732: rev. legend, *General of the American Armies,* 1775. *Resigned* 1783. *President of the United States,* 1789. *J. Manly, &c.,* 1790. This is very rude, but to a collector it has the valuable quality of being rare.

12. Brass 1⅛ in. in diameter. Obv. Head of Geo. king, legend *Georgius, D. G. Mag. Brit. Fra. et Hib. rex.;* rev. a rose surmounted by a crown, above *Rosa Americana,* 1823; below, *utile dulci.*

Nos. 1. and 11. cost 2*s.* 6*d.*, the rest 6*d.* each.

Mr. Doubleday is in very friendly terms with Mr. Young, and is allowed to copy any thing he may desire in his collection; they have also in the British Museum a collection of American coins and medals, together with medals struck in England, during their late war with us, of all of which copies can be taken.

2. Bead Manufactory at Venice.

Venice! How much like the impressions of a fair vision are my recollections of that city and of the week I spent in it. *Dreamy* is the term for it, for its crowded yet noiseless thoroughfares, the constant gliding of gondolas, its rich palaces, its dungeons, aud even its history, are in character more like the fancy of a dreamer than a sober reality. It was a fiesta when I arrived there, and the three large banners were waving in the piazza of St. Mark's; while close by it a temporary bridge of boats, some hundreds of yards in length, was filled with crowds in gay dresses hurrying to or from the church whose saint claimed the day. I recollect also particularly, one evening, I was seated under the high arcade that lines three sides of the piazza of St. Mark's; the gay shops and coffee houses were brilliantly illuminated, the piazza was filled with company; in the centre a band of forty musicians were performing; I had an ice-cream before me and the last number of Gallignani in my hand and I thought the situation as luxurious an one as I had ever occupied. Among the objects that help to make up the splendor of this piazza, probably the most magnificent in the world, the bead shops, first attract the stranger's attention; I was so much interested by them that I determined to visit the Island of Murano where the beads are made, and, as the process was new to me, a notice of it may also be gratifying to some of your readers. Suppose Dr. T., then and myself reclining upon the soft cushions of a gondola, the blinds of its pretty little chamber drawn so as to admit just the requisite degree of light and air, and gliding along the canals with a kind of rocking motion, sufficient only to let us know that we were moving. We stopped a few minutes to examine the church of St. John, on one way, and soon after found ourselves at the skirts of the city and before and on each side of us a wide expanse of water, dotted in all directions with villages and groves rising apparently from the waves. Among them and distant about a mile and a half, we distinguished the village of Murano, covering an island of that name, or rather islands, for like all others here, it is cut up in all directions by canals. The bead manufactories occupy a range of houses immediately on the left as we entered; that for mirrors is within an enclosure on the right: but as we were not there on one of the days in which it is in operation we did not visit it; indeed the establishment has fallen very much into decay. The bead manufactories however presented a busy scene. In the first to which they conducted us we found a large reverberatory furnace in the centre, with a basin of liquid vitreous matter. A workman put in the end of an iron rod and whirling it slowly around, until a sufficient quantity of matter had attached itself, he withdrew the rod and formed the mass into a rude hollow cone about six inches in diameter, the apex being attached to his rod. Another workman had been doing the same thing at an adjacent opening, and the bases of the two cones being now brought together and united, a quantity of air was thus inclosed. As soon as the junction was perfected, they carried the mass to one side of the chamber and here strips of wood were laid cross-wise along a passage and each one holding his rod in hand they began to walk rapidly in opposite directions. As they did so, the glass drew out and in less than a minute we had a tube of uniform bore and about one hundred and fifty feet in length. This one was of about the thickness of a quill; for the smallest beads they increase the pace to a pretty rapid trot. When a sufficient number of these tubes are formed, they are broken into lengths of about twenty seven inches, and are then carried to an adjoining building called the assorting house. Here they are assorted, the workman being able from the feeling only, to arrange them in different boxes according to their thicknesses and colors. From this house they are now carried to another where the laborers are mostly women and boys. Each one is seated in front of a kind of little anvil, having in the right hand a thin plate of steel, nearly triangular in shape and with a blunt edge: in the left he takes as many of the tubes as will form a single layer between the thumb and fore finger, and advancing their ends against a measure on the anvil, by a dexterous use of the steel, breaks off from each tube a piece of sufficient length for a bead. The bits fall into a box and are about twice as long as the thickness of the bead, (if a common one) is intended to be.

The next operation I thought the most interesting one. The boxes are carried into a large chamber with a furnace in the center of it. A substance which I took to be ashes is moistened and made into a paste, and the bits of tubes are worked about in it until the holes are completely filled; they are then put into a sheet iron cylinder about eighteen inches in length and a foot in width, with an iron handle to it, and about twice as much sand being added, the cylinder is thrust into the furnace and subjected to a rotatory motion. In a short time, the glass becomes soft and yielding: the paste in the holes keeps the bits from being compressed, and from an elongated they assume a spherical shape: when this is done, the paste is worked out by the sand, and the latter penetrating into the holes, the hard, sharp edges are rounded and smoothed, and the heads are soon brought to the shape in which we see them in the market. When cooled, the sand is sifted from them, and after being rubbed in a cloth for the pnrpose of brightening them, they are fit for use.

The quantity manufactured is very great. They are worked up into ladies' bags, sashes, watch guards, shawls, and even caps, &c. and as these are tastefully displayed, a bead shop along the piazza of St. Mark's is a very pretty object.

3. Spectacle Glasses.

Going along an obscure street one day, my attention was attracted by some curious fixtures in a shop, and on going in, I found they were preparing spectacle glasses. One set of the apparatus may be taken as a specimen of all. It consisted of a hemisphere of stiff putty, with another concave one of lead to fit on to it: the latter having its surface sprinkled with emery or some such article. The glasses having been first cut of the proper shape, and having had their sharp edges taken off, were pressed into the surface of the putty, and the leaden hemisphere was made by the hand to move rapidly over, both vertically and horizontally. In a short time, they were worked down so as to form a part of the smooth surface of the hemisphere: and the other side having undergone the same operation, the process was completed. Their convexity was thus, of course, uniform, a primary object in glasses of this kind. For concave glasses, the hemispheres were simply reversed.

4. Papyrus.

Inclosed you will find a small sheet of papyrus, manufactured from plants growing in the neighborhood of Syracuse, in Sicily. One of my first excursions, among the numerous interesting objects that lie about this city, was to the papyrus region; and on the whole, I was highly gratified.

The harbor of Syracuse is large, and its upper end is lined with low marshy lands. Among these, winds a small river, or what we should call a very small creek; and on the banks of this, about two miles from its mouth, the papyrus commences. We had been forcing our boat along the stream with considerable labor, sometimes entangled among the weeds, and sometimes having to lie down to enable it to pass among the overhanging canes, when we suddenly came to a clearer space, and saw, at the head of it, a clump of the plants of which we were in search. They are in every respect very pleasing objects. The roots are from three to four inches in thickness, tortuous and knotty, sometimes running into each other, and forming a thick matted mass which often extends several feet into the stream: they are tolerably woody and hard, and from their lower part send out a number of fibres, which keep them more firmly attached to the soil: except in size, there is a considerable resemblance between them and the root of our calamus,* or water-lily. At the extremity of each root rises a stem which, when full grown, is about ten or twelve feet in height; it is triangular, (the corners rounded,) and without any joint, the rind or bark being perfectly smooth throughout the whole length; the periphery, at the lower part, is about eight inches; from this it tapers gradually to the upper end, where it is not more than from a half to three quarters of an inch in thickness. At the top, it carries a thick tuft of pedicles, somewhat resembling coarse grass thrown out like the top of a parasol, each pedicle being from fifteen to eighteen inches in length, triangular, and at about eight inches from the stem divided into three smaller pedicles, also triangular. At the point of division, is a small red flower, guarded by small sheathes or leaves, also of a reddish color. At the foot of the stem, and fitting close to it, are a number of what may be called reddish leaves; they appear, however, to be the remains of the sheath that protected the plant when yet tender: the same thing occurs, also, at the top or point from which the pedicles spring. The color both of the stalk and pedicles is a dark green: they grow in clumps of from ten to thirty feet in diameter: the stalk is slightly curved by the weight of its tuft, and the smooth surface and graceful tossing figure of the former, with the spread and fullness of the latter, produce together a very good effect. In the sketch enclosed, the stalks are arranged so as to show the tufts, and not in thick clumps, according to the reality.

I have said that the exterior consists of a rind or bark without any joint: it incloses a pith, watery and spongy at the bottom, but becom-

---

* That is the Pennsylvania name: I believe that in New England you have another for this plant.

ing firmer as we ascend. From this *pith* the enclosed specimen has been formed. The only book within my reach, that treats on this subject, states, on the authority of Pliny, that the ancients, in making paper, used the coats or pellicles which form the covering for the pith. If this authority were not of so high a character, I should have said that it is impossible to make paper, or any thing of that nature, from any part of the bark or rind. The stalk appears to consist only of two substances, the pith noticed above and a covering, very much resembling that of a stalk of Indian corn. I attempted several times to divide this coat into parts, and to flatten and make something like paper from it, but never could succeed. It would split up immediately into narrow shreds, and, from the want of cohesion in the parts, I was forced to relinquish the attempt. Seignor Vincenzo Politi, a Syracusan gentleman of considerable antiquarian research, manufactures and sells, to the curious, paper from the plant, but it is always made from the pith. The inclosed is some of his making, and, from a close examination which I have subsequently made of a vast number of specimens of ancient papyrus, in the museums from Naples to London, I have no hesitation in saying that they were formed of exactly the same material, and in the same way.

Mr. Politi, in cutting the plant, rejects the upper part as too narrow, and the lower as too spongy; he divides the remainder into pieces of from eight to twelve inches in length, and stripping off the bark, slices the pulp longitudinally, by means of a sharp knife, into slices about a sixteenth of an inch in thickness. These are placed under a roller, and, when they are pressed very thin, a sheet is formed by joining the strips, making the sides of the adjoining pieces overlap a little. If he wishes to make the paper strong, one sheet is laid crosswise over another and cemented with the same paste employed in uniting the strips. If you will try, on the piece inclosed,* you will find that you can write on it with a blunt pen without difficulty; and even in our day, it would form no despicable paper.

5. Fountain of Cyana.

In our excursion, after giving the first clump of papyrus an attentive examination, we continued up the stream, passing other clumps,

* The small sheet of prepared papyrus transmitted to us, bears, on one side, colored figures of the plant, and on the other, neat well defined writing.—*Ed.*

at short intervals; and, at the distance of about a mile from the first, we came to a spot where the plants stretched considerably to the right and left, forming a larger plantation than any we had yet seen. In the midst of this we found the celebrated fountain of Cyana. You recollect she was a Sicilian nymph, and, endeavoring to assist Proserpine against the violence of Pluto, was changed by the enraged god into a fountain. It is a very pretty spot. The fountain is about forty feet in diameter, and about fifteen in depth; the water is perfectly clear, and fish of a large size were darting about in the deeper parts: the bottom was carpeted quite across with grass of a delicate green color, while all around, the graceful forms of the papyrus bent over it, a screen and an ornament to the abode of the martyr-nymph.

6. Notice of a part of Majorca.

Orange Groves, Olives, Mountains, People, Costume, &c.—Along the western side of this island is an unbroken range of mountains, so high that at my visit, they were tipped in many places with snow. Just at the place where they are highest, a crater-shaped hollow seems to have been scooped out, and at the bottom of this is the little town of Soller, (pronounced Solyé by the natives;) it is three miles from the coast, but a good road follows the windings of a roaring stream, and conducts the traveller to a small harbor so shut in as to resemble a pretty little lake. In this harbor I landed. The captain and crew had told me a great deal about the beauty of the orange groves of Soller, but I was not prepared for the scene in which we found ourselves as soon as we left the harbor. The valley or glen we were traversing, rapidly widened, the orange gardens commenced, and soon nothing was to be seen all around but continuous orchards of orange trees, rising often to a height of twenty or twenty five feet, and loaded as thickly with ripe fruit as I have ever seen apple trees at home. The ground was covered with them, and they lined the sides of the stream, sticking by dozens against the rocks that interrupted its course. The lad whose donkey was carrying my baggage, asked me, if I would have some, and on my replying in the affirmative, ran into the next open gate, and soon came out with as many as he could carry. I selected half a dozen; he asked me if I would not have more, and when I answered no, he opened his arms and let the rest of them tumble down into the road. They told me in the village, that the groves cover an extent of about one mile wide by three in length—nothing but orange groves, and the fruit some of the best I have ever tasted.

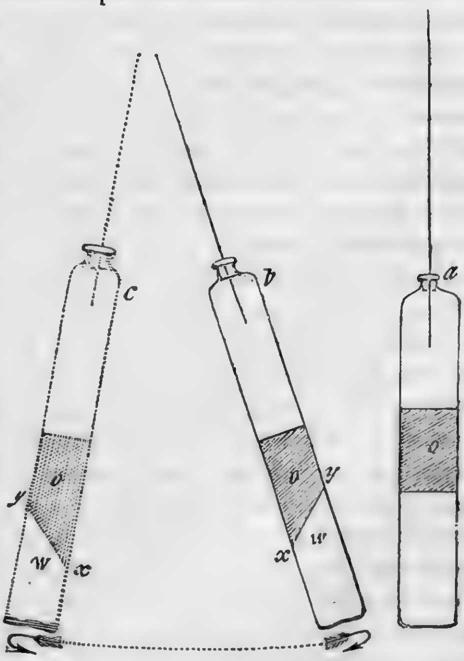
Above them on the mountain sides, is a broad belt of olives; then a belt of pines, and then come the naked summits of the mountains, I suppose more than three thousand feet in height. I had to cross among them on the way to Palma, the capital of the island, and thought the scenery nearly equal to any thing in the Tyrolese. They completely shut out the stormy blasts that blow from the gulf of Lyons, and make the temperature of the island delightful: its soil is good, and I think, with proper care, Majorca might be made the Madeira of the Mediterranean. It was Sunday when I was at Soller, and the village was filled with the peasantry of the surrounding mountains. Their costume retains much of the Moorish character: trowsers short and full, vest without collar, jacket the same, with short slashed sleaves; over this a cloth coat reaching to the knees, with very wide sleèves; head shaven on the crown, with hair behind long and curled; a skull cap, and over this a low crowned hat, with a brim fifteen inches wide, turned up at the edge, and ornamented with tassels,—with all this, a man of Soller looks like a giant a short way off, and the plaza in front of the church was full of them when we arrived. They are a very hospitable and simple people, and for the stream that goes roaring through their village, they have no other name than "Torrento," *Torrent:* many of them, probably, do not know that there is another in the world.

Art. V.—*On the apparent anomaly observed in the rotation of liquids of different specific gravities when placed upon each other;* by Walter R. Johnson, Prof. of Mech. and Nat. Philosophy, in the Franklin Institute, Philadelphia.

A notice read at the Academy of Sciences, at Paris, Sept. 30, 1833, has appeared in some of the French Journals, particularly the Revue Encyclopedique for that month, of certain experiments by Mon. E. J. Thayer, in which it seems to be imagined that some new principle either of hydraulics or chemistry, or both, is about to be unfolded. My attention having been called to that notice by my friend J. P. Espy, Esq. we arranged a little apparatus with which we repeated a few of the experiments,* sufficient to exemplify the phenomena, and to demonstrate their cause.

The first of M. Thayer's experiments was to suspend a jar or phial containing two liquids of different specific gravities, and cause it to oscillate like a pendulum, in which case, even if the oscillations be small, the heavier liquid will be found to undergo a considerable variation in the position of its surface, so much indeed, as to render the *surface of separation* of the two liquids greatly inclined to the horizontal position, and sometimes even so much as to divide the liquid superficies, and to form it in part of the heavier, and in part of the lighter of the two liquids. If the oscillations become so great as to be ultimately changed into a complete rotation, the heavier liquid will, when the vessel is in the upper part of its course, be found at the surface, and the lighter at the *bottom*, (then the highest part,) of the vessel.

Dr. Franklin made use of the first part of this experiment to illustrate his idea of the effect of oil upon the surface of the ocean.



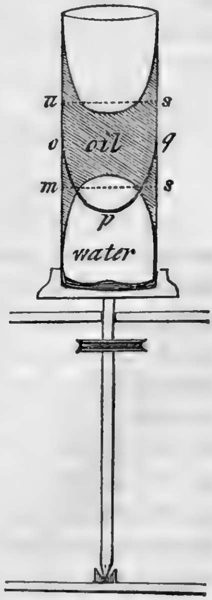
It is represented by figures *a*, *b*, and *c*, the first supposed to be at rest, and the second and third in different parts of their oscillation. O and W represent respectively portions of oil and water, but any other two liquids of unequal specific gravities which will remain separate, will answer the purpose equally well. The arcs described by the water being larger than those described by the oil at the same time that its specific gravity is great-

* These experiments were repeated at the monthly meeting of the Franklin Institute, in May, 1834.

er, it is obvious that its momentum must also be greater, and consequently that when an oscillation is completed, as all the bodies, viz. the glass vessel, the oil, and the water, are necessarily compelled to commence their descending motion at the same instant that, among them which has acquired the greatest momentum, must tend to continue its previous course, while the others are tending in the reverse direction. Hence the water rises up on the sides of the vessel, whose motion it encounters, just as it would do if encountering any other obstacle. The lighter liquid, by taking the place of the heavier in that part of the vessel (at x,) which is opposite to the elevated point (y), allows the line xy to be much more inclined to the horizon than would be consistent with the condition of equilibrium if a single fluid were used. When a complete revolution is made by the jar, the positions of the two liquids in the higher part of the course must obviously depend on the relation of the *force of gravity* to the *centrifugal force* occasioned by the revolution of the apparatus; if the former predominate, the liquids will change places in the vessel, otherwise not. Here is no departure from known laws.

The second modification of the experiment mentioned, is that in which a jar or other vessel containing two (or more) liquids is caused to revolve horizontally on its axis. In this case the well known laws of equilibrium and motion require that the upper surface should be a concave paraboloid dependant on the form of the vessel and the quantity of liquid. The experimenter, and probably many others have supposed that the *surface of separation* must also necessarily take the same concave form, and have formed their theories accordingly. He was therefore not a little surprised to find the latter varying with the nature of the liquids and the rapidity of rotation. Thus he found that employing a cylindrical jar, and placing oil at the bottom and alcohol above it, the rotation gave a concave surface of separation according to theory; while oil upon water revolving under similar circumstances gave a surface of separation convex upward, which rose even to the upper surface forming the center of the latter, of water, and the periphery of oil. Placing equal quantities of spirits of turpentine in the one case upon *oil*, and in the other upon *alcohol*, (both these liquids having the same density,) the surface of separation was, with the same velocity of revolution, concave in the former case, and convex in the latter.

It is stated in the notice above referred to, that " the *chemical affinity* of the liquids is to be regarded as the cause of these apparent discrepancies, and that the experimenter is preparing with nice instruments to determine the forms affected by liquids under various circumstances, and *thence to derive a mechanical measure of chemical affinity.*" We have therefore deemed it expedient to state, that the anomaly of the case is entirely due to the different degrees of adhesiveness of the liquids which, while the velocity of the apparatus is *increasing*, causes the most adhesive, to take, almost immediately, the velocity of the jar, while the less adhesive substance is not so soon brought into a rapid rotary motion; consequently, if the most adhesive liquid is placed at bottom, it will, by taking the velocity of the jar, possess the concave surface, and more so than the upper liquid, while if the least adhesive substance be below, it will be longer in attaining the velocity; and, consequently, the centrifugal force of the upper liquid being greatest, it will force itself downwards as well as upwards around the sides of the vessel, forming, so to speak, a "*solid of revolution*" like a double concave lens. If, however, the rotation be continued long enough to have the liquids both acquire the velocity of the apparatus, the anomaly will disappear so that the lower and less adhesive liquid will present a concave surface as well as the other. In bringing the jar suddenly to rest, the concavity of separation will continue after that of the upper surface has disappeared. The annexed figure represents a jar placed on a suitable base, and resting on a spindle furnished with a pulley for multiplying the speed. The axis being vertical, if we fill the jar to *ms* with water, and then place upon this a quantity of oil rising to *u s*, these two lines will represent respectively the *surface of separation* and the *upper surface* of the liquids when at rest. As the apparatus begins to revolve, the oil partaking almost immediately of the velocity of the jar, while the water obeying its inertia, and possessing less adhesiveness, allows the jar to move with a considerable relative velocity, and hence having less centrifugal force than the oil, the latter will not only rise above the line *u s*, but likewise sink below *m s*, as indicated in the shaded part of the figure. Such, however, will be the appearance no longer than till the apparatus has come to a uniform



velocity, and the water has had time to attain that velocity; then the *surface of separation* will be of the form $o\,p\,q$.

The explanation of the case of the turpentine, oil, and alcohol, is obvious. Spirits of turpentine have more adhesiveness than alcohol, and will consequently become soonest possessed of the velocity of the apparatus, while it has less adhesiveness than *oil*, and the latter will rise up round the jar even more rapidly than the upper surface of the former.

By adjusting balls of wax or other solids, exactly to the specific gravity of each liquid, it is easy to observe the actual, as well as the relative velocity of each, and particularly to determine which continues longest in motion after the *jar* has been brought to rest. M. Thayer has varied his experiments by using a rectangular instead of a cylindrical vessel; but all such variations can only serve to complicate the effect, without adding any thing to our knowledge of the cause. In all this there is nothing new either in chemistry or hydrostatics.

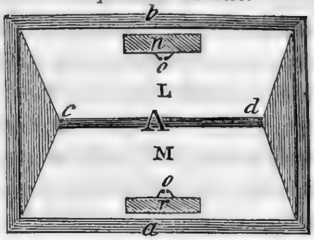
The most direct use which seems likely to be made of this *experiment*, is to detect differences of adhesiveness between different liquids and solids, for which it may furnish a very delicate test, wherever the liquids in question allow of being placed one upon the other. It may thus possibly connect itself with the important question of the advantage of different unguents in obviating friction.

Art. VI.—*Theory of the Bellows*; by H. Strait.

TO THE EDITOR.

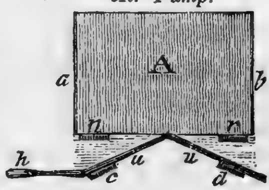
Dear Sir,—I here send you a communication on the true theory and practice of constructing, moving and using bellows; or, of exhaustion and compression or condensation of air on the principle of a balance, which I have lately discovered, and which promises, in my estimation, to be a valuable and powerful acquisition to practical blowing, desiring you to give it an immediate publication, as I am now engaged in giving it a thorough experimental demonstration. I will now proceed to illustrate the principles of my theory of exhaustion and compression of air, by representation and description, first, of compression, then exhaustion, and conclude with some general remarks on its advantages, &c.

Compression Bellows.



A represents a strong and firm box, four feet square, two of whose sides, *a*, *b*, are a foot deep each; and its other two sides *c*, *d*, two feet deep at their center, and from thence tapering down, even with the sides *a*, *b*. L, M represent the bottom of this box, which is fastened air tight to the tapering sides *c*, *d*, and the others *a*, *b*. This box, when constructed, will resemble an inverted roof with a small portion of the sides of the building attached thereto, and its bottom the ridge. In the two sides of the bottom L, M, are to be inserted two valves *n*, *r*, one in each, four inches by eight, which are to open upwards into this box, from ten to twenty degrees. These valves *n*, *r*, must be hung as near to the sides *a*, *b*, as they conveniently can. *o*, *o*, represent the sides of the valves *n*, *r*, hung to the bottom. A strong cover is now to be made that will exactly cover over the top of this box, or even more; and we must provide a strong strip of leather or some other very strong and flexible substance impervious to the air, four feet wide and nearly seventeen long, with its ends tightly sewed together, which is to be fastened air tight, first around the tops of the sides *a*, *b*, *c*, *d* of the box A, and then around the sides of the cover. This will form the cistern into which the air is to be compressed or condensed, and from which it can be let out in any direction required, or with any velocity. Immediately under this cistern and directly under the valves *n*, *r* in its bottom, a strong board, one foot wide and four long, is to be exactly balanced across its ridge and hung by means of staples, hinges, or otherwise, so as to move easily upwards and downwards, and without wavering. On one end of this board, a handle to move it is to be attached, which can be of any length required. Holes are to be cut for valves, through each end of this board, of nearly the same size of those in the box A, and so as to be directly under them. Valves are to be hung over these holes so as to open and move just the same as those in the bottom of the box A. This being done, the sides of this board and the box A, are to be connected by some impervious and strong substance, such as leather, fitted on air tight, and so as to allow the balancing motion of the board. The box A or air cistern being now, in some way or other, made fast, so as to allow the free balancing of this board, all is ready for operation. The handle attached to the balancing board, being now moved or raised and depressed powerfully, it will open and shut the valves, alternately, on each side of the ridge of the bottom of the box A, and consequently alternate partial vacuums will be formed, into which the adjacent air will rush, and from which it will be forced into the air cistern, where it can be compressed to any degree. When the handle which is attached to one extremity of this valved and balancing board is raised, the valve between it and the ridge closes tight and forces all the air inside between the valves into the air cistern, through the valve over, which likewise opens upwards; while on the opposite side of the ridge, the valve in the air cistern closes tight to hold what air is in; and the valve below it opens to let air between the valves, which will be forced into the cistern, when the handle is brought down. The cistern of this compression bellows, especially if very large, instead of being filled full by the sole motion of this balancing board, may be nearly immediately filled, by having a staple clenched through the middle of its cover, and a rope attached to that, and then run over a fixed pulley, so that as fast as the cover is raised by pulling the rope, the cistern will fill, as all the valves will open up merely by the pressure of the atmosphere; and when it is thus filled, the balancing board can be moved so as to give the air drawn in, any pressure. Instead of having the bottom of the cistern roofed or ridged for the purpose of balancing the board across, it can be flat, and then the board must be bent at the balancing point, each way downward, or being hung immediately by its middle to the bottom of the cistern, its extremities must be gradually and sufficiently inclined to allow the balancing motion required, in order to force the gathered air into the cistern above. The width and even length of this balancing board can be varied to answer the dimensions and construction of any cistern. The dimensions, shape and construction of bellows made on this principle of a balance are susceptible of a great variety of different modifications; those that I have given were for the purpose of easier illustration, not the best operation, as this can be determined only by extensive experiments. With regard to the operation of bellows on this principle, it is evident from reason and the extent of my experiments, that it will be easy, steady, and regular, and susceptible of powerful exertion. Where a constant and very powerful blast is required, as in great furnaces and for casting and hammering, it will probably answer better than in common shops. On this principle there will be no loss of motion, and whether the handle is moved upwards or downwards, it will force the same quantity of air into the cistern. To require less leather in the construction of the cistern, and still have the blast longer and equally powerful; its cover may be made so small that it will sink as far below the fixed top of the cistern, as when full it would be raised above: this to a certain degree would compensate for a larger sized cistern. To increase the pressure, the bottom of the cistern and its cover can be connected by strong spiral wires, while the blast through the pipe can be governed by a regulating screw, which can be made to close the whole aperture air tight, or any part. Having now described the compression bellows, I will proceed to describe the exhaustion or air pump bellows. A represents a cistern four feet square, made air tight, of firm timber, which is to have the air in the inside of it exhausted or drawn out. *n, r* represent two strong light valves which are to open out on the under side of the cistern, near to the sides *a, b*. These valves must open but a little way. *u, u* represent a strong board four feet long, two wide, and so bent in its middle, where it is movably and strongly hung to the bottom of the cistern A, directly under the valves *n, r,* so that by alternately raising and depressing its handle *h*, it will close flat on the bottom. Two valves *c, d*, are to be hung in this board, immediately under those in the cistern, which are to open as far outwards, and then the sides of this board are to be fastened air-tight all around, by leather to the bottom of the cistern, so as to allow the balancing motion, by moving the handle *h*, upwards and downwards, and will exhaust as much by an upward as by a downward motion. The operation of the valves in a compression bellows, is the reverse of those in the exhaustion; the shape and dimensions are as variable. This balancing principle is applicable to water as well as air in compressing and exhausting it. The exhaustion bellows can be applied, with very little inconvenience, to exhaust cisterns or reservoirs of any shape or size.

Air Pump.



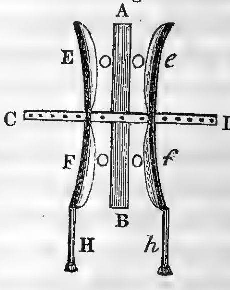
P. S. Since writing the above, I have tried the " principle" there explained experimentally. The air cistern was conical, five feet at top, four and a half at bottom, in diameter, and two high. The cover was four feet in diameter, and made by means of leather to play up and down in the inside of the air cistern. The balancing board or its two wings, which are hung angling together, and movably hung to the flat bottom of the air cistern, was two feet wide, and four feet four inches long. The handle was four feet. The operation is very easy, and the blast very powerful and regular. The principle of motion is universally applicable to practice. It meets with the entire approbation of all that have seen it operate.

Alps, Nassau, Rensselaer Co. N.Y. February 17th, 1834.

Art. VII.—*Application of the Principle of a Balance; by* H. Strait.

The principle of a balance, is a powerful one when ingeniously and judiciously applied to mechanics and the arts. Its applicability is universal. There are few if any machines, now in operation, that are not dependent upon this principle or to which it cannot be beneficially applied. Look at the numerous machines employed in the various manufactories of America and Europe: how diversified, how multiplied and how complex their operations; what a consumption of power is required to work or move them; what expense is incurred and how great is their performance; nevertheless, how few are the parts, and simple the motions, absolutely necessary to answer, if not overrun this performance. Indeed, what cannot man do, on the principle of a balance, and what can he do without it. With it, with liberty to exert his power, he might displace the world, and without it, how limited would be his influence in mechanics and the arts, and how small his accessions of power and profit derived from that source. I conclude my premises (as effects balance causes and causes, effects) by suggesting, that some of the greatest discoveries yet to be developed to the world, may, in all probability, be founded on the powerful and universal principle of a balance, which pervades not only mechanics and arts, but every part of the universe.

Fig. 1.



1. *Application to Milking.*

Fig. 1, represents a machine for milking. A B, represent a light block, five inches long, three wide, and an inch and a half thick. C D, represent a ruler-like piece of wood or metal, five inches long, one third of an inch thick and two thirds wide, perforated with holes at every sixth of an inch from end to end. This piece C D is to be firmly inserted and fastened at right angles in the middle of the block A B. E F, *e f*, represent two similar, strong, light thin, boards, a little curved from their centre, each five inches long, three wide, and half or two thirds of an inch thick. H *h*, represent the handles, which can be formed in connexion with the boards or attached separate. The boards are to have each, one mortise cut through its middle of a sufficient size, for the easy and regular motion of the ruler-like piece C D. Holes are to be made at right angles through the centre of each of these mortises, corresponding with those in the piece C D, so that by means of small pins or screws, these boards E F, *e f*, can be movably hung nearer or farther from the block A B, as required. o o o o, represent the spaces between the block A B, and boards E F, *e f*, which the teats are to occupy to be milked. The sides of the block A B, and the inner sides of the boards E F, *e f*, are to be lined with leather or some other soft substance, stuffed with cotton, &c. so as to be elastic and press easy against the teats and not injure them. This lining should be harder and project farther, the nearer it comes to the upper sides of these boards and blocks; so that when the pressure is given, it will commence at the upper parts of the teats and gradually increase downwards, till all the milk is forced out. Instead of this stuffed lining, springs, spiral wires, or some other elastic substance may be used; perhaps springs are best. To work this machine, it is to be supported by the hands by means of the handles H *h*, in such a position, that the teats will hang down between the block and the boards at o o o o, two teats each side of the piece C D. Both handles are to be moved inwards and then outwards either fast or slow, so that the operation of milking can be performed or regulated at pleasure. When the handles are moved inwards, the two nearest teats to the milker will be milked; when moved outwards, the two farthest and thus as the motions can be so quick, there will almost flow four streams, till the operation is performed. Instead of communicating the pressure on the outside, it may be applied on the inside by altering the construction a little. This machine is applicable to other purposes allied to the operation of milking. The construction, dimensions, weight and quality of the materials are variable, but the principle of operation is the same.*

---

* Having stated to the author some doubts as to this new process of milking, we have received his assurance that he has proved it practicable, and that he desires its publication.—*Ed.*

2. *Application to Pumping.*

Fig. 2.

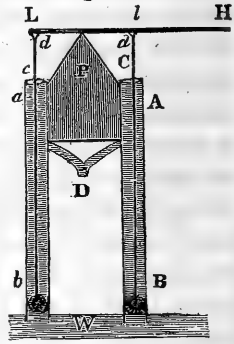


Fig. 2 represents a balance suction or forcing pump, for water or air, wherein there is no loss of motion. W represents a body of air or water. A B, *a b*, represent two similar hollow cylinders, whose lower ends are inserted perpendicularly, equidistant and parallel in the body W of air or water. P. represents a pivot, which firmly connects the top of the cylinders, and across which the balancing lever L *l* is to be movably hung and poised. H represents the handle of the lever L *l*. C *c* represent two similar piston-rods whose upper ends are movably hung to the lever at *d d*, and to whose lower ends are attached either pistons or valves, as it is designed for a suction or forcing pump. D represents the pipes of both cylinders, united to convey off the air or water. It can be conveyed off separately. This is operated by an upward and downward motion of the handle H. Any equal number of pumps either suction or forcign, of equal dimensions, can by being connected on this principle of a balance, be worked or moved by one handle. This application is susceptible of numerous modifications.

3. *Application of Churning.*

Fig. 2 will serve to illustrate its application to churning. A. B, *a b*, represent two churns; C *c*, their dashers or piston-rods; L *l*, the balancing lever; H its handle; P its pivot, which connects them the same as the cylinder A B, *a b*. It is worked by an upward and downward motion of the handle H. This construction may be modified into a forcing or piston churn, by having a communication at the bottom between them, to force the cream alternately from one into the other. Instead of two churns, one churn resembling those commonly wrought by a crank, with a piston through the middle and an aperture through that, would answer the purpose. I am of the opinion, that in churning, the cream would gather sooner and form butter, by being powerfully forced alternately, through small apertures than by any other means, unless it be by adding some substance or composition, that will immediately fetch it. Instead of the cream's being forced from one churn into the other and backwards, constantly, a small wheel, full of holes, (the lids of the churns being made tight and fast,) might be attached to the lower end of each piston-rod or dasher, and made to operate up and down, and answer the same purpose or a better than the former method.

4. *Application to Washing.*

Fig. 3.

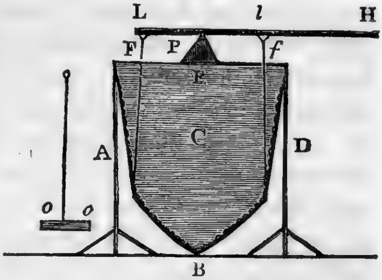
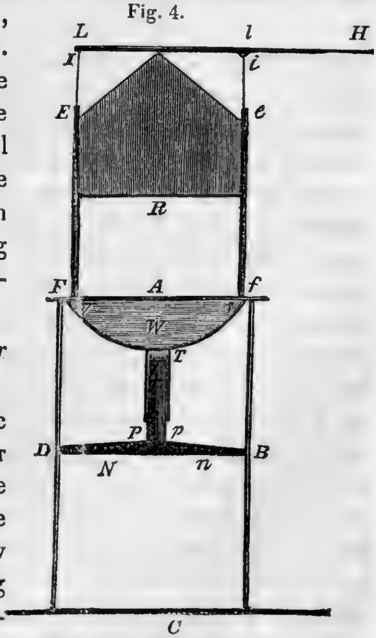


Fig. 3 represents a washing-ing machine. C represents the cistern, which can be lined with rollers on the two sides A D, to hold the water and the clothes, to be washed; three feet high and three wide; A B D E its frame; P the pivot; L *l*, the balance lever; H its handle; F *f*, the rods on which the washers, beaters or rollers are hung; *o o*, represent a beater, &c. attached to its rod F or *f*. This machine is operated by the upward and downward motion of the handle H, and can be variously modified.

5. *Application to Fulling.*

Fig. 3 will serve to illustrate its application to a fulling mill or machine. There are two constructions to this application; a vertical and horizontal. Fig. 3 enlarged, will represent the vertical one. The horizontal one is nearly the same as the vertical, only that the lever and rods have a horizontal motion, and the cistern must be modified a little to answer it. In both constructions, the operating power is to be applied to the handle H.

Fig. 4.



6. *Application to an Aërostatic or Hydrostatic Press.*

Fig. 4 represents an aërostatic or air, or a hydrostatic or water press *A B C D*, its frame; *W* the air or water cistern, which in shape resembles the segment of a hollow sphere or hemisphere; *T* a strong hollow cylinder inserted in, or attached to the bottom of the cistern; *N n* the follower, a strong bar, fitted to move up and down in the sides *D B* of the frame. To this follower is attached the piston *P p*, which is exactly fitted to move up and down in the cylinder *T* so as to prevent the escape of air or water. The pressure of this press is given between the follower *N n* and the side of the frame *C*. *E F*, *e f*, represent two hollow pipes, whose lower ends are tightly inserted into the cistern *W*. *V v*, two valves that exactly cover the lower ends of these pipes, and open sufficiently into the cistern. *R* the pivot of the operating lever, which connects the top of the pipes. *L l* the operating lever. *H* its handle. *I i*, two rods that move up and down in the pipes, whose upper ends are movably hung to the lever *L l*, and to whose lower ends are attached wheels or pistons with valves in their centre, opening downwards, exactly fitted to move up and down, and not allow the escape of air or water. To give the pressure either by air or water, it is admitted into the top of the pipes, passes through the valves in the wheels and the valves *V v*, until the cistern is full; the handle *H* is then to be worked, and the water or air will force down the piston *P p*, and consequently the follower *N n*, and press whatever is between it and *C*. To take off the pressure, the air or water can be let out of the cistern. Pistons might be used in the pipes. This press is susceptible of numerous modifications and applications.

7. *Application to Printing.*

Fig. 5.

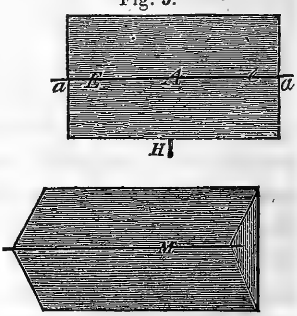


Fig. 5 represents a printing machine. *A* represents an oblong table or frame, set full of types and balanced on its axle *E e*, which supports it at *a a*, movably in two upright standards. *H* represents the operating handle. *M* a heavy or solid, oblong, triangular block, as wide and long as the table; over which it is to be firmly hung, so that one of its angles will run parallel and laterally with its axle *E e*. The two sides of the block *M*, immediately over the types, or against which they will press, when the handle *H* is operated, must be lined with some elastic substance, in order to give a good impression. The types are to be inked by inking rollers, and the paper applied by hand or machinery. Instead of the table's being movably hung and the block fixed, it may be reversed; the table fixed and block movably hung. Instead of the block being triangular and table flat, the block may be flat and the table triangular. Every motion of the handle *H*, either upwards or downwards will give an impression.

East Nassau, Rensselaer Co., N. Y., April 28, 1834.

Art. VIII.—*Improvement of the Barometer*; *by* Chas. F. Durant.

TO PROF. SILLIMAN.

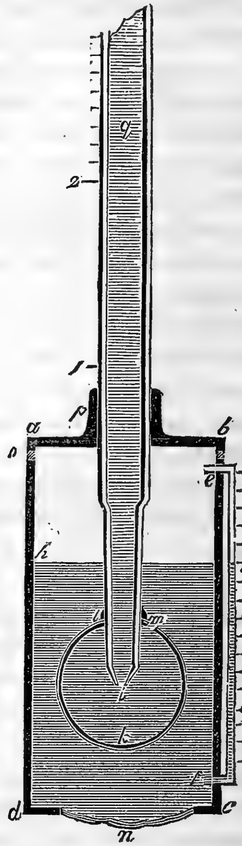
Dear Sir—In the frequent use of the portable barometer, I have often experienced much inconvenience from air entering the tube, at times when, perhaps, great precision was necessary, not only for ascertaining the altitude, but likewise for weighing the atmosphere, which is sometimes intimately connected with other experiments, then under a course of investigation.

Although one of the most simple in form, the barometer is probably one of the most difficult instruments to *construct.* The frequent breaking of the tubes, while undergoing the great heat which is necessary to exhaust the air, requires more patient care for this tedious process, than most men are able or willing to devote; and yet without this process, and that, well and effectually performed, the air must be diffused through the mercurial column, or escape to the top, where it destroys the vacuum, in which case the instrument is not suitable for the purposes intended, and does not deserve the name of barometer. The manufacturer who would allow such an instrument to pass from his hands to the world, is guilty of a great misdemeanor, and deserves the censure of all good men; for such imperfections, have prevented the barometer from attaining the rank which it deserves in the estimation of the world. It is an insult to the memory of *Torricelli*, who will yet be ranked among the greatest benefactors to mankind.

It is to be regretted, that so many imperfect or deranged instruments, are in use. It destroys all confidence in the barometer, and I know some persons, who *deride* its well known properties of predicting winds, and even treat the idea as *chimerical.* But such men could not have possessed a perfect instrument, or have devoted a proper attention to the observations, as thousands can testify to its efficient warnings; when, by suitable and timely preparations for the predicted hurricane, property and lives have been saved from the devastating elements, which would otherwise have involved the whole in ruin.

Although in the construction and repairing of my barometer, I was generally fortunate in clearing the tube entirely of air, yet in use, I think I never kept it one year in that perfect condition. This repeated derangement and consequent expenditure of time, patience and money, led me first to enquire the cause, which I soon learned, and then undertook to invent something which should effectually prevent the evil. I soon succeeded, even beyond my most sanguine expectations, so as even to render the instrument perfectly secure against all accidents, except breaking, to which *all* instruments are subject. With this security, I have not encumbered the barometer with any thing on the outside, but the whole is confined to the cistern, thereby retaining the instrument in the most *portable* form.

The annexed engraving, represents a vertical half section of the barometer.—*a*, *b*, *c*, and *d*, is the cistern two inches long and one inch in diameter. *e* and *f* is a glass tube, open at both ends, and let into the cistern above and below zero, which in the barometer, is always changing its position. The original zero is marked on this tube at *g*, with decimal parts of the inch, extending above and below, to be deducted from or added to the height of the mercurial column, in the large tube. *h* is zero, which when made, on a level with the ocean, stood $\frac{6}{8}$ of an inch from the top of the cistern, which immerses the top of the globe $\frac{3}{8}$ of an inch in mercury. The $\frac{6}{8}$ of an inch between original zero and the top of the cistern, leaves sufficient space for the column in high altitudes to fall; a circumstance which has never been properly attended to, in constructing barometers; although probably no other barometer will admit of so much space, without endangering the instrument. *i* is the end of the tube, with the column drawn to a small point, which answers precisely the same purpose as the contraction in Mr. Gay Lussac's "improved marine portable barometer." But in this case, the contraction at the bottom of the tube, possesses other advantages than merely to prevent the sudden rise and fall of the mercury; for by placing the contraction at the bottom, we can draw the end of the tube to a small



point, which renders the column less liable to admit air, either from a concussion or inverting its position.

This improvement, alone, I deemed of sufficient importance to justify the *construction* of a new barometer, and was actually prosecuting it, when an idea of the *globe* suggested itself to me.

In all the portable barometers that I have seen, the end of the tube is cut or broken off in a careless manner, which as often leaves it *concave* as *convex*, and it must be apparent to every one who will examine the subject, that bubbles of air striking the *concave* end of a straight tube, are more likely to enter the column than to roll off.

k is the *globe*, $\frac{5}{8}$ of an inch in diameter, fixed firmly on the tube at *l*, and has a very small aperture at *m*, the only place where the mercury inside can communicate with that in the cistern. The globe is of cast-steel, with which mercury is known to come in *perfect contact;* consequently, the atmospheric pressure *cannot* force the air through this aperture nor through the bottom of the tube. By examining this arrangement, you will perceive the impracticability of even *forcing* the atmosphere through the globe, much less the possibility of its being driven there by inverting and re-inverting the instrument, or by any jar or concussion which it may receive while in use or being transported.

Even admit air to be *placed* in the globe, it is apparent that it would find its way out by the aperture, one hundred times oftener than it could possibly enter the tube.

n is the leather bag through which the atmosphere communicates its influence to the whole interior of the cistern and column. Leather is the most in use, although there are other methods to admit the atmospheric pressure, in forms of the instrument, which are perhaps not so portable; although for general use, a short tube, with a stop-cock or plug inserted in the top of the cistern, is probably the best.

o represents a screw-joint of the cistern, where it is separated while attaching the globe to the tube; for the tube being connected with the cistern at *p*, would render it impracticable to fasten the globe without this separation. I mention these minutiæ, because those who undertake to make a barometer on this plan, may otherwise be subject to the same perplexities which I experienced in the construction of mine.

I did not succeed in obtaining a globe, until the *third* person made the attempt, and produced it from a solid piece of steel. If made in *two* parts, it would necessarily be joined with solder, on which the mercury would act too powerfully.

The screw-joint at *o* may appear simple and useless, but the *want* of it occasioned a delay of many days, and caused the breaking of several tubes, while trying to fasten the globe. The person employed on this part, twice threatened to abandon the work as impracticable, when fortunately the idea occurred to me of disconnecting the cistern in that part to afford ample space to work at *p*.

q is the mercurial column, $\frac{3}{8}$ of an inch in diameter, except the part inside of the cistern, which is diminished, in order to leave the more vacant space for the column to fall in high altitudes, and likewise to lessen the large orifice in the globe through which the tube enters.

Other proportions than those here given, may serve equally well to construct a barometer on this principle, but these are the dimensions of the one which I have now completed, and for distinction, will call the *Globe Portable Barometer*. It has been inspected by several scientific gentlemen, who with my request, exposed it to all the causes which usually derange barometers, such as jaring, shaking, concussions, inverting and reinverting its positions, without causing the least perceptible derangement. I invite all who are so inclined, to call and see it; and to those who desire to make one, I will cheerfully give any information in my power, to aid them in its construction.

Since the invention of the barometer by Torricelli, many learned men have devoted their attention to the improvement of this valuable instrument, and among the most useful, is probably M. Gay Lussac's "*Improved Marine Portable Barometer*," wherein, at a certain point, the column of mercury is contracted to prevent the sudden rise and fall of the mercury by the undulating motion of the ship, while the remainder of the column retains sufficient diameter to avoid a very sensible effect from the temperature of the atmosphere. But this, as well as other forms of the barometer, whether secured by the screw and cushion pressing on the bottom, or by the stop-cock as employed by Mr. J. F. Daniels, is liable, by sudden turning or concussion, to admit air into the tube; for although the cushion and stop-cock renders the instrument *portable*, it never can be *employed* as a barometer, until the entire column is open from the hermetical seal to the cistern or atmosphere below. It is in this situation, (the only one of practical use,) that the instrument is deranged. *First*, by suddenly inverting and re-inverting the position, so that, (while passing from the bottom to the top of the cistern,) the air strikes the end of the mercurial column, and must rise in the tube, because it is lighter. *Secondly*, by a concussion which it receives, every few minutes while in use, either from the motion of the ship, the carriage, the shrubbery on a mountain, or the unavoidable contact with the car and cords in a balloon; for by observing the mercury in a glass cistern, you will perceive that a concussion causes a motion like the sea waves, which mounting on one side, frequently leaves the end of the tube exposed to the atmosphere, which here strikes the base of the column and rises in the tube by its comparative weight. *Thirdly*, it is asserted that the barometer, in a course of years, will have accumulated air above the column, even if during all that time, it should have been suspended in a room, without any jar or concussion to communicate the least motion; and the two most probable causes assigned are, first, that the air enters through the pores of the tube, and secondly, that mercury never comes into perfect contact with glass; the latter is the most probable cause, from which it is inferred, that the air in the cistern, is by the atmospheric pressure forced down, in extremely minute particles between the mercury and tube, where it acquires the additional impetus of its own comparative specific gravity, and rises between the mercury and internal surface of the tube to the top of the column. As a preventive to the latter derangement, it has been suggested, and I believe practiced by some, to fit closely on the bottom of the tube, a ring of platina or any other substance with which mercury comes in perfect contact, although without sufficient action to cause, for years, any perceptible diminution.

From the important purposes to which the barometer is adapted, it may well be supposed to have enlisted the attention of the most scientific men in all countries, and indeed for some of its uses it is invaluable, and probably no instrument will ever be invented, with any proportion of its combined properties. For although by a number of instruments, we can weigh the atmospheric pressure, yet even if the instruments would give the precise weight, the time occupied to obtain the result, would render useless the object for which the trial was made, as the wind or calm would have actually arrived which was predicted by the state of the atmosphere when the barometrical observation was made.

A gentleman commanding one of the New York and Havre Packets, for whose scientific knowledge I entertain a high regard, told me, "that when the ship was moving with much velocity, even the barometer could not indicate the current of air," for said he, "the ship will have moved beyond the influence of the wind, which was indicated when the barometrical observation was taken." The remark is worthy of consideration, and the want of a due attention to it, is probably one of the causes which has aided to retard the more general use of this instrument among mariners. But by far the greatest cause which has prevented the universal use of the barometer, is the difficulty of procuring a good one, and the still greater difficulty of retaining it in perfect condition. It is not always easy to procure a workman competent to construct one, and when such a man is found, he is not able to devote that attention which is necessary to its adjustment and to the boiling of the mercury in the tube, lest he should not meet the views of his customers, who are in the habit of purchasing at too low a price.

We may measure mountains by observed angles, but those who have tried the various methods, give a decided preference to the barometer, which, in some cases, is the only instrument by which we can ascertain their altitude. For, the cyanometer never can be used with accuracy, while sight differs with different men, or while coloring the matters for the blue tints, differ so much in consequence of the soil or matter which produce them, and are so subject to change by exposure to the various climates. In the account of his travels and philosophic researches, Baron Humboldt has, in many instances, given us the degrees exhibited by the cyanometer, but for any satisfaction to the world or benefit to science, he may as well have spared himself that trouble. For allowing all men to see alike—who, on being told that the cyanometer exhibited 10 or 60, has any conception of the height? —We have nothing to which we can refer for accurate comparison, either impressions on the brain or unalterable blue colors portrayed in cyanometrical form.

Being at Paris in July 1828, I applied to some of the most reputable philosophical instrument makers for a cyanometer, but not one of them had any knowledge of it, or even knew there was such an instrument. I then called on Messrs. Gay Lussac, Cuvier and Biot, for information respecting it. The last named gentleman was absent from the capitol, which deprived me of the pleasure and information I should have derived from a conversation with him. Mr. Gay Lussac told me, "that he considered the instrument of very little utility, and that it was found only in the works of Mr. Saussure, a young gentleman of extensive scientific acquirements, who with an inventive genius, combined an untiring zeal for knowledge. He travelled extensively, and it was during his passage over the Alps, where from the blue color of the heavens, an idea occurred to him of constructing an instrument, with degrees and altitudes marked to each of the blue shades, which should correspond to those in the heavens." And, continued this sage philosopher, " Saussure is dead, and those only who have been at great heights, and retain a recollection of the color, are capable of making a cyanometer."

With the information I derived from him and my subsequent experience of these colors, I constructed such an instrument; and after repeated trials, comparing it with the barometer, at various altitudes, I found it could not be relied on for accuracy.

Many men who have devoted their attention to the subject, I believe, are convinced that both the cold and darkness increase as we recede from the earth; and I have no hesitation in saying, that beyond the earth's atmosphere, it is as much darker than night as any thing we can conceive; and although this darkness may increase in regular progression from the earth, still from causes before related, I do not believe that any instrument can be found, as a substitute for the barometer, in measuring high altitudes.

At my fifth ascent with a balloon, from New York, in May, 1833, I was compelled, in consequence of a high wind which prevailed, to unmoor without any philosophical instruments, except the cyanometer, which I had fortunately placed in my pocket book. From causes which were stated in the public journals, the balloon was uncontrollable for some minutes, (a part of which time, it was ascending with nearly the rapidity of an arrow,) although immediately on leaving the earth, I opened the valve, which is near the top, and through which the gas would soon have escaped, but for the rapid upward motion, which caused so much resistance or pressure from the atmosphere, as to retard the escape of the gas, until thirty or forty minutes, when the aerostat was poised in air, and I had reached a greater altitude than I have before or since attained. Here for the last time, I tried the cyanometer, which for any utility, I might as well have left below with the barometer. The heavens were many shades darker than the blue tints to which I had affixed an approximate degree and altitude on my cyanometer, and so uncertain is sight, that when I had selected a corresponding shade on the cyanometer, in one instant the heavens would appear too light and the next moment too dark. I resolved then to abandon all further experiments, with an instrument which promised to be of so little use; and if it was not to confirm Mr. Gay Lussac's remarks, and prove the superiority of the barometer, I should not have considered the experiments with the cyanometer worth communicating to the world.

I am aware, that among scientific men, there is an unbelief of the fact, that *intensity of darkness increases as we recede from the earth*, but I do not consider it my duty here, to enter on a proof of the assertion, or attempt to explain the cause which produced it. I should infringe on your pages, with a work which I do not feel competent to perform, and will leave that for more able pens than mine. The world may expect to have soon, a rich intellectual treat on that subject, from a gentleman in Baltimore, whose scientific acquirements, added to his profound reasoning and lucid mind, I am satisfied (from personal acquaintance,) render him in all respects, competent to perform the task.

My object in this communication, is to explain the principles of my improvement in the barometer, to point out its *advantages* over all others, and induce the world, through your widely circulating Journal, to use the *globe* in all cases where the instrument is required to be *portable*.—If science can be improved, and mankind receive a benefit from this effort, it will afford me much pleasure to have contributed a mite to so noble a cause.

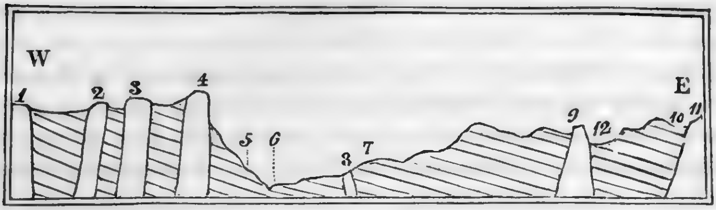
Jersey City, 28th July, 1834.

Art. IX.—*Junction of Trap and Sandstone; Wallingford, Conn.* By A. B. Chapin, Esq.

The geology of the township of Wallingford, affords little of interest to a superficial observer, the whole surface presenting low waving ridges of sandstone, with occasional ridges and peaks of trap, (greenstone), and the whole mostly covered with a soil resulting from the disintegration of the sandstone, which is in many places a puddingstone.

The dip of the strata, with some partial exceptions, is eastward at an angle of from ten to fifteen degrees; and the general course of the trap ridges from north to south. The following section, cutting Wallingford through the center from east to west, will give the relative situation of the different rocks.

Fig. 1.



It appears from this sketch that there are seven dykes of trap cutting through the sandstone in this town, and such seems to be the case to a traveller passing through the town from Durham to Cheshire; but of these seven only two are principal ranges, the remaining five being subordinate. The dyke at No. 1. fig. 1., is one of the principal ranges, being of itself a continuation of Mont Carmel range in Hamden. It enters Wallingford at the south west corner, presenting precipitous ledges on the south eastern side, runs northerly near the western boundary of the town, nearly, or quite its whole length, and is probably connected with the high ridges between Meriden and Southington, about four miles further north. The dykes cutting through at Nos. 2, 3, and 4, are probably ramifications of the one just described; but although 2, and 3, are upon the surface, about thirty rods distant from each other, I am inclined to the opinion that they have a subterranean communication.

The small dyke cutting through at No. 8, is seldom seen above the surface, nor does it seem to be directly connected with any of the other dykes. It makes its appearance at the summit and foot of a bluff about a mile south of the town, and also on the surface three or four times north east from the center, from a quarter to a half a mile. At the northern point it seems to turn east, and pass under the strata of sandstone, and a continuation of this same, or some other dyke appears on the surface about three fourths of a mile onward in the same direction, near Mr. Hill's Manufactory. Of this, and the dyke last described at No. 4, I shall have occasion again to speak.

The dyke at No. 9, enters Wallingford on the south side, from Northford, and running nearly parallel to the eastern boundary, reaches more than two thirds the whole length of the town, and is possibly connected with the range farther east.

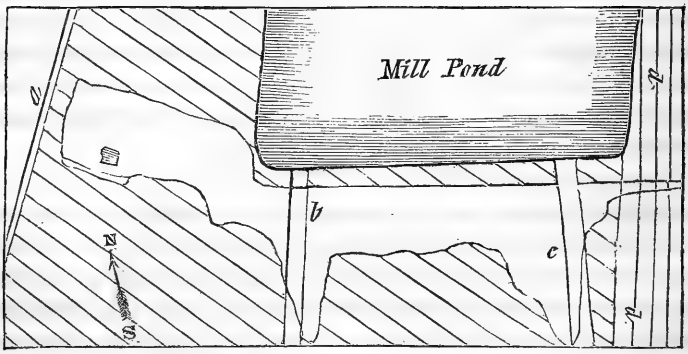
The range at No. 11, extends the whole length of the town, presenting a high mural front on the Wallingford side through its whole course, excepting only two passes through the ridge, which seem to have been designed expressly for roads, for which purpose they are used.

This brief description will give the reader an idea of the general geological aspect of Wallingford. At No. 5, the turnpike leading from Hartford to New Haven passes, and at No. 6, is the bed of Quinipiac River. The first rise and plain east, is what properly now constitutes the river meadows. From the second rise eastward, are extensive sandy plains, the materials of which seem to have been originally primitive. At No. 7, is the town, commanding a view of the plains, meadows and highlands to the westward, at No. 12, runs Muddy River, and at No. 10, lies Paug Pond.

The dyke of trap which emerges from beneath the sandstone near Mr. Hill's Manufactory, with its course across the stream, is represented by fig. 2.

Fig. 2.

Surface view.



a, road. *b*, aqueduct. *c*, stream. *d d*, strata cropping out in high banks.

Its first appearance is on the east side of the way; about eight feet in width, extending down to the bank of the pond, where it suddenly turns south, running down stream about three feet, when it again turns east, and cuts across the valley and bed of the stream into the opposite bank. At the corner of the dam, where it makes its turn, the dyke is not more than three feet in width, and where it enters the opposite bank, it is scarcely one foot; although in the intermediate space it is five or six feet wide. There is a mass branching out from the main dyke extending down the bed of the stream, but whether it is a dyke or an overlying mass, is not very easy to determine. Another mass similarly situated reaches from the main dyke at the west bank of the stream, and may be either a dyke, or superincumbent mass. The sides of the dyke are irregular, not presenting the uniformity of width and fracture, which we should expect in a seam, arising, either from desiccation or refrigeration; but rather the appearances we should suppose would result from a violent disruption of the strata. There are several small veins, ramifying from the principal dyke, when a fracture or breach in the sandstone offered a place for its introduction, presenting such appearances as would result from filling a shattered wall of huge brick with melted lava, affording, it would seem indubitable evidence of its igneous origin. The junction of the two rocks affords no less striking proof of the existence of an intense heat. The sandstone, at the junction of the two rocks, appears to have been fused, and although where the veins are extremely narrow, the sandstone is unchanged at the distance of an inch from the dyke, yet when the dyke stretches to a considerable width, the two rocks are so thoroughly incorporated, as to render it impossible to decide where one rock ends, and where the other begins; and although in the distance of two feet, one is a hard fine grained trap, and the other a coarse sandstone, the transition is so gradual as to defy the most accurate observations of the most experienced observer to point out any precise line of demarcation between them.

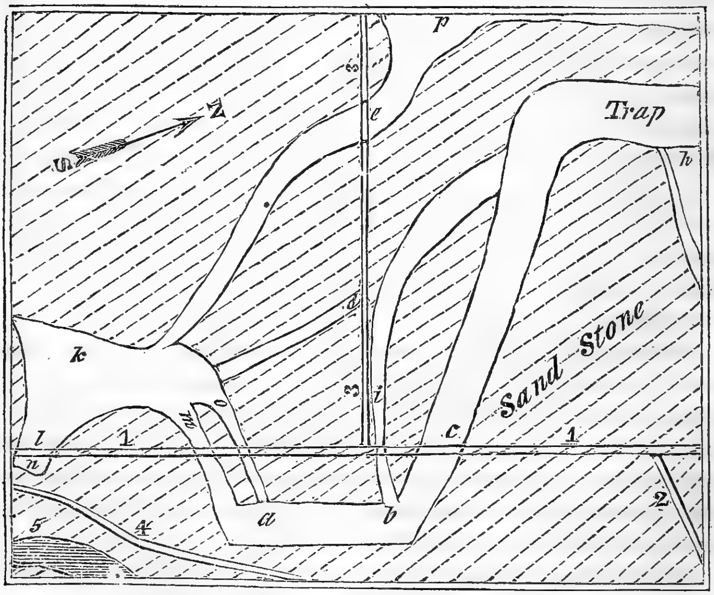
Fragments of sandstone disengaged from the strata to which it formerly belonged, are imbedded in the trap, and seem to have been most thoroughly baked ; are harder than sandstone in places operated upon by the rains, frost, and atmosphere ; have lost, in many instances, much, and in some instances, most of the redness of color, and present the same fused edges, and gradual passage into trap, as do the edges of the strata before described.

Another mass or fragment of sandstone torn from its original bed, and resting on trap, may be seen in ridge No. 9, fig. 1. on the road leading from Wallingford to Northford, about two miles south east from the center of the former place. The ridge of trap rises at an angle of about 70°, to the height of from fifty to sixty feet above the sandstone which appears at its base, and near the top of this ridge of trap, and surrounded by it on all sides except the front, lies a huge fragment of sandstone near twelve feet square.

Other instances of the junction of sandstone and trap, with similar effects attending them, may be seen in the south-east part of Wallingford, near the Northford line, in the form of veins, dykes, overlying masses and beds injected between the strata.

The most interesting of all the places in Wallingford, on account of its geological structure, is to be seen on and near the road leading from this place to Cheshire, in that portion of country occupied by dyke No. 4, fig. 1. The trap here makes its appearance in two places near the bank of the Quinipiac river, between the turnpike and river, in steep though not high mural fronts, facing the water, branching out and crossing the turnpike in five distinct veins or dykes, as may be seen in figure 3.

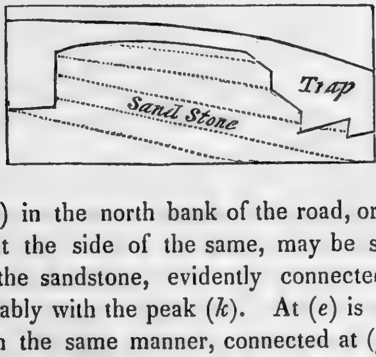
Fig. 3.



1, 1. Road from New Haven to Hartford. 2. To the mills. 3, 3. Road to Cheshire. 4. Road to Wallingford. 5. Quinnipiac.

This place may be readily found by any person travelling on the turnpike running from New Haven to Hartford, it being about two thirds of a mile north of Cook's hotel, formerly the Bishop place, and on the first hill north of the same. Its first appearance on the turnpike, from the south, will be at (*k*), in the form of a small peak rising considerably above the adjacent country, with a dyke* at the south-east corner of its base, cutting across the road, and seen in the west bank of the same at (*l*), or in the side of the hill descending from the turnpike to the road on the bank of the river, where it *apparently* terminates the dyke. At (*m*) and (*o*) in the same bank of the turnpike, may be seen two other dykes, which, though covered with diluvium, except in the bank, judging from their direction and the form of the land, are evidently connected with the peak (*k*), and *probably* with the dyke (*a b*). From (*b*) two other dykes (*c*) and (*i*), branch off and pass up the side of the mountain, near the road leading to Cheshire. At (*c*) the trap is rudely columnar, and the columns considerably inclined eastward, or down the hill towards the road. The dyke (*i f*) is probably connected with the dyke (*c j*) at the upper end, but this connection is inferred for the same cause and on the same ground as the connection of the dykes (*m o*). At (*j*) the dyke presents a mass of trap lying over and upon the sandstone, the upper surface of which is extremely irregular. Figure 4 presents a profile view of a section of this place.

Fig. 4.



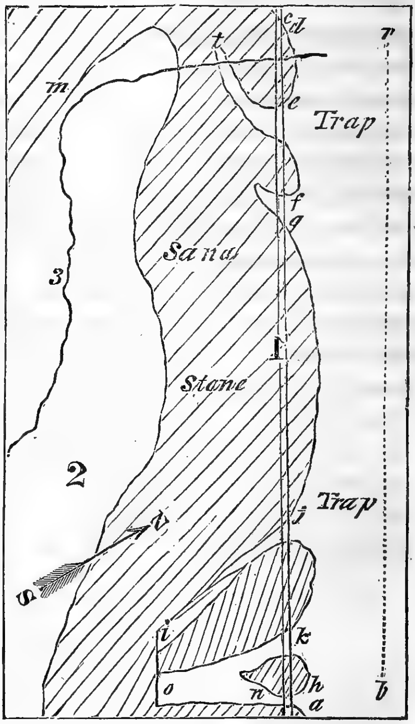
At (*d* fig. 3,) in the north bank of the road, or rather in the bed of the ditch at the side of the same, may be seen a dyke cutting through the sandstone, evidently connected with the dyke (*i f*), and probably with the peak (*k*). At (*e*) is another dyke cutting through in the same manner, connected at (*p*) fig. 3, with the ridge (*c*, *a*, *b*,) fig. 5, and most likely with the peak (*k*).

* We have seen most of the dykes described in this paper, and can bear testimony to the correctness of Mr. Chapin's account.—*Ed.*

After leaving the dyke (*e*), fig. 3, passing up the hill, we cross dykes at (*n*, *k*, *j*, *g*, *e* and *c*), all of which are evidently but ramifications of a ridge, or large dyke running north of the road and nearly parallel to it.

The distance from the river, fig. 3, to (*c*) fig. 5, is about seventy rods, and the distance between the dykes (*b* and *c*) fig. 3, is about forty rods. The width of the different dykes is various; (*d*) fig. 3, is about four feet; (*e*) about eight feet; (*n*) fig. 5, from one to two feet in different parts of its course; (*k*) about three feet; (*j*) about six feet; (*f* and *e*), in the north bank of the road, from thirty to forty feet.

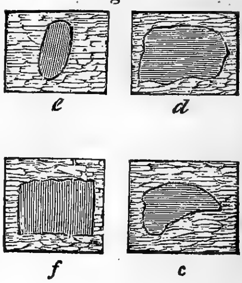
Fig. 5.



1. Road to Cheshire. 2. Deep dell. 3. Brook.

The two dykes (*n* and *k*) are connected on both sides of the road, completely surrounding the sandstone, and I think it more than probable that they unite at some distance below the surface, beneath the sandstone, thereby separating the same from its original connection with the strata, and giving it the form of a large fragment of sandstone resting on and surrounded by trap, as in the two places already described. The dyke (*ij*) is probably connected with the dyke (*o*, *n*, *k*), the evidence however is only presumptive, but all the other connections marked on fig. 5, are apparent. At (*c*, *d*, *e*, *f* and *g*), are fragments of sandstone surrounded by trap.

Fig. 6.



Of these fragments, (*e*) fig. 6, is a portion of sandstone stratum, about ten inches in thickness, and about three feet in width, standing nearly vertical in a bed of trap: (*f*) is a mass about three feet square, similarly situated: (*c* and *d*) are fragments of sandstone about three feet wide and two feet thick, surrounded on all sides by trap, except the front, where they may be seen in the bank of the road. A small stream of water crosses the road between (*e* and *d*), and descends the hill in the direction (*l*, *m*) into a deep dell or valley which commences a few rods west of that place, and extends down by the side of the Cheshire road, and within a few rods of it, until it approaches near the turnpike, when it suddenly turns south, and passing the peak (*k*), spreads out into a plain in the river meadow. The bed of this brook from (*l*) to the bottom of the valley, may be seen from figure 7, and a profile section of the same, figure 8.

Fig. 7.
Surface View.

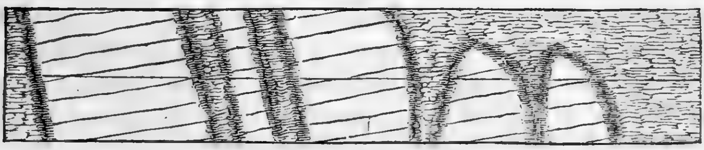
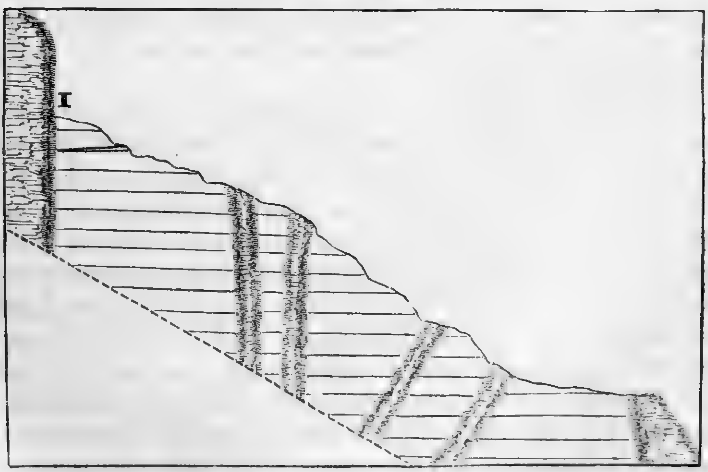


Fig. 8.
Profile View.



Rise 32 feet. Distance 74 feet.

The same appearances are presented in all these dykes at their junction, as in the one at Mr. Hill's manufactory, and the change wrought upon the sandstone, seems to have been in exact proportion to the mass of trap with which it is in contact.

From (p) fig. 3, to (r) there is a steep precipice fronting eastward, evidently the termination of a large dyke which lies beneath the surface. East of this, the dip of the sandstone is considerably greater than in the other parts of the town, being in some places inclined at an angle of from 25° to 30°. South of the dyke, supposed to run north of, and parallel with the Cheshire road, the inclination of the sandstone is less to the east, but it appears to have an additional dip to the south. This dip, though inconsiderable, is sufficient to show that the disturbing cause did not uniformly act in parallel lines, and it is not impossible but the sandstone may have been fractured, both in the lines ($p\ r$) fig. 3, and ($b\ p$), fig. 5, by the force which elevated it; on which supposition, a small diagonal fracture in the direction ($p\ k$) fig. 3, would cause the sandstone south of ($b\ p$) fig. 5, to dip gently to the south. It should be mentioned that there is no visible connection between the sandstone lying on the Cheshire road, and that south of the dell through which the brook I have described flows, until we pass west of the point (c), fig. 5: but that the sandstone at (m) fig. 5. retains the ordinary dip to the east, as if it had been undisturbed by the commotion that rent its nearest neighbor north.

The supposition of such a force, fracturing the sandstone in two directions, accounts satisfactorily for the existence of those numerous rents and fissures in the sandstone, now occupied by trap, in the form of veins and dykes.

It is not my intention to go into an inquiry concerning the origin of the trappean family of rocks; and I will only remark, that the appearances presented by the sections I have attempted to describe, in my opinion, and in the opinion of others who have visited those places, whether men of science or not, carry as convincing evidence of the former action of fire, as does the fine coal and ashes left in the bed of a pit of charcoal. To the sections already described, I will add one more, about a mile south-west from the Cheshire road, where the sandstone, at its junction with the trap, has been fused, and both sandstone and trap are vesicular. To a knowledge of this last section, and for some suggestions concerning the others, I am indebted to the kindness, scientific knowledge, and extensive acquaintance with the geological structure of this region, of my friend F. Cook, M. D. of this place.

Wallingford, July 21, 1834.

Art. X.—*Observations on the disturbance in the direction of the Horizontal Needle.—1. During the Aurora Borealis, visible at Philadelphia, on the 17th of May,* 1833; 2. *During that of July* 10, 1833; by A. D. Bache, Professor of Natural Philosophy and Chemistry in the University of Pennsylvania.

1. Aurora of May 17, 1833.

Communicated to the committee of publications of the Franklin Institute.

Gentlemen—Circumstances having prevented me from witnessing more than a very small part of the unusually brilliant aurora which was visible on the evening of the 17th of May last, I am indebted for the following description of it to my friend J. P. Espy, Esq., who has kindly furnished it to me from his journal.

"On the 17th of May, 1833, the temperature of the air being 68°, and the dew point 66°, a brilliant aurora appeared in the north, about twenty or thirty degrees above the horizon, and extending about thirty or forty degrees on each side of the north point.

"I first saw it a few minutes after nine o'clock, when it was brighter than it appeared afterwards. Streamers, not in motion, were distinctly visible, rising from a dense light below, which seemed to rest on dark clouds underneath, reaching the horizon. All the rest of the sky was clear, and had been so all the afternoon. In a few minutes the streamers disappeared, clouds, which suddenly formed, seeming to take their places, the northern lights still appearing nearly the same, only interrupted in part by a greater number of clouds. I continued to observe the aurora with intervals of but few minutes, and at nearly ten o'clock I discovered that a very brilliant arch had been formed, passing through the zenith, and terminated by the horizon, about twenty degrees south of east, and the same number north of west.

"This arch was much denser, brighter, and narrower, near the horizon than in the zenith. It passed gradually towards the south, and disappeared, at twenty minutes past ten, about eleven degrees south of Lyra. The clouds, at the time of the disappearance, were rapidly forming north of the arch, all the south being yet clear; in fifteen minutes afterwards the whole sky was overcast, and the light in the north was hardly visible through the clouds. The air had been coming from the north in the morning, and had changed round by the west, and at the time of the occurrence of the arch it is believed was nearly south west; below, the direction of the clouds was not observed.

"The dew point had risen, since the preceding day, twelve degrees Fah. It is highly probable that an upper current (not the uppermost) of air, was moving in the direction in which the arch moved, as the air had been moving in that direction a few hours before, and I have frequently observed, when the wind changes, the lower strata next the earth change first. From the 10th until the afternoon of the 15th of May, the wind had constantly been by night and day, almost exactly south, with a high dew point, carrying an immense quantity of vapor to the north; on the evening of the 15th, and until the night of the 16th, the wind was NE. with rain, and on the morning of the 17th the wind was north."

On returning home at eleven o'clock, on the evening just referred to, and observing the different magnetic needles which I have arranged for observations on the diurnal variation, a considerable disturbance was indicated. The journal of the hourly observations, kept during my absence in the evening, confirmed my opinion that what I had witnessed was but a part of the disturbance which had actually taken place, and which seems to have affected the horizontal needle especially.

The needles to which I have referred are three in number, two long horizontal needles, of which one is within doors, and the other* is under cover in the yard attached to my residence, and a long dipping needle with a knife edge suspension, contained in a small observatory, constructed for the purpose, and also in the yard of my dwelling house. The observations of the horizontal needle, within doors, were made very regularly, and also of the dipping needle out of doors, but the observer not being aware of the appearance of the aurora, did not take the corresponding hourly observations of the horizontal needle out of doors, throughout the whole of the evening.

In order to convey a better idea of the variation on the evening in question, I precede the observations by those made on the following day and night, on which the changes of variation and dip were nearly the regular mean diurnal changes at this time of the year. The variation is referred to the mean variation for the day, or to a point nearly corresponding to this, the sign + being prefixed to the positions *west* of this line of mean variation, and the sign – to those *east* of

---

* A complete description of this needle is given in a paper read before the American Philosophical Society, in November last, and which will appear in the first part of the fifth volume of their transactions.

the same line. The height of the thermometers contained in the boxes with the needles is given.

Time of observation.	*Horizontal Needles.*				*Dipping needle*			Weather.
	Diurnal changes of variation. Needle out of doors.	Attached Thermometer.	Diurnal changes of variation. Needle within doors.	Attached Thermometer.	Dip of the needle.*		Thermometer attached.	
	Minutes.	Fah.	Minutes.	Fah.	°	′	Fah.°	
A.M. 8¼	− 7.5		0.0	72°	71	40	71.4	Cloudy.
9	−16.5	70°	0.0	73	"	36	72.5	Do.
10¼	− 7.5	72	−1.5	73	"	36	72.5	Do.
11	− 4.5	74	−3.0	74	"	36	74.2	Do.
12	+ 0.5	74	0.0	74	"	36	75.3	Do.
P.M. 1	+13.5	77	0.0	74	"	33	78.1	Sun out occasionly.
2½	+12.5	82	+3.0	75	"	30	82.1	
3	+15.0	83	+3.0	75			82.6	Sun out. Clear.
4½	+13.5	82	+3.0	76	"	42	83.8	Clear.
5¼	+ 6.0	82	−1.5	76	"	42	82.6	Do.
6	+ 1.5	81	−3.0	76	"	48	81.5	Do.
7	− 4.5	79	−3.0	75	"	51	79.3	Do.
8			0.0	75	"	45	75.9	Light fleeces. (Cirrus.)
9¼	−10.5	76	0.0	74	"	48	74.8	
10½	−10.5	74	0.0	74	"	48	74.8	
11	− 3.5	74			"	42	74.0	Clear.

From the table just given it appears that on the 18th of May, the westerly variation, as shown by the horizontal needle out of doors, had two distinct points of minimum, the former at 9 A. M., and the latter between 9¼ and 10½ P. M., and two points of maximum, the first at 3 P. M., and the second at some period, not ascertained, after 11 P. M. The same variation shown by the needle within doors, had its minima at 11 A. M., and from 6 to 7 P. M., its maxima between 2½ and 4½ P. M., and at some hour of the night which was not ascertained. The temperatures of the two needles being very different, the effect of changes of temperature should be ascertained, to render the results strictly comparable; a remark which suggests the object, in part, of the observations upon these two needles, so differently situated.

In the dip we find a minimum at 2½ P. M., as the only point very decidedly marked: there is an apparent maximum at 7, which the

* As this needle was intended for differential results, the dip here recorded is not to be supposed the true dip for this place.

subsequent observations seem to indicate to have been the result of causes foreign to those producing the regular diurnal changes of dip.

The observed changes for this day, just given, are not entirely regular, and should be considered, of course, in the light of particular results affording merely a term of comparison, which is sufficiently accurate for the purpose in view.

I now give a table of some of the observations for May 17th, with a column of remarks, the portion of which relating to the aurora is drawn from the description by Mr. Espy, already given.

Hour of observation.	*Horizontal Needles.* Changes of variation. Needle out of doors.	Attached Thermometer.	Changes of variation. Needle within doors.	Attached Thermometer.	*Dipping needle* Changes of dip.	Attached Thermometer.	Remarks.
	Minutes.	Fah.	Minutes.	Fah.	° ′	Fah.°	
A.M. 8¼	− 1.5	60°	−9.0	70°	71 33	59.6	Cloudy.
11			−1.0	70½			Sun out.
P.M. 1			+7.0	71			
3			+7.0	72	" 12	74.8	Cloudy.
4	+15.0	67	+7.0	72	" 9	75.9	Sun out.
5	+ 1.5	77	+5.5	72	" 18	75.9	Clear.
7½					" 36	73.4	
8½			−3.0	72	" 30	71.9	
9			−1.5	72	" 34	71.4	Aurora bright; streamers; arch forms about 10 P. M.; arch disappears 10*h*, 20*m*.
10½			−13.5	72	" 30	70.3	Sky overcast.
11	− 13.5	68			" 36	69.1	Low stratus.

By comparing the fourth column of this table with the corresponding column of the first table, we find throughout the day a general accordance in the relative positions of the needle; a minimum of westerly variation at about 8 A. M., a maximum between 1 P. M. and 4 P. M., a second minimum about 8 P. M., a tendency towards a second maximum, which was interrupted by the aurora. There does not appear to have been any marked change from 8½ P. M. to 9; so that the first part of the phenomenon does not seem to have affected the variation. Observations are wanting to show when the effect began to be felt, and when it was at the greatest, and the near coincidence of the observation at half past ten, with the time of the disappearance of the arch, must, of course, be regarded as accidental. In the interval of an hour and a half, between 9 and 10½ P. M., the needle had moved to the eastward 12′, or one-fifth of a degree; and the observations during the early part of the phenomena tend to show, if they do not prove, that this motion took place in the latter part of the interval, the mean hourly rate of motion, as shown by the observations at 8½ and 9 P. M., being only three minutes. I regret that the observations were not more regular; but as no particular interest attached to the evening, the observer, as I have already stated, not being aware of the presence of the aurora, I considered myself fortunate in the frequency of those observations which were made; this being a part of the evening in which, usually, there is nothing to require regular observations, being the interval between the evening minimum and the night maximum.

The observations on the horizontal needle out of doors do not contradict any of the remarks just made, and they show further that at 11 P. M., forty minutes after the disappearance of the arch, the effect on the needle was still strongly marked; the westerly variation at 11 P. M., having been ten minutes less than on the same hour of the next succeeding evening. The very rapid formation and disappearance of clouds during the evening, and the low stratus which formed about 11 o'clock, would all, in ordinary cases, have produced slightly marked changes in the variation, but nothing of the character of those noted in the table. The temperature having remained stationary, within doors, during the evening, no part of the changes in the position of the horizontal needle noted in the third column, were due to variations of temperature. The results, in the absence of correction for these changes, are therefore the more valuable.

The dip, recorded in the sixth column of the table last given, has its minimum at 4 P. M.; a rise then begins, which is so very irregular as not to permit any inference from it; diminishing between 7½ and 8½ P. M., it increases between 8½ and 9, decreases between 9 and 10½, and subsequently increases to 11 o'clock. These changes do not seem to attach to the different phases of the aurora, and are not more considerable than ordinary meteorological phenomena would produce, such, for example, as are recorded in the first table.

My aim having been merely to establish that a decided disturbance of the horizontal needle took place during the aurora of the 17th, I have not thought it necessary to apply the corrections for the temperature of the needles, which the successful establishment of the changes in diurnal variation will require.

2. Aurora of July 10, 1833.

(with a copperplate.)

In the number of the Journal of the Franklin Institute for July last, I gave an account of a disturbance in the direction of the horizontal needle, during the occurrence of the Aurora Borealis, on the 17th of May. On the occasion of the brilliant aurora of the 10th of July, I had a remarkably favorable opportunity of observing a similar disturbance, and as the subject is one which is considered to require further observations for its elucidation, I send you an account of those made on the evening referred to.

The needles with which the observations were made, are the same which were referred to in my note of observations made in May. Their places had remained unchanged from that time; the horizontal needle out of doors, under a small wooden enclosure; the horizontal needle within doors on a table placed against a partition wall in my study; the dipping needle out of doors in a small observatory constructed entirely of wood, copper, and brass. The needles out of doors have only the local attraction unavoidably incident to a city location; that within doors has, of course, an irregular and more considerable attraction to affect it. The latter needle is exposed to very slight variations of temperature. These particulars are probably sufficient for the present purpose.

I first saw the aurora on the evening of the tenth of July, at three-quarters past nine o'clock; it appeared then as a low nebulous light, resting upon dark clouds, and interspersed by them, but was not sufficiently brilliant to make me entirely certain that it was an aurora: the test afforded by the magnetic needle shows that the phenomenon began before this time, and the attention of my observer had been so far drawn towards the sudden diminution of variation at nine o'clock, that an inaccuracy in the observation was suspected, and the needle recurred to, at five minutes past nine, to verify the result before obtained. At ten o'clock, the light in the north was more distinct, extending upwards, nearly 30° from the horizon. At this time I began a systematic set of observations, which were continued until one o'clock on the morning of the 11th. By going a short distance from my dwelling to the east, I have a tolerably good view of the north eastern portion of the horizon; by going a greater distance to the west, a complete view of the north western portion, and from the top of my dwelling a tolerable field of view to the north.

At ten minutes past ten the light of the aurora was as brilliant as at the observation at ten o'clock, the brightest portion extending from 20° to 30° east of the north point, and the diffused light extending at least 60° from the north towards the west. The upper limit of the light was a waving line declining rapidly in the eastern portion, and more slowly in the western part. The substratum of black clouds (cumulo stratus) from behind which the aurora appeared to emerge, and which at ten o'clock extended about eight degrees above the horizon, had risen, and a number of small and very black clouds (cumulus) appeared, intercepting portions of the light. At fifty minutes past ten, the waving line, forming the top of the nebulous light, had become more regular, its elevation not being, in any part, more than 12° above the horizon, its extent being about 100°. The floating hill-clouds (cumulus) had elongated, diminishing in number, but increasing in size. I supposed the phenomenon to be passing off, when just before twelve o'clock commenced the most brilliant display which I remember to have seen. At twelve, the nebulous light had risen in an irregular line nearly 40° above the horizon; and to the westward of north, apparently emerging from behind the luminous cloud, were diverging beams of light, more brilliant than the body of the aurora, varying constantly in the degree of brightness, and in extent. The appearance at within a few minutes of the time mentioned, I have attempted to represent in the annexed figure, (Fig. 2, plate I.) When I speak of the beams being diverging, I mean, of course, that they *appeared* to diverge; the point of divergence was below the horizon, but its position I could not, at any time, determine to my satisfaction. The phenomenon resembled, in form, the beams sometimes seen in the eastern part of the sky when the sun is setting, and which appear to proceed from a point below the eastern horizon, except that these beams were of a beautiful light, apparently streaming from behind a cloud of light. There was at this time no dark cloud visible to the north.

Of the beams which I have endeavored to describe, those nearest the north faded first, and new ones sprang up further to the west of north, much exceeding in apparent breadth those seen near the north. Small black cumulus and cumulo stratus were scattered through the cloud of light. At eight minutes past twelve, four beams were visible, the broadest being furthest to the west; the last beam died away at twenty five minutes past twelve, vanishing, after appearing to move westward, about 60° west of north. The general light to the north was still bright, and at half past twelve the most luminous point was about 15° west of north. At one o'clock, the aurora had almost ceased, there being still a feeble and diffuse light to the north. A dark cloud (cumulo stratus) occupied a portion of the horizon, having above it two smaller clouds of the same description; in the intervals between these clouds, and to the eastward of the one in the horizon, the feeble light was seen.

In the following table of observations on the magnetic needle, the results which belong to the horizontal needle are referred to the same point, as a zero, to which those in May were referred; this point is not the mean of the days immediately preceding and succeeding the tenth of July, but a reference to it renders the results of the present series immediately comparable with that for May. In the observation of the dipping needle, I have been perplexed by a defect, of which this is not the place to give an account, but which it is necessary for me to allude to, as explaining why the observations of that needle, made prior to half past ten P. M., are not given: those which are set down, I have referred to the first observation recorded, as a zero; as differential results, I believe them to be worthy of confidence, although not in the same degree with the corresponding ones for the horizontal needle. The differences marked + correspond to an increase of dip, and those marked – to a decrease. In the column of remarks the different phases of the aurora are briefly referred to.

Time of observation		Horizontal needle.				Dip. needle.		Remarks.
		Changes of variation, needle out of doors.	Attached thermometer.	Changes of variation, needle within doors.	Attached thermometer.	Changes of dip.	Attached thermometer.	
Hrs.	Min.	Mins.	Fah.	Mins.	Fah.	Mins.	Fah.	
July 10.								
A.M. 8	30	— 1.8	62°					
9				— 1.0	74°			Wind N. W.
11		— 5.0	74	+ 1.0	75			
12			78	+ 2.0	75			
P.M. 1	15	+ 1.5	81	+ 3.0	76			
3		+ 4.5	84	+ 4.5	76			
4		+ 3.0	83					
5		+ 1.5	80	+ 4.5	76			
6		+ 3.0	78	+ 6.0	75			
9		—24.5	70	+ 3.0	72			
"	5			— 2.5	72			
10		—27.0	67½	— 9.5	71			Clear.
"	20	—28.5	67	— 9.5	71		66.3	Aurora bright.
"	30	—29.0	67	— 9.5	71 ?	+6.5	66.3	Less bright, extends about 60° around the horizon, and is from 12° to 15° in height, at the highest point.
"	40	—28.5	66¾	— 9.5	71	+5.0	66.0	Dark cumulo stratus to N.
"	50	—24.5	66½	— 8.0	71	+2.0	65.5	Aurora decidedly diminished. Wind variable, N. E. to S. E.
11		— 18.0	66	— 8.0	71	+0.5	65.2	Aurora 5° to 6° high, very bright,—a faint light rises about 15°. Clouds have changed since last observation.
"	10	—12.5	65½	— 6.0	71	—2.5	65.0	Brighter than when first seen at 9¾ hours.
"	30	— 9.5	65½	— 4.5	71	+0.5	64.8	Aurora faint as at 9¾ hrs.
12		—25.5	65	— 6.0	70	+2.0	64.4	See fig. 2, Plate 1.
July 11. A.M. 12	8	—21.0	64¾	— 6.0	70	— 5.5	64.2	Beams move to W. of N.
"	20	—10.0	64½	— 4.5		— 0.5	63.8	
"	30	— 9.5	64¼	— 2.5		+2.0	63.8	Last beam dies away at 12*h.* 25*m.* 60° W. of N.: the N. still bright; brightest spot 15° W of N.
1		— 4.5	63¾	— 1.5		—5.5	63.2	Aurora nearly gone; the light still appears to the north where the clouds are drawn up.

In examining the column of this table which contains the observations on the horizontal needle out of doors, there appears a remarkable decline of westerly variation, a movement of the north pole of the needle to the east, at some time between the hours of six and nine, P. M. This variation goes on diminishing until between thirty and forty minutes past ten, after which, with the diminished brilliancy of the aurora, the north pole of the needle begins to move westward. This motion was so regular, and its correspondence with the decrease of the brightness in the northern light so complete, that I supposed the phenomenon about to cease, and left my station on top of the house to examine the record of observations already made. On observing at twelve o'clock, I found to my surprise, that the north pole of the needle had again moved eastward, as shown in the table, and on passing rapidly into the street, the beautiful beams of which I have spoken were seen: this sight I might have missed, having supposed the aurora to be disappearing, but for the warning given by the needle. It is not improbable, from the general course of the phenomenon, as already described, that the beams which I saw first to the west of north, were not the first which had appeared, and that others which preceded them may have been to the east of that point. The variation did not reach as low a point during the brilliant part of the phenomenon as during the former part, the observation at half past ten giving a variation less by 3½ minutes than that for twelve o'clock; it is possible, however, that the second minimum occurred between half past eleven and twelve o'clock. At one o'clock the disturbance of the variation had not ceased, although it had become comparatively trifling, and the northern light had not entirely disappeared. This I have reason to believe was the last part of the phenomenon.

In order to present the results just stated in a form which addresses itself more readily to the eye, I have traced (fig. 1, plate I,) a broken line, in which the intervals between the vertical lines represent the intervals between the times of observation, and those between the horizontal lines the differences of variation. In other words, the abscissæ of the line correspond to the times of observation, and the ordinates to the amount of variation. From this figure it is at once observable that the westerly variation increased irregularly from 8½, A. M. until 3 P. M., when it attained a maximum; that the decrease from this maximum was also irregular, and very rapid between six and nine, P. M.: this includes a portion of the time of the occurrence of the aurora, and the striking irregularities, which follow, in the broken line, represent those of the phases of the aurora; the second minimum, at, or before, twelve o'clock, corresponding to the time of the occurrence of the diverging beams.

Recurring to the table, to trace the changes of variation in the needle within doors, we find it after nine P. M. sluggishly following the changes of the needle out of doors, the north pole moving three minutes of a degree to the westward between six and nine, P. M., while the same pole of the needle without doors moved over 27.5 minutes: suddenly obeying the force which had already moved the needle without doors, the variation diminishes 5.5′ of a degree in five minutes; between nine and ten, P. M. the diminution amounting to 12.5′, while that of the needle without, was but 2.5′. At this point the needle within is stationary until after a decided impression has been made upon the other needle, of which the variation began again to increase. This increase is observable from forty minutes past ten until half past eleven, between which observation and that at twelve, the variation of the needle within doors has disminished 1.5′, and that without doors 16′. It should be observed that while this needle regained at twelve o'clock the place which it had at half past eleven, the one out of doors passed the corresponding point to the eastward, and was further to the east than at fifty minutes past ten. The correspondence in the motion of the two needles, in any of the intervals between two consecutive observations, although a general one as to direction, is by no means the same in relative amount.

It cannot fail to strike any one who attentively examines the foregoing table, or the line traced to represent the results, that the great *changes* in variation, the motions of the north pole of the needle to the east or to the west, take place rapidly at the beginning of changes in the phenomenon, and that the needle moves but slightly during the continuance of the same class, and degree of brilliancy, of appearances. The beautiful connexion which seems thus to be shadowed out between the effects of electricity in motion, as recently developed by the researches of Faraday, and these observed effects, is too obvious not to strike the mind even of one more intent upon recording facts than of hazarding speculations.

The results of observations upon the dip recorded in the sixth column of the foregoing table, are not altogether regular. Between ten, P. M. of the 10th, and one, A. M., of the 11th, there is a decrease to a minimum, which is sufficiently regular, a subsequent increase followed by a very sudden decrease, and a second increase, which is followed by as sudden a diminution. With such irregularities before one, it would be ill judged to attempt any conclusion from the apparently regular portions of the changes in dip: further observations may throw light upon the causes of the discrepancies, and I have recorded them here, principally with that view. For future observations I hope to have another instrument in which the defects of the present one will be remedied; the results then obtained may give a confidence which I do not now feel in those furnished by the present instrument.

The meteorological changes which took place about the time of the occurrence of this aurora, are worthy of record. On the morning of the 9th of July there was an irregular rain, with the wind at west, terminated by a shower at noon, and succeeded by a clear afternoon, with the wind at west and north west. On the morning of the 10th, the wind was still from north west, but in the evening had hauled round to the east and south east.

I subjoin an extract from the meteorological diary kept by James P. Espy, Esq., which shows a sudden diminution in the amount of vapor in the air, between the 9th and 10th of July. The remarks in relation to the winds agree with those already given.

Day of the month.	Temperature at noon.	Dew point.
6th.	82° Fah.	53° Fah.
7th.	—	70
8th.	86	71
9th.	79	65
10th.	78	51
11th.	83	55

"On the 9th the wind was from the N.W., and on the morning of the 10th from the N. N. W., and at noon the upper current from the W. and the lower from the S. E.; on the 11th the upper current was all day from the W., and the lower from the S. S. W."

To return to the observations on the magnetic needle. To determine from them the absolute effect attending the aurora, it would be necessary to make two corrections; the first for the effect of a change of temperature upon the needles, the second for the regular diurnal variation. The first of these is not for any considerable range of temperature amounting, during the few hours between 9, P. M. of the 10th, and 1, A. M. of the 11th, to $6\frac{1}{4}$° Fah. for the needle out of doors, and to 2° Fah. for the needle within. An idea of the general effect of the diurnal variation, may be formed by the comparisons contained in the annexed table, in which the observations made on the 10th of July, are compared with the mean of those made on the same hours, two days previous, and two days subsequent to the 10th.

Time of observation.	*Horizontal Needle out of doors.* Mean changes of variation and temperature on 8th, 9th, 11th, and 12th of July.			Changes of variation and temperature on the 10th of July.		Difference of variation.	*Horizontal Needle within doors.* Mean changes of variation and temperature on the 8th, 9th, 11th, and 12th of July.			Changes of variation and temperature on the 10th of July.		Difference of variation.	Remarks.
Hours.	No. of obs.	Mins.	Fah.	Mins.	Fah.	Mins.	No. of obs.	Mins.	Fah.	Mins.	Fah.	Mins.	
A.M. 8½	4	−10.0	69°	− 8.0	62°	+ 2.0							
9¼	3	− 8.0	73				4	−3.0	77½°	−1.0	74°	+ 2.0	
11	2	− 3.0	75	− 5.0	74	− 2.0	2	−2.5	81½	+1.0	75	+ 3.5	
P.M. 1	2	− 1.5	82	+ 1.5	81	+ 3.0	1	+2.5	83 ?	+3.0	76	+ 0.5	
2	4	+ 3.5	85				4	+0.5	83				
3	4	+ 7.0	86½	+ 4.5	84	− 2.4	4	+1,5	82½	+4.5	76	+ 3.0	
4	3	+ 1.0	85	+ 3.0	83	+ 2.0							
6	2	− 1.5	80	+ 3.0	78	+ 4.5	2	+2.0	79	+6.0	75	+ 4.0	
7	3	− 1.5	82										
9	2	− 9.5	75½	−24.5	70	−15.0	3	+0.5	76	+3.0	72	+ 2.5	Aurora.(?)
10	4	− 9.5	75	−27.0	67½	−17.5	3	+1.0	76	− 9.5	71	−10.5	Aurora.
11	2	− 8.5	74	−18.0	66	− 9.5	4	+1.5	74½	−8.0	71	− 9.5	Bright.
12	2	− 6.5	71½	−25.5	65	−19.0	1	+3.5 ?	74	−6.0	70	− 9.5	Do.

In this table the columns are arranged as in the foregoing one, additional columns being introduced to show the number of observations from which the mean is obtained, and to give the differences between the changes of the 10th and the mean changes. The comparison with the variation on the 10th, is assisted in the case of the needle out of doors by the curve of mean variation being traced in a dotted line upon fig. 1, plate I. In following the curves we see the increase from the morning minimum, at, or before, 8½ A. M., to the day maximum at 3, P. M., and the subsequent descent towards the evening minimum, with an irregularity in the progress of the variation, observable at 7, P. M. on the 10th of July. The lines now cease to have even the most general resemblance. The descent towards an evening minimum at 9, P. M., which appears upon the line of mean variation, concurring with the descent attending the aurora, might be supposed to have produced the suddenness of the effect noted, were it not that a similarly rapid fall occurs between half past eleven and twelve o'clock, contrary to the direction of the line of mean variation. It is possible that the coincidence in the direction given by the diurnal variation with that of the change attending the aurora, between eight and nine, and their opposition between half past eleven and twelve, is the cause of the first minimum being lower than the second, supposing this to have been at 12 o'clock, since the difference between the second minimum and the mean is greater than that between the first and the mean, by four minutes. At 1, A. M. of the 11th, the needle appears to have regained about the mean position, the variation being rather more than the proportional mean for that hour, supposing the increase from twelve to one, to be the same as that from eleven to twelve. Midnight is about the hour of the night maximum, which, however, not unfrequently occurs, after as well as before, that time.

The conclusions deduced from the observations on the needle within doors, coincide, generally, with those obtained from the one without.

Having made material improvements in the needles referred to in this paper, and completed two small observatories in the yard attached to my dwelling, expressly for magnetic observations, I purpose to follow out this subject, and in connexion with it to study the effect of meteorological changes, and, as necessary to the solution of these questions, to preserve an account of the diurnal variation, in such a way that the requisite corrections for the temperature of the needles may be applied. Thus I hope to be able to make a contribution towards determining a question to which the attention of men of science has been particularly called by the recent discussions in the British Association for the Advancement of Science.

Philadelphia, December 24th, 1833.

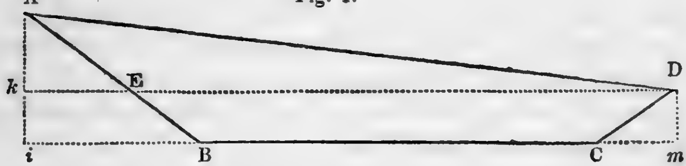
Art. XI.—*Problems;* by D. C. Lapham, Civil Engineer.

Problem I.

To find the area of a cross section of a canal, when the surface is inclined.

Given BC, A*i*, D*m*, (Fig. 1,) and the ratio of the side slopes, (C*m* to D*m*,) to find the area.

Fig. 1.



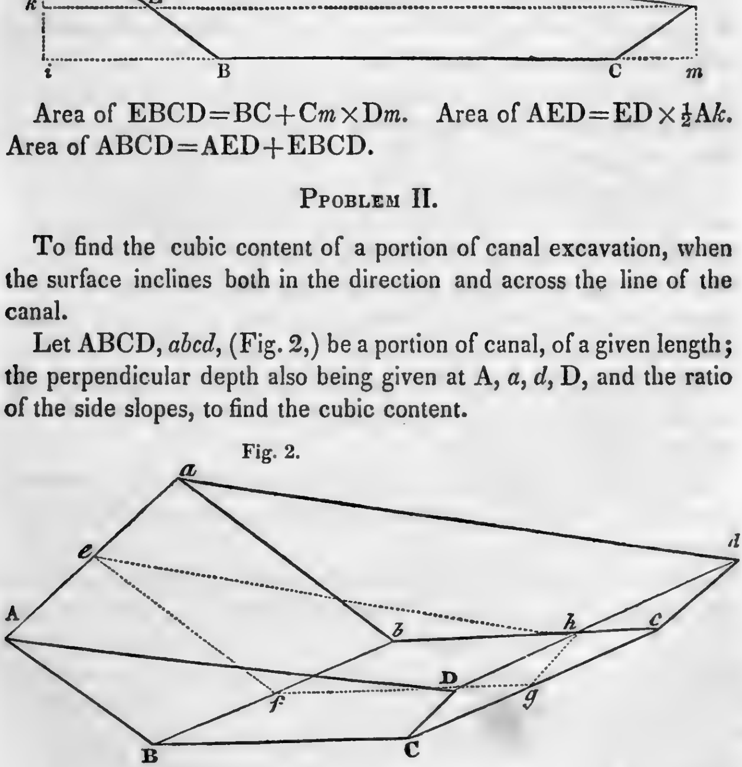
Area of $EBCD = BC + Cm \times Dm$. Area of $AED = ED \times \frac{1}{2}Ak$. Area of $ABCD = AED + EBCD$.

Problem II.

To find the cubic content of a portion of canal excavation, when the surface inclines both in the direction and across the line of the canal.

Let ABCD, *abcd*, (Fig. 2,) be a portion of canal, of a given length; the perpendicular depth also being given at A, *a*, *d*, D, and the ratio of the side slopes, to find the cubic content.

Fig. 2.



Rule.—Find, by Prob. I, the area of the cross sections ABCD, *abcd;* also the area of the middle cross section *efgh*, (which is deduced from the given depths thus, $A + a \div 2 =$ depth at *e*, $D + d \div 2 =$ depth at *h*.)

Put the area ABCD=E.
abcd=F.
efgh=G.
length=L.
solidity=S.

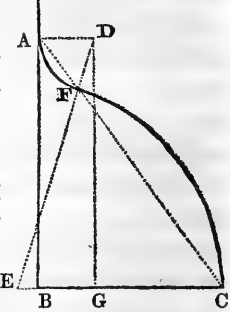
Then $S=\frac{1}{6}L.(E+F+4G)$.* Or,

To the area of the two ends, add four times the area of the middle cross section: multiply by one sixth of the length.

It is evident that the above solution holds true, whether the inclination of the surface at each end be in the same ratio or not.

The solutions of this problem given in Major Long's Rail Road Manual, and also by Mr. Charles Potts, in a pamphlet on canal cutting, are correct *only* when the surface inclines in the same ratio at each end of the given distance.

Fig. 3.



In the construction of wing walls for culverts, bridges, &c., the form represented in Fig. 3, has been adopted by some engineers, as combining the greatest advantages. The large portion of the curve presents its convex surface to the pressure of the embankment, and the smaller curve allows the water and floating bodies to pass more readily without injuring the walls.

The distance AB, BC and the smaller radius AD are usually given. The problem is to find the corresponding radius EF.

Find the angle BCA. The angle DAF=BCA, (Euc. Book I, Prop. 29;) and the angle DFA=DAF, (Euc. Book I, Prop. 5.)† Therefore, (by Euc. B. I, Prop. 32,) $180-\overline{DFA+DAF}=ADF$; and (Euc. Book I, Prop. 29) DEG=ADF. Then, as log. sin. of GED : DG : : radius : ED. ED − FD=EF. Or, algebraically,

Put $FD=AD=a$.
$DG=AB=b$.
$BC-AD=GC=c$.
$EC=EF=x$.

* Day's Mensuration, Part III, p. 37.

† It may be well to add, for the sake of practical men, who have no time for mathematical investigations, and as a truth which is essential to their clear understanding of the problem, that the point F, which is the intersection of the lines AC, DE, is also, *in fact*, the point of *contact* of the two circles.—*Com.*

Then, $x=\frac{b^2+c^2-a^2}{2a+2c}$.* Or,

From the sum of the squares of AB and GC, deduct the square of AD or BG: divide the remainder by twice BC.

Cincinnati, Ohio, Feb. 6, 1834.

ART. XII.—*Remarks on Professor Mitchell's method of preparing Carbonic Oxide, free from carbonic acid;* by L. D. GALE, M. D. Acting Professor of Chemistry in the University of the City of New York, and Prof. Chem. in the New York College of Pharmacy.

HAVING received No. 2 of Vol. XXV of this Journal, containing Prof. Mitchell's paper on a new process for preparing carbonic oxide, about the time I was to lecture on that subject before my class in the College of Pharmacy, I adopted Prof. M.'s plan and followed his directions as nearly as possible, but much to my discomfiture found the gas obtained was perfectly incombustible: but I should here state, that it was used immediately after preparation. As gases will sometimes burn from a large orifice, when they will not from a smaller one, I varied the size of the aperture, but all to no purpose. I then collected more gas, with "heat duly moderated," and preserved only the first and last portions, but did not succeed in causing it to burn from an orifice. I then threw up, by means of a syringe, some caustic potash into the receiver containing the gas; a rapid absorption took place, amounting to nearly half the original quantity, and the remainder was sufficiently pure carbonic oxide. I also ascertained, that if the gas, when procured, be allowed to stand over cold water, and especially in broad and shallow receivers, for two or three hours, so much of the carbonic acid is absorbed that the remaining gas will burn with its ordinary appearance. The same remark will apply to carbonic oxide, prepared by any of the ordinary methods described in the books. Indeed, I am constantly in the habit of preparing the gas in the morning, when it is to be used in the afternoon, and thus avoid the occasion of using any alkali.

Although from the above experiments I was quite satisfied that carbonic acid is always produced in the above mentioned experiments, yet, that I might be able to speak with perfect confidence, I was in-

* I am indebted to my brother, J. A. L. for the algebraic solution.

duced to make a complete analysis of the gas obtained after Dr. Mitchell's plan. Taking a given weight of the oxalate of ammonia, and the proportion directed of sulphuric acid, I collected the whole gas evolved from the materials over mercury, that none should be absorbed during the operation. One hundred equal parts having been set aside for examination, pure liquid potassa was thrown up by means of a syringe, and the vessel agitated until no more absorption took place, when fifty parts of the gas had disappeared. The residual gas, on being detonated with oxygen, was found to be nearly pure carbonic oxide. In order to ascertain whether the gas differed in its qualities, at different stages of the process, I collected portions of it at regular intervals, throughout the operation, and subjected them to careful examination. The result of these experiments was pretty uniform, not varying in any case two per cent. from fifty measures of each gas; and hence I infer, that the oxalate of ammonia, treated as above, for obtaining carbonic oxide, yields the same products as the binoxalate of potassa or oxalic acid, treated according to the methods described in the books.

Professor Mitchell states, that "on examining the residuary matter left in the retort, it is found to be strong sulphuric acid." I must confess, I am at a loss to know in what way he made an examination, to arrive at such a conclusion, unless it be that he used more than "one or two drachms of sulphuric acid," for in each case in which I examined the residue, where an ounce of the oxalate and two drachms of acid were used, I found crystals in the retort, after the materials had cooled, answering in every respect to the acid sulphate of ammonia. If the quantity of sulphuric acid be increased to four or five drachms, and the heat be stopped a little before the gas ceases to come over, the acid will then hold the sulphate in solution and exhibit to the eye an appearance of sulphuric acid; but a single and very simple experiment—namely, the evaporation of a few drops of the liquid on a platinum or glass capsule, until a part of the acid is expelled, will indicate the presence of some salt, and that, on examination, will be found as above mentioned. That ammonia should escape from the retort, in a free state, while it is in contact with a large excess of free sulphuric acid, and then combine with the carbonic acid resulting from the decomposition of the oxalic acid, appears to me unphilosophical, and is disproved by experiment, for we recover the whole, or very nearly all the ammonia in combination with sulphuric acid.

Art. XIII.—*Rail Road Curves;* by Thos. Gorton, Civil Engineer.

To join two straight lines, which, if produced, would intersect each other, by a curve, so that those lines shall be tangents to it.

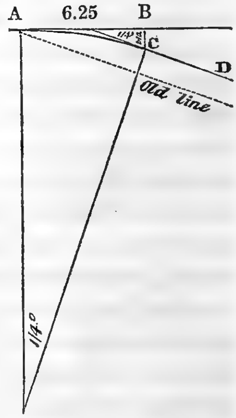
Find the difference in the bearing of the two lines, which suppose to be 24°; then, by inspecting the ground, find what curve will suit best, and let it, for example, be one of 6°. There will then be five deflections and four stations of curve. These deflections will be 3°, 6°, 6°, 6° and 3°, the sum of which is 24°. Then commence the curve at some point in one of the straight lines, and run it round, by making the above deflections at their respective stations, when, if the last deflection coincide with the other straight line, the work will be done: but, which is probable, suppose that it falls to one side of it. Then, at the station where the last deflection was made, turn the instrument 24°, viz. to the bearing of the first straight line, and looking back or forward, as the case may be, see where it cuts the line you wish to run into, which point, if the work has been carefully done, is the place where the curve will join the said line. Measure the distance from the instrument to this point, then go back to where the curve was begun and set off the same distance back or forward as before, in the straight line, from which run the curve round, and the lines will be joined.

The correctness of this rule will readily be seen. It is simply moving the curve back or forward, keeping the line a tangent to it, until the other end of the curve falls in the other straight line. The rule is also easy in practice, as in every case two lines may be joined in this manner by only two trials, if the curve be carefully run.

To make a slight change in the direction of a line.

In running a line for the superstructure of a rail road, it will be found occasionally to vary a little from the grading line. A correction may be made in the following manner, at the curves, by lengthening or shortening them a few feet. Suppose, on coming to the end of a curve, that the line comes out in the centre of the grading, but that, in continuing the straight line to the next curve, it is found to vary 0.44 feet in 100 feet, or one fourth of a degree, and consequently, if the line be long, it will fall at the other end much to one side of the graded road. Now let the curve just run be one of 4°, then the chord of 4° being 100 feet, (the length of a station,) the chord of $\frac{1}{4}°$ (the variation) will be $\frac{100}{16}=6.25$ feet, (this being near enough for practical purposes,—or the arc may be used in place of its chord.) From the end of the curve measure back or forward 6.25 feet, in the line of its tangent, and from that point set off to the right or left the variation for $\frac{6.25}{2}$, which is 0.014 feet, and the point thus found will be the end of the curve, from which the tangent being produced will nearly coincide with the grading line. The variation is found by the following proportion.

100 feet : 0.44 (the variation in 100 feet) :: $\frac{6.25}{2}$: 0.014.

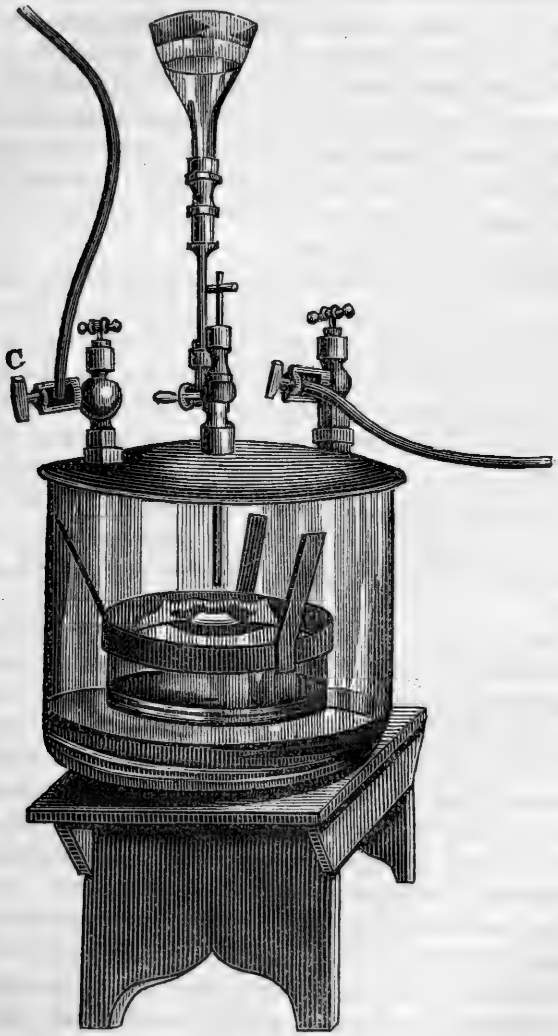


The annexed diagram will serve as an illustration.

Here by producing the curve from A to C, the direction of the line is changed from AB to CD. The 6.25 was measured on the line AB, as before stated, for the difference between the line AB and the arc AC, or its chord, is so inconsiderable that either may be used, in this case, with equal accuracy in practice.

Art. XIV.—*Apparatus for freezing Water by the aid of Sulphuric Acid*; by R. Hare, M. D. Prof. of Chem. in the Univ. of Penn.

The congelation of water by its own vaporization, accelerated by exposure to the absorbing power of sulphuric acid, or other agents, in vacuo, has always been a difficult experiment. A distinguished professor complained to me lately of want of success in his efforts to repeat it. In November, 1832, after having three times succeeded in freezing water by the process in question, yet having failed before my class, I was led to give more than usual attention to the process in order to obviate the causes of disappointment. It appeared to me that the failure arose from imperfection in the vacuum. An excellent pump, with perfectly air tight cocks, is indispensable; and not only must the pump be well made, it must likewise be in good order. Neither should the packing of the pistons, the valves, nor the cocks, allow of the slightest leakage. If a pump has been used previously for freezing, by the vaporization of ether, it will not be competent for the experiment in question, unless it be taken apart and cleaned.



Cocks of the ordinary construction, are rarely if ever perfectly air tight, and their imperfection always increases with wear. Under these impressions, having, cleansed my air pump, and put it into the best order possible; for the purpose of obviating leakage through the cocks associated with the instrument, I closed the hole in the centre of the air pump plate by a screw, and for a receiver made use of a bell glass with a perforated neck furnished with a brass cap and a female screw, by means of which one of my valve cocks was attached. A communication between the bell, and the chambers of my pump, was established through the valve cock and a flexible lead pipe, in a mode analogous to that already described in the account of the valve cock. In this way I succeeded in preserving the vacuum, longer than when the cocks of the air pump were employed in the process; and accomplished the congelation of water by means of the vacuum, and sulphuric acid.

Latterly, I have used an apparatus which is represented by the adjoining figure, in which a brass cover is made to close a large glass jar so as to be quite tight. In operating, the bottom of the jar was covered with sulphuric acid, and another jar with feet, also supplied with acid enough to make a stratum half an inch deep on the bottom, was introduced as represented. The bottom of the vessel last mentioned, was, by means of the feet, kept at such a height above the surface of the acid in the outer jar, as not to touch it. Upon the surface of the glass vessel, a small piece of very thin sheet brass was placed, made concave in the middle, so as to hold a small quantity of water.

The brass cover was furnished with three valve cocks, one communicating with the air pump, another with a barometer guage, and the third with a funnel supplied with water. Under these circumstances, having made a vacuum on a Saturday, I was enabled to freeze water situated on the brass, and to keep up the congelation till the Thursday following. As the water in the state of ice evaporates probably as fast as when liquid, during the night the whole quantity frozen would have entirely disappeared, but for the assistance of a watchman whom I engaged to supply water at intervals. At a maximum I suppose the mass of ice was at times about two inches square, and from a quarter to a half an inch thick. The gradual introduction of the water, by aid of the funnel and valve cock, also of the pipe represented in the figure, by which it was conducted to the cavity in the sheet brass, enabled me to accumulate a much larger mass than I could have produced otherwise. The brass band which embraces the inner jar near the brim, with the three straps proceeding from it, serves to keep this jar in a proper position; that is in fact concentric with the outer jar.

In this last mentioned experiment, I employed an air pump upon a new construction, which I have lately contrived, and of which I shall soon publish a description.

ART. XV.—*On the general principles of the Resistance of Fluids, in a notice of the Fifth Article of No. XV of the Southern Review;** by LEWIS R. GIBBES, Columbia, S. C.

THE works selected as the subjects of the review are, "Remarks on Canal Navigation, &c. by W. Fairbairn, Lond. 1831," and "A new Theory of the Resistance of Fluids, &c. by T. Tredgold, article 41st of Phil. Mag. April, 1828." The first portion of the review is occupied by remarks on the great utility, and, indeed, necessity, of uniting sound theoretical knowledge with practical information. Fairbairn's work, the reviewer observes, shows the want of this combination, while Tredgold's works, particularly his "Treatise on rail roads and carriages," evince the superiority derived from it. The reviewer next proceeds to state the experiments detailed in Fairbairn's work. The results of these are, that when boats, single or twin, were drawn on a canal with different velocities, from five to thirteen miles an hour,

---

* PROF. SILLIMAN—*Dear Sir*—Ever since the publication of the article, "Remarks on Canal Navigation and the Resistance of Fluids," in the eighth volume of the Southern Review, (fifth article of No. 15,) I have been expecting, with no little interest, to see or hear of some notice of it, but as yet none has come to my knowledge. At this I am somewhat surprised, as from the principles the able writer of it† has demonstrated, it is peculiarly valuable to the science of hydrodynamics, so much cultivated during the last half century by the French and Italians. Perhaps, from the comparatively small extent of circulation enjoyed by that work, the article has been seen by few to whom it would prove interesting, and has therefore met with no attention, especially as theory has lent but little aid to the practical engineer in this branch of science. I am induced, therefore, to give the following short notice of the contents of the article referred to, in the hope that it may meet the eyes of others, who with abilities far beyond mine, will duly appreciate the subject, and do it full justice. I have annexed a few of the simplest results of the important theorem furnished by the article, which will illustrate the difference between it and the theorem usually given in books on the subject. If you think the whole worth inserting in your Journal, by so doing you will oblige your obedient servant,

LEWIS R. GIBBES.

† Rev. James Wallace, Prof. Math. Astron. in South Carolina College.

the wave or surge that rose in front of the boats, at velocities from five to ten miles an hour, diminished rapidly or ceased altogether at the higher velocities, from ten to thirteen miles. This result Mr. Fairbairn considers as "very anomalous and contrary to all previous theory," because it does not accord with the theorem that the resistances increase as the squares of the velocities, but the reviewer points it out as affording an instance of the necessity of uniting theory with practice, and assigns a sufficient reason for it afterwards. He then proceeds to lay down the general laws and principles on which inquiries concerning the resistance of fluids depend. His first theorem is the well known one, "If a non-compressible fluid act upon a plane opposed perpendicularly to the direction of its motion, the force with which it impels the plane, or acts upon it, will be as the square of the velocity of the fluid." Under this, he remarks the corrections necessary to be observed in experimenting on this subject. The next theorem is the one to which, particularly, I wish to call attention, as it is an extremely important correction of a theorem which has been adopted in all scientific works, from Newton's to the present day. The old theorem is well known. It is this: "If the inclination of the plane to the direction of the motion of the fluid vary, the resistance perpendicularly to the plane will vary as the *square* of the sine of angle of inclination." The demonstration is as follows. Since the particles of the fluid strike the plane obliquely, their force perpendicularly to the plane will vary as the sine of angle of inclination, by resolution of forces. The breadth of the column of fluid, and consequently the number of particles striking the plane, also varies as the sine of same angle; the breadth being estimated perpendicularly to the direction of the fluid. The resistance in a direction perpendicular to the plane, which depends on the number of particles multiplied by their force in that direction, will therefore vary as the *square* of the sine of angle of inclination. The theorem of Mr. Wallace is this: *If the inclination of the plane vary, the resistance perpendicularly to the plane will vary as the* SINE *of the angle of inclination.* His demonstration may be thus expressed. Since the particles strike the plane obliquely, their force perpendicularly to the plane, as in the former theorem, will vary as the sine of angle of inclination. But the number of particles striking the plane, he argues, does *not* depend on the breadth of the column, but *on the surface of the plane,* because the particles that act on the plane are those in contact with it, and therefore their number is as its superficial area.

As the surface of the plane, by supposition, does not vary, the number of particles acting on it, therefore, does not vary, and the resistance, consequently, is as the *sine* of the angle of inclination—the number of the particles being the same at all inclinations, and the force of each, varying as the sine of angle of inclination. Mr. Wallace, to whom this correction is entirely due, then cites authors to show that his theory agrees more nearly with experiments than the old one. All authors agree that the resistance obtained by experiment is greater than that deduced from the old theory, and as much greater as the angle of inclination is less, in both of which points does the new theory coincide with experiments. Indeed, Prof. Robison, in speaking of the French experiments, (in the Art. Resistance, in Encyc. Brit.) makes this remarkable observation: "The theoretical law, (the squares of the sines,) agrees tolerably with observation in large angles of incidence; that is, in incidences not differing very far from the perpendicular; but in more acute prows, the resistances are more nearly proportional to the *sines* of the angles of incidence than to their squares,"—thus actually recognizing this law, without even hinting at the reason of it. The reviewer next observes, that the force perpendicular to the plane may be resolved into two others, one in the direction of the motion, which will vary as the square of sine of inclination, (by the old theory it is as the cube of the sine,) and one perpendicular to the direction of the motion, which will vary as the product of the sine and cosine of same angle. This latter force in boats moving on the surface of the water, acts in a direction contrary to gravity, and being unopposed, tends to raise them out of the fluid, and diminish the surface immersed. This upward force, "which" says the reviewer "appears to be entirely overlooked by writers on this subject," accounts for the diminution of the surge in Fairbairn's experiments, and shows the incorrectness of an observation of Dr. Lardner, (in Vol. XVII of the Cabinet Cyclopedia,) on the advantages of rail roads over canals, which is quoted by the reviewer.

To illustrate the theorem of Mr. Wallace, I will investigate a few of its simplest results in the resistance of fluids to bodies moving in them.

To find the resistance to a solid of revolution, moving in the direction of its axis of revolution. Let x and y be the coördinates of the curve, whose revolution generates the surface of the solid, their origin being at the extremity of the axis. By the theorem, the number of particles that act on a surface is as its area, while only their force varies with the inclination. The number of particles, therefore, that act on the increment of the surface of the solid, is as the area of the increment, that is, as $2py(dx^2+dy^2)^{\frac{1}{2}}$, and their force in the direction of the motion, as already said, is as the square of the sine of the inclination of the increment to the direction of the motion, that is, as $\frac{dy^2}{dx^2+dy^2}$. Therefore, the resistance to the increment is as $\frac{2py\,dy^2}{\sqrt{dx^2+dy^2}}$, and the resistance to the whole surface as $2p\int\frac{ydy^2}{\sqrt{dx^2+dy^2}}$. The resistance to the circle generated by the revolution of the ordinate y, is as the area of that circle, that is, as py^2. Therefore, F, the resistance to the circle whose radius is y, is to f, the resistance to the solid, as $\frac{y^2}{2} : \int\frac{ydy^2}{\sqrt{dx^2+dy^2}}$.

If the solid be a sphere, then $dx^2=\frac{y^2dy^2}{r^2-y^2}$. Therefore, $F : f ::$ $\frac{y^2}{2} : \int\frac{ydy^2}{\sqrt{\frac{y^2dy^2}{r^2-y^2}+dy^2}} :: \frac{y^2}{2} : \frac{r^3-(r^2-y^2)^{\frac{3}{2}}}{3r}$ and when $y=r$ as $\frac{r^2}{2} : \frac{r^2}{3} :: 1 : \frac{2}{3}$. That is, the resistance to a sphere is equal to two thirds of the resistance to one of its great circles. By the old theory, the resistance is only one half of the resistance to the great circle.

If the solid be a cone, $dx^2=a^2dy^2$. Therefore, $F : f :: \frac{y^2}{2}$: $\int\frac{ydy^2}{\sqrt{a^2dy^2+dy^2}} :: \frac{y^2}{2} : \frac{y^2}{2\sqrt{a^2+1}} :: \sqrt{a^2+1} : 1$; that is, resistance on the base is to that on the convex surface, as slant height to radius of base. The old theory gives the ratio, square of slant height to square of radius.

If the solid be generated by the revolution of a parabola about its axis, then $dx^2=\frac{4y^2dy^2}{a^2}$, and $F : f :: \frac{y^2}{2} : \int\frac{ydy^2}{\sqrt{\frac{4y^2dy^2}{a^2}+dy^2}} :: \frac{y^2}{2}$: $\frac{\sqrt{a^4+4a^2y^2}-a^2}{4}$; and so on for other solids.

To find the resistance to a curve moving in the direction of its axis. The increment of the curve is $\sqrt{dx^2+dy^2}$, and the square of sine of inclination is $\frac{dy^2}{dx^2+dy^2}$, therefore, the resistance to the curve is as $\int\frac{dy^2}{\sqrt{dx^2+dy^2}}$. The resistance to the ordinate y is as its length, therefore F, the resistance to the ordinate, is to f, the resistance to the curve, as $y : \int\frac{dy^2}{\sqrt{dx^2+dy^2}}$. If the curve be a semicircle, then $F : f : : y : \int dy\sqrt{r^2-y^2} : : y : \frac{y\sqrt{r^2-y^2}+r\,\text{sin.}^{-1}y}{2}$, and when $y=r$, as $r : \frac{pr^2}{4}$, and putting radius unity, as 1 : .7854. From this it is also evident, that if a cylinder move in a direction perpendicularly to its axis, the resistance to a section through the axis is to the resistance to the convex surface as 1 : .7854. The old theory gives it as 3 : 2.

To find the best angle for the sails of a mill, a rudder, &c. at the beginning of their motion. The number of particles being the same at all inclinations, the best angle will be that at which the force of the particles in a direction perpendicular to their motion is a maximum. This force, as already said, is as the product of sine and cosine of angle of inclination. Let $x=$ sine of the angle, then $\sqrt{x^2-x^4}$ will be a maximum, $2xdx-4x^3dx=0$, and $x=\sqrt{\frac{1}{2}}=$ sine of 45°, which is the maximum angle. The old theory gives 54° 44′.

The following are two somewhat remarkable results of the new theory. The resistance to a square is the same, whether it be moved in a direction perpendicular to one of its sides, or in the direction of its diagonal. In the latter case, the force of the particles in the direction of the motion is as square of sine of inclination, which is 45°. The square of sine 45° is $\frac{1}{2}$, radius being unity. Their force, in the latter case, is then half the force in the former. But in the latter case two sides are presented to the action of the fluid, and the number of particles is doubled; consequently, the resistance is the same in both cases. The resistance to a cube is the same, whether it be moved in the direction perpendicular to one of its sides, or in the direction of its diagonal. In the latter case, the square of sine of inclination is $\frac{1}{3}$, radius being unity. The force of the particles is therefore only one third of their force in the former case. But, three sides being presented to the fluid, their number is trebled; consequently, the resistance is the same in both cases.

Art. XVI.—*Essay on the Indian Summer, read at a meeting of the Maryland Academy of Sciences, by one of its members, Baltimore Dec.* 16, 1833.

The following pages, contain a few observations, on that peculiar and periodical appearance of the atmosphere, usually termed Indian summer; in this essay, the writer has made a feeble attempt to explain some of the more prominent causes concerned in its production—and to offer views, explanatory of the attending phenomena—such as the smoky and reddish aspect of the sky, the increased temperature, &c. &c.

Attention was directed to this investigation, in consequence of the verbal notice taken by one of the members of this Academy, of a paragraph contained in a late number of the American Journal of Science, and which requested of some one of the correspondents of that valuable work, an explanation of the causes of this occurrence. The subject at once presented itself to the mind, as one of much interest; and indeed excited astonishment that hitherto no written, or satisfactory explanation had been made of a phenomenon, which, from its regular appearance, obvious character, and marked duration—has become familiar to almost every inhabitant of this country. The total silence of books, and consequent want of reference, is a sufficient apology for many imperfections—the writer was left to draw conclusions, wholly from his own reflections, on the more prominent and attending facts, and of which there is no other record than memory.

The term Indian summer, has been applied to that obscure and hazy condition of the atmosphere, which usually occurs towards the last of November, attended with a peculiar redness of the sky—an absence of rain—and we might add an obviously increased temperature; which latter fact is in some degree significant of its name:—probably the appellation of Indian, is derived from the circumstance of this period of the year, being selected by the aborigines of the country, as their hunting season, to which it is highly conducive, not only on account of the plenty and perfection of the game, but also in consequence of the haziness or obscurity of the air, which favors a near, and unsuspected approach, to the object of pursuit:—The New England tradition is, that the term Indian summer, is derived from the prevalence of the south west wind at that time—and which the Indians supposed to be sent as a peculiar favor from their good deity Coutantowit, supposed to reside in that quarter.

Having stated that the Indian summer appears usually in the month of November, we do not however, wish to be understood, that a haziness or obscurity of the air occurs in that month only, and that its duration is confined, and peculiar to, a few days in the latter part of the autumnal season—on the contrary, common observation (as well as minute reference to meterological tables) proves, that it is by no means uncommon in the month of October, and is frequently mistaken then for the true Indian summer, by persons unacquainted with the proper period of its accession. This is a fact which we wish borne in mind,—as it enables us to account for one of the general laws, on which the phenomenon is dependant, but which would not apply, were we erroneously to confine the prevalence of a hazy atmosphere, to a few days at the commencement of winter.—It is true that at this period, there is usually a longer and more closely connected exhibition of character, and to which (as before observed) the term Indian summer is correctly applied—but were we to see no analogy in the general aspect of the fall season, we should be forced to search wholly among local causes, for the explanation of a fact, in which a regular and extended variation of temperature, (dependent on the sun's annual declination) is obviously concerned as a leading or predisposing cause.

The regular yearly changes of temperature greatly affect the transparency of the atmosphere, and give it, at certain seasons, a peculiar appearance; for instance, during the spring, when the temperature of the air is evidently on the increase, its capacity for moisture increases faster than the additions which are made to its humidity by evaporation or moderately moist winds; whereas, during the autumn, the temperature is as rapidly on the decline, and the capacity of the air to contain moisture being on the decrease, a slight addition to its humidity produces hazy or foggy weather. This autumnal obscurity of the atmosphere would prevail more generally here (as it does in England and the northern shores of Europe) were it not for the frequency of our north westerly winds, which from their dryness are always attended with a cloudless sky. Having ascertained that the annual variation of temperature is one of the great predisposing causes of the phenomenon before us, we shall proceed to trace out other auxiliary causes. A second prominent cause, which we therefore notice, is the prevalence of peculiar winds; for the translations of large portions of the atmosphere from one parallel to another must always be regarded as one of the most powerful causes by which the transparency of the air is affected; and as before observed, a north westerly wind (from obvious causes) brings with it a smaller supply of moisture than belongs to the mean hygrometric condition of the air in this region, and is hence always attended with a transparent atmosphere, so the very reverse is occasioned by easterly and southerly winds which obscure and thicken the air. The humid effects of particular winds are however greatly modified by local circumstances—a celebrated naturalist remarks, "that the sky of Xalappa in New Spain, which is beautiful and serene in summer, assumes a gloomy appearance from the month of December to the month of February; whenever the north winds blow at Vera Cruz, the inhabitants of Xalappa are enveloped in a dense fog, and the thermometer then descends to 45 or 50 degrees;" (on our coast the haze is produced by a warm current from the south, hence the thermometer rises with us instead of falling.) So at Lima, in Peru, the cloudy state of the air begins about the middle of July, and continues to the end of November, the wind blowing chiefly from the south and south east. The third cause which we shall notice as concerned in the production of the Indian summer is the elevation and depression of atmospherical strata; this effect is sometimes produced by electrical agencies, by elevation and conformation of country, but more generally and extensively than either by changes of temperature at the earth's surface, for it is a well known fact, that the air, being a diaphanous body, can receive no direct heat from the solar rays, but becomes warmed only by the contact of its lower stratum with the earth's surface, which portion when rarified ascends and gives place to a cooler descending one: this remains below, until its thermal condition is again altered, when it reascends, thus establishing a constant circulation and perfect admixture of the different strata of air. That electrical agencies are concerned in the elevation and depression of atmospherical strata, there can be no doubt, but we are aware that the immediate and more extensive operation of this cause, is in tropical latitudes. Thus Humboldt, in his personal narrative, remarks, "that the rainy season takes place within the tropical regions, when the causes which concur to produce a mixture of the atmospherical strata operate with the fullest effect; for instance, when the sun approaches the zenith of any particular parallel, the trade winds become less regular, the temperature increases, and the causes which contribute to the humidity of the atmosphere act with fullest vigor. The superincumbent columns of air are soon saturated with vapor, the production of which is accompanied by a great accumulation of electricity in the higher regions of the air; at length an intermixture of the strata begins to take place, produced chiefly, it would appear, by electrical explosions; the precipitation of the condensed vapor commences, and proceeds (especially during the day) with scarcely any intermission. The rain now descends in vast sheets; the rivers, raised above their ordinary level, can no longer be confined within their banks; and the supply they receive from the clouds exceeding the discharge by their channels, they spread far and wide over the adjacent fields, and exhibit on every hand a dreary expanse of muddy and discolored waters. This state of things undergoes little alteration until the sun returns to the signs of the other hemisphere; at that period the aerial currents from the homonymous pole are renewed, and the air which flows from it being very far from the point of saturation, the rains cease, and the sky resumes its former clearness and serenity."

From this detail of facts, it appears to us highly probable that electrical causes are negatively concerned in the production of the Indian summer; for instance, as during the warmer months, they act vigorously by producing an intermixture of the different currents or strata of air; so, on the contrary, at the approach of winter, they act with diminished energy, and hence suffer portions of air, differing greatly in their temperature and humidity, to remain for a length of time without flowing into each other. We might mention evaporation as one of the causes concerned in the production of haze or clouds, but as it is dependant on, and influenced by, existing temperatures, we shall, in summing up our arguments, shew how far the mean hygrometric condition of the air is affected by the annual change of temperature, as also by particular winds, and by the local conformation and geographical position of the adjacent country. Having now noticed the more prominent causes concerned in the production of the phenomena of the Indian summer, we proceed to explain, as far as possible, their mode and extent of operation.

The first important conclusion that we draw from the above details is, that the formation of haze or clouds, viewing the subject in its most general outline, must depend essentially on a reduction of atmospherical temperature, which brings the water contained in the air to a visible sub-vaporous state, constituting haze, or to an actual liquid condition, (minutely divided,) forming clouds. We believe further, that this visible alteration, or increased density, is confined chiefly or wholly to the lower stratum of air, and is immediately referrible to partial and slow currents of moist winds from a southerly or south-easterly direction, (as meteorological records confirm,) and that these moist winds usually follow cool dry westerly or northerly ones, which having prevailed extensively both in the higher and lower regions of the atmosphere, have lowered its temperature and reduced its absolute quantity of moisture. Now, if we suppose this moist and warm current of air (extending perhaps in height some hundreds or even thousands of feet above the earth's surface) to come into contact with a cool dry northerly one, the obvious result would be a reduction of temperature, attended with a hazy or cloudy formation; while the superior stratum of air being altogether westerly or northerly, would remain dry and cloudless, which is in fact the precise condition of things during the Indian summer.

It might be asked whether those partial currents do not occur in the spring and summer season, and if so, why not give rise to the same phenomena? The reply would be, that the general tendency to foggy or cloudy weather is obviously less at those seasons than in the fall, from the existence of a cause which we mentioned in the early part of this paper, viz. that the mean temperature of the air being on the increase during the spring and summer seasons, (from the more direct action of the solar rays on the earth's surface,) its capacity to receive moisture and contain it invisibly is also augmented. Hence, an easterly wind will not produce rain, nor indeed sensibly affect the transparency of the air until it has continued for such a length of time as to bring a great excess of moisture; when the solar heat becoming also obstructed, a further reduction of temperature, and consequent precipitation occurs. And again two other very important agents concur to prevent these phenomena from appearing in warm weather, we allude to the excessive heat at the earth's surface, acting on the lower stratum of air, and the vigorous movement of electrical agencies on the higher regions, both of which causes concur to produce a constant and steady admixture of the atmospherical strata; the former, by rarifying the lower stratum and causing it to ascend; the latter by exploding and destroying large portions above, and reducing the temperatures of others, which as rapidly descend, and it is this activity of circulation among the currents of air during warm weather, that prevents the formation and continuance of a hazy or foggy atmosphere.

In confirmation, we may remark, that during the cold summer of 1816, when of course both these causes were acting with a diminished force, there was a very constant haziness of the air, so much so, that the sun could be viewed with the naked eye until 9 or 10 o'clock in the morning. A celebrated traveller in the south, relates a fact which will convey some idea of the actual condition in which we suppose the lower stratum of air to exist during the prevalence of hazy weather; he remarks "that over the ocean the sky exhibits a paler blue than over the land; when from the summit of the Andes the eye is directed towards the great South Sea, a haziness uniformly spread to about 10,000 feet in height is observed to cover as with a thin veil the surface of the ocean—this appearance takes place in a season when the atmosphere viewed from the coast, or at sea, appears pure, and transparent; the existence of the opaque vapor is announced only to mariners by the little intensity of the azure color of the sky." Here it is evident that a slight additional density in this lower stratum would intercept a large portion of solar light and give a turbid or hazy appearance to the general atmosphere.

By a very careful reference to Capt. Brantz' meteorological tables, we find, that in a very few instances, he notes hazy weather coexisting with a northerly wind—this fact, however, does not militate against the view we have offered, viz. that hazy weather is the result of a southerly or easterly current, supervening to a cool northerly one —for it is evident the same result would be produced if the differing portions of air only come in contact—with this qualification, that the superior dryness and force of a northerly wind, would give a much shorter duration to the existence of haze—the continuance of which would be incompatible with a dry westerly or northerly wind.

We shall now proceed in a very general manner, to enquire, why the Indian summer makes its appearance more particularly at the close of autumn. This part of our subject, by no means void of difficulty—appears capable of solution in the following manner. It is well known that a constant and general wind prevails within the tropics, moving round the earth from east to west, called the trade wind; observation also confirms that without the tropics, both north and south, the prevailing winds are westerly: the object of which appears to be a restoration of the equilibrium, which is disturbed by the trade winds—this westerly or north westerly current, (for it would be oblique in our parallel,) being often counteracted during the summer by opposite winds, [brought into existence by local causes—and the direct action of the solar heat on our continent during the summer, and early part of the fall,] comes to act again with renewed force, during the first cold weather of autumn, and continues at intervals until it has, as it were, more than fulfilled its intention, and is hence usually succeeded again in November and the early part of December, by what may be termed a southern reaction—at which period the phenomenon of the Indian summer occurs, being at the precise time when the general predisposition of the air to form haze or fogs, is at its maximum.

It appears to us also, that the existence and duration of the Indian summer in this country, has an important connection with the extensive forests and uncultivated lands, peculiar to America, and it is worthy of remark, that according to the recollection of our older inhabitants, its former duration was often three or four weeks, whereas its present continuance is short and uncertain, seldom exceeding ten or fifteen days. It appears further, that this decline has been somewhat regular, keeping pace with, and evidently influenced by, the gradual uncovering of the country. Humboldt states, that plains abounding with trees, are usually characterized by a foggy atmosphere. This is particularly the case with Brazil and Guiana, and the great central basin of South America, which receives the waters of the Amazon. In the middle of a continent overspread with forests and watered by equatorial rains, the humidity is nearly the same as on the ocean.

The temperature of the atmosphere, diminishes at an average of one degree for every three hundred feet, hence the humidity is greatest in the lower regions. The hygrometric condition of the air also varies (of course) with different elevations of country, the more elevated, possessing the drier atmosphere. Again in tropical latitudes the clouds form at a greater height above the earth's surface, because the point of condensation or congelation, is confined to those cold elvated regions, whereas in the temperate zones, (and especially in the fall season, when the mean temperature of the air is but a few degrees above the point of deposition,) fogs and clouds form near the earth's surface—all these facts, if closely examined, corroborate the views we have been trying to establish—but which we confess are too imperfectly and theoretically founded.

One of the most remarkable phenomena of the Indian summer is the peculiar redness of the sky, which in our opinion is explained on the principle that the white beam of light being unfolded in its passage through the foggy stratum near the earth's surface, its more delicate rays are either reflected back, or absorbed, while the stronger rays of red and orange, all penetrate to the earth's surface, and by their excess tinge surrounding objects with their own color, and especially the lower atmosphere, which reflects and refracts them in every possible direction: much on the principle that to the eye of a person who has descended to a great depth in a diving bell, every thing appears reddish, because nothing but red rays can penetrate the dense medium which is interposed between him and the sun. Again this redness of the air together with the mechanical irritation produced by the denseness of the aerial vapor, excites a painful affection of the eyes—this sensation connected with the smoky appearance of the sky, induces great numbers of the inhabitants of this country to believe that the Indian summer consists of a smoky state of the air produced by burning the vegetable decidua which are collected together in the fall season for this purpose, or as some will have it the firing of the neighboring mountains. This appearance of actual smoke is however an optical illusion, produced by the foggy appearance of the air, and which seems to find confirmation by the great irritation of the visual organs, effected by the excess of red rays, &c.

The increased temperature which accompanies the existence of this hazy weather is referrible to several causes, viz.

1st. The prevailing wind, which being from a southerly direction is usually warm.

2d. The heat radiated from the earth's surface is immediately returned (on a well known principle) being reflected back by the haze of the atmosphere, while lastly the temperature is further increased by the condensation of both air and moisture during the formation of the foggy stratum.

We have now hastily explained, or rather touched upon the leading phenomena of the Indian summer, but acknowledge to have written on this subject, rather with a view to elicit further enquiry from others than to establish any theory of our own; every phenomenon connected with the earth's atmosphere is highly deserving of our most earnest investigation, for daily observation confirms, that not only the health, but also the moral qualities of our species, are greatly under the control of its influences. We hope therefore to see this subject taken up by some one whose time and opportunity are less restricted than our own, and whose superior knowledge of the laws which direct and govern our atmosphere, shall enable him to place it on more sure and elevated ground.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Abstract of the Proceedings of the N. York Lyceum of Nat. Hist.*

(Continued from vol. XIX, p. 355 of this Journal.)

It may be proper here to state, that although, owing to circumstances which have threatened the existence of the society, the Lyceum has not published its annals since 1828, nor any abstract of its proceedings since 1830, its members have by no means relaxed from their former exertions for the promotion of Natural History. The Library and collections of the various departments, have been greatly augmented, as will be seen by the following abstracts. The collection of minerals, from private donations and especially that of the valuable cabinet of the late Dr. Mitchill, and from the replacement of inferior by more perfect specimens, has been very greatly augmented and improved. Ample matter has been collected for the future numbers of the Annals, one of which, it is hoped, will soon appear. We may indeed affirm, that the Lyceum was never in a more flourishing condition than at the present time. The rooms, situated at the corner of White and Centre streets, are open daily from 12 o'clock until sun-set, where the librarian and keeper will be present to welcome all visitors who are interested in the promotion of natural history.

Abstract for 1831.

January.—Dr. Dekay read a paper, entitled "Examination of the facts and arguments by which it is attempted to be proved that Lava has not been subjected to great elevations of temperature." In this memoir, the author, avoiding any decided hypothesis, confines himself to the examination of the heat of volcanic lava, and endeavors to show that the arguments by which the doctrine of low temperature had been defended, were opposed by numerous facts; at the same time, he explains, on different principles, the few facts by which the idea of low temperature appears to be supported.

Dr. Dekay read a paper on the propriety of preparing a Natural History Catalogue of the region within thirty miles of the city of New York. The subject was referred to a committee, upon whose recommendation the following gentlemen were appointed to arrange the catalogue.

President *Delafield*, on Minerals; Prof. *Torrey*, Phenogamous plants; Mr. *Halsey*, Cryptogamous plants and Arachnides; Dr. *Dekay*, Zoophytes, Fishes, Mammalia and Annelides; Maj. *Leconte*, Insects; Mr. *I. Cozzens*, Crustacea; Mr. *Cooper*, Mollusca, Reptiles and Birds.

February.—Prof. McVickar presented, among other minerals, specimens of Anthracite from the Great St. Bernard, found at a height of one thousand feet above the Convent, (Hospice.)

At the anniversary meeting, on the 28th inst., the following officers were elected for 1831.

President, *Joseph Delafield;* 1st V. President, *Abraham Halsey;* 2d V. President, Dr. *J. E. Dekay;* Corresponding Secretary, Dr. *J. Van Rensselaer;* Recording Sec'y, Dr. *J. J. Graves;* Treasurer, *Wm. Cooper;* Librarian, Dr. *J. E. Dekay.*

March.—Mr. Cooper read a notice of several birds seen by him in the neighborhood of the city of New York during the past winter, which he stated were not usually noticed at that season. The same gentleman read a communication from Maj. Leconte, stating that he had recently discovered two new species of *Unio*, and had heard of four others, one of which is spinous. In plants, he had discovered a new species of *Thymus*, and a new genus allied to *Gerardia.*

May.—Mr. Cooper, from the committee on the Catalogue, read a Report on the Birds in the vicinity of the city of New York, accompanied by a catalogue of the species, with preliminary remarks on their migration and geographical distribution.

Mr. Cooper stated, that the large collection of bones recently disinterred at Big Bone Lick, Kentucky, were then in the city, and belonged to Messrs. Barber and Graves—that it contained fourteen or fifteen tusks, ten or eleven lower jaws, and a skull, nearly perfect, (of the Mastodon,) with a large quantity of bones, stated to belong to nearly twenty different species, forming a variety and extent unrivalled, as follows: bones and teeth of fossil elephant, mastodon, horse, ox, deer, and Megalonyx; of the latter genus, parts of the right lower jaw with four teeth, a separate tooth, clavicle, tibia? and perhaps other portions now for the first time discovered, as belonging to that animal. (The report, relating to these bones, and presented to the Lyceum, was subsequently published in this Journal.)

September.—The President announced the death of their late member, Dr. Samuel L. Mitchill, whereupon a resolution, expressive of the feelings of the Lyceum, and of the loss which science in general had sustained, was unanimously passed by the Society. A resolution was also passed, that Dr. Samuel Akerly be requested to draw up a biographical memoir of the late Dr. Mitchill.

November.—Dr. Gale exhibited for inspection specimens of several different alloys of sodium and potassium, a number of which were liquid at the ordinary temperature, (60° Fah.); one, containing 12 parts of potassium and 1 of sodium, was so light as to float on naphtha, and congealed at the freezing point of water. Dr. G. stated, that this alloy was a remarkable instance of expansion, from the union of two different bodies, and that from the liquidity of the alloy we should infer, according to the laws of caloric, that much heat would have been absorbed, and consequently a considerable diminution of temperature would follow; on the contrary, an elevation of temperature was the consequence of the union.

During the present year many valuable donations have been received, and the following gentlemen elected as members.

Resident.—*S. T. Carey*, Dr. *Thomas D. Devan*, *Benjamin Pike.*

Corresponding.—*Wm. R. Clapp*, Philadelphia; Prof. *Dobereiner*, Jena; Prof. *Breithaupt*, Freiburg; Mr. *McGillivray*, Edinburgh; Don *Claudius Gay*, Valparaiso.

Abstract for 1832.

January.—Dr. Perrine, U. S. Consul at Campeachy, read a paper on an article used in the manufacture of cordage, and brought to our market under the name of Sisal Hemp. It is stated, by the author, to be a species of Agave, (*Agave Americana,*) growing wild in great abundance in Yucatan.

Prof. Torrey read a paper from the Rev. L. De Schweinitz, entitled "Remarks on European plants, which have been more or less naturalized in the United States."

Mr. Cooper communicated a paper on the anatomy of the Wild Swan (Cygnus Bewickii) of Long Island, and exhibited parts of the skeleton of this animal.

Dr. Feuchtwanger read a paper on Lucullite or black marble.

Dr. Akerly exhibited for inspection numerous relics from a temple in the ancient city of Palenque, in Central America.

February.—At the anniversary meeting, on the evening of the 27th inst., the following gentlemen were elected officers of the society for 1832.

President, *Joseph Delafield;* 1st V. President, *Abraham Halsey;* 2d V. President, *J. E. Dekay;* Corresponding Secretary, Dr. *J. Van Rensselaer;* Recording Secretary, Dr. *L. D. Gale*; Treasurer, *Wm. Cooper;* Librarian, *James E. Dekay.*

March.—Prof. Torrey read an interesting communication from Dr. Johnson, of Chiapas, on the history of the Mexican Albinos, and was requested to forward the communication to Prof. Silliman for publication.

April.—Dr. Gale read a paper, entitled "Observations on the bases of the alkaline earths, earths proper, new method of separating some of these bases, and on the new metals, Thorium, Pluranium, Ruthenium and Vanadium.

Dr. Dekay read a paper on the volcanic islands which appeared in the Mediterranean, in 1831.

May.—Dr. Harlan, of Philadelphia presented a variety of casts of the fossil Megalonyx, chiefly from White Cave, Kentucky, most of them unique and highly interesting specimens. Mr. Cooper made some verbal remarks on these fossils, and demonstrated the osteology of the parts hitherto known.

June.—Mr. J. Finch gave an account of some Geological observations made by himself on the region in the vicinity of Lake Erie and the River St. Lawrence, in which he pronounced the basin of those regions to be principally *tertiary;* he also gave an account of the columnar limestone found in the vicinity of Kingston, U. C., and on the Island of Montreal.

Mr. D. J. Browne, of Boston, announced a locality of *Fulgorite* at Gurnet's point near Duxbury, Mass., being the first locality noticed in the United States.

October.—Dr. Geo. W. Boyd read a paper entitled, "Observations on the Mineralogy and Geology of the gold region of the southern United States," and also presented an extensive suite of characteristic specimens. Dr. B. considers this region decidedly *primitive,* and also that the *auriferous deposites* have no connexion with the *veins* at present worked.

Mr. Dewey reported on the Geological Text Book of Prof. Eaton, in which he stated, that although the work contains many valuable fats, yet for a text book he considers the arrangement a bad one.

November.—Mr. Sampson read a paper on a cetaceous animal (*Delphinus Globiceps*) lately stranded on Fairfield beach, state of Connecticut, of which Mr. Jno. I. Glover gave a sketch and description at a former meeting.

The President read a communication from Jno. E. Holbrook, M.D. Prof. of Anatomy and Physiology in the Medical College of Charleston, (S.C.) stating that he proposes publishing a work on the Herpetology of S. Carolina and Georgia.

December.—Dr. Feuchtwanger read a paper, entitled " Observations on Nickel, and its application in the preparation of the new metal *Argentine* or *New Silver*," in which he described most of the ores of Nickel, and the various modes of reducing them.

Dr. Dekay presented a suite of specimens illustrative of the geology of the island of Mytilene, the Dardanelles, the Bosphorus, the neighborhood of Smyrna, and the Asiatic shores of the Black Sea, accompanied with observations.

Numerous donations in nearly all the branches of Natural History have been received from members and correspondents.

The following gentlemen have been elected as members during the present year :—

Resident.—Dr. *Wm. Baxter*, Dr. *R. P. Tanner*, Dr. *J. C. Jay*, *Wm. F. Denning*, Dr. *J. M. Leon*, *Fred'k. Prime.*

Correspondent.—*Alonzo Clarke*, Williamstown, Mass.; Dr. *H. Perrine*, Campeachy; Counsellor Dr. *Keugg*, Berlin; Capt. *F. A. Fokkes*, Hamburg; *Geo. Gibbs*, jr. Turks Island; Prof. *Naccari*, Chioggia, Venet. Terr'y; Col. *Ed. Clarke*, Saugerties, N.Y.

Abstract for 1833.

January.—Dr. Dekay read a paper on the *Gavial* of New-Jersey, of which he exhibited to the Society a considerable portion of a lower jaw discovered there by Lieut. W. W. Mather, of West Point, from whom he also read a letter communicating some geological observations on this region.

Mr. Cooper read a report on the specimens of Megalonyx referred to by him at a previous meeting. They consisted of several phalanges of the fore foot, and there is reason to presume that they formed part of the original specimen made known by Mr. Jefferson.

February.—At the anniversary meeting, held on the 25th instant, the following gentlemen were elected officers for 1833.

President, *Jos. Delafield;* 1st V. President, *Abm. Halsey;* 2d V. President, *Jno. Torrey;* Corresponding Secretary, Dr. *Jeremiah Van Rensselaer*; Recording Secretary, Dr. *Jas. E. Dekay;* Treasurer, *Wm. Cooper;* Librarian, Dr. *J. C. Jay.*

April.—Mr. Cooper read a communication from Prof. Troost, of the Nashville University, entitled, "Description of a new genus, Acontia, and of two new species of Heterodon, accompanied with drawings.

Under the genus Acontia, the author describes two species, viz.

Acontia leucostoma, or Cotton Mouth, with poisonous fangs.

" atrofuscus, Highland Mokeson, Copper Head, Pilot, &c.

Under the genus Heterodon the author enumerates 3 species, viz.

Heterodon niger, of Beauvais.

" annulatus of Troost, inhabits swamps.

" tigrinus of Troost. All of which are found in Tennessee.

Dr. Gale read a report on Dysodile or mineral paper, presented at a former meeting by Capt. Perry, and referred to Dr. Gale for examination and report.

May.—Dr. Samuel L. Metcalf read a paper entitled, "A New Theory of Terrestrial Magnetism, in which he maintains, 1. the identity of caloric and electricity; that atmospheric electricity or lightning, results from the accumulation of caloric in aqueous vapor, and from its rapid passage out of vapor into bodies which contain less of it: 2. that galvanic electricity is produced by the oxidation of metallic plates in acids or alkalies; that its properties vary according to the size and number of the metallic plates, and the rapidity of their oxidation: 3. that common electricity is derived from the atmosphere, and from other bodies by pressure, and by friction; in short, that the latent caloric of all bodies is convertible into heat or electricity, according to the mode of its disengagement from other matter.

He further maintained, that caloric is the cause of all the powers and motions of other matter; that it is the combining force in cohesive and chemical affinities; that it is the cause of capillary attraction, and of gravitation; that it is the cause of light, by expanding common matter into a state of extreme diffusion, until it becomes phosphorescent and imponderable. He also maintains that the aurora borealis is produced by the caloric which is given out by the upper current of the atmosphere, as it passes from the tropical to the polar latitudes, by which it is greatly condensed; and further, that caloric is the source of *all life* and motion throughout creation.

In Part II. he endeavored to show, that magnetic polarity was caused by the passage of radiant caloric from the tropical to the polar latitudes, because the force of magnetic power coincides with the coldest points in the polar regions. He maintained from numerous analogies, that if the whole earth were of uniform surface and elevation, the true north and south poles would be the centers of the greatest cold, and of magnetic action, and that there would be no variation of the needle; but that from the varied distribution of land and water, mountains and plains, they followed a corresponding variation of territorial temperature in the same latitudes, which was also accompanied by a corresponding variation of the needle. He maintained that the unusual accumulation of ice in the polar seas caused a shifting of the magnetic poles; that they are further north during summer than winter; that their movements are sometimes eastward, and at other times westward, but not uniformly so. He further showed, that all the variations of the needle, annual, monthly, and diurnal, uniformly obeyed the variations of terrestrial temperature. He has identified all the phenomena of magnetism with the fundamental doctrines of climate; and the whole work may be considered as an attempt to resolve all the motions and changes which take place throughout nature, into the agency of a simple and universal element. He considers the relations of caloric to ponderable matter, as the basis of the whole structure of physics.

This treatise has been since published under the above title.

July.—Mr. Partridge exhibited specimens of pink-colored silk, dyed by the flowers of the Monarda didyma, or sweet balm.

August.—Dr. Swift, U. S. N., exhibited some new and singular reliques recently disinterred from the ancient city of Palenque in Central America.

September.—Dr. Akerly read a communication, entitled "Extracts from a correspondence of Don Francisco Corroy of Tobasco in relation to the antiquities of Palenque."

Many valuable donations have been received by the Society during the present year, of which are mentioned a large box of interesting Swedish minerals, received from H. Wheaton, Esq., Charge d'Affairs from the U. S. to the Court of Denmark; and also a box of minerals, marine and fresh water shells, and Corallines, from H. Perrine, Esq., U. S. Consul at Campeachy.

The following gentlemen have been elected as members during the present year:—

Resident.—*Jos. Foulke*, junr., Dr. *Edward Ludlow*, Dr. *William Edgar*, Dr. *S. L. Metcalf*, Dr. *Minturn Post*, *J. M. Bradhurst*, *Hen. C. Brush*, *Rufus Prime*, *William Partridge*, *R. H. Brown*, Dr. *W. C. Wallace*.

Corresponding.—*M. V. De Meleon*, Paris; Dr. *Thos. Dillard*, U. S. N.; Dr. *Jno. Finch*, London; *Don Francisco de Corroy*, Tobasco; Dr. *A. Adee*, U. S. N.

Abstract for 1834.

Jan. 6.—The President, Joseph Delafield, in the chair. Visiters—Mr. T. Craven and Lieut. H. Pinckney, as a committee from the U. S. Naval Lyceum, return thanks for the donation of our Annals, which were voted to them at the meeting of Dec. 16, 1833, and offer a reciprocation of civilities on the part of the Naval Lyceum, and an invitation to the members of this society to visit their rooms at all times. The Treasurer announced the receipt of No. 17 of L. and E. Phil. Mag. for November; also No. 36 of Mag. Nat. Hist. (Loudon's) for November, 1833.

Jan. 13.—The President in the chair. Dr. J. Augustine Smith presented "Report of Commissioners in relation to supplying the city of New York with water." The President mentioned an inquiry made by Commodore Dekay, relative to the water of the Dead Sea, a quantity of which was presented to the Lyceum some time since; the water was referred to Mr. Chilton for examination, and the latter gentleman was called upon for a report thereon.

Jan. 20.—The President in the chair. Dr. Torrey presents, in the name of the author, Icones Lithographicæ, &c.; by I. A. Guillemin. The same gentleman also presents, Bryce's Tables of Minerals, Rocks, &c.; also, Bibliotheca Americana; also, Essai sur le genre "Hieracium," par Auguste Mounier; also, a specimen of palm in slate from the East Indies, a specimen of fossil wood from near Edinburgh, and a specimen of sandstone, containing vegetable remains in a state nearly unaltered, from Scotland. Dr. Torrey made some remarks upon fossil wood, and stated that it was at present supposed that all dicotyledonous fossil wood was of only one or two kinds, and principally *pine*. The same gentleman exhibited some specimens of petrified wood, in a rough massive state, and also polished, yet not exhibiting any appearance of organic structure; the same article, when cut or ground very thin and attached to a piece of glass, exhibits a *decided organization.*

Jan. 27.—Dr. Torrey in the chair. Dr. Torrey presented a fine trilobite, found at Utica, (in the carboniferous limestone of Eaton,) which appears to be a species not described by Green in his Monograph on American trilobites; referred to Dr. Feuchtwanger. Mrs.

Samuel L. Mitchill presented eighteen boxes of minerals, being the chief part of the valuable collection of the late Dr. Mitchill, the former President of this society. This donation contained a large number of choice and elegant minerals, which the cabinet of the society did not previously possess, and was particularly rich in specimens of the metals. The Secretary was directed to announce their reception, and communicate the thanks of the society to Mrs. Mitchill. It having been mentioned by the President at the last meeting, that it was the intention of the Government to send the newly raised corps of U. S. Dragoons, during the ensuing summer, to the Rocky Mountains and different other parts of the western country, Dr. Torrey suggested, that it would be very desirable that the society should exert its influence to obtain the appointment of an experienced naturalist to attend the expedition; and upon motion it was resolved, that the President and Corresponding Secretary do make application, in the name of the society, to the Secretary of War, for the purpose of obtaining such appointment to be made, in which case the society will cheerfully undertake to find a person in all respects qualified for this duty.

Feb. 3.—The President in the chair. The Corresponding Secretary presented, from the Russian Consul, in the name of the Imperial Academy of Sciences, the following works, viz.—"Memoires de l'Academie Imperiale des Sciences de St. Petersbourg," Vol. II, in four parts; "Catalogue raisonnée des objets de Zoologie recuilles dans un voyage au Caucase," &c. par E. Ménétries; "Transactions of Imperial Academy at St. Petersburg," Dec. 1832. Mrs. J. G. Bogert presented "Memoirs of Baron Cuvier, by Mrs. Lee." A MS. communication, received through Mr. Audubon, from the Rev. John Backman, of Charleston, S. C., was read, "On the powers of Sight and Scent possessed by the Turkey Buzzard, (Cathartes aura,) and the Black Vulture, (Cathartes atrata,)" detailing a series of experiments tending to prove that these birds are attracted to their prey only by the sight, and cannot discover their food, however strongly tainted, if hidden from view; also, that they very readily feed on fresh as well as putrid meat. On motion, this paper was forwarded to Prof. Silliman for publication.

Feb. 10.—The President in the chair. The President reported, that the resolution of the society on the subject of the expedition to the Rocky Mountains, had been communicated, as directed, to the Secretary of War.

Feb. 17.—The President in the chair. Dr. Boyd reported, that he had prepared a collection of the duplicate minerals from the society's museum, and on motion it was resolved, that the same be presented to the Naval Lyceum. Capt. Perry presented, from the Naval Lyceum, specimens of the Chilian Bark, used for cleansing, as a substitute for soap. Referred to Dr. Torrey.

Feb. 24.—*Anniversary Meeting.*—The President in the chair. The following gentlemen were elected as officers of the society for the present year.

President, *Joseph Delafield;* 1st V. President, Dr. *John Torrey;* 2d Vice President, *Wm. Cooper;* Corresponding Secretary, Dr. *J. Van Rensselaer;* Recording Secretary, *Samuel T. Carey;* Treasurer, *Wm. Cooper;* Librarian, Dr. *Geo. W. Boyd.*

March 3.—The President in the chair. The usual annual reports were presented by the Treasurer, Curators and Librarian. The Curators report, that the extensive collections of the society are now kept in proper order and arrangement, and that the rooms are open daily for the reception of visiters. They also state, that many and valuable additions have been made to every department of the society's museum during the past year, and that the keeper appointed by the society to have charge of the library and museum, has been actively engaged in the arrangement and preservation of the numerous articles in the museum of the society. The library is announced to be in a state of proper arrangement, and to have been increased by the addition of many valuable works during the past year. Dr. Boyd presented a report upon the minerals lately received from Mrs. S. L. Mitchill, and states that the majority of them will be acquisitions to the cabinet, either as new, or of a superior quality to those already belonging to the society. The President announced the receipt of Part 1, Vol. I, of the "Transactions of the Zoological Society of London;" also "Proceedings of the Committee of Science and Correspondence of the Zoological Society of London," in two vols., accompanied by a letter from the Secretary of the Society, inviting an interchange of correspondence. On motion, the Annals of the society were directed to be sent to the Zoological Society of London. Dr. Torrey presented, "Tabular Arrangement of Minerals," by Dr. Thomson of Glasgow. The President presented a specimen of Blende in primitive limestone, from Yonkers, N. Y. Mr. A. R. Thomson mentioned the discovery of a large mass of native copper, in the vicinity of Somerville Copper Works, New Jersey

Dr. Torrey laid before the society the first volume of N. A. Gramineæ and Cyperaceæ, by Asa Gray, M. D., illustrated by dried specimens of the plants. On motion, a copy of this work for the library was ordered to be purchased. Mr. Edward Harris was elected a resident member.

March 10.—The President in the chair. The Treasurer laid on the table the December and January Nos. of the Philosophical Magazine. The President read a letter from the Secretary of War, in answer to that conveying the resolution of the society relative to the appointment of a scientific person to accompany the proposed expedition to the far West, in which it is stated that no provision has been made for a naturalist to the expedition, but that any such person can join the expedition at his own expense. The President also read a letter from Mr. Geo. Catlin, corresponding member of the society, accompanying a beautiful specimen of *Baculite*, from the banks of the Missouri, and offering to procure a further supply for the cabinet of the Lyceum. The Corresponding Secretary read a letter from the U. S. Naval Lyceum, conveying thanks for the donation of minerals lately made to that institution. Dr. S. L. Metcalf read a paper on "Molecular Attractions," in which he considers *caloric* as the cause of that and all other attractions. A. R. Thomson presented a specimen of native copper from Somerville, N. J.; referred to Dr. Gale for examination and report.

March 17.—The President in the chair. The Treasurer laid on the table Phil. Mag. for February, and Mag. Nat. Hist. for January, 1834. Dr. Gale reported on the specimen referred to him at the last meeting, that it is native copper and red oxide of copper. Mr. Cramer exhibited to the society a drawing of a gigantic emerald, discovered in the Ural Mountains, and which is at present in the collection of the Emperor of Russia. On motion, the President was requested to acknowledge to Mr. Geo. Catlin the receipt of his letter and the accompanying specimen of *Baculite*, and at the same time to request him in the name of the society to furnish specimens of all such fossils as he may be enabled to collect from the locality mentioned in his letter, or its neighborhood, with any information he can furnish respecting them. An undetermined mineral from the society's collection was referred to Dr. Feuchtwanger for examination and report. Mr. Cooper presented three different species of Asteria from Turks Island; also, a number of preserved fishes, of species not previously in the museum of the society.

March 24.—The President in the chair. Dr. Feuchtwanger reported on the mineral referred to him at the last meeting, and presented an analysis of the same. The mineral was pronounced to be a variety of *Miemite.* The keeper laid on the table a list of minerals wanting to the society's collections. Dr. Swift presented, from the U. S. Naval Lyceum, "The Constitution and By-Laws" of that society. Dr. Torrey laid on the table a specimen of native crystallized sulphur, belonging to the cabinet, which he had prepared and polished so as to exhibit its power of *double refraction.* Dr. Swift presented seeds of the Sesamum orientale, or Bhenne plant, grown at Charleston, S. C. Dr. Torrey exhibited a specimen of *Iolite,* from Haddam, Conn., which had been cut and polished as a gem.

March 31.—The President in the chair. Dr. Ludlow took his seat as member of the society. The Treasurer laid on the table No. 31, Edin. New Phil. Jour. Oct. 1833 to Jan. 1834. Dr. Torrey and Dr. Gale reported on the mineral referred from the society's collection, which they find to be a pure phosphate of lime. On motion, a committee of journals was appointed for the present year, consisting of Dr. Torrey, Wm. Cooper, and Samuel T. Carey.

April 14.—The President in the chair. The Treasurer presented, from Capt. F. A. Fokkes, our corresponding member, now in South America, an interesting collection of shells and fossils from different countries; referred to Mr. Cooper, and thanks voted for the same. Dr. Jay exhibited a very beautiful and perfect specimen of Trigonia pectinata; a recent species, from New South Wales. Dr. G. W. Boyd presented some minerals, including Datholite, from Patterson, N. J.; Lignite, from South Amboy, N. J.; and sundry varieties of Quartz, from Brazil. The President presented specimens of Sil. Carb. Zinc, from Westphalia. Mr. Charles Cramer, of St. Petersburg, was elected a corresponding member.

April 21.—The President in the chair. A translation, by Dr. Feuchtwanger, of a letter from Prof. Breithaupt of Jena, was communicated, in which he describes some American minerals, one of which he considers a new species. Dr. Torrey presented, from the author, a copy of Prof. Hitchcock's Report on the Geology and Natural History of Massachusetts; thanks voted. Dr. Gale exhibited an experiment showing the vibration of metallic bodies at different temperatures.

April 28.—The President in the chair. The Treasurer laid on the table L. and E. Phil. Jour. No. 21, for March. The Corresponding Secretary read a communication from the Secretary of the Physical Class of the Asiatic Society, at Calcutta, accompanying a donation of "Asiatic Researches, Transactions of the Physical Class, Part 2;" also, "Journal of the Asiatic Society of Bengal," edited by James Prinsep, F. R. S.; also, "Gleanings in Science," Vol. III, title page, preface and index. Thanks were voted for the same, which the Corresponding Secretary was requested to communicate, together with a set of the Annals. An invitation was received from the President and Secretary of the American Lyceum, inviting the attendance, by delegation, of the Lyceum of Natural History at their annual meeting, 2d proximo. On motion, a committee was appointed to attend the meeting of the American Lyceum, as requested; committee composed of Drs. Torrey, Van Rensselaer and Gale. Dr. G. W. Boyd presented a series of geological specimens from the Cherokee country of Georgia.

May 12.—The President, Joseph Delafield, in the chair. Visiter, Mr. Whelpley, of Cleaveland, Ohio. The Librarian announced the reception of the American Journal of Science and Arts, No. 53, and Loudon's Journal, No. 38. Dr. Gale, from the committee appointed to attend the meetings of the American Lyceum, reported upon the transactions of that society at their late session, and which related specially to the subject of education. Dr. Swift announced that Dr. Adee, our corresponding member, who is about to visit South America, had expressed his readiness to collect objects of natural history for the society, and had requested directions to guide him in the pursuit of them. Dr. Dekay was appointed a committee to prepare instructions for Dr. Adee. The President laid before the society a list of a collection of books, plates, &c., chiefly relating to natural history, being from the library of Dr. Dekay; also, a box of shells, fish, nests and eggs of birds, &c., forwarded from South America, by Mr. Reynolds, which are deposited with the Lyceum by Dr. Dekay. Mr. Whelpley, of Cleaveland, Ohio, laid before the society part of the skeleton of a fish, the species of which he was desirous to identify; referred to Mr. Cooper. Dr. James E. Dekay presented an extensive collection of *Fuci*, finely preserved; an extensive collection of plants, from the vicinity of Constantinople; a suite of colored casts to illustrate "Green's Monograph on American Trilobites;" a jar of fishes from the Bosphorus; various articles, as follows—five minerals, four trilobites, fossil crab, fossil shells from Athens, specimen of Pterocera, box of plaster for casts; also, a specimen of a recent crustaceous animal, said to be allied to the trilobite, brought by Dr. Eights from the South Pacific Ocean. The plants were referred to S. T. Carey for examination. Dr. Jay presented minerals and fossils, as follows—cubic pyrites, forest marble, quartz crystals, two specimens of fossil fishes from Mount Hebron, fossil Ostrea from Florida, four specimens of polished madreporites. Mr. Glover presented a specimen of reddish clay, raised in the Chinese Sea upon the flukes of an anchor. Dr. David Hosack presented a bust of Sir James Edward Smith. Mr. H. R. Schoolcraft presented, through Dr. Dekay, a box of fossils from Lake Huron and the surrounding country. Mr. Cooper exhibited, from Baron Lederer, a number of a work recently published, on the animals of Brazil, entitled "Collectanea ad Faunam Brasiliæ, von Karl Von Schreibers, Vienna, 1833," which work he was desired to exchange for others on natural history. Dr. John Backman, of Charleston, S. C., was elected a corresponding member. James McGillivray, Esq. of Edinburgh, was elected a corresponding member.

May 19.—Dr. Swift in the chair.—Visitor, Mr. Whelpley of Cleaveland, Ohio. Dr. S. L. Metcalf delivered some remarks on the phenomena of the galvanic pile, and declared his opinion, that the results perceived on varying the number of plates, proved beyond doubt the identity of caloric and latent electricity. As the size of the plates were diminished and the number increased, the imponderable fluid evolved presented less and less the properties of caloric, and more and more those of electricity. By immersing the plates in the acid solution, the oxygen of the acid and the metal, give out their caloric in the process of oxidation. Dr. Boyd presented a specimen of Orthoceratite from Newburg, N. Y.

May 26.—The President in the chair.—Mr. Cooper reported on the shells presented by Capt. Fokkes.—The Treasurer announced the reception of No. 22 L. and E. Phil. Mag. for April. "Contributions to Geology," by Isaac Lea, was presented by the author, thanks voted. "Memoires de la Société de Physique et d'Histoire naturelle de Genève," Vol. v, was presented by that Society, thanks voted for the same, and a copy of the Annals to be forwarded in return. Mr. Cooper presented "Ornitologia Toscana" Vols. 2 and 3, also two specimens of the "Chironectes lævigatus," of Cuvier. Mr. Cramer presented "Constitution of the St. Petersburg Mineralogical Society." Prof. Hitchcock presented through the Treasurer specimens of some fossils described in his "Report of the Geology of

Massachusetts," also a specimen of the Bucholzite? Various shells, molluscous animals and fishes presented by Dr. Dekay, were exhibited by the Librarian—referred to Mr. Cooper.

June 2.—The President in the chair.—Visitor, Mr. Francis Alger of Boston.—Mr. Cooper reported on the articles presented by Dr. Dekay. Dr. Feuchtwanger exhibited beautiful specimens of ruby silver from Xacatecas, Mexico, the same gentleman presented two perfect specimens of the Murex radix, and one specimen of the Murex regis from the Pacific Ocean, also "An Essay on green ochreous iron, in Latin and German, by Gustavus Schueler." Dr. Boyd presents a specimen of the Harpa nobilis. Mr. Archibald Robertson presents a specimen of gold rock from Cabarrus Cy., N. Carolina, thanks voted. Mr. T. Whelpley of Ohio, presents the skull of an undetermined fish, which was referred to Mr. Cooper. Mr. Cooper presents a prepared specimen of "Hemitripterus americanus of Cuvier," (Scorpæna flava of Mitchill) from the New York waters. Dr. Swift presents Smith's Treatise on "an Improvement in the Mariner's and Surveyor's Compass needle." Mr. Thomson presents some fresh water shells from Pompton, N. J. Dr. Tobin was elected a resident member. Dr. Jno. Watson was elected a resident member. Mr. Francis Alger of Boston, was elected a corresponding member.

June 9.—Mr. Cooper in the chair. Dr. Watson attended and took his seat. Ed. Phil. Jour., Oct. to April was received. Dr. Feuchtwanger announced the discovery of a new mineral in Hungary, named *ozokerite*, of the consistence of wax, burns readily, leaving when extinguished an agreeable odor. The same gentleman also mentioned the discovery in the south of France of an argentiferous galena, yielding about $\frac{22}{1000}$ of *platina*. Dr. Swift announced that the Naval Lyceum had received from Madagascar a living specimen of *Lemur mongos* of Cuvier. Mr. D. Jay Browne of Boston, presented through the Treasurer, a copy of his work, entitled "Letters from the Canary Islands,"—thanks voted. "A practical treatise on dyeing woollen, cotton and silk, by Wm. Partridge," was presented by the author. Mr. Cooper presented a specimen of calcareous spar (doubly refracting) from Turks Island, also several marine animals, principally crustacea, from the mediterranean, also three specimens of Serpula and one specimen of Pterocera truncata from the Mauritius, also a mass of mica slate with an imbedded mineral, from the vicinity of New York, the latter referred to Dr. Feuchtwanger. The Librarian announced the reception of a book case for the Society, presented by Mr. Charles Cramer of St. Petersburg,—thanks of the Society voted for the same.

June 16.—The President in the chair. Dr. Feuchtwanger reported in part on the specimen referred to him at the last meeting, that it appears to be a phosphate of lime, but requests opportunity for further examination. Mr. Cramer presents writings of the Mineralogical Society of St. Petersburg in Russian, Vol. 1. Dr. Feuchtwanger presents a large and fine specimen of elastic bitumen from England. Dr. Jay presents a fine specimen of Bulimus ovatus, also of Bulimus goniostoma, also of Auricula leporis, from Rio Janeiro, S. A. Capt. F. A. Fokkes presents a large echinite from Montmartre near Paris, also an ancient hatchet (greenstone) from France, and another (hornstone) from Germany, also a beautiful wax model representing the anatomy of the internal ear, made by Heinemann of Brunswick, accompanied by the advertisement of the author.

June 30.—Mr. Wm. Cooper in the chair. The Treasurer lays on the table Nos. 22 and 23 of Lon. and Ed. Phil. Jour. for April and May, 1834. Dr. Swift presents a book entitled "History of the Herculean Straits, by Lieut. Col. Thomas James, 1st Vol., London, 1771. Dr. G. W. Boyd, presents a suite of magnesian minerals from Hoboken, New Jersey, twenty eight in number, including fine and characteristic samples of all the varieties occurring at that celebrated locality. A pamphlet entitled "Geology of New London and Windham counties, Conn." by Lieut. W. W. Mather, U. S. A., was presented by the author through Dr. Torrey.

2. *Stony concretions in the Ovary of a Turtle.*—(Extract of a letter from Joseph E. Muse, A. M., to the editor, dated Cambridge, E. S. Maryland, April 3, 1833.)—I offer for solution in your inestimable Journal, a philosophical problem of much intricacy, the formation of three minerals, true oolites, (so I name them, not from imaginary similitude, but real character,) in the body of a living and healthy animal.

At supper a few nights ago, on a dish considered in our section of the country to be a great (although a very usual) luxury, the terrapin, 'Testudo fluviatilis,' was boiled and served up, on the table, as usual, with the shell unbroken. Having broken the shell of one of the heaviest and fattest, though not the largest, I dissected the four quarters and placed them over a lamp for dressing, and proceeded to open the ovary, when, to my utter astonishment, I found three of the eggs had turned to stone, which I now send you.

The ovary was of the usual size and appearance, and contained a large quantity of eggs, perfectly natural, both in appearance and quality, except the three above named.

As I am informed that in the eastern States you have not this delicacy, (the terrapin,) it may be well to state that the ovary, during the winter, and at this season, is generally large and full of eggs, inclosed, when *full grown*, within a very tender and soft shell or membrane, hardly admitting of the correct application of this term ; when not matured, this membrane is absent ; and the same ovary contains always both kinds : in the former stage the eggs are long, in the latter round, and the yolk floating in a viscid albumen ; they are generally so closely compressed in the ovary as to appear like one mass ; and when it is opened, having been previously boiled in that state, they exhibit flattened and deeply excavated sides, the impress of each other, such as you will perceive in two of the specimens sent ; one of which my curiosity led me partially to break with a chisel and mallet ; the knife could not accomplish it : I have sent of this the scaly fragments. The third you will perceive is larger than the rest, and not indented ; from which the inference must be drawn that its growth and petrifaction happened first, and when the others were in their soft and natural state : they all bear evident marks of recent and continuing, although partial and irregular, accretion, since their original formation.

The exterior thin layer of these stones obviously represents the outer thin membrane of the natural egg ; yet it has a yellowish tint ; whereas that membrane is naturally white : the next larger, which is much thicker, was clearly the albumen, and is nearly white ; the large solid ball or nucleus, on which these two are formed, has concentric layers of a dull color, marking the limits of the yelk : the two first are chiefly calcareous petrifactions, and almost wholly soluble in dilute muriatic acid ; these are readily cut with a knife ; the ball or nucleus is extremely hard, consisting of layers cemented by carbonate of lime, so intimately or firmly uniting them, that a keen chisel is necessary for their division ; a knife cannot penetrate it.

What caused this petrifaction ? why so partial in its operation ? three full grown eggs being alone changed into stone in the midst of numerous others, in the same ovary, wholly clear of its influence : why should not all the eggs in the ovary be obedient to the same laws which governed these three ?

What adventitious causes could have operated, without disturbing the animal economy, which was, with the single exception named, healthy, and bearing full internal evidences of organic and functional perfection?

To me the case appears mysteriously anomalous; the calculus of animal production; the stalactites, and other petrifactions, have obvious causes to be found in the filtration and deposition, from surcharged fluids; or, chemical precipitates, under uniform and well defined laws: but the case before us is referable, I apprehend, to no definite or known law.*

Remark.—The above communication has been delayed, because the petrified eggs which, although, as it now appears, they arrived safely and in season, found a hiding place where they were long overlooked, and were supposed to be lost.

Their appearance corresponds perfectly with the above description; their shape is not unlike that of the Echinus ananchytes, for which, in a hasty view, they might be mistaken; their color is yellowish white, structure perfectly lamellar; when heated they emit an animal odor; dissolve rapidly, with brisk effervescence, in muriatic acid, but leave a considerable residuum, probably of phosphates and animal matter. Since their re-discovery there has not been time for an exact analysis.—Ed.

3. *Vertebral Bone of a Mastodon.*—In digging a canal for a manufactory in the town of Berlin, parish of Britain, Connecticut, about twelve miles S.W. of Hartford, the workmen found a vertebral bone of a mastodon in a state of high preservation.

The spinous process is 17 inches long; the extremes of the transverse processes are 10 to 12 inches apart; the bones which contained the spinal cord is $5\frac{1}{2}$ inches in diameter, and nearly 3 inches thick; it is cup-shaped, or concavo-convex, with the convex portion forward. The cavity for the spinal cord is $3\frac{1}{2}$ inches in height by $2\frac{3}{4}$ in breadth.

The bone is of a dark chocolate color: it is not mineralized in the least; no portion of it is injured or missing, except a small part of the terminating processes; the spinal canal is smooth and polished, as are the cavities for the articulation of the ribs: they appear to retain their cartilage, which is very smooth to the touch, and from

* Pearls are believed to have their origin in blighted ova, since the enquiries relative to this subject by Sir E. Home, (see his Comp. Anat. Vol. v. p. 302 and Phil. Trans. 1826, part III. p. 339.) May not the explanation of their formation equally apply to the present bodies?—(*C. U. S.*)

the double cavity on each side of the vertebra, it is obvious that the heads of the ribs were bifurcated.

The bone bears the impress of the muscles and tendons that were inserted into it; there is even a degree of lustre where these soft parts played, and had the bone been preserved in an anatomical museum, it could scarcely have been more perfect. It was discovered in a tufaceous lacustrine formation, containing bleached individuals of the genera Planorbis, Lymnæa, Cyclas, &c. similar to those occupying the waters of the vicinity; and from the high preservation of the bone, the hope was entertained that the other parts might be near at hand, and that possibly a skeleton might be obtained. This is we believe only the third instance of a mastodon bone found east of the Hudson river.

1. One presented to Yale College Museum by Hon. John Cotton Smith, late Gov. of Connecticut, found we believe in Sharon, Conn.

2. Molar teeth found at Cheshire, in digging the canal from New Haven to Northampton.

3. The other is the present case.

The vertebra of Berlin was generously presented by Mr. E. H. Burritt, and several other gentlemen were active in procuring and forwarding this specimen, and in promoting an investigation of the ground. We are particularly indebted to Dr. John R. Lee.

4. *Fossil Tooth.*—From Mr. John Hazeltine, of Jamestown, Chatauque County, State of New York, we have received by the kindness of Mr. John T. Norton, of Albany, an interesting specimen of a portion of a fossil jaw, containing two molar teeth in a high state of preservation. The circumstances attending their position and discovery are thus described in a letter before us, dated Aug. 4, 1834.

"They were found by Mr. Hazeltine in digging for the foundation of a manufactory on the outlet of Chatauque Lake, about ten feet below the surface of an unbroken soil. The man who twenty two years ago cut the first trees where the village of Jamestown now stands, is still living; and the whole of that region was then an unbroken forest. The soil where these teeth were found is mostly gravel; they were imbedded, in the words of Mr. H., in 'a kind of black muck.' Some other bones were visible, but too much decayed to be rescued. As near as I could judge, the teeth were found a little below the present level of the creek. Chatauque Lake is situated seven miles from Lake Erie, about sixty miles above Buffalo; it is between six and seven hundred feet above the level of Lake Erie; its outlet, on which Jamestown stands, and where these teeth were found, is about twenty miles from Lake Erie; its waters unite with Caunewauga Creek seven miles from the lake, and forty miles from the lake unite with the Alleghany river at Warren, Pennsylvania."

The two molar teeth together measure $2\frac{1}{2}$ inches in length, by 1 inch in breadth; their depth from the top of the ridges to the bottom of the prong, is from $1\frac{1}{4}$ to $1\frac{1}{2}$ inch. The jaw, and the parts of the teeth included in it, are of a dark brown; the exposed parts of the teeth are mainly white, but on the ridges where they are worn down by mastication, they are brown in the proper bony portion of the tooth, and white in the enamel. The processes of the teeth were evidently once very high and sharp, like those of the mastodon, and they are still very prominent, although much worn down by grinding; the surfaces exposed have a high polish, both in the brown bone and in the white enamel. The teeth, although moveable in their sockets, are perfect in their connexion with the jaw, and the entire structure is apparent.

The question being put to Prof. Knight, of the Medical Institution of Yale College, whether it is possible that they might belong to the young mastodon, although that idea was immediately abandoned as untenable, the reasons assigned by Dr. Knight being instructive, we take the liberty to annex them.

"I have examined the fossil teeth which you gave me, and I am satisfied that they cannot be the infant teeth of the mastodon: for the following reasons:—

"1st. They are evidently the teeth of an adult, and probably an old animal: I judge this to be so, not so much from the wearing away of the crown, as from the entire and unperforated state of the end of the root. In infant teeth, there is usually, perhaps always, a deficiency at the extremity of the root, or at least a foramen of some size for the entrance of the nutrient vessels.

"2d. They are too small. I know of no instance in which there is so great a difference in the size of the infant and adult teeth of an animal, as there is between them and the known size of the adult teeth of the mastodon.

"3d. A more conclusive reason is, that these are evidently graminivorous teeth: while those of the mastodon are, in the arrangement of the enamel, carnivorous. You will see that, in addition to the external covering of enamel, there are plates of enamel running from the crown of the teeth perpendicularly downwards through their central parts, while those of the mastodon have only the exterior covering.

"Either of these reasons would probably be thought sufficient; together they are conclusive. I am not certain to what animal they belonged; but from some resemblance to the teeth of the bullock, it is probable they were of the same genus, perhaps the Buffalo."

Note.—It is obvious, as our correspondent observes, that "from the position in which these teeth were found, they must be of high antiquity; and it is possible they may supply a link in the chain of facts respecting the animal remains of this continent." There can be no reasonable doubt that these fossil teeth are of the age of the mastodon, and other animals, whose remains are found at the Big-bone-Lick in Kentucky.

5. *Some account of the Organic Remains found in the Marl Pits of Lucas Benners, Esq. in Craven County, N. C.; by* H. B. Croom, Esq.—It has long been known to the public, that large deposits of sea shells exist in different parts of the alluvial country of the Southern States. They have been observed on or near the Tar River, a few miles above Tarborough; on Neuse River in the Counties of Wayne, Lenoir, and Craven; on Cape Fear River in the County of Bladen; on the Savannah River a few miles below Augusta on the Oakmulgee River, at Hartford; and finally, I have observed them on the Appalachicola River, in Florida, on the summit of a ridge not less than one hundred and fifty feet above the bed of the river. Of these deposits I have seen, and superficially examined two on the Neuse River, the one at Hartford, and that on the Appalachicola. They appear to be coeval. Oysters, pectens, and arcas, of the same species, predominating in each, mingled with the teeth of sharks, and a variety of other univalve and bivalve shells. The catastrophe by which these remains were buried, appears to have been *sudden.* This is evidenced by the fact that many, both of the largest, and of the smallest and most delicate bivalve shells are found with their two valves closed and arranged as in a living state, as although they had been suddenly covered up while living.

Of all these deposits however, not one has been extensively explored except that on the estate of Mr. Benners, occupying the north bank of Neuse River, sixteen miles below Newbern. Several years ago Mr. B. commenced digging the marl which accompanies these deposits, (and which has resulted from them by the mingling of the decomposed shells with the contiguous earth) and spreading it on his fields, which have been much benefited by the application. In the course of his operations, several pits have been dug, some of them to the depth of twenty five feet below the surface of the earth, and ten feet below the present surface of the river. In the course of these excavations, a great variety of interesting organic remains have been found, consisting of sea-shells, bones and teeth of fishes, and the bones of land animals of prodigious size. Mr. B. informs me that the following is the order in which these remains have been found:—1st. Shark's teeth, and the fragments of bones of marine fishes, mingled with sea-shells. 2d. Teeth, horns, hoofs, ribs, vertebræ, &c. of quadrupeds that inhabited the land, mingled with sea-shells of great varieties. These remains of land animals are found at the depth of from twenty to twenty five feet below the surface of the earth. Among them are recognized with certainty, the teeth of the great mastodon, [Mastodon giganteum of Cuvier,] the hoof, horns, and vertebræ of an elk of great size and the teeth of an animal supposed to be the hyena.*

I will now subjoin a more minute account of some of these remarkable remains:—

I. *Shells.*

1. Pholas costata. Length $1\frac{5}{8}$ inches. Breadth $3\frac{1}{2}$ inches.
2. Clam shells, [Venus] one of these in my possession measures 5 inches in length and 7 inches in breadth. One which Mr. B. gave to Mr. Nuttall is a third larger than this.
3. The grooved Conch, [Strombus.] Length $5\frac{1}{2}$ inches. A species supposed to be extinct.
4. Murex. Abundant and of different sizes.
5. Cardium, [Cockle.] Not common.

6. Solen, [Razor shell.]	Length	$\frac{3}{4}$ inch;	breadth	$4\frac{1}{8}$	inches.
7. Arca.	"	$2\frac{1}{4}$ "	"	$2\frac{7}{8}$	"
8. Pecten, [Scallop.]	"	$4\frac{5}{8}$ "	"	$4\frac{1}{2}$	"
9. Ostrea, [Oyster.] An extinct species?					
10. Patella fornicata.	Length	$1\frac{1}{8}$ inches;	breadth	$\frac{7}{8}$	inch.
11. Pectunculus.	"	$1\frac{1}{2}$ "	"	$1\frac{3}{4}$	"
12. Conus, [Key shell.]	"	$2\frac{1}{2}$ "	"	1	"
13. Buccinum.	"	$2\frac{1}{2}$ "	"	1	"
14. Mya, [valves gaping.]	"	$3\frac{1}{2}$ "	"	$5\frac{5}{8}$	"

* It will require very rigorous observations, to establish this fact, as we have hitherto no evidence that the hyena ever existed on this continent.—*Ed.*

15. Donax? breadth ¾ inch.
16. Nerita.
17. Madrepora porites.

II. *Bones and teeth of Fishes.*

1. Tooth of a Shark. Length 5¾ inches; breadth at base within the socket 6¾ inches. Many others of smaller size.

2. Vertebræ of fishes about one inch in length, and nearly the same in diameter.

III. *Bones and teeth of land animals.*

1. Fragments of the Horns of a fossil Elk?
2. Hoof of a fossil Elk? 9 inches in length.*
3. Teeth of the Elk? breadth 3 inches, depth 4½ inches.
4. A vertebra 8 inches in diameter. [Presented to Th. Nuttall, Esq.
5. A vertebra 3½ inches in diameter, 4¼ inches in length. [In my possession.]
6. A vertebra 1 inch in diameter, 2 inches in length.
7. Grinders, 2 inches broad, 3 inches in depth.
8. Fangs, 3 inches in depth; tapering to a point.
9. Grinder of the Mastodon giganteum of Cuvier. Breadth 7 inches; depth 9½ inches. Presented by Mr. B. to the cabinet of the University of North Carolina. A tooth was found at the depth of 25 feet below the surface of the earth, mingled with sea-shells.

The dimensions of this animal as given by Harlan, in his Fauna Americana, are as follows:—Height at the withers from 10 to 11 feet; length from the end of the snout, to the posterior part of the pelvis, from 15 to 16½ feet. It is remarkable that not more than 10 miles distant from these pits, to wit, in the Clubfoot Canal, was found about 4 feet under the surface, the skeleton of another species, the Mastodon angustidens of Cuvier.—See Harlan's Fauna p. 214. One of the grinders of this skeleton in my possession measures 6¼ inches in width. The cutting surfaces consists of elevated and conical points, (4 pairs of points and an odd one,) differing considerably from those of M. giganteum, and scarcely seeming to have been inten-

* The animal to which the *hoof and teeth* above-mentioned belonged, must have been much larger than a horse. The space between the extremities of the horns of the fossil Elk of Ireland is said to have been eleven feet. The bones of the American fossil Elk, have hitherto been discovered only in the morass near the falls of the Ohio, called Big-bone Lick, in company with the bones of the Mastodon, &c.—*Harlan's Fauna*, p. 247.

ded for grinding *grass* and *leaves.* The dimensions of this species are said to be one third less than the other.

That was certainly a strange world in which such animals as these browsed and prowled! and, it might seem, scarcely compatible with the coexistence of man in his rude state, armed only with the bow and the club.

Newbern, Sept. 12, 1833.

6. *Confirmatory Notice of the medical virtues of Guaco;* in a letter to the Editor from Prof. W. R. Johnson, dated July 1, 1834.—On the subject of Guaco, about which some doubts have been expressed, I have recently seen in Poulson's American Daily Advertiser, an article from one who has been on the spot where it is used, strongly attesting in favor of its medical virtues, and have just conversed with a highly intelligent gentleman,* himself a native and resident of Venezuela, who assures me of its high estimation and extensive use in the medical practice of that part of South America. Its tonic and sudorific properties, not less than its efficacy in destroying animal poisons, were particularly mentioned.

7. *Notice of a hail storm in Louisiana;* in a letter from Mr. W. M. Carpenter, dated Jackson, Louisiana, June 19, 1834.—I take the liberty of addressing you at this time, to give you some account of a hail storm which happened here on the 28th of March last. About midnight the cloud rose in the west, and the storm commenced at 1 o'clock, accompanied with incessant lightning. The hail fell with considerable obliquity and great force, with but little wind. The stones were of different sizes, from that of a pigeon egg to four inches, but generally from three to four inches in diameter; in the centre was a nucleus of transparent ice, of half an inch in diameter; on the outside was a stratum of ice resembling snow pressed hard; this again was covered by three other layers of the same kind as those mentioned, alternating in the same manner; the smaller, of course, consisted of fewer layers. The storm lasted about ten minutes, doing great damage to houses and timber, and great numbers of cattle were killed by it.

8. *Ledererite not a new mineral.*—The Editor of the Lond. and Edin. Phil. Mag. &c. for May, 1834, mentions having received a

* Don Fernando Bolivar, nephew of the late Liberator.

small specimen of the supposed new mineral Ledererite; but, on examination, it proves, by its form and angles, to be the Hydrolite of De Drée, or Gmelinite of Sir D. Brewster. The analysis of Vauquelin gives silica 50, alumina 20, which agree nearly with the proportions of the Nova Scotia mineral. Vauquelin, it is true, found 21 of water, instead of 8.58; but as, perhaps, water may turn out to be *isomorphous* with both lime and phosphoric acid, the two analyses may, when expressed *symbolically*, appear to agree with each other and with the theory; or there *may* be some error in one of the analyses.

9. *Meteorology.*—A letter to the Editor, dated Feb. 24, 1834, at St. Brieux, Cotes du Nord, from M. Morin, Ingenieur Ordinaire des Pontes et Chaussees, membre de plusieurs societiés scientifiques, &c., invites the meteorologists of this country to a communication and interchange of observations on this interesting subject. M. Morin states, that meteorology has engaged his attention for twenty years; that in 1814 his observations were confined to a single place; that he gradually extended them, until, in 1821, they comprised many departments of France; that, in 1825, he resolved to extend them over the whole world, by giving the history of the seasons from October 1, 1823. For some months before the date of his letter, he had entertained the intention to carry back his record to the year 1658, beyond which period there are no connected meteorological observations. He has published five memoirs upon the subject of the correspondence which he has established with most of those who cultivate meteorology; a sixth memoir was in the press, and they will be forwarded to the Editor, as soon as a proper channel is indicated. M. Morin solicits of us, either direct information, or that we will invite, through this Journal, the communication of observations, and a correspondence with himself. He has received various documents from the United States, but they are incomplete; he is in want, particularly, of continued and precise barometrical observations from this country, from 1824 to 1833, inclusive. We earnestly invite the attention of meteorologists to the above communication, and we offer our pages and our personal agency in promoting this important object, whose interest is not local or temporary.

We have received from M. Morin a memoir containing Instructions sur la manière de faire des observations météorologiques, published at Paris, in 1834.

10. *Meteorological Journal.*—Abstract of Meteorological observations, taken at Savannah, Geo. by W. H. Williams, from June 1st. 1833, to June 1st. 1834; lat. 32° 8′ north—lon. 4° 8′ west of Washington city.

MONTHS.	Thermometer.			Warmest day.	Coldest day.	Atmosphere.				Prevailing winds, stated in days.				Prevailing wind for the month.
	Mean temp.	Maximum.	Minimum.			Fair days.	Cloudy days.	Rainy days.	Variable days.	N. W & N.	N. E. & E.	S. E. & S.	S. W. & W.	
June, 1833.	82	90	72	8	10	18	9	1	2	4	4	5	17	S. W. & W.
July, "	82	87	77	31	8	18	5	2	5	3	5	13	10	S. & S. E.
August, "	81	90	72	1	22	12	7	12	0	6	14	5	6	N. E. & E.
Sept. "	78	88	68	10	25	18	6	2	4	5	11	11	3	S. & E.
Oct. "	68	85	42	17	30	21	7	2	1	9	10	4	8	N. E. & E.
Nov. "	59	88	40	12	17	22	4	2	2	4	9	5	12	N. W. & W.
Dec. "	53	64	44	2	20	9	13	4	5	9	16	0	6	N. E. & E.
Jan. 1834.	52	72	32	20	7	6	10	10	5	6	15	0	10	N. E. & E.
Feb. "	63	80	46	25	1	12	8	5	3	5	5	5	13	S. W. & W.
March, "	63	76	48	8	3	13	8	5	5	9	12	6	4	N. E.
April, "	69	80	50	23	6	16	7	3	4	6	3	8	13	S. W. & W.
May, "	74	86	66	12	16	12	7	6	6	0	13	8	10	N. E. & E.
	68°66.					177	91	54	43	66	117	70	112	

Mean temperature of the thermometer for the year,				68°66′
" average	"	"	summer months,	81 66
" "	"	"	autumn "	68 33
" "	"	"	winter "	56
" "	"	"	spring "	68 66

There have been one hundred and one rains during the year. The greatest quantity of rain fell in January, 1834. More rain fell in January, than in the autumn months. June, 1833, was the warmest month—1° warmer than the month of June, 1832, and 2° colder than the preceding year. Average of the thermometer 82°. January, 1834, was the coldest month. Average of the thermometer, 52°—2° colder than the preceding year, and 4° colder than January, 1833. June 8 and August 1, 1833, the warmest days; thermometer 90°—5° colder than the warmest day during 1832. January 7, 1834, the coldest day; thermometer 32°—12° warmer than the coldest day of 1833. The first frost was on the evening of the 22d of Oct.—two days earlier than the last season. On the night of the 30th of Oct. ice was seen in the suburbs of the city. Less rain fell in the month of Nov. 1833, than in any month during the year. The splendid phenomenon that appeared about the middle of Nov. 1833, we were not privileged to witness. The last frost in the spring of 1834, was on the night of April 28. Uninterrupted health has been enjoyed during the year; at no one period could it be said of Savannah, it was unhealthy. It may also be stated, that for the last four years, no city at the south, and perhaps few, if any, in any part of the whole U. States, has been blessed with more health. No prevailing sickness has appeared for this period of time.

Chatham Academy, Savannah, Geo. June 28, 1834.

11. *A Treatise upon Elemental Locomotion, by means of steam carriages, upon common roads*, London, 1832; and *Journal of Elemental Locomotion*; by ALEXANDER GORDON, Esq. Civil Engineer. No one can peruse these works without being pleased with the forcible manner in which the author has set forth the advantages of applying steam power to the purposes of conveyance upon common roads. He seems fully aware of the obstacles which prejudice or individual interest would oppose, and with no inconsiderable talent and philanthropic feeling he grapples with them, until they are entirely demolished.

The changes which he proposes to effect, by the substitution of steam for animal power, are very extensive, and if realized, they may produce the most beneficial results to society. The work contains an account of the progress of improvement in the use of steam, and the construction of steam engines and carriages; the importance of a rapid and cheap inland communication, in its bearing upon the commercial, moral and agricultural interests, and to many branches of national industry; the means of accomplishing this, with a great economy of time and an increase of power, at a much less expense.

He proves that the plan proposed will dispense with the use of two millions of horses, and while it prevents cruelty to the brute creation and the degradation which inflicts it, he calculates there will be a saving of grain sufficient for the support of eight millions of people. His conclusions are mostly the result of calculation or actual experiment. Several journeys, for trial, were made, and the practicability of the scheme has been fully proved by "the running of a carriage, four times a day, (Sundays excepted,) between Gloucester and Cheltenham, for four months, and over nearly four thousand miles of ground, *without a single accident*, during which period it carried upwards of three thousand passengers, at one half the expense of four-horse coaches." The subject was fully investigated by a select committee of the House of Commons, and their very favorable report, together with all the testimony adduced before them, is contained in this work.

Some of the arguments of Mr. G. to show the fitness of the scheme to relieve the suffering population of Great Britain, and as a remedy for future evils, are cordials to a British public; and in estimating the favorable reception which the plan has met, much must be attributed to this.

In no other country will the roads admit of elemental locomotion, and no other has such a population to relieve, and to no other are many of the arguments applicable; we think, therefore, the plan will be, at least for a time, limited in its adoption to Great Britain.

12. *Notice of ancient pottery;* in a letter from Dr. John H. Kain to the Editor, dated Trafalgar, Knox County, Tenn., Sept. 26, 1833. Mr. Rich, who will hand you this, will likewise deliver to you a specimen of the ancient crockery, found among the mounds on my farm. A careful examination of them solves a difficulty which has puzzled the antiquarians not a little. Associated with the mounds are found large heaps of shells, of different kinds, but small, and principally such as are found in the neighboring river. A number of these were composed of a small univalve, resembling the conch. The conch is sacred to one of the Hindoo deities, and it was supposed that these shells had been offered to Vishnu, and consequently, that the mounds had been erected by the Hindoos. On inspecting the specimen of pottery which I send, you will perceive that it is coated with small fragments of shells, which must have given the vessel a beautifully white and shining appearance; and I can suppose they formed articles of furniture, which would not be disdained in the present age of refinement and luxury. I suppose that the banks of shells, instead of being collected as offerings to a heathen deity, were intended to be used in glazing and ornamenting their pottery. I have seen, in West Tennessee, near Columbia, the remains of an ancient furnace, which had been used for baking earthen ware. But I think it probable, that the specimens I send you were never subjected to a very strong heat, which would have decomposed the shells with which they are coated. It is probable, that the shells were coarsely pulverized, and dusted over the vessel in its soft state, which was then dried in the sun. This earthen ware abounds in the neighborhood of the ancient mounds, of which your Journal has contained so many notices, and is one of the few monuments left us of a race of people long since extinct.

13. *Notice of the culture of the potatoe in France;* in a note to the Editor, dated June 27, 1834, from Mr. Wm. Foster, of Boston—then in New Haven.—In 1796, living in a part of France where potatoes were but little known, and less used, as food for man, and having obtained some Irish seed, I gave them to a country gentleman, at whose castle I was then residing, to plant. He asked me what soil was the most suitable. I informed him, that on that subject there were various opinions, but that I had known very good crops, and of good quality, raised on moist ground. He told me that he had one place that was moist enough, being nothing but bog and water, and another dry enough, being nothing but sand or gravel, and that he was willing to make the sacrifice of these two places for the experiment, since the seed cost him nothing; at the same time saying, that he was not partial to Englishmen or potatoes, and reciting the following lines.

> Si vous allez en Angleterre,
> Il faut louer jusqu'aux pommes de terre;
> Mais, gardez vous de dire que Paris soit plus grande que Londres,
> Ou, ils seroient gens a vous tondre.

By the side of the morass there was a gravel hill, without a sign of vegetable earth in it. The morass was then frozen so as to bear our weight. I proposed to him, (or he to me, I do not remember which,) to imitate the process which one of the children had adopted for his spring garden, in the house; which was, sowing seeds in tow, floated on water, and to use the dry gravel in the place of the tow, as a mere receptacle, to hold the potatoes for vegetation. The plan was adopted; many wheelbarrow loads of gravel were placed at proper distances on the bog, and the potatoes planted therein, under my direc[illegible]n. The result was a very early crop of excellent potatoes, fari[illegible]ous and large; and the same process was continued for years aft[illegible]casionally adding a little gravel, when a part of the first deposit h[illegible]nk into the morass. The potatoes planted on the dry gravel pr[illegible]ed a few plants and bulbs, of a very bad quality. Their producing [illegible] thing must have been owing to the dampness of the climate, a[illegible]he copious dews which proceeded from the vicinity of the mora[illegible]

Is it no[illegible]bable, sir, that in New England, where good arable land is no[illegible] sufficient quantities for our wants, there are many such morasses, [illegible] of no value, which might be made to produce potatoes, and perhaps other useful vegetable food? The experiment seems to be worth trying.

I will further remark, that this aquatic potatoe patch had no hoeing or other labor bestowed on it; a matter of some importance in our country, where labor is so dear. Again, the labor of transporting the heaps of gravel may, or must be done in the winter, when the time of the farmer is less valuable.

14. *Annual Report of the Regents of the University to the Legislature of New York.*—In Vol. XXV, No. 2, we gave, rather at large, an exposition of the relation of the Regents to the various literary institutions of the State, the supervision they exercised over them, and the several subjects upon which, constantly, scientific observations were required to be made. The results of these latter were severally noticed, and it is only necessary to record the progress and results of the last year.

The reports from the several colleges include 750 students and 101 graduates; from the medical schools, 375 members and 55 graduates; sixty seven academies, (making the required reports, in whole or in part, and receiving the usual appropriation of $10,000,) reported 5,506 students, of whom 3,390 pursued classical studies, or the higher branches of English education, for four months or more of the year; and showing an increase over the whole number of last year of 650.

In the studies pursued, in addition to those of last year, we observe anatomy and mineralogy; and from the academy where mineralogy is taught comes a report of the mineral localities in its vicinity. Were mineralogy taught at all the academies, there would be observers at all; and then more numerous and extended reports. We think it would be a valuable accession to the means of instruction, if each academy were furnished with a sufficient cabinet of characteristic specimens.

The meteorological returns are more ample and complete than usual. The annual mean temperature, from the average of the returns from thirty five academies, 44.1°. Highest degree during the year, (99°,) was observed at Dutchess County and Montgomery academies, and the lowest, (−32°,) at Governeur. Greatest annual range, (122°,) at Governeur and Lowville; greatest monthly range, (96°,) at Governeur.

The annual average of rain and snow at thirty one places is 37.03 inches; greatest quantity, at Union and Erasmus Hall, 51.83 inches. An average of all the observations made for eight years at forty three places gives 36.61 inches of rain and snow, and the average temperature at forty six places is 47.29°.

There is the usual appendix of observations upon vegetation, and of meteoric phenomena, with valuable "Instructions for observers of the Aurora Borealis," circulated by the British Association for the Advancement of Science.

It is gratifying to witness the continued success of this experiment, which is unique in this country, and to learn of the cooperation of the War Department, which, through its officers at the various military posts, will secure such an uniformity in making observations as must prove "extensively useful to our country and to the general cause of science."

15. *Picture Gallery of Toronto.*—The name of York, the capital of Upper Canada, has been changed to Toronto. There have been, for several years past, striking proofs of the advance of society in Canada, among which the publications of the Literary and Philosophical Society of Quebec and the notices of the Natural History Society of Montreal are conspicuous.

We now see, with equal pleasure and surprise, a catalogue of the first exhibition of the Society of Artists and Amateurs of Toronto, for 1834. This catalogue contains a list of nearly two hundred pictures and prints, very creditable indeed to the spirit which is so active in Canada, and to which we cordially wish success, in every effort to advance the interests and honor of that fine country, to whose welfare we can never be indifferent.

16. *Spontaneous Combustion.*—The Lancaster (Penn.) Journal publishes the particulars of a very singular instance of spontaneous combustion, which recently took place in that city. Mr. Adam Reigart had been presented, about two years before the occurrence, with a small piece of wood, evidently cedar, which had been detached from a large piece, found in excavating the deep cut of the rail-road, at the Gap, in that county, about thirty nine feet below the surface. This piece, weighing not more than two ounces, was broken in two, and laid upon a white pine shelf in Mr. Reigart's counting room. About three or four days before the discovery of the fire,

Mr. Whitaker, a gentleman who resides with Mr. Reigart, on wiping the dust from the shelf with a wet cloth, took up the pieces of wood, and after having dusted the shelf, laid them as before. Three days after this it was discovered that one of the pieces had ignited, and combustion was progressing so rapidly that the shelf would have been in a few minutes on fire. On examination, a portion of one of the pieces was found reduced to ashes of a dark grey color, and from some of the outer fibres being sound, and ashes lodged in the interior, under them, it would appear that combustion had commenced, not upon the outer part of the wood, nor upon the sides which lay in contact with the shelf, but in the interior of the stick—the surrounding fibres being disintegrated by the action of the fire within, and ready to fall to pieces.

17. *Wood set on fire by the heat of the Sun.*—The Hartford (Conn.) Review states, that on Tuesday, the 5th of August, three men being at work at hay in a meadow about one mile east of Winchester, (Conn.) about 2 o'clock, P. M., they discovered, a few rods from them on a piece of barren upland, which had been cleared some seven years since, a small smoke arising; the sun shining excessively hot at the time, they were induced to go and examine it. They found the fire was just kindled, and had not commenced blazing, nor consumed any of the fuel in which it commenced, which was the remains of an old, decayed hemlock log. It immediately burst into a blaze and burned vividly; and when the writer of this saw it, more than twenty hours after, it had consumed most of the old log and mulch for more than four feet square, and was then burning. From the locality of the place, and all the other circumstances, the fire cannot be accounted for at all, but from the direct influence of the rays of the sun, which shined brighter and hotter at that time than any time previous, this season. The men who saw it, are respectible men, of the strictest integrity.

18. *Substitute for linen.*—The following communication is from a a gentleman of very high respectability in Salem, Mass., and at his request it is inserted.—*Ed.*

There has recently been discovered, in Salem, Mass., and patented, a new and beautiful material, resembling silk and linen, which holds out to the manufacturers of this country the high promise of an original, beautiful and invaluable fabric, far surpassing in strength and beauty of texture that of linen, which it is doubtless destined wholly to supersede, as the culture of it requires much less labor and expense than flax, and does not, like that and similar materials, require to be renewed annually, (being a perennial,) and the preparation of it for manufacturing being far more simple than either; and its great natural affinity for coloring matters, and its requiring *no bleaching*, being objects of the highest importance, give it a very decided preference over that manufacture. A few specimens of the manufacture of this material into small fancy articles have been produced, some of which being colored of varied tints present such a beautiful silk-like appearance as to have been actually, in some instances, mistaken for it; over which, however, it possesses this decided advantage, that it not only sustains the action of water uninjured and undefaced, (which it is well known silk will not do,) but the repeated action of water rather appears to strengthen and beautify it. It is ascertained to be the opinion at Lowell, where they have offered to make the experiment, that it can be spun upon machinery.

And while it offers to other branches of manufacture very important substitutes for those substances hitherto used, it offers a material very superior, in many points, for paper. It is believed, from some specimens already produced, that paper of every description may be manufactured from it, possessing a pearly whiteness, durability, beauty of texture, and smoothness of surface, unrivalled by any other ever before manufactured in any country. And it is susceptible of the most brilliant colors, in grain or otherwise. This is believed to be the first material of the kind ever before discovered in this country, that holds out the prospect of a staple commodity, silk, linen and cotton being exotics, and the discoveries of course exotic; but this material is indigenous, is a native of this country, discovered by a native citizen, one of her own daughters, which circumstances, together with its intrinsic worth, seem peculiarly to enhance its value to us. It is open to any one who may wish to make experiments.

19. *Notice of the United States Medical and Surgical Journal.*—In the publisher of this work we recognize the former editor of the Medical Recorder, published some years since in Philadelphia, and one of the best medical periodicals that have been published in this country. We observe, also, that he has in this, the first number of the present work, proposed a premium for the best essay on a particular subject. This plan was first adopted, with respect to a med-

ical periodical, we believe, by the present editor, when he published the Recorder, and he elicited, by that means, some of the best medical essays that have been published in this country.

The editor premises that he is not pledged to support the doctrines of any medical school, or of any individual or class of physicians, but that he will, with the best assistance that he can procure, disseminate useful information, on all branches of the medical profession.

Medical periodicals are useful to the profession, not only to give information of all real improvements and new facts, that are constantly unfolding, but also to expose error, and to inform the members of the profession of the false pretensions of many writers, who make new books as apothecaries make new mixtures, by pouring in a little from one bottle and some from another.

From the figure of a lancet on the cover of the periodical, we may probably infer, as well as from the express declaration of the editor, that the knife, and probably the cautery, will be used, when necessary. These measures, although harsh, are necessary in some cases. A physician at a distance from a large town, and of course from book stores, and who is disposed to keep up, his knowledge of the progress of the medical profession, may be induced, by the lofty pretensions and high sounding titles of various productions, especially when duly *puffed* by some periodical, to purchase books, either of no intrinsic value at all, or in which the valuable matter of a large volume may be contained in a few pages of a periodical.

A periodical which will judiciously analyze works of this description, separate the chaff from the wheat, and expose the unjust pretensions of certain book-makers, may do great service in this way to the profession.

The first paper of No. 1, on Medical Ethics, although not new, is valuable, and it is proper that the attention of the profession should be frequently called to it, to prevent any violation of its precepts. The other papers in this number are respectable, and on the whole judicious. We wish the publisher* success in his undertaking.

---

* Mr. Webster, under whose name the work appears, although he is not of the medical profession, yet he has had extensive experience in the publication of medical books. The tact which he possessed of availing himself of the best medical assistance, as the editor of the Medical Recorder, is a guaranty that he will take care that the best talents shall be elicited in the present work.

20. *Strontianite discovered in the United States.*—I embrace an early opportunity of stating, through the medium of the Journal of Science, the discovery of the Carbonate of Strontia in this country. So far as my knowledge extends, this mineral has not, until the present time, been observed in the limits of the United States, and it is even considered rare in Europe. This fact makes it peculiarly interesting to our mineralogists. Perhaps I ought to make a reserve in pronouncing it pure Carbonate of Strontia, as the mineral may contain other elements besides Carbonic Acid and Strontia. The following are some of its most interesting characters.

Color, nearly pure white; sometimes tinged yellowish on the surface. Lustre, vitreous; fibrous varieties, pearly. Translucent . . . opake. Brittle, and easily reduced to a powder. Hardness $=3{\cdot}5$, of the scale of Mohs. Specific gravity, undetermined. Streak, white. Cleavage, apparently parallel to the plane of a rhombic prism. The crystallization is too imperfect to admit of measurement.

Before the blowpipe it is infusible, but with a strong heat an imperfectly friable, white mass is formed, which has an acrid alkaline taste. Color of the flame, red or reddish purple.

In muriatic acid it dissolves, with an active effervescence, accompanied with the disengagement of carbonic acid. Solution incomplete in cold muriatic acid. The muriatic solution, on the addition of alcohol, burns with a fine carmine red flame. From this solution sulphuric acid throws down a white precipitate.

The varieties of this substance are mostly compound. The most perfect consist of stellated groups, or rather of imperfect individuals diverging from several centres, forming masses of different sizes. On one partially decomposed specimen, I observed a few small but regular six sided prisms. In all other cases, the crystallization is too confused to permit the determination of the precise forms, or their dimensions. Some pieces, which evidently contain Carbonate of Strontia, resemble, externally, its congener, the Sulphate; that is, they are tinged bluish, and present a structure both laminated and fibrous.

I conjecture that some of the specimens are the Baro-strontianite of Traill. Others seem to be Strontia, combined with Carbonate of Lime.

The locality of this mineral, or family of minerals, is Scoharie, N. Y., in the vicinity of Ball's Cave, which has already furnished so many fine things for our cabinets.

I hope, ere long, to furnish a more particular account of the varieties mentioned in this communication. EBENEZER EMMONS.

Williams College, Aug. 15, 1834.

Note, by C. U. Shepard.—A second communication from Dr. Emmons, relating to the foregoing, has been received, from which it appears, that he has ascertained the specific gravity of the mineral to be 3·5. He adds, that "the point with me is to prove that it contains carbonate of strontia, or consists of it in the main: I do suppose that it contains some sulphate of baryta or sulphate of strontia."

Dr. Emmons was kind enough to enclose a few fragments of the mineral in the letter, which, in hardness and structure, agreed with the description he has given. As the fragments appeared remarkably pure, I thought it worth while to settle the question of their containing either of the sulphates of baryta, strontia, or lime.

Accordingly, I heated 8 grs. of the mineral, in the state of an impalpable powder, to a dull redness, in a platina crucible; and on restoring the crucible to the balances, found that it had lost 0.2 grs. or 2.5 per cent. The 7.8 grs. were introduced, with extreme caution, into a small glass flask, and dilute hydrochloric acid affused at intervals, until the effervescence had nearly subsided. Heat was then applied, for a few minutes; when nearly the whole of the powder had disappeared. The quantity remaining undissolved appeared too minute to allow of being withdrawn from the flask and estimated by the scales. I attempted to form an opinion of its quantity, therefore, by withdrawing the supernatant solution. This was done with care, and the washings of the flask added to the fluid. The solution was evaporated, in the platina crucible, to dryness, and maintained for five minutes at a red heat. The chloride of strontium thus obtained weighed 8.7 grs., which is equivalent to 4.35 of strontium. But the strontium in 7.8 carbonate of strontia $=4.637$. The difference of 0.28 (between 4.35 and 4.637) is to be attributed to the undissolved matter in the flask, and to loss. The appearance of the undissolved portion being that of minute grains, it occurred to me that it might still be carbonate of strontia; and that the reason of its not having been dissolved was a want of pulverization. Accordingly, I treated it with an additional portion of hydrochloric acid and heat, when it soon yielded a perfect solution.

I therefore fully coincide with Dr. E. in the opinion that this mineral is the Strontianite.

Yale College, August 26, 1834.

21. *Munificent donation to Yale College Library.*—The following important (British) National Works, printed by order of the Commissioners for the Preservation of the Public Records, have lately been received from the Record Commission, through the friendly agency of O. Rich, Esq. of London, as a donation to the Library of Yale College.

The Statutes of the Realm, in 9 vols. royal folio.

(The first volume contains the Charter of Liberties, from Hen. I. to Edw. I.; and the Statutes from Hen. III. to Edw. III.; the remaining volumes, from that time to the end of the reign of Queen Anne. This is the most perfect collection of the Statutes, for the given period, in existence.)

An Alphabetical Index to the above, royal folio.

A Chronological Index to the same, royal folio.

Taxatio Ecclesiastica Angliæ et Walliæ, A. D. 1291, royal folio.

Valor Ecclesiasticus. Temp. Hen. VIII. Vol. I. to VI.

Placitorum in Domo Capitulari Westmonasteriensi Asservatorum Abbreviatio. Temp. Ric. I. Johan. Hen. III. Edw. I. & II. folio.

(Abstracts of Pleadings before the King in Parliament and Council, &c.)

Calendarium Rotulorum, Chartarum, et Inquisitionum ad Quod Damnum, folio.

(Charter Rolls in the Tower from King John to Edward IV.)

DOMESDAY BOOK, with Indices, and Supplements, 2 vols. royal folio.

Indices et Additamenta to Domesday Book, 2 vols. demy folio.

Testa de Nevill. Temp. Hen. III. Edw. I. folio.

(Book of Fees held of the King, Churches in his Gift, &c.)

Calendarium Rotulorum Patentium in Turri Londinensi, folio.

(Calendar of Patent Rolls in the Tower.)

Rotulorum Originalium in Curiâ Scaccarii Abbreviatio. Temp. Hen. III. Edw. I. II. & III. 2 vols. folio.

(Original Rolls in the Court of Exchequer of Estreats, &c.)

Placita de Quo Warranto. Temp. Edw. I. II. III. In Curiâ Scaccarii Asservata, folio.

(These Documents are frequently referred to in Courts of Law.)

Rotuli Hundredorum. Temp. Hen. III. & Edw. I. Vol. I. folio.
Vol. II.

Rymer's Fœdera, Conventiones, &c. Vol. I. 2 parts, folio.
Vol. II. 2 parts, ditto.
Vol. III. 2 parts, ditto.

(Many important additions have been made to the celebrated Collection by Rymer in this work, which is not yet completed.)

Ducatus Lancastriæ, Pars Prima. (*Calendar of Inquisitions, post mortem.*) Pars Secunda et Tertia. (*Calendar of Pleadings, &c.*) 2 vols. folio.
Calendarium Inquisitionum Post Mortem, sive Æscætarum. Hen. III. Edw. I. II. III. Rich. II. Hen. IV. 3 vols. folio.
Vol. IV. Hen. V. VI. Edw. IV. and Ric. III. with an Appendix.
Inquisitiones Nonarum in Curiâ Scaccarii. Temp. Edw. III. folio.
Catalogue of the MSS. in the Cottonian Library, folio.
Harleian MSS. 4 vols. folio.
Lansdowne MSS. folio.
Calendars of Chancery Proceedings in the Reign of Elizabeth. Vols. I. II. and III. folio.
Parliamentary Writs and Writs of Military Summons. Vol. I. folio.
Vol. II. 3 parts.
Inquisitionum Retornatarum Scotiæ Abbreviatio. 3 vols. folio.
Registrum Magni Sigilli Regum Scotorum, folio.
(Royal Charters of the Kings of Scotland.)
Acts of Parliament of Scotland, folio, Vol. II. to XI.
(The first volume is not yet published.)
Rotuli Scotiae. 2 vols. folio.

In reference to the above, the Corporation of the College, at their last meeting, passed the following resolves:

Resolved, That the grateful acknowledgments of this Board be presented by the President to the Record Commission in England, and, through them, to the British Government, for the munificent gift to the College of seventy-four folio volumes of the publications of the Record Commission; and for the liberality of feeling hereby manifested towards the interests of sound learning and thorough investigation in the literary institutions of our country.

Resolved, That the thanks of this Board be presented by the President to Mr. O. Rich, of London, for the generous regard which he has shewn for the interests of this College, by his influence and aid, in procuring and transmitting the valuable publications of the Record Commission of the British Government.

22. *Telescopes.*—In the number of this Journal for January, 1833, we noticed the successful efforts of Mr. Amasa Holcomb, of Southwick, Mass., in the manufacture of Telescopes. We have now the pleasure to add, that Mr. Holcomb has since that period prosecuted

his enterprize with great diligence and ingenuity, and has brought his instruments to a degree of perfection, which enables them to sustain a very honorable comparison with the large telescopes imported from abroad.

In conjunction with Professor Olmsted, we have recently had an opportunity of examining one of his large Reflectors. It is constructed after the manner of Herschel's great Telescope, with a single mirror, the image being thrown so near to one side of the open end of the tube, that the eye can be applied to it without intercepting any considerable portion of the light. By this arrangement, the light that is lost by a second reflexion, as in the Gregorian Telescope, is saved, and so much is added to the brightness of the image. The tube is of sheet iron; the focal length is 7 feet, and the aperture 6½ inches. The mounting is remarkably simple, consisting merely of two upright staves or supports, which meet in an angle at the open end of the tube, while the farther end may rest on a chair, or even on the ground. Its adjustments in altitude and azimuth, are effected by means of two thumb screws, attached to the staves near the top.

Although the two nights on which my colleague and myself examined the heavenly bodies with this instrument, were not the most suitable for observation, yet we were both very favorably impressed with the character of the instrument. We viewed the moon, then in quadrature, with different powers from 40 to 350. The mountain ridges and peaks, the deep craters, the elongated shadows, and the various other objccts exhibited to the best telescopes, were seen to great advantage. The double star ζ in Aquarius was distinctly divided; and, when in the center of the field, the two separate stars were well defined. We believe it, however, in the power of the artist to make farther improvements in the quality of his eye glasses, so as to embrace a larger field of view, with less of chromatic aberration, and also in the delicacy of his horizontal and vertical movements.

On the whole, we are of opinion that Mr. Holcomb has, under all the circumstances of the case, achieved wonders in this difficult department of the arts; and we cordially recommend his work to such of our public Institutions as may desire to purchase powerful telescopes.

Yale College, August 15, 1834.

The Committee on Science and the Arts, appointed by the Franklin Institute of the State of Pennsylvania for the promotion of the

Mechanic Arts, to whom was referred for examination a Reflecting Telescope, made by Mr. Amasa Holcomb, of Southwick, Hampden County, Massachusetts: Report—

That the following description of the instrument is given by Mr. Holcomb. "The telescope is of the reflecting kind, and has a focal length of six feet. The diameter of the speculum is three inches nine-tenths; the rays of light are reflected but once; the image formed in the focus of the speculum is viewed by a common astronomical eye piece, or by a single lens. It has also an eye piece for viewing land objects, which shows them erect. The telescope is of the same construction as those of Sir William Herschel; the observer having his back towards the object, and looking directly towards the speculum. It has the advantage over those of the Gregorian and Newtonian forms, by showing the object brighter with the same aperture, there being no light lost by a second reflection. The diameter of the speculum is small in proportion to the length of the instrument. It will bear a diameter of eight inches with much advantage, for viewing very small stars, in consequence of the great increase of light. The magnifying powers used are forty, ninety and two hundred and fifty."

Through the politeness of Prof. Alexander Dallas Bache, the committee were permitted to compare the performance of Mr. Holcomb's reflector with that of a five feet achromatic of four inches aperture, by Dollond, the property of the University of Pennsylvania. The instrument was also compared with a three and a half feet achromatic by Dollond, and with a Gregorian of four inches aperture, the mirrors of which had been lately repolished in London. The short stay of Mr. Holcomb in Philadelphia, prevented the comparison of it with reflectors in the possession of other members of the committee.

On the evening of the 14th of April, the committee met by adjournment in the open lot south of the Pennsylvania Hospital, the use of which was politely permitted to the committee by the managers of that institution. The following were the results of the comparison:—The moon, nearly full, was too bright to be viewed with the lower powers of the instruments; with the power of 350 in the five feet achromatic, the moon appeared bright and well defined;—with the same eye piece, giving a power of 400, in the reflector by Mr. Holcomb, the moon was sufficiently bright, and equally well defined. The same (with the exception that the moon was more brilliant, and the field of view much greater) was remarked with the use of Mr. Holcomb's highest magnifier, giving a power of two hundred and fifty.

As an illustration of their comparative performances, it was remarked that the waved appearance of the outer declivities of the craters of some of the apparently extinct lunar volcanoes, indicating the successive depositions of the lava, was more manifest with a power of 400 in the reflector.

The immersions of 3 and 4 Geminorum, of the sixth and seventh magnitude, were observed at the same instant of time in each.

The same occurred the evening before with a star of the eighth or ninth magnitude. The immersions, however of two very small stars, apparently of the tenth or eleventh magnitude, were observed with difficulty in the refractor, but could not be observed at all in the reflector.

The companion of Polaris was best seen when the moon was up, in the refractor, but in the absence of the moon was readily seen in both.

Castor was easily divided with the lower powers of either, but in the case of this as well as other binary, or double stars, the dark space between the stars was less disturbed by scattering rays in the reflector than in the refractor.

ε Bootis was seen double in each, but more distinctly in the reflector. μ Draconis, γ Leonis, and 4th and 5th ε Lyræ were seen distinctly double in both instruments; μ Draconis from the equality of the disks and softness of light presented the finest appearance.

γ Virginis, with a power of 350 in either telescope gave, no certain indication of being double: some of the members of the committee were of opinion, that it was slightly elongated. It was stated by the artist that his reflector would divide stars distant 3″ from each other.

Estimating the distance of the stars observed by the late observations of South, Struve, and Herschel, Junr., the committee were of opinion that his instrument is adequate to the distinct division of double stars distant from each other 2.5″.

The motion of this instrument plainly mounted was steady, and with the finder, even without rack work, objects were easily made to range with the centre or line of collimation of the instrument.

The position of the observers with the Herschelian telescope was natural and easy in contemplating objects having 70° or 80° of altitude, though quite constrained and inconvenient in using the achromatic.

The reflector gave a distinct view of land objects even when within one fourth of a mile: some light was lost by the position of the head, an inconvenience partially obviated by making the end nearest the object three inches greater in aperture.

The Gregorian, which was probably not a very fine instrument of its kind, bore no comparison in distinctness, or in quantity of light with the Herschelian telescope.

From these trials the committee are of opinion, that Mr. Holcomb has been entirely successful in the difficult art of polishing specula with the true curve, which gives to the object viewed all the distinctness of figure that is given them by the best refractors by Dollond.

In one respect, the largeness of the field of view, the reflectors by Mr. Holcomb have a decided advantage over achromatics and reflectors of different construction: the apparent diameter of the field of view in the Herschelian, being nearly double that of either, with equal freedom from aberration.

The quantity of light furnished by the refractor was greater with the same aperture; an important advantage in searching for, and observing, very minute objects. This deficiency of light, in the Herschelian, for viewing faint objects near the moon, or satellites near their primaries, the committee are of opinion may be removed by enlarging the aperture of the Herschelian reflector to five or five and a half inches.

The simplicity of the method of preparing and mounting Mr. Holcomb's telescope is worthy of notice, since on this plan the artist is enabled to furnish for an expense of one hundred dollars, with plain mounting, or of one hundred and fifty to two hundred dollars, with more expensive mounting, telescopes whose performance equals that of Gregorian and achromatics, hitherto imported into the country at an expense of five hundred dollars.

(A true copy by order of the committee,)

William Hamilton, *Actuary.*

Philadelphia, May 8th, 1834.

Extracted and Translated by J. Griscom.

23. *On Electromotors.*—The Abbé S. Dal Negro, Professor of Physics at Padua, having ascertained by multiplied experiments that the smallest plates of zinc produced the greatest *relative* effect,

endeavored to ascertain the cause of such result. He observed, to his surprise, that in five different cases, with various plates, the effects in all those which had the relation of 3 to 4, were equal. Almost despairing of being able to discover the cause of this, he happily remarked, that if from a square of 4 inches one square inch be taken off, a surface remains, which has precisely the same perimeter as the entire square. He remarked also, that a rectangle of 3 inches base by 1 in height has a perimeter equal to a square of 4 inches, and also that a rectangle of 6 inches by 2 has the same perimeter as a square of 4 inches in the side.

From this he drew the conclusion that zinc plates act in the ratio of their perimeters, and hence that the smallest plates have the greatest relative effect, because they have the greatest relative perimeters.

A plate of zinc of 4 sq. inches produced an effect represented by the number 9·26. For this plate was substituted another of the same zinc, having 16 inches base and 3 lines in width; and by this simple modification a force was obtained of 17·18.

A rectangular plate of zinc of 45 square inches gave 37·50. From this plate there was then cut out one half the surface, leaving a hollow square equal to the other half. This last gave a force of 35·10.

From out of a plate containing 94 sq. inches, a hollow square was cut 3 lines wide, 15½ long, and 6 high, having a total surface of 10½ sq. inches; this gave 32·25. The rest of the plate, equivalent to 83½ sq. inches, (8 times the surface,) gave only 43·50. A plate of 94 inches gave 46·20. From the interior of this, 55 inches (that is, 8 inches more than half) were removed, and the remaining hollow square gave 41·75.

These results fully demonstrate the great influence of contour in experiments of this nature.

Various experiments were made with zinc wire, with a view of increasing the effect, both by wrapping the wire round wooden frames, or placing it in a zig zag form, in copper cases, on Dr. Wollaston's plan. The results were very interesting, particularly in relation to the electro-negative metal.

An electro-motor constructed in this manner is extremely convenient and economical, since with a simple wire of zinc all the experiments of Ampère relative to electro-dynamic properties may be performed. To determine more fully the relation between perimeter and surface, hollow squares or frames of zinc were formed and covered (first) entirely with an isolating substance, viz. black pitch, melted with resin. When this was placed in a copper case, and plunged in acidulated water, no magnetic effect was produced. The exterior perimeter was then uncovered, and a magnetic force of 5.16 was acquired. The interior and exterior perimeters were then exposed, and the force became 10.83. When the whole surface was uncovered the force was 16.16.

With a larger frame the exterior perimeter gave 8, the two perimeters 13.60, the whole frame 21.40.

Having demonstrated this remarkable relation between the contour and the surface of the zinc portion of the battery, the author was urged by an earnest desire to ascertain whether the same kind of relation took place in the copper portion.

A plate of zinc of 14½ square inches of surface was placed within a double plate of copper, so that the latter covered the two surfaces of the zinc without touching them. This element, put into a glass vessel of acidulated water, gave a force of 28.20; 10¾ sq. in. of the zinc were then removed, leaving a frame of 3⅓ sq. in.; the force was 26.50. The copper was then cut in like manner, so as to leave the zinc frame only covered with copper; the force was 25.00.

A similar element, with a zinc plate of 9 sq. in., covered with a double plate of copper, gave 21.30. The zinc reduced to a frame of 3 lines in breadth, covered with a frame of copper of equal dimensions, produced a force of 29.30.

Another simple element of 4 sq. in. of zinc, with an equal plate of copper, gave 18.25. The plate of copper was cut into a frame so as to cover the two surfaces of the zinc, and the force rose to 21.87.

Thus assured by direct experiments that the law of perimeters held good in both the metals, the author constructed electromotors which not only developed magnetic but calorific effects superior to those of larger surface, but more circumscribed in the contour. But he also ascertained that the magnetic action does not follow the same progression as the calorific. The former increases or diminishes in proportion to the metallic perimeters, and the latter varies with the surface of the metals agreeably to some unknown law.

With respect to the electric action elicited by an electromotor of zinc and copper, it is manifest only when the circuit is interrupted. But if the circuit be completed by the spiral of the temporary magnet, this action becomes manifest, because the magnetic action then developes its greatest force, but the electric action is not manifest. When the circuit is broken, the magnetic action is disguised, and the electric action manifests itself by a lively spark, the force and sound of which are greater in proportion to the magnetic intensity at the closing of the circuit.

With an element formed of a small plate or wire of zinc, inserted in a canal of copper of any form, containing acidulated water, temporary magnets and strong electro-magnetic sparks may be procured, from which it may not be difficult to derive some advantage.

In fact, with an element composed of simple wires of zinc and copper, twisted into spirals, all the experiments may be made relative to attractions and repulsions, electro-dynamic currents, and temporary magnets.—*Abstracted from the Bib. Univ., Aout.* 1833.

24. *Influence of the Moon on the weather;*—substance of a paper read at the Natural History Society of Geneva, in October, 1833, by F. Marcet.—On the question whether the moon has any influence over the weather or not, there are two opposite opinions; the great mass of the people, including sailors, boatmen, and most practical farmers, entertain no doubt whatever of the influence of the moon; whether the change of weather at the lunar phases will be from fair to foul, or from foul to fair, none of them pretend to decide beforehand, but most of them think, that at the new and full moon, there is generally a change of some kind. On the other hand, philosophers, astronomers, and the learned in general, attribute this opinion altogether to popular prejudice. Finding no reason, in the nature of atmospheric tides, for believing that changes should take place on one day of the lunation rather than another, they consider the popular opinion to be unsupported by any extended series of correct observation.

In the *Annuaire* for 1833, Arago, the learned editor, has presented the result of the observations of Schubler, in Germany, during 28 years, or 348 synodic revolutions of the moon. During this period of 348 new moons, &c. the number of rainy days were as follows:—

It rained, on the day of		the new moon,	148	times.
Do.	do.	first quarter,	156	"
Do.	do.	full moon,	162	"
Do.	do.	last quarter,	130	"

The observations of Schubler were made, during 8 years, at Munich, 4 years at Stuttgard, and 16 years at Augsburg.

As a good meteorological register has been long kept at Geneva, the author thought it would be interesting to ascertain from the tables, (which have been carefully published in the Bibliotheque of that city,) whether, during a period of 34 years, viz. from 1800 to 1833, any inferences could be drawn for or against the popular opinion on the subject of lunar influence. He finds, during these 34 years, the number of rainy days and the quantity of water fallen to be as follows:—

	Rainy days.	Water fallen.
At the New moon, - -	123	432 lines.
First quarter, - -	122	429.6 "
Full moon, - -	132	415.7 "
Last quarter, - -	128	368.6 "
Throughout the whole period,	3,657	968 inches, 9.3 lines.

Thus it appears, that during 34 years, or 12,419 days, comprehending 420 synodic revolutions of the moon, there have been 3,657 rainy days. This gives, for every 100 days, 29.45 rainy days, and we find, that

For every 100 days of new moon, 29.29 have been rainy.
Do. do. first quarter, 29.05 do. do.
Do. do. full moon, 31.43 do. do.
Do. do. last quarter, 30.48 do. do.

Hence, it is evident, that during these 34 years at Geneva, the days of new moon and the days of the first quarter have been just about as liable to be rainy days as any other common day of the month, while the days of full moon and those of the last quarter have been *rather* more liable.

But although the days of full moon have been rather more frequently wet days than those of new moon, it does not follow that more water has fallen at full moon than at the change. The result of observation in that respect is as follows:—

For every 100 days of new moon, there fell 102.9 lines.
Do. do. first quarter, do. 102.3 "
Do. do. full moon, do. 90.0 "
Do. do. last quarter, do. 87.9 "

The average quantity for every 100 days is 93.6 lines, whence it appears, that at the new moon, the first quarter, and the full moon, more water has fallen than on common days; at the last quarter, less. The quantity fallen on the total of the lunar phases, surpasses that on other days in the proportion of 98 to 93.6.

Another question is, whether a *change of weather* is more liable to happen on the four principal days of the lunar phases than on common days. But it must first be decided what is meant by the term change of weather. This term should, the author thinks, be limited to a change from clear weather to rain, or from rain to clear weather, and not be understood to include, as some meteorologists make it, all changes, such as that from calm to windy, or from clear to cloudy, &c. As the author accepts it, the weather must have been steady during two days at least; that is, that the weather has been clear, or that it has rained more or less during two consecutive days. For example, a week has passed without rain; it rains on the eighth day, and on the ninth the weather is again fine. In this case, according to the author's definition, there is no change of weather. So, also, if it has rained during five successive days, the sixth and the seventh must be clear, in order to constitute a change of weather. This may be arbitrary, but at least it is not vague, and if practised it will prevent, in the balancing of calculations, any leaning to a favorite hypothesis. To avoid another error, into which some have fallen, the author marks no change as occurring on lunar phases but those which take place on the very day, and never those which may happen on the evening before or on the next day.

With these precautions he finds that during the 34 years or 12,419 days, there have been 1458 changes of weather. Of this number, 105 have taken place at the epoch of the two principal lunar phases, viz. 54 at the new moon, and 51 at the full moon. Now the whole number of principal phases during the 34 years is 840, therefore,

As 12419 : 840 : : 1458 : 98.6 the number of changes which would have taken place at new and full moon, had these lunar phases had no more than the share of common days, but instead of which, the number was 105.

Of the 54 changes at new moon, 32 were from rain to fine weather, and 22 from fine weather to rain. Of the 51 at full moon 31 were from rain to clear, and 20 from clear to rain. Thus at the new and full moon the changes to fine weather are to those to rain as 63 to 42.

Having thus proved that the epoch of new and full moon are not absolutely without some effect on the weather, the author examined whether this effect was confined to those very days, or extended to the day following. On the days following the new and full moon, there were 129 changes, instead of 98.6 which would have been the number, had these shared the proportion only of common days.

With respect to the days of the first and last quarter, the changes on these were 96, which bring them nearly to the condition of common days.

It is thus shewn from the tables, that the chance of a change at new and full moon, compared with the chance on ordinary days is as 125 to 117, and that the chance on the day following these two phases, compared with the common days is as 154 to 117.

Upon the whole therefore, this examination lends some support to the vulgar opinion of the influence of new and full moon, but none whatever to any especial influence of the first and third quarters.

With respect to *barometical pressure,* it is ascertained that out of the 1458 changes of weather there were in 1073 cases a corresponding rise or fall of the barometer, according as the change was from rain to fair, or the contrary. This is nearly as 3 to 4. Of the 385 false indications of the barometer 182 were on a change from rain to clear, and 203 on a change from clear to rain. Finally, of the 385 anomalies of the barometer, 17 were at full moon, and 10 only at new moon.—*Bib. Univ. Fev.* 1834.

25 *Artificial ultra-marine.*—M. Guimet in a letter to Gay Lussac dated Lyons, May 31, 1831, informs him that he had been for two years directing his attention to the improvement of the fabrication of this article, with a view especially of rendering it cheaper,—that experience had proved, that it might supersede with advantage and economy, not only the blue of cobalt in painting, but also the azure or colored glass (smalt ?) used in such enormous quantities in blueing paper, linen, calico, muslin, &c. and with which Germany supplies almost all Europe. As to painting he never had any doubt of the result; but with respect to paper painting, &c. he had despaired on account of the low price of cobalt, the best quality of which sells for 2 $\frac{75}{100}$ francs or 3 francs per pound, while the best quality of the ultra-marine, that which is refined for the use of painters is 60 francs, and that of the second quality is 20 francs per pound.

A trial however, of the ultra-marine having been made in paper staining, and found to answer extremely well, M. Guimet distributed 200 pounds of his article among the paper makers in the vicinity of Lyons at 20 francs a pound, it was proved that one pound of the ultra-marine, on account of its intensity and extreme division, went as far in coloring as ten pounds of the finest and most beautiful cobalt. In consequence of this remarkable success, the demand for the article became so great, as it was found to give to letter paper a finer and more uniform shade than cobalt, he had resolved to give great extension to his manufactory, and had purchased nine miles from Lyons a situation, where he was forming an establishment large enough to supply the article in quantity sufficient for the consumption of the country, and to reduce the price of it to 16 francs per pound.

Cobalt he thinks will eventually be confined to the vitrification and and coloring of porcelain. Ultra-marine is unchanged by caustic alkalies, and therefore very favorable to the dyer, and is used in paper staining, artificial flower work, and oil painting. Crape is perfectly dyed with it, and acquires a blue of extraordinary brilliancy and solidity.—*Annales de Chimie.*

26. *Magnesium, the metallic radical of Magnesia.*—The improved method of obtaining this metal, as practised by M. Bussy and improved by Just. Liebig, is to procure first chloride of magnesium by evaporating to dryness equal parts of hydrochlorate of magnesia and sal ammoniac, and projecting the mixtures in small portions into a red hot platina crucible, and continue the heat until all the sal ammoniac is evaporated and the chloride remains in quiet fusion.

A mass is thus obtained of chloride of Magnesium, white, transparent, and having much resemblance to pure mica.

Introduce from ten to twenty balls of potassium of the size of a pea, into the bottom of a perpendicular glass tube from three to four lines in diameter. Put the chloride of magnesium, in large pieces, upon the potsassium, heat it over coals till it begins to melt, then by inclining the tube, cause the potassium, which is now fluid, to flow through the chloride. The latter becomes reduced with the disengagement of light. The mass, when cold, is to be treated with water, and there collects, at the bottom of the vessel, a quantity of small metallic globules, as white as silver, very brillant and very hard. These may be forged and filed,—they are not changed by water, hot or cold.

This metal dissolves in dilute acetic acid with the disengagement of hydrogen, without leaving the least residuum. The solution contains, besides magnesia, no foreign metallic oxide. With nitric acid, at common temperatures, much nitrous gas is disengaged, and with sulphuric acid, sulphurous acid gas.

When heated in air or in oxygen, this metal burns with brilliancy at a temperature at which bottle glass softens. The interior of the vessel is coated with magnesia, and a black spot appears where the metal was, which, the author takes to be silicium, because it is not removed by boiling acids.

The metal does not unite with sulphur by fusion, but inflames in chlorine.

Its solution in sulphuric acid, gives by evaporation crystals of pure sulphate of magnesia. It is thus proved that magnesia contains a metal possessed of properties well worthy of attention.—*Annales de Chimie.*

27. *On crystalizable acetic acid; by C. Despretz.*—The method by which crystalizable acetic acid is made has been kept secret. After various trials, I obtained it in very fine crystals by heating a mixture in proper atomical proportions of acetate of lead, melted and dried, and boiled sulphuric acid, (203.4 parts of the former, and 61.4 parts of the latter.) All the manufacturing chemists that I have consulted, inform me that they procure their acid from a factory which has not made the process known.

Anhydrous acetates ought necessarily to produce the same result as acetate of lead.—*Ann. de Chimie, Fev.* 1830.

28. *On the separation of antimony from tin; by Gay Lussac.*—The alloy of the two metals being dissolved in hydrochloric (muriatic) acid, in excess, a plate of tin is dipt into the solution, and it becomes immediately covered with antimony in black powder. The precipitation is not complete in the cold, at least, a long time will be required for it; but by heating it in a vapor bath it will soon be completed, provided an excess of acid be kept up in the liquid. The antimony may be afterwards perfectly washed and dried on a water bath.—*Ann. de Chim. et de Phys.*

29. *Method of destroying the worms which attack fruit trees, by M. De Thosse.*—Unforeseen circumstances often lead to useful discoveries. One fact or discovery leads to another, and may form eventually a succession which constitutes the chain of our knowledge.

Agriculture is one of those pursuits in which theory should be combined with practice, and those who follow it ought to be duly sensible of the many things which, in its various branches, it is still desirable should be found out.

Among these desiderata are the means of removing from our fields, gardens, and orchards, that multitude of destructive insects which blast our hopes and the fruits of our labors.

I do not find in the various processes which have been published for banishing these hostile armies, the use of a substance which I have found to be a strong poison to all sorts of insects. I have employed it in certain cases,—its use may perhaps be much extended. The reasonableness of its price and the rapidity of its execution in the several cases in which I have used it, seem to claim for it the attention of Agriculturists.

This substance is the spirit of turpentine. I was led to try it by observing that certain plants which have naturally a strong odor, are not infected with insects. Such plants however cannot always be immediately obtained, nor is it common for them to emit so strong and penetrating an odor as spirits of turpentine.

Wishing some years ago to raise four young puppies, I perceived them, when a few days old to be very languishing, and discovered that they were full of insects or lice, which were preying upon them. It was vain that they were combed,—new generations succeeded, or were renewed from the mother, and the little animals were on the point of perishing. I then took it into my head to sponge both the mother and the pups with warm water impregnated with spirits of turpentine, and soon found to my agreeable surprise that every turn of the comb brought out numerous dead insects. The little animals soon acquired vigor, and were saved by a single repetition of the process during the course of the summer.

I tried the spirit on various insects. Lice when touched with it on the point of a pin, made a few rotary bounds and fell down dead. Bed bugs, anointed with the same fluid, after a few steps, turned on their backs and died. A green, gilded insect, as large as a bean, which attacks pear trees, was touched and died immediately, although another insect of the same kind, lived a long time in warm quick lime.

Butterflies, flies, caterpillars, May-bugs, die more or less promptly when attacked with it.

Having learnt these facts, I soon found occasion to try its effects on some of my trees, which were attacked by a multitude of worms. These I destroyed entirely by putting into a bowl a few handfuls of earth on which I poured a small quantity of the spirit—then adding water, and stirring the whole together until it had a proper consistence to be rubbed or brushed over the ends of the branches. The insects perish with their germs,—the odor remains several days about the tree and repels fresh invaders. A mixture of earth is necessary, because spirits of turpentine swims upon pure water and will not mix with it, and if used in too great quantities might burn the leaves.

The drought which occurred a few years ago in the canton in which I live, produced a mange in cattle and horses, very extensive and injurious, and those which escaped this infection were filled with lice, from which they were promptly relieved by sponging earth with water impregnated with the spirits. This infection caused horses, fatigued with labor to rub themselves so much against their mangers and the walls of the stables as to deprive them of much of the rest so necessary to their comfort.

I cannot therefore doubt, from the trials that have been made, that much benefit might result from the use of turpentine in clearing fields and trees from insects of different kinds, and that a mixture of ashes with which a portion of this liquid has been incorporated, would remove by its odor the ticks and other insects which infest turnips. Its odor is more penetrating in the open air than that of sulphur and some other materials used for this purpose.

It would perhaps be useful in destroying ants or driving them away from espaliers and other places. These insects are very fond of the slime or honey left by grubs, &c. on trees and plants attacked by them.

The essence now recommended is of so moderate a price and is used in so small a quantity as to be accessible to every body; and it is moreover an article that ought to be found in all farm and country houses, from its being so good a remedy for the wounds and accidents to which horses are liable, and for the feet and horns of cattle.—*Jour. des Conn. Usuelles.*

30. *A brilliant and useful varnish for articles of cast iron.*—Suspend the article by a bent wire and give it, with a brush, a thin coat of linseed oil, then hang it eight or ten inches above a wood fire so that the smoke and flame may frequently play around it. After being thus exposed over a good fire during a full hour, bring it down very near the burning coals, without touching them; after it has thus remained about fifteen minutes, dip it into cold spirits of turpentine.

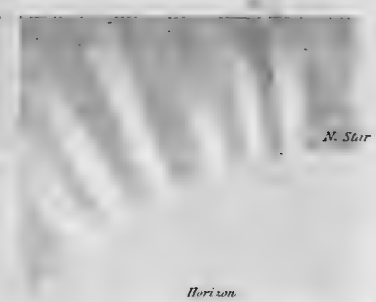
If this single operation does not give it sufficient brilliancy, it may be heated again over the coals and dipt a second time in the spirits. —*Idem.*

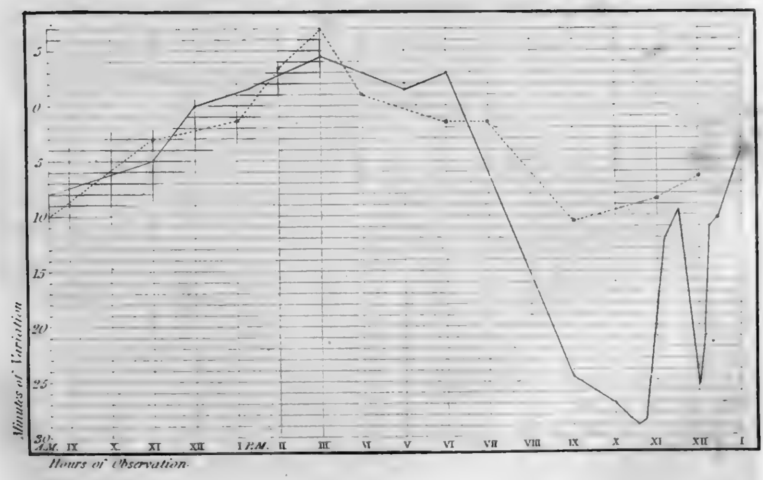
31. *Recipe for the beverage called imperial pop.*—Put into an earthen pot two pounds of sugar, two lemons cut into slices, and two ounces of cream of tartar. Add nine quarts of boiling water, mix the materials well, cover the vessel with a stout cloth and let it cool. When cold, spread two table spoons full of good yeast from beer on a thin slice of bread and put into the vessel, which must be covered as before, and left till the next day. It may then be filtered through a fine cloth, and bottled and corked tight in strong bottles. In the course of three or four days the fermentation will be nearly complete, and the liquor may be drunk.—*Jour. Con. Us.*

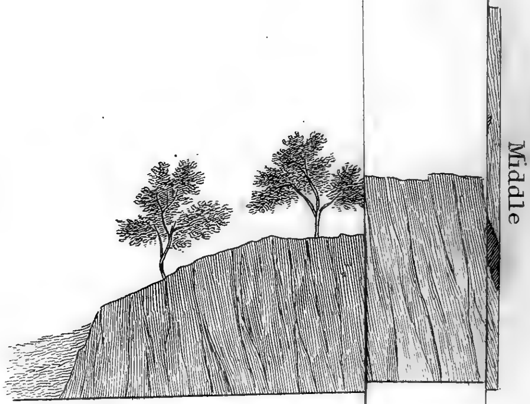
32. *Heat by phosphorus and iodine.*—Prof. Cesar Gazzaniga has proved that the combustion produced by the contact of these two substances is not prevented by a very great reduction of temperature of the materials before contact. This is manifest by placing the phosphorus and iodine on a thin glass and putting this in a freezing mixture, and as soon as they have acquired the temperature, incorporating them by mixture, when inflammation always take place, although the temperature may be 24° R. below zero. With two grains of phosphorus and three of iodine, the flame continued nearly fifteen minutes.—*Bib. Univ.*

Treatise on Mineralogy, by Charles U. Shepard, Lecturer on Natural History in Yale College.—The second and concluding part of this work, embracing general descriptions of the species arranged alphabetically, together with tabular views of a natural history, and of a chemical arrangement of the species, is now in press, and will shortly be published by Hezekiah Howe & Co.

Transactions of the Albany Institute, No. 1. Vol. II. has just been received and contains the following articles:—1. Abstract of Meteorological observations made at Albany, and calculations tending to establish its mean temperature, by Dr. T. R. Beck.—2. Observations on the Solar Eclipse of July, 1832, and the longitude of Albany, by Stephen Alexander, A. M.—3. Annual address before the Institute, by A. Dean, A. M.—4. Description of a new crustaceous animal found on the shores of the New South Shetland Islands, by Dr. T. Eights.—5. On the Functions of the Moon, from observations on the Solar Eclipse of June 16, 1806, by Simeon DeWitt.—6. Astronomical Observations made at Berlin, Worcester Co., Md. Feb. 1831, by S. Alexander, A. M.


N. Star
Horizon


Minutes of Variation
Hours of Observation
A.M. IX X XI XII I P.M. II III IV V VI VII VIII IX X XI XII I
5
0
5
10
15
20
25
30



South end

Wm. Duesbury.

wing t

THE

AMERICAN

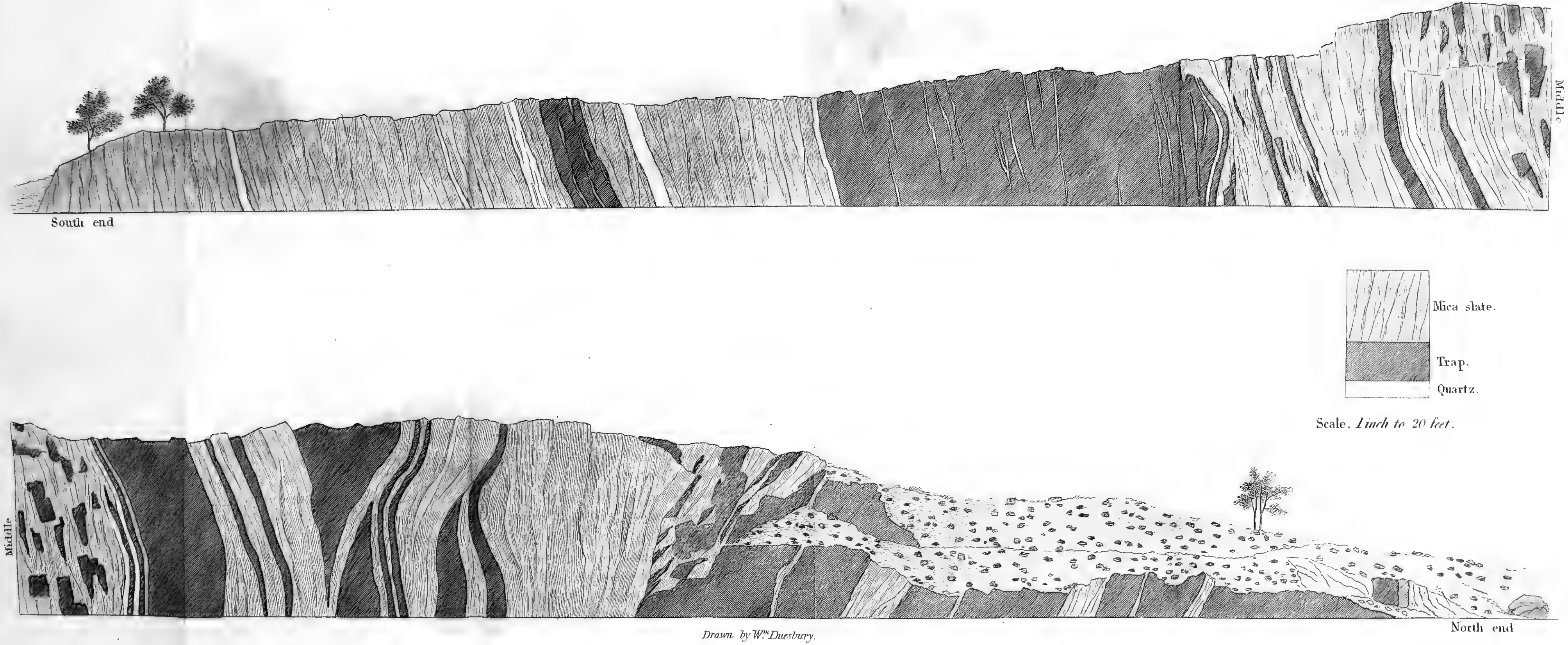
JOURNAL OF SCIENCE, &c.

ART. I.—*Historical Notice of the Life and Writings of M. Desfontaines;* by A. P. DeCandolle, Professor of Natural History in the Academy of Geneva.

Translated from the Bib. Univ., by J. Griscom.

Biographical notices, designed to remind us of the services which the inventions and labors of learned men have bestowed upon science, become materials of literary history, and in this relation they already present much historical interest; but they assume a far more dignified character when they exhibit to us also the union of the most engaging virtues of private life,—of goodness and modesty the most perfect,—with distinguished talents. They then furnish examples of practical morality, and possess, above all fictitious narratives, designed to improve mankind, the immense advantage of truth. Such is the predicament in which I stand in speaking of M. Desfontaines one of the most excellent of men, and at the same time one of the most distinguished savans of the present epoch. I fear not to advance this opinion; I have owed him many obligations; I have devoted to him the most sincere and profound attachments. I shall however endeavor to avoid all exaggeration; I shall not forget that I have assumed the character of an historian, but shall strive to exhibit him in all the features of simple truth. If the most severe impartiality, and the strictest verity are found to constitute an eulogy, it will surely not be required of me that I should disguise them.

Rene' Louiche Desfontaines was born in Britanny, at the village of Tremblay, (department of Ille-et-Vilaine) a place already named in the records of science, as the country of the anatomist Bertin. The exact period of his birth and of course the precise age to which he attained, has not been determined with certainty, as the registers of the commune of Tremblay were destroyed during the storms of



SECTION through MICA SLATE at LOWELL, shewing the intrusions of TRAP and GRANITE.

the revolution, he judged it to be at the close of the year 1751 or beginning of 1752. His father, whose fortune was very moderate, was desirous of giving him the advantages of as good an education as could be procured at a distance from the large towns, and accordingly placed him at a boarding school in his native village. Here he was taught a little Latin, but the master, with a view to form his morals, adopted a very rough and rigid treatment, which, although it may succeed with certain dispositions, almost always revolts those whose native energy gives them some superiority. Reprimand and correction applied for the slightest infractions of duty, and the frequent and repeated assertion that he was good for nothing at all, disgusted the young Desfontaines, and almost persuaded him that he had no capacity. In this state of discouragement he was one day threatened with severe punishment for having taken a few apples from an orchard; a fault from which few children perhaps are exempt. Wishing to avoid this punishment, he escaped through a window and fled for refuge to his father's house. Great was the embarrassment of the family! what shall we do said they with this naughty fellow, who resisits every chastisement and is good for nothing. His father, prejudiced by the evil reports of the master, and believing that his son was not likely to succeed in his studies, resolved to send him to sea as a cabin-boy. It is not known what were the circumstances which diverted him from this project, the execution of which might have deprived Science of one of her honored sons. I am induced to believe that maternal influence had a principal share in changing his destination. A further trial in the way of a literary education was decided on, and the little robber of orchards was sent to the College of Rennes.

The young scholar was still under his first impressions: disliking study in consequence of the rough manner in which he had been initiated, and persuaded that he never should succeed in the career of intellect, he entered upon his duties with great indifference. Nothing equalled his astonishment when, on the occasion of one of his first compositions, he heard his name called among the three or four highest boys of his class. This worked a complete revolution in his mind. He began to think that his first master might have been mistaken, and he was not perhaps sorry at the prospect of proving him to be so. If there are children whose self confidence requires to be repressed, there are others, and among them not always the most *mediocre* whose courage must be sustained, and to whom a first evidence of success is a sure pledge of the future. The young Desfontaines from that time pursued a course of stubborn assiduity; his efforts were successful, and at the end of the year he obtained several prizes. In announcing his success to his father, he begged him to communicate the fact to his old master and to remind him of his prediction that he *could never do any thing.* He persisted in this sort of vengeance, on every occasion of fresh success, and certainly it was a species of malice that was very often repeated. It was only until after his election to the Academy of Sciences, that he thought his revenge sufficient, and that he ceased his malign communications. Those who were acquainted with the mildness and habitual modesty of Desfontaines will find it difficult to recognize these qualities in this trait of his youth; but he had been deeply wounded, and even in a heart as good and affectionate as his, there may be found, from time to time, a feeling of vivacity and something of a Bretonnic Spirit.

At the termination of his studies at Rennes, Desfontaines came to Paris to study medicine; but in the pursuit of his medical studies he felt himself drawn by the impulse of a decided taste towards Botany, and it was unquestionably this impulse, which, by diverting him from the practice, retarded his admission to the Doctorate. This did not take place until 1782, at which time he was about thirty years of age. During his medical studies he had occasion to connect himself with Lemonnier, first physician to the king and professor of Botany in the garden of plants. Lemonnier, without attaining the highest ranks of science, contributed much to its progress in France, by the influence which his situation gave him over the most eminent statesmen, and the honorable use which he made of it in the encouragement of young naturalists. Commerson, Michaux, Labillardiere, Desfontaines, were indebted to his protection for a portion of their success.* Alas! it was almost at the same moment

---

* J. J. Houton de Labillardiere, member of the Academy of Sciences, born at Alençon in 1775, died at Paris the 8th of January, 1834, fifty three days after his most intimate friend Desfontaines. He had made a journey in Syria under the protection of Lemonnier and was afterwards in the expedition of D'Entrecasteaux in search of La Peyrouse. He published five Decades of the plants of Syria, the narrative of his voyage round the world, two volumes of the plants of New Holland, one on those of New Caledonia, and some memoirs. I could not advert to him without rendering homage to his memory and to the services he has rendered to science.

that the two latter of these protegées of Lemonnier finished their career, and the history of learning alone remains to testify to this beneficence.

Desfontaines was the favorite pupil, and soon become the intimate friend of Lemonnier; their dispositions simple and amiable, both devoted to the love of Science and truth, created between them a powerful tie, notwithstanding the difference of their ages: it was through this connexion that Desfontaines enjoyed such intimate relations with Malesherbes, Duhamel, Denainvilliers, Fougeroux, &c. all of whom brought to the study of the natural sciences, the mildness and modesty of their manners; he received also encouragement and assistance from Ant. Laur. de Jussieu, who, several years, older than himself had just succeeded his uncle Bernard in the professorship of the King's Garden.

Thus situated in the midst of the most distinguished Botanists of the age, Desfontaines was able to conciliate their esteem and affection. In 1783 he was chosen a member of the Academy of Science. This title which he has since rendered so illustrious, was at that time bestowed upon him for labors which his own modesty, judged unworthy of it;—his memoirs on Tithonia and Aïlanthus, and that on the irritability of the sexual organs, which have since been published, are the best of those which he presented on that occasion. His election however was far from being a favor; he was evidently the most skillful botanist of the day, but he had devoted all his time to the study of plants, and very little to the publication of his works.

Faithful to this method, scarcely had he entered the Academy, when instead of making it a pretext for repose, he sought out the means of rendering himself more useful to science. He obtained the funds necessary for a botanical voyage, and encouraged by his countryman De Kercy, then consul at Algiers, he determined on exploring the coast of Barbary, from the frontiers of Tripoli to those of Morocco, namely, the countries of Algiers and Tunis;—these regions, notwithstanding their proximity, were in fact, but little known. Dr. Shaw was the only naturalist who had visited them and botany constituted but a subordinate portion of his researches. This project was agreed to by the Academy, and Desfontaines set out from Marseilles for Tunis on the 6th of August, 1783. He remained two years in the Regency of Tunis and Algiers, visited them in all their extent from the sea shore to the summits of Atlas and even that zone so privileged by climate and vegetation which lies on the south of Atlas and extends to the desert of Sahara; his researches in these two regencies were facilitated by the protection of the French Consul and by the kind disposition, with which our traveller was successful in inspiring the Deys. He had permission to accompany them in their annual excursions for the collection of taxes, and was thus enabled to visit in safety provinces which strangers cannot penetrate without great danger: he herborized every day, accompanied by an escort, or at least by a Grand Turk, who armed with a musket, defended him from the attacks of the Moors. Although he found the utility of this protection, it was often at his own expense, and I have more than once been gratified in hearing him relate with an unaffected sentiment of horror, the fear which he constantly felt, that the least impoliteness in a Moor might be punished by a shot from this vigilant guard, as a simple proof of his devotedness to his service. But if the brutality of these subaltern agents inspired him with real horror, he often testified the admiration which he had felt at the sagacity and impartiality, with which the ignorant and barbarous princes of these regencies rendered justice to their subjects by processes, which, it is true, are somewhat rude, awarding damages to him who was justly entitled to them and the bastinado to him who had been extortionate under the guise of Justice.

During the two years of his stay in Barbary, Desfontaines relaxed nothing in his efforts to travel over and to study the country in all directions. As strong and vigorous as a hunter, of temperate habits, active in the pursuit of objects which possessed any interest, he did in a manner, exhaust the botany of that country so that during the half century, nearly, since he left it, scarcely a single species has been known to have escaped his penetrating eye. He also devoted much attention to its zoology. The beautiful collections of insects, deposited by him in the museum, furnished Fabricius and Latreille with various new objects,—and he described himself in a special memoir published in 1787, several new species of birds observed on the Barbary Coast. His acquaintance with the writings of antiquity, qualified him to collect very judiciously, many documents on the ancient geography and antique monuments of the country. His memoir on the Lotus of Lybia, which nourished the Lotophagi,—that upon the sweet acorn oak, which grows on Mount Atlas, and which has given rise to the idea, that our ancestors fed on acorns, and that upon the economical uses of the date tree,—are proofs of his classical knowledge, and the sound criticism with which he employed it.

During his sojourn in Barbary, he met with two botanists who were also exploring the country, and with whom he formed a friendly connexion which continued till death.—These were Martin Vahl, afterwards professor at Copenhagen, and who acquired celebrity by the exactness of his botanical details, and M. Poiret, who published his travels in Barbary, and then devoted his time to the completion of the botanical part of the Encyclopédie Méthodique. Friendships of this nature, formed at a distance from ones natal soil, and under circumstances connected with the remembrance of danger and fatigue, leave we know full well, more profound impressions than those which spring up in the easy life of refinement and civilization,—often has this reflection been forced upon me in hearing these old men relate with the utmost animation and vivacity, the reminiscences of this active period of their lives.

On his return to Paris in 1785, Desfontaines found Lemonnier still animated with the same sentiments of kindness towards him. He was for a short time drawn into the project of joining the noble but unfortunate expedition of La Peyrouse round the world. A beneficent illness preserved him from this danger. His protector was then desirous of settling him in life, and of yielding to him his place of professor of Botany in the Jardin du Roi. This establishment was then under the direction of the illustrious Buffon, whose superior talents, as is well known, were combined with an imperious and resolute temper, and who moreover had had several court quarrels with the first physician. In him was the right of nominating to the professorships, on which account Lemonnier was afraid to resign, lest some other than his friend should be put into the chair. He endeavored to sift the opinion of Buffon, in case of his resignation, but the most intimate friendship could get no other answer than "let Lemonnier resign and then I will exercise the right invested in me." After hesitating a long time, L'Héritier, thinking that he perceived the intention of Buffon, induced Lemonnier to send an unconditional resignation. This was accepted by Buffon, who diverted himself by suffering his decision to remain in suspense during two whole days;—he then, in a very gracious manner, nominated Desfontaines, as if he wished it to be understood that it was done on his own account, and not on that of his patron.

He was thus, in 1786, placed in a situation the most conformable to his wishes and his taste. Fresh marks of the esteem of the learned and of the government poured in upon him. He was called among the first to the formation of the Institute, and was frequently elected by his colleagues, either to the presidency of the Academy of Sciences or to the direction of the administration of the Museum of Natural History, when that administration was confined to the body of Professors. He was named, at its origin, a member of the legion of honor, and at the organization of the faculty of the sciences he was included as professor of botany. These distinctions, the more flattering as they were never sought for by him, could scarcely fail to render his situation more agreeable; but his chief pleasure, was in finding himself established as a professor in the modest dwelling, whence his labors have diffused so much light and information.

The cares and duties which resulted from his new situation, diverted him to some extent from the preparation of his travels in Barbary. The King, Louis XVI, who had taken an interest in this expedition, from the statements given him, by his first physician, testified the wish to be more fully acquainted with it; and Lemonnier requested his friend to trust him with his papers, that he might read them to the King. Unfortunately these papers had been dispersed, and as no regular copy of them has been preserved, every thing relating to the journey, except the collections themselves, was almost wholly lost. A few fragments only remained with Desfontaines, of which by chance he had taken copies, in addition to a very incomplete account of the first part of the journey published by the astronomer, La Lande, in the Journal des Savans, August, 1784. This incident discouraged Desfontaines from any publication of the history of his journey. It was only at the close of his life and when the expedition to Algiers attracted renewed attention to that country that he gave up his manuscripts, at the earnest request of M. Walkenaer. Seven of these fragments were printed in 1830 in the Nouvelles Annales des Voyages (Vol. xv and xvii) but their author had no part in the publication of them, and often regretted to see them in print in the negligent style in which they were hastily written, and often disfigured by typographical errors. As they are, however, they furnish an interesting view of the manner in which he had examined the country, and occasion much regret at the loss of the rest.

This loss having rendered all labor unavailing, with respect to a digested history of his journey, Desfontaines determined to devote himself entirely to botany. He revised with scrupulous zeal the nomenclature of the plants of the garden, and arranged the materials of his botanical course. In following the path of his predecessors, he improved it, especially in relation to the generalities of vegetable physiology, in which he pursued the method of Duhamel. His manner of lecturing was simple, clear, unostentatious, without efforts, and was relished to the very last by the pupils, who pressed in crowds to his room. Extracts from his course have been inserted in the *Decade Philosophique* and republished in the Annales d'Ustéri. While they exhibit his views of the science, they testify to the clearness and elegance of his style.

It was at that epoch of his life when occupied with the plants of Barbary, he presented to the Academy and published, either in its memoirs, in the Journal of Fourcroy, or in the Acts of the Society of Natural History, various descriptive memoirs. But the revolution had reached the sanguinary period of its history, and if, in certain respects, by disgusting men of science, it turned them more earnestly to study, it deprived them also of the freedom of spirit, and often of the means of publishing their labors. Desfontaines spent this gloomy period within the recesses of the garden which he had the charge of, and in writing a description of his African Herbarium. A stranger to all party spirit, but alive to the feelings of friendship, and to merit in misfortune, he left his retreat only when he could do good. In a few instances, he displayed great courage and was successful in rescuing L'Héritier from impending destruction.

As soon as tranquility was restored and the Institute was again opened, Desfontaines reappeared upon the scene with a work of high order. His sojourn in Barbary, by affording an opportunity of seeing many date trees, had called his attention to the structure and vegetation of the palms. He had written a few notes on this subject to Danbenton, who made use of them in his memoir on the organization of wood, and presented in 1790, some ideas to the Academy on that subject. Later reflexions, and the comparison of a great many trunks of trees, extended his ideas, and showed him the intimate connexion which subsists between the structure of stems and that of the seminal organs, which had been exclusively made the basis of natural classification. He presented to the Institute in 1796, a Memoir on the organization of the Monocotyledons, which was received with acclamation by all Botanists and which placed its author in the first rank of Savans. This memoir shews the immense difference which exists in the structure and mode of growth of the two great classes of phanerogamous plants, one of which has conical stems provided with bark, increasing by the addition of fresh layers to the exterior of the ligneous body,—and the others a cylindrical stem, without real bark and increasing by the developement of fibres, the youngest of which are in the center and the oldest on the outside. This memoir confirmed the distinction of plants by these most important characteristics, opened a new career to anatomists and classifiers, and has not ceased, during forty years, to constitute the basis of the principal labors of Botanists, the key of the natural method and of vegetable organography. The scientific Journals were eager to republish this beautiful production, and the Academies to include the author in the rank of their members. He however, astonished as it were at his own triumph, seemed to fear that he might have occasioned too great a revolution in science; he stopped in this brilliant career and left to others the care of developing all the consequences of his discovery; this is a remarkable instance in the history of science, proving that to the possession of talents so superior as to lead to the discovery of great and important truths there must be superinduced a certain boldness of character in order to deduce from it, its legitimate results.

After his return from Barbary, Desfontaines did not cease to study to describe, and to draw the plants which he had collected. He decided on publishing this great work, and in 1798 appeared the first numbers of his Atlantic flora. This work was an epoch in descriptive botany and still remains among the most classic and valued books. The very few deficiences which even a rigorous critic can discover in it, (and I have known none more so than was the author himself with respect to his own work) attach to the period in which he travelled and to the circumstances which ensued. Thus he regretted having been so sparing in his details with respect to the geographical distribution of the plants of Barbary,—but these views were entertained by nobody in 1784 and the loss of his manuscripts had deprived him of numerous documents. He regretted also that he had neglected to observe some farther details relative to the fruits and seeds of plants; but six years prior to Gærtner no one thought of the importance which those characters have since acquired. If contrasted with those slight defects which a rigorous impartiality induces me to state, (a feeling which the author would command me to exercise were he now by my side as he always is in my heart) we reflect on the precision which distinguishes the descriptions and the nomenclature of the Atlantic flora, on the sagacity with which the ancient synonymy is there cleared up, and on the number of new objects which he brings to light, we shall not be surprised at the high estimation in which botanists have held this work. It has become the basis for the study of the plants throughout the whole valley of the Mediterranean, and its comparison with the south of Europe has elicited many a new idea on the general distribution of plants.

May I be permitted to interrupt my narrative for a moment to state, that it was at the time when Desfontaines was putting a finishing hand to this work that I had the happiness of being admitted to an intimate acquaintance with him. He allowed me to work, with him, furnished me with all the means of research, which I had till then been deprived of, and instructed me by his advice and example in the art of observing plants and of eliciting truth from the contradictory assertions of botanists. From that time he manifested towards me the sentiments of a tender and enlightened father. It is a period which is engraved on my heart in characters of profound gratitude, and if I may thus style myself in speaking of my master, the perfect kindness with which he received young botanists, is not one of the least honorable traits of his character. Most of those who have figured in the science since the commencement of the present century may make the same acknowledgment. Two of them, afterwards his colleagues, have testified their gratitude in discourses pronounced over his tomb;—but let me turn from this moving perspective and resume the series of his labors.

As soon as he had completed his Atlantic flora, he entered again with the ardor of a neophyte upon the care of the garden of plants for which he felt an attachment almost like that of a man for his native country. He attended vigorously to the administration of it, and was busily occupied in determining with precision the nomenclature of the plants. From this time and until extreme old age, he labored in the botanical school, bringing his books and his herbarium to facilitate the denomination of the species, and to oppose errors, perpetually springing up, from seeds improperly labelled, or from the transposition of plants which are consantly taking place in large gardens. Neither the ardor of the sun nor the vigor of the season arrested his zeal in this ungrateful labor, from which no other honor could result than that of a conscientious discharge of duty, and this, it is well known, is a labor not always the most highly appreciated by the world. By these efforts he gradually prepared the three editions of the catalogues of the garden, which he published in 1804, 1815, and 1829. The establishment of the Annals of the Museum afforded him an opportunity of making known a certain number of new or obscurely known plants which had flourished in the garden; it was from 1802 to 1807 especially that he pursued this object by which science was enriched with various interesting particulars. In 1807 and 1808 he was engaged in an analogous labor by inserting first in the Annals, and then collecting into a volume, the beautiful plates that Aubriel had made of oriental plants when he accompanied Tournefort, and by adding descriptions derived mostly from the herbal of this illustrious botanist. This publication was a real homage to the memory of Tournefort, for whom Desfontaines had a high admiration, and this work, received with gratitude by botanists, has, in reality served to establish in the records of the science, a multitude of objects discovered by Tournefort, and which the moderns had forgotten or misunderstood.

The labor of Desfontaines on the plants of India, suggested to him for a moment, the idea of publishing for the benefit of students, a work containing an abridged description of all the plants there cultivated. He did me the honor to assign to me a small part of this duty, and during two or three years, we described, for this purpose, a great number of plants on a uniform plan; but the immensity of the labor, and the continual renewal of species in the garden, rendered this enterprise at length repulsive. He confined his attention to the resumption of some former engagements on trees, commenced during his connection with Lemonnier and Malesherbes. Animated with a desire of connecting botany with agriculture, he prepared and published in 1809, his history of trees and shrubs, which may be cultivated in open ground on the soil of France.

This work was not destined to extend the limits of science, but to render it practical and popular. It contains a clear, elegant and exact statement of what is known of the history of trees,—a link between the theory of systematic botany, the practice of horticulture and the art of the forester. The author was aided in some parts of this work, as he had also been in the cares of the garden and plants of the museum, by M. de Leuze, an enlightened and literary botanist of good taste, to whom he had been several years attached, and who had ever manifested towards him the most devoted affection.

These valuable works being completed, Desfontaines began to feel a void. He had never acquired any relish for worldly pleasures. At the period of the revolution, he lived in a very retired manner, devoted only to the few intimate friends around him. He spent every evening at the house of his colleague Thouin, or in the company of a few select and intelligent acquaintances.

The learned professor of the museum, had, like a true patriarch, adhered to the manners and to the habitation of his father, who was the gardener of the establishment. It was in the modest kitchen, and around the hearth, where his frugal meals were cooked, that were assembled every evening, the academicians Thouin and Desfontaines, whose science and intelligence served as guides to the company, along with Van Spaendonk, who loved to relate anecdotes of the old Courts, and the geologist Faujas Saint-Fonde, whose conversation, volcanic, like the subject of his studies, animated the whole company, and the gardener of the museum, John Thouin, who by his wit and raillery, tempered the gravity of the Deans, and lastly one of the five Directors of France, La Reveillère-Lépeaux, who slipped away from the gilded canopies of the Luxemburg, to talk upon science, and make diversion of the cares of government.

The picture of these meetings, (which I occasionally although rarely attended,) can never be effaced from my remembrance, replete as they were with the most agreeable excitements. The meetings were by degrees broken up by the death of several of its members. Several of the most intimate friends of Desfontaines were removed from him either by absence or by death. A sister whom he tenderly loved, frequently came from her village in Brittany to bestow upon him her cares and affection, but could not remain long away from her domestic engagements. Thus situated, he perceived the estrangements which threatened him, and having met with a young female, without fortune, it is true, but of an open and agreeable disposition, he chose her for the companion of his life and married her at the age of 63. This connexion commenced under happy auspices and his letters often spoke of the happiness which he enjoyed; he became the father of a daughter who was afterwards the source of his greatest comfort. His wife, in consequence of a second and most unfavorable accouchement was attacked by that cruel malady which, while it respects life and its physical faculties, takes away all that appertains to the heart and understanding. Desfontaines, obliged, even from a regard to his wife, to separate himself from her, was plunged into a state of solitude so much the more painful as it was contrasted with six years of previous enjoyment; but he was a father and the infantine caresses of his little Mary, afforded him the sweetest of his consolations.

But he endeavored also to divert himself with the most determined labor: he had commenced some time before, an arrangement of the herbals of the museum. He resumed this labor with renewed zeal. A task so long and difficult was facilitated by an astonishing memory, with respect both to forms and beings and even to names; he rarely lost the recollection of a plant, or even of a print of it, which he had once seen, but it must also be acknowledged that this prodigious memory was sometimes a snare, in preventing him from noting his observations, and from pursuing more method in his researches. He has often warned me of this danger, and I now transmit it in his name to young botanists, who may, like him, be endowed with this happy faculty. Whenever, in revising these collections, he met with a new genus, he published a drawing and description of it in the memoirs of the museum, and thus from 1815 to 1822 he enriched science with seventeen remarkable genera,* which formed the subject of as many memoirs which have all been sanctioned by the suffrages of botanists. He published also, about the same time, various new observations on plants before known, such as the genera *Leucas*, *Amaivua*, *Copaïfera*, *&c.* He redoubled his zeal also in preparing such reports, as the Academy were pleased to charge him with, from the great confidence which they had in his intelligence and impartiality.

This extraordinary activity, so laudable even in young men, Desfontaines preserved at the age of between seventy and eighty, an age when the most laborious men seek only for repose. But his faculties began at length to yield;—his sight formerly so penetrating, gradually became dim, and when near 80, he was threatened with total blindness. He even endeavored, in this situation, to continue his observations, and I shall insert in a note, an extract from a letter he wrote me on the 11th of Oct. 1831, in which he mentions an observation on the fecundation of plants, which, although not very new is nevertheless interesting. His friend endeavored to cheer him with

---

* *Pogostemon, Chardinia, Ricinocarpos, Gymnarhena, Ancylanthos, Heterodendron, Mezoneuron, Heterostemon, Ledocarpon, Micanthea, Diplophractum, Stylobasium, Chamælancium, Polyphragmon, Asteranthos, Gyrostemon, Condylocarpon.*

the hope that an operation for cataract might one day restore him to sight;—he sometimes yielded to this hope; but again, remembering that the same illusion had been held up to his colleague Lamarck, he smiled at his own credulity. He still preserved however his mild and benevolent cheerfulness of temper and clearness of intellect,—he loved to converse on botany and to point out observations which he thought ought to be made; he was led into the conservatories, and was gratified in distinguishing the plants by feeling. He dictated useful notes relative to the Colonization of Algiers, a subject on which he was often consulted by the government.

In the mean time a violent catarrh, to which he was periodically subject, began to manifest itself with a force which his constitution seemed inadequate to resist. In anticipating the event one subject alone rendered him unhappy. He was leaving his daughter, still young, without protection in life. Happily, his nephew, to whom he had acted the part of a father, and who then held a station among the most distinguished civil engineers of the government, had been cherishing, for a long time, the desire of being united to his cousin. Informed of this desire, Desfontaines had the satisfaction, on his death bed, to join the two individuals whom he loved the most,—he gave a protector to his daughter, who still preserved the name which had received so much honor from the father. He also learned that the government had taken care to provide after his demise for the support of his wife. Thus encouraged with respect to those the most dear to him, he awaited death, in the midst, indeed of great bodily suffering, but with a serenity, a calmness, and brightness of mind which cannot be surpassed. His goodness had assumed a more touching character, and at his bed side, one of those who was then bestowing upon him his final and most attentive cares, (A. de Jussieu) wrote me *I have learned to love him still more.* He recalled to memory all the classic lines that were applicable to his situation; he recollected the slightest wrongs that he thought he had committed, in order to express his regrets; he testified his friendship for his friends who were present, and sent tender messages to those who were absent. He yielded his last breath the 16th of November, 1833, aged about 81 years.

His death spread a general grief throughout the Museum of Natural History, all of whose inhabitants had been long devoted to him by sentiments of attachment and veneration. Just and feeling testimonials were borne to him at the grave, by his colleagues. His place has been, agreeably to his wishes, bestowed upon a young botanist of the highest hope (Adolphe Brongniart) who had been selected by him to perform his duties during his blindness. He left his classical herbarium of Barbary to the Museum, and his general herbarium has passed into the hands of a Botanist, (M. Webb) who will doubtless turn it to a useful account.

I am aware that in thus retracing the life and labors of my excellent master, I have taught nothing to the botanists who have studied them; that I have added nothing to the eloquent written accounts by which Mirbel and De Jussieu have rendered homage to his character; but, I have discharged a debt of my own heart, a duty of gratitude, a last tribute of friendship.

Extract from a letter of M. Desfontaines, dated 11*th of October*, 1831.

The following is the result of an experiment that I made this year in my little garden, and which may be added to those of Linnæus and others on fecundation.

I raised, in the course of June, a stalk of *cucurbita pepo*, which put out branches in different directions. All the male flowers were successively and carefully removed before they were unfolded, about forty female flowers opened with their stigmates and ovaries well conformed. I procured two male flowers of *cucurbita pepo* from a very distant plat of my garden, and shook the pollen of one of them over the stigmates of one of the female flowers, and placed the bundle of stamens of the other male flower, in a second female flower. Both of these flowers produced firuit. That of the first is very large and is now near its maturity; that of the second, (in which the bundle of stamens was placed) attained the size of a common melon and then rotted; but it was well formed. All the other female flowers of my gourd entirely perished. I have several witnesses of these facts and among others M. Mirbel. I am nevertheless far from believing that there are no plants which can produce seeds without the concurrence of stamens. This may do for a blind man. *Vale, et iterum vale, amice.* (Signed,) DESFONTAINES.

Art. II.—*Dissection of the Eye of the Streaked Bass,* Perca Nobilis vel Mitchelli, *with Observations on the accommodation of the Eye to Distances;* by W. C. Wallace, M. D., Surgeon to the New York Institution for the Blind.

The eye is of an irregular form. It is directed outwards and a little forwards and upwards. It is attached to a cartilage that surrounds the anterior part of the orbit by a conjunctiva that forms a fold before it is reflected. The sclerotica is strengthened at each canthus by a firm piece of cartilage; behind, it is perforated for the passage of the optic nerve; before, the cornea which is oval is connected in the usual way.

Beneath the sclerotica is a layer of fat, nearly half the diameter of the eye in thickness at its posterior part, but it becomes thinner as it approaches the cornea where it disappears. Is this fat for retaining the retina at a proper temperature for receiving impressions?

Imbedded in the fat and covered by a membrane of a tarnished silver color which also surrounds the choroid is the red colored spongy substance of the shape of a horse shoe that is peculiar to many fishes, supposed by Hunter to be a muscle that alters the distance of the retina from the crystalline lens, by Cuvier to be an erectile tissue possessing the same influence and by others to be a gland. This is easily separated into two parts as if it were cut through longitudinally; the one part remaining attached to the opthalmic vessels the other to the choroid coat. When quicksilver is injected by the opthalmic artery it does not find its way to the choroid coat nor even to the choroid portion but it well exhibits the vessels of the portion connected with the artery.

The *choroid* extends from the part just described to the circumference of the iris, where it appears to supply the vitreous humor and where it sends vessels to the superior and inferior axes of the crystalline lens.

The *tunica ruyschiana* is firm and appears to have a membrane over that which secretes the *pigmentum nigrum,* as it does not readily soil the fingers.

The *iris* before, consists of layers of a silver color. At its circumference there are a number of radiated streaks. Behind, it is covered with pigmentum nigrum. At its inferior portion there is a loop for the passage of a muscle soon to be described.

The *retina* consists of two layers, a fibrous* and a pulpy. A vascular or a serous cannot be demonstrated. There is a division at its lower part from the entrance of the optic nerve to its termination at the iris. The optic nerve is folded up like the ruffle of a shirt, and if it be pulled after the sheath is divided, the retina may be drawn through the foramina in the coats.

There appears no aqueous humor. What is contained in the anterior chamber, communicates with and has the same cellular structure as the vitreous humor. The membranes of the vitreous humor pass off in rays from the edge of the choroid and from the capsule of the crystalline. There is no appearance of Petit's canal.

The crystalline lens is spherical, completely surrounded by the vitreous humor; as usual it increases in density towards the centre. When immersed in a solution of corrosive sublimate, it gradually becomes white but it is not acted upon like albumen. When the lens of a sheep is allowed to remain in a solution of corrosive sublimate, scarcely any change is perceptible and consequently it is not albuminous. According to Berzelius the composition of the crystalline lens resembles that of the red globules of the blood. In fishes, the blood passes through the ramifications of the posterior portion of the choroid gland; the red globules appear to be taken up by the other portion, to pass in a tortuous direction over the choroid and to be deprived of their coloring matter before passing to the lens. In animals that live in air, the choroid alone seems capable of preparing what the lens requires.

At the inferior axis of the crystalline lens and attached to its capsule, is a small triangular body having its inner surface covered with pigmentum nigrum. It adheres to a cord placed at the divided portion of the retina. It passes through the loop in the iris and is inserted into the vitreous humor behind the crystalline. Its mechanism may be seen by inspecting the plate, fig. 3. When the portion a part of which passes through the loop, is brought into action, the vitreous humor is drawn forwards and the lens is pushed before it. When the other portion acts, the lens is drawn backwards.

---

* A fibrous coat may be exhibited in the retina of a bullock by immersing an eye for a few days in alcohol, pouring a solution of corrosive sublimate on the retina and separating the fibres by a camels hair pencil. Four coats may thus be demonstrated, a vascular, a fibrous, a pulpy and a serous.

Cuvier states that, "in a great number of fishes, there is a falciform ligament which passes through a slit in the retina, and penetrates the vitreous humor." "It contains blood vessels and nerves and is attached to the capsule of the crystalline at its inferior surface, sometimes by a simple elevation or by a fold a little more opaque; at other times by means of a grain or tubercle, transparent and harder than the vitreous humor in which it is placed." Cuvier has ascribed no function to what is described. Jurin has named it the ganglion of the crystalline. I considered it the expansion of a nerve before closely examining its fibrous structure and its connexions.

Fig. 1.

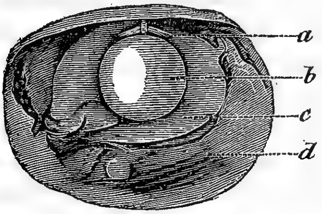
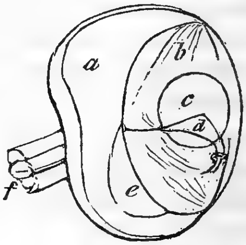
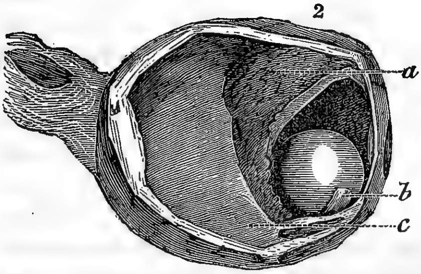


Fig. 3.



2



4

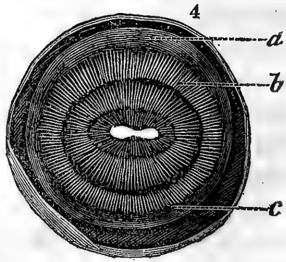
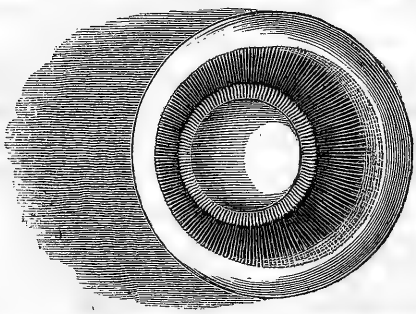


Fig. 5.



DESCRIPTION OF THE CUTS.

Fig. 1, 2. Preparations of the eye of the streaked bass.

Fig. 1, *a*. Triangular muscle passing through the loop above.—*b*. Crystalline lens.—*c*. Vitreous humor.—*d*. Fat.

Fig. 2, *a*. Choroid gland.—*b*. Muscle attached to the crystalline lens.—*c*. Fat.
Fig. 3, Plan.—*a*. Fat.—*b*, Vitreous humor.—*c*. Crystalline lens.—*d*. Muscle.—*e*. Choroid gland.—*f*. Optic nerve.
Fig. 4. Section of the eye of a sheep.—*a*. Superior choroid muscle.—*b*. Ciliary processes.—*c*. Inferior choroid muscle.
Fig. 5, Crystalline and vitreous humor of a sheep, shewing the unequal diameter of Petit's canal and the impressions of the superior choroid muscle.

On the accommodation of the Eye to distances.

Notwithstanding all the attention that has been paid to the eye, there is much discrepancy of opinion about the method by which it is accommodated to distances. We still read in the works of highly respectable authors about the change being effected by the alteration of the size of the pupil, by the muscularity of the crystalline lens, by a greater or less degree of convexity of the cornea, or by the muscularity of the ciliary ligament, without either of these theories being sufficiently proved.

It is evident that the change in the size of the pupil, can have no more effect in the adjustment of the eye, than the increasing or diminishing of the aperture at the end of a telescope, can have in bringing it to a focus. When it is dilated by belladonna, the power of accommodation, in my own case, to a certain extent, continues.

The crystalline lens bears no analogy to muscular structure. If it did, there is no attachment to its capsule, from which the fibres could act. In a certain species of hawk, it is a plano convex, so exquisitely cut, if I may use the expression, that if changed by muscular action, its delicate edge would be acted upon, and its figure would not likely return.

The hypothesis of Mr. Travers, that the radiated fibrous processes connected with the iris, bear upon the circumference of the crystalline lens and elongate its axis, admits of no proof but is liable to many objections.

The theory of Dr. Hosack, accounting for the phenomena by the degree of convexity of the cornea, will not apply in every case. In the eye of the sturgeon a thick cartilage encases the globe, as far as the circumference of the cornea. It is so firm that no change of form can be produced by the external muscles, nor have I been able to perceive that any alteration of the laminæ of the cornea, can be made by their action. A structure similar to that of the sturgeon exists in many fishes. In animals that live in air, no change of form in the cornea is, to unassisted vision, perceptible. In attempting proofs with the microscope the difficulties in adjusting it have probably been sources of error.

It was the opinion of Porterfield, that by the contraction of the ciliary ligament, the crystalline was drawn forwards, that the distance of the cryrtalline from the retina was farther increased by the compression of the vitreous humor behind the ligament, and that the aqueous humor pressed against the cornea made it more convex. Porterfield uses the term ciliary ligament synonymously with ciliary processes. The reason that his opinion did not receive more attention, may have been that the ciliary processes alone did not seem adequate to the purpose.

The opinion that the ciliary ligament or *annulus albus*, is the muscle by which the eye adapts itself to the perception of distant objects, has been recently advanced by Dr. Knox. The *annulus albus* has not the least appearance of muscularity. The muscular fibres at the roots of the ciliary processes seem to be meant, which are insufficient to account for the phenomena.

In fishes the iris does not seem capable of much motion, yet their vision contrary to the usually received opinion seems to me to be very acute. I have sometimes over a small lake watched the motions of trout. They appeared to sport with each other and to enjoy life as much as animals that live in air, and there was no error in their judging of the position of a fly, nor in their aim at obtaining it. The speed with which they elude the grasp of the hand that darts towards them is very great, and can be accounted for only by the quickness of their vision. Those who attempt to catch fishes with their hands, find it no easy task to secure them.

From the apparent structure of the triangular body already described, from its origin, its attachment to the crystalline lens, its passing through the loop in the iris and its insertion into the vitreous humor, it appears to be the means of adjusting the eyes of fishes to different distances. As the crystalline lens in these animals appears a perfect sphere, a slight rolling motion will produce no change in the direction of the rays. A very small force is thus advantageously applied, it is increased by the passing of the muscle over the pully, and by its favorable insertion into the vitreous humor the power of moving the crystalline is still farther inceased.

It should be observed that in some fishes as the poigee, the muscle does not pass through a loop in the iris, but is only attached to it. In the herring, the mackerel and the shad, the falciform process described by Cuvier, is evidently constructed for the motion of the crystalline.

This simple mechanism, will not succeed in adjusting a lens that is not a sphere, without altering the direction of the rays of light. Another and a more complicated structure exists in the amphibia that I have examined, and in animals that live exclusively in air. The ciliary processes arranged in a radiated manner around the lens are very vascular. When wounded, they effuse so much blood that they are cautiously avoided by the operator. Each process is like a folded leaf having its sides of a triangular form.* In the eye of an animal recently killed they adhere firmly to that portion of the hyaloid membrane that forms the anterior wall of the canal of Petit, and can only be seperated from it by rupture. The ruptured portion forms the *halo signatus*. At their base upon the inner surface of the choroid coat there is a range of muscular fibres. In the sheep the fibres of the upper portion run transversely to the ciliary processes. Those of the lower portion run parallel to them. The transverse fibres leave a distinct impression upon the hyaloid membrane when they are separated from it. Petit's canal is broader here than it is below.

When Petit's canal is inflated without removing the support of the vitreous humor the crystalline advances. When the inflation is discontinued it resumes its place. Petit's canal thus appears to be formed for limiting its motion and maintaining its position as it becomes nearer to or more distant from the retina. The ciliary processes are received into depressions with elevations of the hyaloid membrane between them to allow of its expansion as it advances and occupies a more extended space. In fishes whose crystalline is a sphere, surrounded by the vitreous humor and moved by a simple muscle, such an apparatus is not wanted and it does not seem to exist.

When the muscular fibres at the roots of the ciliary processes contract, the ciliary veins will be compressed, and the processes will become erect and expanded; their sides will recede from each other, the anterior wall of Petit's canal will be lifted forwards and the crystalline will advance. When the muscular action ceases, the processes will become less turgid, their sides will approach each other, the anterior wall of the canal of Petit will be pushed back and the crystalline will resume its situation.

Different directions may be given to the rays of light proceeding from objects by a change of the position of the crystalline produced

---

* See the elegant plates of Mr. Bauer, Phil. Trans. Lond. 1822.

by the contraction of the fibres at the roots of one portion of the ciliary processes while the other fibres are relaxed.

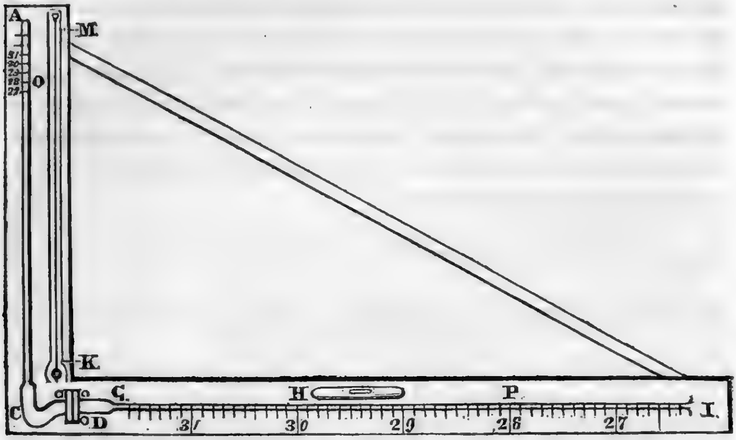
The design of creative Wisdom in varying the structure of the eye to the purposes to which it is to be applied is very conspicuous in the sheep. The muscle on the choroid coat is larger above than that which is below; its fibres take a different direction that it may more effectually compress the ciliary veins, and Petit's canal is broader allowing the crystalline more extended motion; in this manner enabling it more effectually to select its food and soon to watch against danger without lifting its head from the ground: or according to the degree of light, enabling it to remove the picture from the lucid tapetum to a part that is darker. The retina terminates where the muscle begins lest its action should interfere with the impressions received upon it. It is slit asunder in fishes apparently for no other purpose than avoiding the motions of the cord to which the triangular muscle is attached.

When we look from one object to another we are conscious of an effort and that some time is requisite for distinct vision; apparently allowing the vascular processes to be filled or emptied by compressing or not compressing the veins that return from them. The winding direction of the carotid before it gives off the ophthalmic artery, the smallness of the ciliary vessels and their bendings and anastamoses before reaching the processes prevent the blood from passing *per saltum* but conduct it in a steady uninterrupted course. In the cat an animal that has to watch her prey often for a very considerarble time, the artery that supplies the eye after making a curve, gives off a number of very small branches which make several convolutions before some of them again unite and penetrate the sclerotica. By this structure the eye may continue for a long time without losing its object. Momentary relaxation of the ciliary processes may be permitted without having again to bring the organ to the same focus.

That the theory advanced by Kepler and supported by Porterfield, that the eye is accommodated to different distances by the position of the crystalline nearer to, or more remote from the retina is the true one, and that the change is effected in the manner described is evident from the structure of the apparatus.

Art. III.—*New mode of constructing the Mercurial Barometer;* by J. L. Riddell, A. M., Lecturer on Chemistry.

The design of this contrivance, is to render the indications of the barometer more obvious and delicate.



A C, is a vertical glass tube near thirty two or thirty three inches in length, as in the common barometer.

C D. An iron joint held together by screws.

G I. A horizontal glass tube five feet long, or of any required length.

A O. Torricellian vacuum. The mercury is continuous from O to P.

M K. A plumb line pendent in a glass tube, for adjusting the instrument so that CA shall be exactly vertical.

H. A spirit level, for detecting any variation of G I, from a horizontal direction.

The iron tubes serve in part as caps, into which the ends of the glass tubes are cemented; and at the places where the glass terminates, the iron must be so drilled that the corresponding calibres will be exactly equal and continuous. If the glass and iron are fitted accurately in the first place by grinding, a little resinous cement applied by heat, (such as shellac,) will render the junctions perfectly secure. That part of the iron tube which embraces the glass, may be attached with common cap cement. The iron faces that are pressed together by screws, should be accurately ground; and if the position of the instrument require it, pieces of thin leather may intervene. If the calibre of the ascending tube be one fourth of an inch, and that of the horizontal tube one fifteenth; the rise or fall of the mercury four fifths of an inch, will cause the horizontal column to move nearly a foot.

The same apparatus modified a little, becomes a very delicate air thermometer. It is only necessary that atmospheric pressure should be excluded, and that the tube G I should terminate at I in a bulb containing air. If the bulb be partly filled with the vapor of mercury, at the time it is sealed, the elasticity of the air within, will be of a low tension, when the instrument becomes cool. In this case the tube AC may be materially shortened, and the iron joint dispensed with. The vapor of water, alcohol or ether may be substituted for air, taking the precaution to leave an excess of liquid in the horizontal tube or bulb. An instrument of extreme delicacy, may thus be constructed, but whether air or vapor is used, it is rather more difficult to adapt a scale to it, than a common thermometer.

Cincinnati, Ohio, April 8, 1834.

Art. IV.—*Apparent Dimunition of Weight in certain circumstances;** by W. E. A. Aikin.

Sir David Brewster, in one of his letters on Natural Magic, addressed to Sir Walter Scott, relates the following "as one of the most remarkable and inexplicable experiments, relative to the strength of the human frame." The experiment was performed in the presence of Sir D. B. by Major H. who had seen it performed at Venice, under the direction of an officer of the American Navy. "The heaviest person in the party lies down upon two chairs, his legs being supported by the one and his back by the other. Four persons, one at each leg and one at each shoulder, then try to raise him, and they find his dead weight to be very great, from the difficulty they experience in supporting him. When he is replaced on the chairs, each of the four persons takes hold of him as before, and the person to be lifted, gives two signals by clapping his hands. At the first signal, he himself and the four lifters begin to draw a long and full breath, and when the inhalation is completed or the lungs filled, the second signal is given for raising the person from the chairs. *To his own*

---

* Mt. St. Mary's College, Emmitsburg, March 12, 1834.

To Prof. Silliman.—*Dear Sir*—I send you the following as possibly possessing sufficient interest to find a place in the Journal of Science; if so, it is at your service. Respectfully and sincerely,

your humble and obedient servant, W. E. A. Aikin.

surprise and that of his bearers, he rises with the greatest facility, as if he were no heavier than a feather. On several occasions I have observed when one of the bearers performs his part ill, by making the inhalation out of time, the part of the body which he tries to raise is left, as it were, behind. As you have repeatedly seen the experiment and performed the part both of the load and the bearer, you can testify how remarkable the effects appear to all parties, and how complete is the conviction, either that the load has been lightened, or the bearer strengthened by the prescribed process. Major H. declared the experiment would not succeed if the person were placed on a board and the strength of the individuals applied to the board. He conceived it necessary that the bearers should communicate directly with the body to be raised. I have not had an opportunity of making any experiments relative to these curious facts, but whether the general effect is an illusion, or the result of known or of new principles, the subject merits a careful investigation."

Upon reading the above, my curiosity was sufficiently excited to induce a repitition of the experiments with a view merely to satisfy myself whether the whole affair was, as is above suggested, an illusion or an inexplicable fact. For this purpose and with the aid of some friends, the trials were varied and continued at different times, until all were satisfied "that the load had been lightened or the bearers strengthened by the prescribed process." As the results we obtained may throw some light on the subject, I subjoin them for the curious. The "load" was represented by a young gentleman weighing about 120 lbs., who was placed on a table with the bearers, two on each side, so that they could respectively apply one hand to each shoulder and leg. The terms "more difficulty" and "more ease" refer to the exertion requisite to lift the load under ordinary circumstances.

1st. Lifted simultaneously, by signal, without preparation to ascertain what resistance was to be overcome.

2nd. Repeated the first.

3rd. Used the method prescribed by Sir D. B., but not acting in unison, felt no relief.

4th. Repeated third, more successfully and evidently lifted with more ease.

5th. Repeated fourth, with same result.

6th. Repeated the first.

7th and 8th. Lifted with the lungs kept inflated, and experienced more difficulty.

9th and 10th. Repeated fourth with same result.

11th and 12th. The bearers only used the prescribed method, the load took no part other than to give signals, result same as fourth trial.

13th and 14th. Having changed the load repeated first.

15 and 16th. Repeated fourth, same result.

17th and 18th. Repeated eleventh and twelfth, same result.

19th and 20th. Similar to fourth, except that the prescribed process was intentionally neglected by one of the bearers, unknown to the others, no difference in consequence was observed by the others, and but very little by himself. Except therefore, so far as the one bearer was concerned, the results were similar to that of the fourth trial.

21st and 22nd. Repeated fourth with same result. On these trials the load was placed on a board and the strength of the bearers applied to the board.

23rd. Repeated first, load still on the board.

24th and 25th. Same as twenty first and twenty second, same result.

26th, 27th and 28th. Load still on the board, repeated seventh and eighth with same results.

29th and 30th. Having changed the load, repeated the first. For this and the remaining trials, the load was kept on the board.

31st and 32nd. Repeated seventh and eighth, same result.

33rd. Repeated first.

34th and 35th. Repeated fourth, same result.

These trials were made at three different times with the assistance of three different parties. At each time it was found necessary after half a dozen trials, to intermit for a few moments, as the wrists of the bearers became quite tired. The following conclusions were deduced.

1st. When the lungs are fully inflated and the act of lifting and that of expiration is carried on simultaneously, the load is apparently lightened.

2nd. No other situation of the muscles of the chest will give the same result.

3rd. The result is independent of the co-operation of the person lifted and is equally perceived with an inactive weight and by consequence with an inanimate weight.

4th. The fact may be explained by the more favorable action of the muscles of the humerus during the transition from a forced inhalation to complete expiration in consequence of their connexion with the muscles of respiration. It is not the load that is lightened, but the strength of the bearers that is more favorably applied, and the apparent difference in weight during a successful experiment is no greater than can be explained by this method.

After being satisfied by actual trial, that the fact was *a true fact*, the obvious inquiry appeared to be, whether the load was lightened or the bearers strengthened. The former supposition seems to be physically impossible, unless we can introduce some "new principle," or contrive some short way to dispose of the laws of gravity, and as I did not think it advisable to attempt either, I was driven to the necessity of accounting for the increased strength of the bearer. And this increased strength, I conceive may be accounted for by referring to the relative situation of certain muscles at the time the exertion is made. The deltoideus, the supra spinatus and infra spinatus, are tense and ready to act, the ribs are elevated to the utmost by the forced inhalation, the scapula is fixed by the action of the muscles of the humerus antagonised by the serratus major anticus and others. The lifting of the load and depression of the ribs, then begin, the serratus muscle is directly affected by this depression, its action is thereby rendered more energetic, and thus the muscles of the humerus attached to the scapula are seemingly strengthened. It may be anatomically demonstrated, I think, that the action of the above muscles in the given position would produce the supposed result, at least in degree. There may be a difference of opinion as to the sufficiency of the cause to produce the effect. To this I could only say, that owing to the peculiar insertion of these muscles of the humerus, only a very trifling additional direct or indirect action on their part would be necessary, as we have only to account for a trifling difference in weight. During the most successful experiments in which I performed the part of a bearer, the sensation of lightening was no more than would have been experienced by the removal of five or six pounds from my hand. If all four bearers experienced the same it would make a difference of between twenty and thirty pounds in the apparent weight of the load. This difference is trifling when divided among four persons, but it is fully sufficient to account for most if not all the prodigious facts generally narrated in connexion with this experiment. When I hear of individuals weighing between two and three hundred pounds, having been lifted on the fingers of four persons with no more exertion on their part than would be required to lift a feather, I cannot avoid reverting to what Sir David Brewster considers a possible explanation, illusion. One great source of error, as I conceive, in the experiment, is that gentlemen do not take the pains to compare at the time of trial the necessary exertion when the prescribed process is used, with the necessary exertion without preparation or under ordinary circumstances.

Remark.—Some years ago, I was interested in the subject discussed above, and at the time when such experiments were mentioned in the public prints, I was concerned in making them repeatedly on others, and was the subject of them myself. I can only say, that when the experiment was made according to the prescribed forms, there was a very obvious apparent diminution of resistance in raising or in being raised.—*Ed.*

Art. V.—*Transmission of Radiant Heat through different solid and liquid bodies.*—An abstract of a statement of the results obtained by M. Melloni, from the Journal of the Institute.

Translated from the Bib. Univ., by J. Griscom.

Nothing can be more suitable than the instrument employed by M. Melloni, for the purpose of rendering totally insensible the influence of the heat which emanates from the screen itself, without altering the value of that which is immediately transmitted through it. It is sufficient to say that, under convenient circumstances it renders sensible the heat of a single person at the distance of 25 to 30 feet. This instrument is composed of a thermo-electric pile, formed of small bars of antimony and bismuth, disposed in a bundle, and of a condensing or multiplying galvanometer whose extremities communicate, by means of two long copper wires, with those of the pile. The rays from the heating source, fall on one of the ends of the bundle which constitutes the pile,—this heat excites an electric current which pervading the apparatus disturbs the equilibrium of the magnetic needle of the galvanometer, the deviation of which shews the intensity of the radiant heat. The instrument may be so adjusted, that at a convenient distance from the heating source, the rays falling directly on the pile, produce a deviation of 30°. When they are to be entirely cut off, a plate of polished brass is interposed. When the transmitting power or capacity of any substance is to be tried, that substance is placed on the opening of the screen, the plate of copper is removed, and in five or six seconds the needle by its oscillations and final deviation, shows the ultimate effect. It is remarkable that the needle acquires a stable position in *a minute and a half,* whatever the thickness of the transparent medium through which the heat passes, *from one hundreth of a line to five or six inches.* The constancy of this interval of time, under such varied thicknesses, proves unquestionably that the heat which falls on the pile is exclusively that which passes immediately through the interposed substance.

Thus it is proved incontestably, that rays of heat are immediately transmitted through solid and liquid bodies, possessed of a certain degree of transparency. But is the amount of heat thus transmitted in proportion to the transparency? This is the question which the experiments of the author appear to have solved.

The following tables give the indications of the galvanometer for different substances, reduced to the same thickness. They were obtained under circumstances the most favorable to the identity of the laws of transmission for heat and light,—for the radiating source being a lamp with a double current of air, there was at the same time a very abundant transmission of both of these agents. The number of rays transmitted, was calculated by dividing the galvanometric force, by the total force when the rays fall directly on the pile. The numbers are expressed in hundredths of the quantity of incident heat.

TABLE I.

Liquids. (Common thicknes 9.21^{mm}.)	Deviation of the galvanometer.	Rays transmitted.
Open screen, - - - - -	30.00	100
Carburet of sulphur, (colorless,) - -	21.96	63
Chloride of sulphur, (deep red brown,) -	21.83	63
Protochloride of phosphorus, (colorless,) -	21.80	62
Hydrocarburet of chlorine, (colorless,) - -	13.27	37
Oil of nuts, (yellow,) - - - -	11.10	31
Essence of turpentine, (colorless,) - - -	10.83	31
" rosemary, (colorless,) - -	10.46	30
Oil of colza, (yellow,) - - - -	10.38	30
Oil of olive, (greenish yellow,) - -	10.35	30
Balsom of copaiva, (pretty deep yellow brown,)	9.39	26
Essence of lavender, (colorless,) - -	9.28	26

Liquids. (Common thickness 9.21^{mm}.)	Deviation of the galvanometer.	Rays transmitted.
Oil of pink, (slightly yellow,) - - -	9.26	26
Naptha, rectified, (colorless,) - - -	9.10	26
Sulphuric ether, (colorless,) - - -	7.59	21
Sulphuric acid, pure, (colorless,) - -	6.15	17
Ditto of Nordhausen, (deep brown,) - -	6.09	17
Hydrate of Ammonia, (colorless,) - -	5.47	15
Nitric acid, pure, (colorless,) - - -	5.36	15
Absolute alcohol, (colorless,) - - -	5.30	15
Hydrate of potassa, (colorless,) - - -	4.63	13
Acetic acid, rectified, (colorless.) - -	4.25	12
Pyrolignous acid, (light brown,) - -	4.28	12
Solution of alum, (colorless,) - - -	4,16	12
Salt water, - - - - - - - -	4.15	12
White of Eggs, (yellowish white,) - -	4.00	11
Distilled water, - - - - - - -	3.80	11
TABLE II.—Solids. Common thickness 2.62^{mm}.		
Open screen, - - - - - - -	30.00	100
Rock salt, (diaphanous and colorless,) - -	28.46	92
Iceland spar, (idem,) - - - -	21.80	62
Another kind, (idem,) - - - -	21.30	61
Rock crystal, (idem,) - - - -	21.64	62
Glass, (idem,) - - - - - -	21.60	62
Rock crystal *smoked*, (transparent deep brown,)	20.25	57
Brazilian topaz, (diaphanous, colorless,) -	19.18	54
Carbonate of lead, (idem,) - - -	18.35	52
White agate, (translucent,) - - - -	12.48	35
Sulphate of barytes, (diaphanous, veined,) -	11.72	33
Aqua marine, (idem, bluish,) - - -	10.16	29
Yellow agate, - - - - -	10.10	29
Borate of soda, (translucent,) - - -	9.87	28
Tourmaline, (greenish,) - - - -	9.54	27
Adularia, (irregular veined,) - - -	8.30	24
Sulphate of lime, (colorless,) - - -	7.15	20
Fluate of lime, (veined,) - - - -	5.40	15
Citric acid, (colorless,) - - - -	5.15	15
Sardonyx, (translucent,) - - - -	4.98	14
Carbonate of ammonia, (streaked,) - -	4.50	13
Tartrate of potash and soda, (colorless,) -	4.40	12
Alum, glacial, (idem,) - - - -	4.36	12
Sulphate of copper, (transparent, deep blue,)	0.00	00

An inspection of these tables, shews at once, that the aptitude of a body to transmit radiant heat, has scarcely any connection with its aptitude to transmit light. The difference between these two properties is enormous, since in the case in which the bodies possess the same degree of transparency, the quantities of heat transmitted, vary from one to eight, and frequently the quantity transmitted by certain substances of a deep tint is four or five times as great as that by other substances perfectly diaphanous.

This faculty of giving passage to calorific rays, diminishes by an increase of the quantity of matter to be traversed, but not to so much as might be supposed. Thus pieces of Iceland spar and rock crystal, *smoked*, from 86 to 1000 millemetres thick, transmitted from 52 to 54 out of 100. The crystal was of so dark a tint that, laid on printed paper, it was impossible to perceive the least trace of the letters through it, even when exposed to the strongest light. Now a plate of alum 2.8^{mm} thick, allows only 12 rays in a hundred to pass through, by reducing it to one mellimetre Melloni could obtain only an increase of 4 to 5 hundredths, the material notwithstanding being as pure as the finest glass. Here then is a very transparent plate which transmits 3 or 4 times less radiant heat than another plate almost opake and nearly a hundred times thicker.

The author finally ascertained that rays of heat are sensibly transmitted through the perfectly opake glass employed in the fabrication of the mirrors which are used in polarizing light.

Not the least doubt therefore can remain of the almost entire independence of the two transparences—calorific and luminous, and it becomes now indispensable to distinguish by a special denomination, the bodies which transmit much radiant heat. Melloni proposes to call them transcaloric or diathermanes, in imitation of the terms transparent or diaphanous, indicating the analogous property relative to light.

It may now be asked whether the faculty of transmiting rays of heat has any relation to other properties of matter, in these trials on liquids and the vitrification of crystalline bodies properly so called. An inspection of the first table assures us that a liquid is diathermous in proportion to its refrangibility. Hence the curburet and the chloride of sulphur, transmit more caloric than oils,—oils more than acids,—acids more than aqueous solutions, and the latter more than pure water, which is the least refringent of the whole series, and also the least diathermanous. Melloni also proved by experiment that the same law holds good with respect to flint glass, crown glass, and different kinds of glass. It is therefore extremely probable, that it extends to all substances, solid and liquid, deprived of regular crystalization. With respect to crystals the single comparison of the two bodies which form the extreme limits of the second table is sufficient to show that they are not at all subject to this kind of proportionality between the faculty of refracting light and transmiting heat, for rock salt possesses nearly the same refraction as alum, and transmits eight times more radiant heat. These two bodies are found often under the same crystalline form, and have nearly the same hardness and specific gravity. The great difference in their action on rays of heat seems not to depend either on chemical composition, since, by dissolving them separately in water, they increase the transmitting power of that fluid in the same manner. Analogous considerations apply to almost every substance of the same kind. In regularly crystallized bodies, there is then no apparent relation between calorific transmission and the other known properties of matter.

We have observed that the author had used an Argand lamp in obtaining the results of the preceding tables. Now by employing as radiating sources, incandescent platina, copper maintained at a constant temperature by the flame of alcohol, and vessels full of mercury or of water at the boiling heat, he found that the order of calorific transmission was the same for all of them; but the numerical value of each transmission underwent great diminutions. Thus, rock crystal, Iceland spar, carbonate of lead, colorless topaz, which gave by the lamp from 62 to 52 were reduced to 26.24 and 20 by the platina. It was the same with other substances: tartrate of potassa and soda, citric acid and alum, gave no sensible transmission.

The quantity transmitted was still more reduced when the source was metal heated to 400° or 500° C. It was reduced to zero when the rays proceeded from boiling water.

These experiments prove that the law which Delaroche found with respect to glass, extends to the other diaphanous substances mentioned in the preceding tables. But there is one extremely remarkable exception to this general rule. Rock salt allows the same proportion of radiant heat to pass, whatever the temperature of the heating source. Thus, whether the rays proceed from the most brilliant flame, from a red hot ball, from boiling water, or from water heated only to 40° or 50° C., rock salt will always transmit $\frac{92}{100}$ of the incident heat. A comparison with the analogous effects of light will more clearly shew the importance of this result.

If we look at a luminous body through a very clear plate of glass, we perceive but a very slight or insensible diminution of the clearness of the body, whatever may be in other respects the force or intensity of the light which emanates from it. The rays of solar light, or those which issue from a glow worm, pass with the same facility through a plate of glass or through any transparent medium whatever. It is not thus with respect to radiant heat: for we have just seen that in regard to glass, Iceland spar, rock crystal, and in general, all diaphanous bodies, the rays are transmitted in quantities which diminish with the temperature of the source, so that they are all intercepted when they proceed from a body heated to about 100° C. There was then every reason to believe that this phenomenon depended on the nature of the agent which constitutes heat, and that consequently no body could exist which was *truly diathermanous*, that is to say, a substance which acts upon rays of heat proceeding from different sources, as every diaphanous medium acts upon luminous rays whatever may be their origin. Rock salt has completely changed the received opinions on this head and established an unexpected connection between those two great natural agents heat and light.

The constant action of rock salt upon all sorts of radiant heat may be usefully applied in a great many cases. Suppose we wish to ascertain whether the rays of obscure heat are susceptible of refraction,—place a receiver full of boiling water at a certain distance from the thermo-electric pile and out of the direction of its axis; the rays emanating from the receiver cannot then enter the tube and the galvanometer remains motionless; but by placing a prism of rock salt properly before the tube, we perceive the needle instantly to leave its position of equilibrium,—proving that obscure heat is refracted like light. If we wish to propagate to great distances the action of a hot body of small dimensions,—fasten it at the focus of a lens of rock salt which refracts the radiant heat and sends out the rays parallel to the axis, forming a true *pharos* of heat. The operation may be reversed when we wish to render sensible the rays which proceed from a very feeble source,—the lens will then receive the rays and cause them to converge to the thermoscopic body. Melloni has in this manner obtained by his instrument and by simple air thermometers, very marked signs of heat from very distant vessels containing warm water. In short, rock salt may be made to act upon rays of heat either obscure or accompanied by light, in the same manner as luminous rays are acted upon by miscroscopes, telescopes and optical instruments in general.

In speaking of the independence which exists between the transparency of bodies with respect to light and heat, we cited examples which shew the little influence which the thickness of the plate possesses on the quantity of heat transmitted; but that applies only in the case then under consideration, namely when operating with the flame of a lamp. Melloni has made similar experiments with other sources, whence it results that the influence of thickness on the phenomena of transmission is greater as the temperature of the source is low. It becomes very great in low temperatures. This proposition is intimately connected with the law of Delaroche, for the differences between the quantities of heat transmitted through the same plate of glass exposed in succession to various sources, diminishes in proportion as the plate becomes less thick, and is completely effaced at a certain limit of thickness; so that in presenting a plate in a certain state of exiguity to two sources of very different temperatures, it transmits the same quantity of heat from each. The author proved this by an extremely thin plate of mica exposed to incandescent platina and to a mass of iron heated to 360° C.

Melloni has also studied the effect which the color of bodies has on the transmission of radiant heat, as well as the condition of the surface, and the resistance of the successive layers which compose it. He has ascertained, 1st, that all the coloring materials which enter into the composition of colored glass, green excepted, act upon rays of heat, as dark substances do upon light when introduced into a diaphanous medium; 2d, that the more polished the diathermanous surface, the more it facilitates the transmission of rays of heat; 3d, that the loss experienced by rays in traversing one of the thin layers into which we may conceive the medium to be divided, is so much the less, the more distant the layer is from the surface on which the rays fall.

In what we have thus far considered, terrestrial heat alone has been the subject of experiment; in applying his methods to solar heat Melloni arrived at this result, that each ray of the solar spectrum acts like the terrestrial rays derived from different sources, so that the most refrangible rays may be compared to the heat from a very hot focus, and the least refrangible to that from one of low temperature.

In fact, if rays of heat, issuing from a prism, be made to pass through a plate of water, between two plates of glass, it will be found that in traversing the fluid, the least refrangible rays suffer the greatest loss. The rays of heat mixed with the blue or violet light pass through in great abundance,—those which lie in the obscure part just beyond the red are almost totally stopped. The first act like the heat of a lamp, and the last like that of mercury or water in ebullition. It was formerly imagined that the temperature of different parts of the solar spectrum was proportional to the intensity of the light, and hence that the yellow contained the most heat. It was afterwards maintained that the maximum of heat lay in the red or just beyond it. The first opinion, based on the experiments of Bérard was much in vogue in France,—the lâtter, on those of Hershell was generally adopted in England and in Italy. Seebeck's researches in 1828 prove that all this may be true, for the maximum of heat depends on the composition of the prism. It was wrong therefore to draw such general inferences from such particular facts. But the error was in some measure justified by the false idea that had been formed of the invariable action of colorless diaphanous substances on all sorts of calorific rays; so the facts announced by Seebeck, remained isolated in science until the researches of Melloni. Now they may be explained with the greatest facility. Let us recollect, 1st, that in the common spectrum formed by a glass prism, the maximum of heat lies in the red; 2d, that the solar rays, in traversing a mass of water suffer loss inversely proportionate to their refrangibility.

This premised—the author reasons thus: The solar heat which falls upon the anterior face of a prism of water, comprehends rays of all degrees of refrangibilty. Now, the ray which possesses the same refractive index as the red light, suffers, in traversing the prism, a loss proportionally greater than the ray endowed with the refrangibility of orange light, and the latter less in traversing it than the heat of the yellow. These ratios increasing in the loss of the less refrangible rays, evidently tend to cause the *maximum* to move from the red to the violet; it may then stop at the yellow. By supposing the action of sulphuric acid to be analogous to, and less active than, that of water, we shall understand why, in the case of a prism of acid, the maximum is stationed at the orange.

In fact, the glass itself of which common prisms are composed, must operate in the same manner and produce upon each ray a loss inversely proportional to its degree of refrangibility. Therefore, if we employ in the construction of a prism a substance less active than common glass, the loss will be weakened in greater proportion for the less refrangible rays; the latter will gain then upon the more refrangible rays and the maximum will advance in a direction opposite to the preceding, that is, from the violet to the red. This is precisely what Herschel, Davy, and Seebeck ascertained in operating with prisms of flint glass.

Let us compare these effects with the numbers which represent calorific transmissions: we shall find that the maximum of heat, in leaving the yellow where it is found to be in the water prism, always advances in the same direction, just as the prism is constructed of substances more and more diathermous. It lies a little beyond the spectrum when flint is substituted for crown glass. Admitting then the exactitude of this theory, the line of the greatest heat must be disengaged entirely from color and be found in the dark space much beyond the red, when rock salt is used, a substance which is as much more diathermous than flint, as flint is than crown glass.

This important verification was made by the author on spectra formed by five prisms of rock salt from different localities. It was completely successful. In every case the maximum was found in the dark space at a distance from the last luminous band equal to that which exists on the opposite side between the greenish blue and the limits of the red.

Melloni has proved also that crystallized bodies act upon rays of heat in the same manner in all directions. He has assured himself of this by making the calorific radiation pass through prisms and plates of the same thickness cut out of the same crystals in different directions relative to the axes of crystallization.—*Bib. Univ. Oct.* 1833.

Art. VI.—*Caricography;* by Prof. C. Dewey.

Appendix, continued from Vol. xxvi. p. 378.

No. 137. Carex *saxatilis*, L.

Willd. Sp. Pl. 4. page 272, and Pursh, No. 23.

Schk. Tab. I and Tt. fig. 40. Wahl. No. 140.

Spicis distinctis, staminifera solitaria, fructiferis *distigmaticis* subternis oblongis obtusis sessilibus, inferiore pedunculata cum bractea *auriculata*; fructibus ellipticis convexo-planis obtusis brevi-rostratis, squamam oblongam obtusam subæquantibus.

Culm six to ten inches high, triquetrous, scabrous above, with leaves sheathing towards the base, and nearly as long as the culm and flat; staminate spike single, oblong, cylindric, with ovate and obtuse scales; stigmas two; pistillate spikes two to four, sometimes staminate above, sub-approximate, oblong, obtuse, sometimes loose-flowered, the lowest with a leafy bract having so large auricles as to be clasping the stem; fruit elliptic, convex on the upper and flat on the under side, obtuse, with a short beak, and light colored; pistillate scale oblong, obtuse, black, and long as the fruit; plant is of light green color.

Found by Dr. Richardson near Fort Franklin on McKenzie's river, and at Bear Lake, and on the sea coast of arctic America. As Pursh's description of this species is taken from Willd., I have quoted him as authority, although it may be doubtful whether he ever saw the species in our country.

No. 138. C. *compacta*, R. Br.
R. Brown's appendix to Ross's Voyage.
Torrey and Schw. No. 54.
Tab. U, fig. 63.

Spicis distinctis; staminifera solitaria, raró binis, erecta oblonga; pistilliferis *distigmaticis* subbinis, pedunculatis erectis oblongis subdensifloris; fructibus ovatis convexis brevi-rostratis ore bilobis, squama ovata nigra acutiuscula longioribus.

Culm six inches high, erect, triquetrous, smooth, leafy; leaves flat, long as culm, and sheathing the base; bracts long, leafy, with short sheaths; staminate spike one, rarely two, erect, cylindric, with oblong and obtusish black scales; stigmas two; pistillate spikes about two, erect, cylindric, half an inch long, pedunculate; fruit ovate, acutish, short-beaked, orifice two-lobed, brownish at the apex; pistillate scale ovate acutish, black, and shorter than the fruit. Found on the Rocky Mountains. Resembles C. *saxatilis*, but differs in fruit, and scale, and general appearance.

No. 139. C. *stenophylla*, Wahl.
Schk. Tab. G. fig. 32.
Wahl. No. 21.

Spiculis in caput subglobosum aggregatis, distigmaticis, superne staminiferis; fructibus subrotundis ventricosis convexo-planiusculis nervosis in margine serrulatis ore bidendatis, squamæ ovatæ acutæ subæqualibus.

Culm three to six inches high, smooth leafy; leaves sheathing towards the base, narrow, longer than the culm; spikelets androgynous, staminate above, several, aggregated into a roundish head; stigmas two; fruit ovate, roundish-ventricose, flattish, nerved, scabrous on the margin, and with a two-toothed mouth, about equal to the ovate, acute, and tawny scale.

Inhabits the Tyrol: it was found also by Dr. Richardson near Carlton House and on the Rocky Mountains. It closely resembles the figure of the European plant.

No. 140. C. *Schkuhrii*, Willd.
Schk. Tab. Qqq, fig. 158.
Willd. Sp. Pl. Tom. IV. p. 264.

Spicis distinctis, staminifera solitaria, pistilliferis subbinis *tristigmaticis*, sessilibus approximatis subrotundis parvifloris; fructibus obovatis brevirostratis subtriquetris-globosis ore bilobis, squamæ ovatæ acutæ vix æquantibus.

Culm six to eight inches high, triquetrous, scabrous, stiff; leaves sheathing, longer than the culm, but lower ones abbreviated, channeled, nearly flat, and scabrous on the edge; one staminate spike oblong and cylindric, with oblong and acutish scales brown, and white on the edge; stigmas three; pistillate spikes one to three, sessile, nearly ovate-globose, few flowered, with an ovate and cuspidate bract and sometimes leafy under the lowest spike; fruit obovate, globose, slightly triquetrous, short-rostrate, orifice two-lobed, scale ovate, acutish, brown, white on the edge, a little shorter than the fruit; color a bright green.

This species was found originally at the Caspian Sea. It was found also by Dr. Richardson at Lake Winipeg. According to Willd., the spkes have *three or six fruit, sometimes two or three.* Its resemblance to C. *supina*, described in Vol. XXVI of this Journal, is remarked by Willd., and Schk. Both the plants are unlike others in our country, and so near these descriptions, that there can be no doubt of their identity.

No. 141. C. *Carltonia*, Dewey.
Tab. U. fig. 64.

Spicis ternis ovatis sessilibus approximatis *tristigmaticis*, superiore androgyna inferne staminifera; fructibus ovatis acutiusculis plano-convexis lævibus ore integris, squamam ovatam acutiusculam æquantibus.

Culm a foot or more high, triquetrous, striate, scabrous, stiff, erect; leaves sheathing towards the base and shorter than the culm ; spikes three, sessile, ovate, near, upper one staminate below, and the others pistillate ; stigmas three ; fruit ovate, acutish, smooth, slightly nerved, flat below and convex above, tapering ; scale ovate, acute, equal to the fruit.

Northern regions near Carlton House. This is a beautiful and distinct species, and belongs in the same subdivision as C. virescens, &c.

No. 142. C. *Parryana*, Dewey.
Tab. U. fig. 65.

Spicis distinctis, staminifera solitaria erecta cylindracea, pistilliferis binis vel ternis *tristigmaticis* oblongis cylindraceis densifloris erectis; inferiore pedunculata bracteata; fructibus obovatis convexo-planis obtusis lævibus vix rostratis ore integris, squama ovata acuta vel submucronata paulo longioribus.

Culm eighteen inches high, erect, stiff, triquetrous, rough, striate, with leaves sheathing and shorter than the culm; staminate spike single, erect, cylindric, or rather tapering towards either end, with oblong scales, obtuse and white on the edge; pistillate spikes two or three, erect, cylindric, close fruited, highest sessile, lower pedunculate and with a leafy and nearly sheathless bract; stigmas three; fruit obovate, obtuse, convex above, flat beneath, subtriquetrous, nerved, orifice entire, and scarcely rostrate; pistillate scale ovate, acutish or sub-mucronate, dark brown, white on the edge, and a little shorter than the fruit; plant a light green. The fruit is compact and small.

This is a beautiful species, found by Dr. Richardson at Hudson's Bay. It seems to be wholly distinct from any heretofore described.

No. 143. C. *arctica*, Dewey.
Tab. V. fig. 66.

Spicis subternis *tristigmaticis* ovato-cylindraceis sessilibus, infima pedunculata bracteata, suprema inferne staminifera; fructibus ovatis plano-convexis obtusis brevissimé-rostratis ore integris, squama ovata obtusa paulo longioribus.

Culm eight inches high, erect, stiff, triquetrous, slightly scabrous; leaves at the base short and flat; spikes three to four, ovate-oblong, round, sessile except the lowest which has also a leafy bract; the highest is staminate below, with an obovate and brownish scale; stigmas three; fruit ovate, convex above, flat beneath, smooth, obtuse, very short-rostrate, dark brown; pistillate scales ovate, obtuse, dark brown, white on the edge, a little shorter than the fruit.

Belongs in the subdivision with C. virescens, &c. and is a distinct and beautiful species, found by Dr. Richardson near Carlton House in the Northern regions.

Note.—The following species was described in Vol. XI. p. 161. The following more full description is taken from specimens from the arctic regions.

C. *aristata*, R. Br.
Schw. and Torrey, No. 104.
Tab. V. fig. 67.

Spicis distinctis, staminiferis binis vel pluribus erectis sessilibus, fructiferis *tristigmaticis* subternis cylindraceis distantibus subdensifloris, inferiore pedunculata, cæteris subsessilibus; fructibus ovato-lanceolatis longo-rostratis alto-bifidis nervosis glabris, squama ovata aristata longioribus.

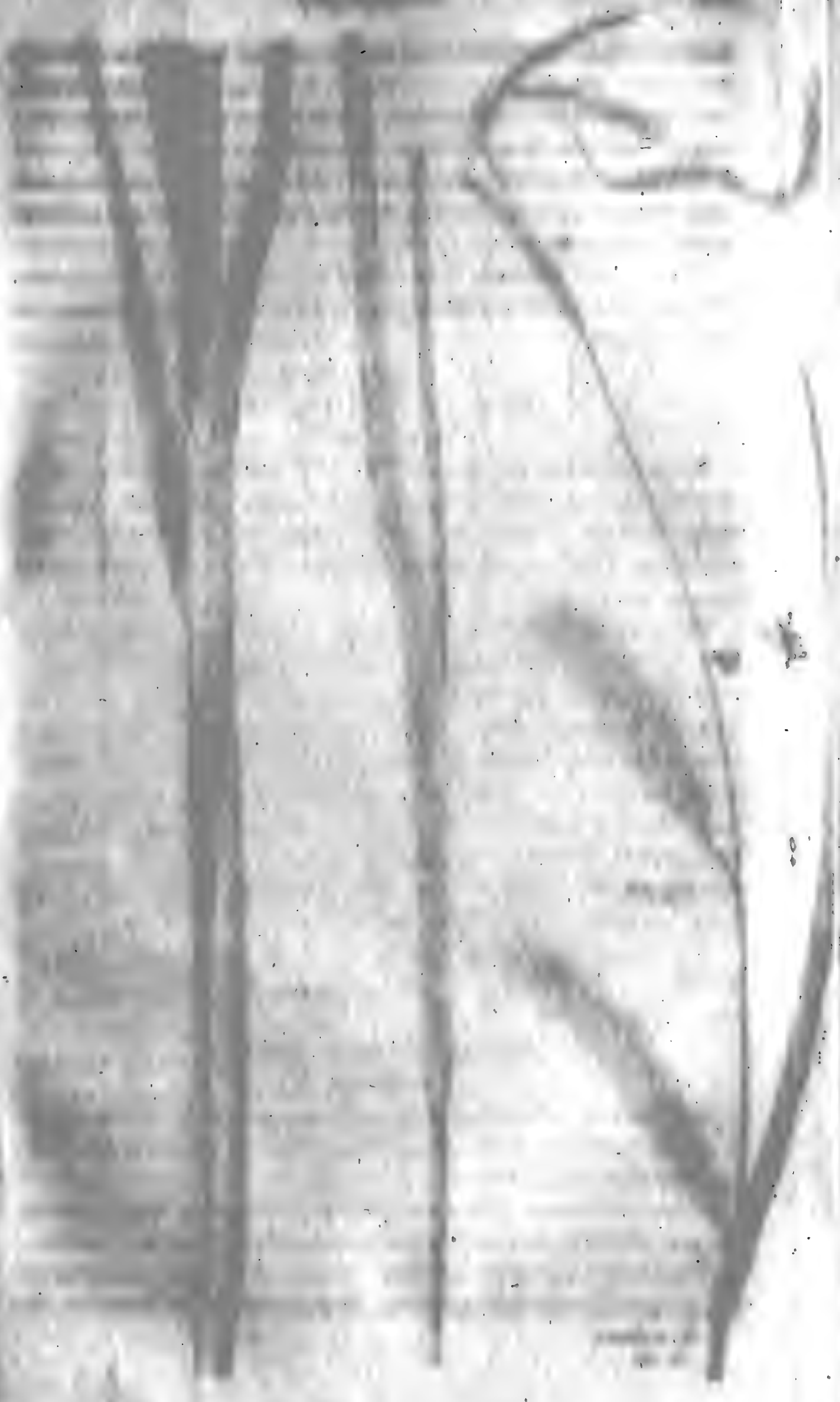
Culm one or two feet high, erect, triquetrous, scabrous above, leafy, with long leafy sheathing bracts; leaves flat, long, linear-lanceolate, striate, rough on the edge, and villose under side and on the sheaths; staminate spikes two to four, erect, cylindric, sessile, sometimes with a few scattered fruit, and with lanceolate and curved scales rough at the point; stigmas three; pistillate spikes two to four, oblong, cylindric, rather distant, upper subsessile, and lower pedunculate, bracted, rather densely flowered; fruit ovate, long-rostrate, glabrous, nerved, smooth, little ventricose, deeply bifid; scale ovate, awned, and the whole shorter than the fruit.

Found near Cumberland House by Dr. Richardson, and seems to be between C. bullata and C. ampullacea. It is a large and handsome species.

No. 144. C. *ursina*, Dewey.
Tab. V. fig. 68.

Spica unica, inferne staminifera, globosa, densiflora, tristigmatica; fructibus ovatis compressis lentiformibus lævibus; squama ovata suborbiculata paulo longioribus.

Culm two to three inches high, striate, triquetrous; leaves narrow, involute, filiform, sheathing at the base; spike single, round, globose, small, densely flowered, pistillate above, three or four staminate flowers at the base; stigmas three; fruit ovate, flattish, roundish, ob-



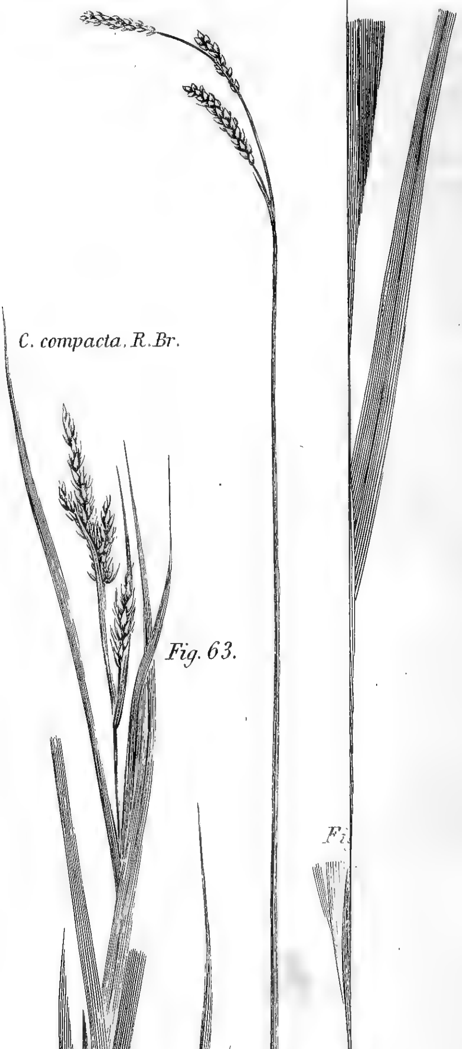


Fig. 63.

tusish, smooth, pistillate scale ovate, rather obtuse, a little smaller than the fruit.

Found by Dr. Richardson on the sea coast of Arctic America. This is the species called by Dr. Richardson, C. *filifolia* of Nuttall; but this is a very different species except in size and leaves, and has three or four staminate flowers at the base of the spikelet.

Figures of the following species accompany this paper.

C. *compacta*,	R. Br.	Tab.	U.	fig.	63.
— *Carltonia*,	D.	"	"	"	64.
— *Parryana*,	D.	"	"	"	65.
— *arctica*,	D.	"	V.	"	66.
— *aristata*,	R. Br.	"	"	"	67.
— *ursina*,	D.	"	"	"	68.

ART. VII.—*Contributions to Chemical Science;* by W. W. MATHER, Instructor of Mineralogy and Geology and assistant Prof. of Chemistry at the U. S. Military Academy, West Point.

I. *Chloride of Aluminium and its Analysis.*

A short notice was published in this Journal, Vol. xx, p. 408, of some chloride of aluminium made by Wöhler's process, in 1831, and of some metallic aluminium, obtained by decomposing the chloride by means of potassium. The chloride of aluminium, was of a sulphur yellow, crystallized, soft, volatile, slightly fuming in the air, attracted moisture from the air and gradually deliquesced into a thick, oily, lemon yellow liquid, of a greater density than water. The solid chloride of aluminium, when put into water, emitted a sound like that of a hot iron plunged in water, and dissolved completely, forming a perfectly limpid and colorless solution. I find no account of this chloride having been analyzed. Thomson in his Inorganic Chemistry calls it chloride of aluminium.

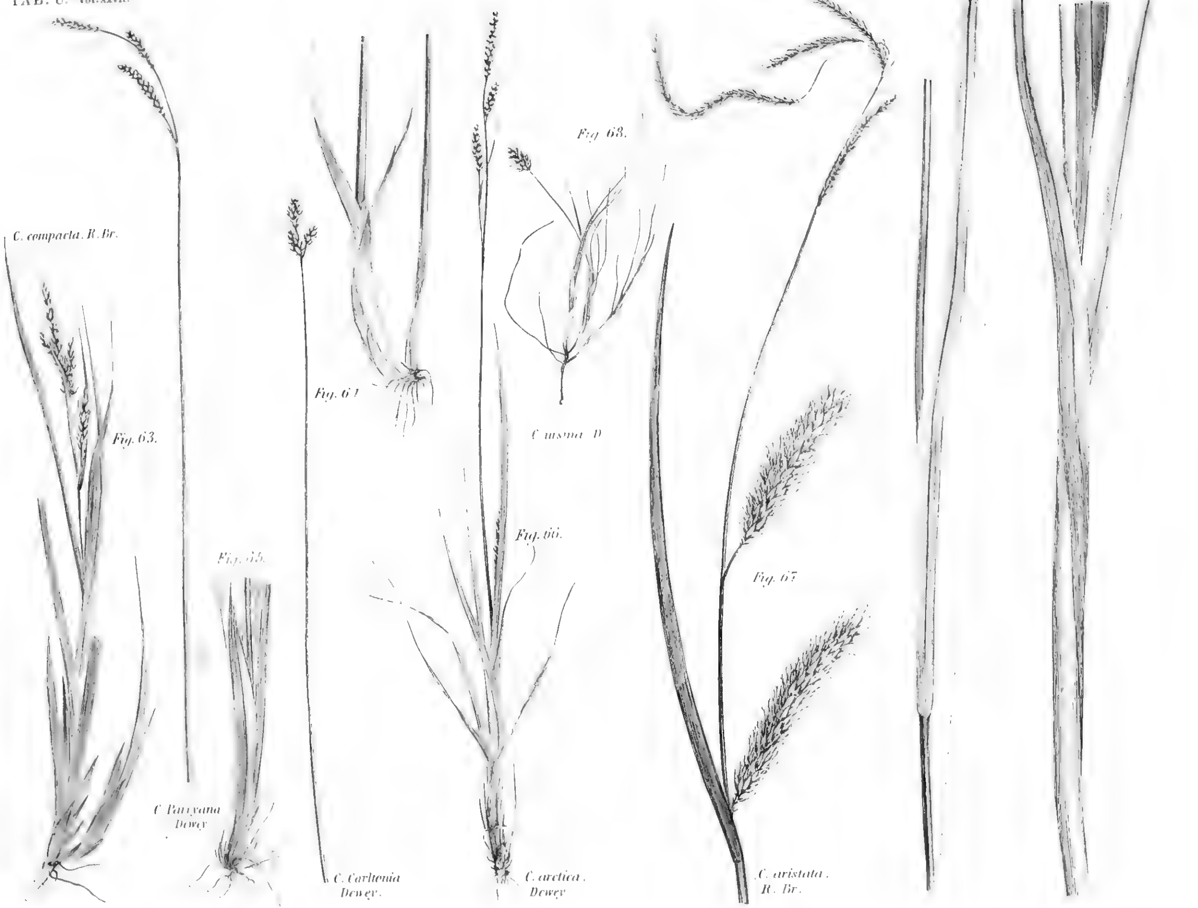
In the reports of the British Association for the advancement of science, page 492, the chloride of aluminium is said to be composed of 2 al. + 3 cl., but without reference to any authority.

Thomson and some others consider alumina as a protoxide of aluminium, and that the chloride derived from its decomposition would, by the application of a general principle, be a proto-chloride.

Probably Berzelius and Mitscherlich form their opinion of its being a sesquichloride from an application of the same principle, the

TAB. U. Vol. XXVII.

TAB. V. Vol. XXVII.



oxide of aluminium being considered by them and others as a sesquioxide, from its isomorphism with the oxide of chromium, and the peroxides of iron and manganese. With a view of ascertaining whether the chloride of aluminium be a chloride or sesquichloride, the following analysis was undertaken. It was thought also, that by means of an accurate analysis of this compound, the atomic weights of aluminium and alumina might be determined. The compounds of alumina heretofore analyzed have been such that no *certain* deductions could be made of the atomic weight, of either the metal or oxide of aluminium. Thomson from an analysis of many minerals and compounds in which he deduces atomic weights varying from 2.0580 to 2.3168, oxygen being unity, finds the mean to be 2.24205, and as this is near 2.25 he assumes that number as the atomic weight of alumina, in accordance with what he considers a general principle, viz. that the atomic weights of all bodies are multiples by whole numbers of the atomic weight of hydrogen.*

Berzelius gives the atomic weight of aluminium 1.71166, oxygen being unity.† The numbers of Thomson and Berzelius for aluminium being so different and in no simple ratio to each other, neither is to be depended on as accurate, unless confirmed by accurate analysis.

Lest there should be some unperceived cause of error leading to erroneous deductions, all the steps of the analysis are given below, so that if there be error, it may be detected.

The balance used weighs easily $\frac{1}{300}$ grain, and is sensible to $\frac{1}{700}$ grain.

Analysis of the Chloride of Aluminium.

A. Some of the chloride of aluminium in fine crystals, when first taken from the tube in which it was made, was put into a small dry glass tube and hermetically sealed. The chloride had been kept thus for three years, and had undergone no change in its appearance. The tube when wiped dry and clean, weighed with its contents 5.027 grammes. The tube was then slightly cut with a file, the dust from filing being made to fall into the scale of the balance, then broken in two where it had been scratched by the file, and thrown into some pure distilled water. An intense action with a hissing sound like that of hot iron under water, continued until the chloride was entirely de-

* Thomson's Elements of Chem. i. p. 306.

† Gaudin, Ann. de Ch. et de Physique, T. lii. p. 132.

composed. There was no visible particle of residue, and the solution was perfectly transparent and colorless. The tube was removed and repeatedly washed with pure water, and the washings added to the solution of the chloride.

The tube when dry and wiped as before, together with the filings of glass weighed 4.381 grammes. The chloride of aluminium in the tube weighed $5.027 - 4.381 = 0.646$ grammes.

B. Nitrate of silver was added to the solution (A) in slight excess, the precipitated chloride of silver being repeatedly stirred well around with a glass rod to prevent any of the solution from being mechanically enclosed by it, and from thus remaining unacted on. When the supernatant liquid became perfectly limpid, it was carefully drawn off with a glass syringe. The precipitate was repeatedly washed with pure water, and the clear liquid drawn off in the same manner. The chloride of silver was thrown upon a double filter of equal weights, care being taken to wash every visible particle of the chloride from the precipitating glass into the filter. The washing was then continued until there was no trace of cloudiness in the washings on adding a drop of muriatic acid, (a small excess of nitrate of silver having been employed in precipitating the chloride.) The edges of the filter were kept continually wet with a dropping bottle, and to prevent any evaporation on the filter and consequent deposition of matter in solution, the funnel in which the filter was contained was kept covered with a glass plate, except when the dropping bottle was in requisition to wash down the edges of the filter. After the washing was finished, the funnel containing the filter, was placed in a stand on the sandbath, and covered loosely with paper to prevent the access of dust and to allow the evaporation to go on with little obstruction. The filter when nearly dry was removed from the funnel, placed on a capsule on the sandbath, and still covered with paper. In this the evaporation was more uniform than in the funnel. In a few days the drying was as complete as the temperature of the sandbath could make it.* The filters were separated and placed in the opposite scales of the balance. The filters being of equal weight, the difference in weight between the loaded and unloaded filter, would give the weight of chloride of silver. This difference of weight was 2.056 grammes.

2.002 grammes of this chloride were fused on a piece of thin green glass weighing 2.996 or both weighed 4.998 grammes. After fu-

* The temperature ranged from 100° to 220° F.

sion the chloride and glass weighed 4.997 grammes. The 2.002 grammes of chloride of silver lost by fusion 0.001 grammes and the whole chloride of silver would have weighed after fusion 2.0549731.

C. To ascertain the relative proportion of chlorine and silver in the chloride of silver, independent of any atomic weights, the fused chloride of silver, weighing 2.001 grammes, was reduced to the metallic state, by placing the piece of glass on which it was fused, and to which it was still adhering, in a capsule, with a piece of zinc lying on the chloride, and then pouring on enough water, slightly acidulated with sulphuric acid, to cover it. In 24 hours the reduction was complete, and the mass of reduced silver had detached itself from the glass. The silver was well washed, but on account of its porosity it was impossible to separate all the traces of sulphate and muriate of zinc, and consequently it could not be weighed, when dry, with any certainty of the accuracy desired. To remedy this evil, the mass of silver was fused, with a little borax, on a piece of compact charcoal, and to prevent the loss that is apt to be experienced from the spirting which takes place when pure silver is solidifying, the globule, as soon as it began to congeal, was taken in the forceps, and thrown into cold water. A few minute particles of silver were observed in the borax, on the charcoal. To obtain these, the borax was fused into a globule, and thrown, when hot, into an agate mortar, containing cold water. This was then ground down, and the borax was mostly separated from the silver. The silver and remaining borax were again fused, and the particles of silver coalesced into one globule; but some care and skill are necessary in the operator, to enable him to succeed in this completely. The small globule of silver obtained, of perhaps $\frac{1}{50}$ grain weight, was placed on the larger globule, and both fused again, to free their surfaces from slight traces of adhering borax.

When the globule began to congeal, it was thrown into water as before, to prevent loss. I do not think that in the reduction and fusions there could have been a loss of $\frac{1}{1000}$ grain in weight. The globule of silver obtained weighed 1.5075 grammes. The chloride from which it was obtained weighed 2.001 grammes, consequently the whole chloride of silver obtained, had it been reduced, would have given 1.548161 grammes of silver, for 2.001 cl. s. : 1.5075 s. :: 2.0549731 cl. s. : x, and x=1.548161. The chlorine then, estimated by difference in the 2.0549731 grammes of chloride of silver is 0.506811 grammes, for 2.0549731 cl. s. − 1548161 s. = 0.506811 cl.

D. To the solution filtered from the chloride of silver, (vide B,) and containing an excess of nitrate of silver, pure muriatic acid was added in excess, to precipitate all the silver as a chloride, the same precautions being taken to avoid loss by mechanical enclosure as are detailed in B. The washings were continued until there was not the slightest trace of cloudiness visible in testing with nitrate of silver, and the solution and washings, containing nitrate and muriate of alumina, were evaporated to dryness. The evaporation was conducted slowly, the liquid not being allowed to boil at any time, and during the latter part of the process, the temperature was carefully regulated, to prevent any loss from the swelling up and breaking of the bubbles, which are then apt to form. The evaporation was conducted, in a capsule of one gill capacity on the sand bath, adding the solution and washings as there was room for them.

The dry mass resulting from the evaporation was removed by an ivory spatula, and placed in a small platinum crucible. A little of the nitrate and muriate of alumina adhered to the capsule, and to obtain the last traces, a little water was added to dissolve it, and this was evaporated in a smaller space. This was detached, as much as could be by the spatula, and the same operation repeated. There was still a *visible trace* of the nitrate and muriate of alumina, but so small as to be inappreciable by our most delicate balances.

The muriate in solution, in the two last operations, was not put into the crucible until evaporated to dryness, because it might create a loss by bubbling up during the evaporation; and secondly, there being a little nitric acid present, as well as muriatic acid, there would be some muriate of platinum formed, which, during the subsequent ignition, would leave platinum mixed with the alumina, and thus increase its weight. The dry mass in the crucible was then heated over a lamp to about 500° F. Soon after the heat was applied, a slight transparent coating, like the chloride of aluminium in color, appeared on the under side of the cover of the crucible, but it soon disappeared as the heat was increased. It is *possible* that the muriate of alumina, in presence of nitric acid, may be decomposed into chloride of aluminium and a higher oxide than that in the muriate.* The crucible was finally ignited.

* To ascertain if what is above suggested be true, some of the hydrated chloride of aluminium, dissolved in water, was evaporated to dryness, and then heated to from 400° to 800° F., but no chloride of aluminium was evolved. Muriatic acid was abundantly given off and condensed in the cool part of the tube receiver.

The crucible and alumina, when cool, (the cover having been retained in its place to prevent the access of damp air,) weighed 16.4755 grammes.

The crucible weighed 16.1780 grammes.

The alumina, is equal to the difference of these weights, =0.2975 grammes.

On removing the alumina from the crucible, it was observed to be very slightly stained gray, where it had been in contact with the platinum. This was caused by the formation of a little muriate of platinum, which was decomposed during the subsequent ignition. This source of error might have been avoided, by decomposing the nitric acid by means of a greater excess of muriatic acid. The error was probably so slight that it would have made no sensible difference in the result, and its tendency is to counteract the slight source of error before noticed, (a *visible* trace of the nitrate and muriate of alumina not being added to that in the crucible.)

As a check upon the weight obtained above for alumina, it was weighed, ten minutes afterwards, separate from the crucible, but in the mean time it had been exposed to the air of the room. The room had had a fire made in it but a short time, so that the air was rather damp. The alumina then weighed 0.306 grammes, and twenty minutes after it weighed 0.312 grammes.

The chlorine in 0.646 grammes of the chloride of aluminium has been found to be 0.5068118. The aluminium is then equal, by difference, to 0.646 cl. al. − 0.5068118 cl. = 0.1391882 grammes.

From what precedes, the chloride of aluminium obtained by Wöhler's process is composed of

Chlorine, - - -	0.5068118	or	78.4538
Aluminium, - - -	0.1391882	"	21.5462
	0.6460000		100.0000

Admitting the weights obtained in the preceding analysis as accurate, the following numbers are chemical equivalents.

Second, some hydrate of alumina was dissolved in muriatic acid, and when the solution was evaporating, nitric acid was added. The solution was evaporated to dryness, put in a tube hermetically closed at one end, then drawn down to a narrow neck, communicating with the wider part of the tube, to serve as a receiver, and the tube beyond drawn down to a long narrow neck. The heat was raised very gradually, as in the experiment of heating the muriate in the platinum crucible, but muriatic acid and some fumes of nitrous acid only were evolved.

a	0.6460000	Chloride of aluminium.
	2.0549731	Chloride of silver.
	1.548161	Silver.
	0.506811	Chlorine.
	0.297500	Alumina.
	0.139188	Aluminium.

Before we can determine whether the chloride analyzed be a chloride or sesqui-chloride of aluminium, it will be necessary to adopt some atomic numbers, and compare the combining proportions obtained in the analysis with the number adopted.

The numbers in common use are those of Thomson and Berzelius.

Atomic weights according to

		Thomson.		*Berzelius.*	
		Oxygen. 1	Oxygen. 8	Oxygen. 1	Oxygen. 8
b	Silver,	*13.75	110	*13.51607	108.1285
	Chlorine,	*4.50	36	*4.42650	35.4120
	Aluminium,	†1.25	10	‡1.71166	13.6932
	Alumina,	§2.25	18	**6.42332	**51.471

The atomic weight of chlorine in Berzelius' number of the above table (b) is double the number that he assigns it, for he thinks the combination of silver and chlorine a bichloride.

Let us now calculate the atomic weight of chlorine, using the combining proportions of silver and chlorine deduced from the preceding analysis, and Thomson's and Berzelius' number for silver.

	Silver.		Chlorine.		S.		Cl.	Cl.
c	1.548161‖	:	0.506811‖	: :	13.75¶	:	x and	$x=4.50125$
	1.548161‖	:	0.506811‖	: :	13.51607¶	:	x' and	$x'=4{\cdot}42467$

The numbers deduced for the atomic weight of chlorine differ from those of both Thomson and Berzelius only in the third place of decimals. Let us now calculate the atomic weight of silver upon the same data, only using Thomson's and Berzelius' numbers for chlorine.

	Chlorine.		Silver.		Cl.		S.	S.
d	0.506811‖	:	1.548161‖	: :	4.5¶	:	x and	$x=13.74617$
	0.506811‖	:	1.548161‖	: :	4.4265¶	:	x' and	$x'=13.52165$

* Thomson's Inorganic Chemistry, Lond. 1831, Vol. I. p. 633.

† Idem, Vol. I. p. 454, and Thomson's First Principles, Vol. I. p. 318.

‡ Annales de Chimie et de Physique, Tome LII. p. 132.

§ Thomson's Inorganic Chemistry, Vol. I. p. 454, and Thomson's First Principles, Vol I. p. 318.

‖ Vide table a. ¶ Vide table b.

** Berzelius' Traité de Chimie, Tome v. p. 9, table synoptique.

The atomic numbers deduced from the above proportions, differ from those of Thomson and Berzelius only in the 4th place of figures.

As the numbers deduced for chlorine and silver approach so near to the atomic weights deduced by both Thomson and Berzelius, we see that these chemists have obtained the same *ratio* for the combining proportions of chlorine and silver.

The tables e and f shew the result of the calculations c and d, and they also shew the comparison of the calculated atomic weights of chlorine and silver with the atomic weights of those bodies as given by Thomson and Berzelius.

		Thomson's number.		*Calculated number.*	
		Ox.=1.	Ox.=8.	Ox. =1.	Ox.=8.
e	Silver,	13.75*	110.	13.74617†	109.96936
	Chlorine,	4.50*	36.	4.50125§	36.01000

		Berzelius' number.		*Calculated number.*	
		Ox.=1	Ox.=8.	Ox.=1.	Ox. 8.
f	Silver,	13.51607*	108.1285	13.52165†	108.17320
	Chlorine,	4.42650*	35.4120	4.42467§	35.39736

The ratios of the numbers for chlorine and silver in the above tables (e and f, and a) are

1st,	For Thomson's numbers, - -	3.05555
2d,	" Berzelius' " - -	3.05344
3d,	" Calculated numbers in e, -	3.05385
4th,	" " " " f, -	3.05696
5th,	" Numbers deduced from analysis,	3.05476

These ratios differ only in the 3d place of decimals, and even there the difference is small.

Let us now calculate the atomic weight of aluminium, using in the 1st proportion, *Thomson's* atomic weight for chlorine,

in the 2d, the atomic weight of chlorine deduced by calculating from the combining proportions observed,‡ and *Thomson's* number for silver;

in the 3d, *Berzelius'* atomic weight for chlorine;

in the 4th, the atomic weight of chlorine deduced by calculating from the combining proportions observed,‡ and *Berzelius'* number for silver.

		Al.	Cl.	Cl.	Cl. Al.	Cl.
g	1,	$x+$4.50000*	: 4.50000	: : 0.646‡	: 0.5068118‡	$x=$1.23585
	2,	$x'+$4.50125§	: 4.50125	: : 0.646‡	: 0.5068118‡	$x'=$1.23620
	3,	$y+$4.42650*	: 4.42650	: : 0.646‡	: 0.5068118‡	$y=$1.21567
	4.	$y'+$4.42467§	: 4.42467	: : 0.646‡	: 0.5068118‡	$y'+$1.21516

* Vide table b. † Vide table d. ‡ Vide table a. § Vide table c.

The values of x, x', y, y', are the atomic weights of aluminium as deduced above. They approach to Thomson's number for aluminium but not to that of Berzelius.

If the chloride of aluminium analyzed be a sesquichloride, the atomic weight of aluminium calculated as above would be

$$h\begin{cases} x=1.85377 & y=1.82350 \\ x'=1.85430 & y'=1.82274 \end{cases}$$

Thus it seems that the atomic number calculated for aluminium, upon the supposition that the chloride contains 1 al.+1 cl., is smaller than Thomson's, and 1 al.+1½ cl. is larger than that of Berzelius.

If the atomic weight of alumina be determined, we shall from that be enabled to determine whether the chloride of aluminium be a chloride or sesquichloride. Berzelius says that alumina is composed of

Aluminium,	-	53.3
Oxygen, -	-	46.7
		*100.0

Let us see how this corresponds with the analysis of chloride of aluminium.

	Alumina.		Aluminium.		Alumina.		Aluminium.
i	100	:	53.3	::	0.2975†	:	x and $x=0.158567$
	Alumina.		Oxygen.				Oxygen.
	100	:	46.7	::	0.2975†	:	y and $y=0.138932$

But the aluminium obtained was 0.139188†, and the oxygen in the alumina was 0.1583118§. These numbers deduced from experiment, correspond very closely with those deduced from Berzelius' composition of alumina, *but they are inverse to each other.*

I infer from this, that the numbers as laid down in Berzelius' Traité de Chimie for oxygen and aluminium in the composition of alumina, were accidentally transposed in the original manuscripts of his experiments.‡ I have no doubt that the composition of alumina should have been written,

* Traité de Chimie, Tome II. p. 373. † Vide table a.

§ 0.1583118 oxygen =0.2975 alumina — 0.139188 aluminium.

‡ The same kind of error occurs in Haüy's Traité de Mineralogie, 2d Edition, Tome II. p. 214. The angles of the rhomboid of nitrate of soda are there laid down P on P′ or P′ 106° 16′
p " p′ " p″ 73° 44′

In measuring some fine crystals of this salt in 1830, by the reflective goniometer I found the angles to be P on P′ or P″ 106° 44′
p " p′ " p″ 73° 16′

The minutes in Haüy are inverse to those observed. I do not know that this error has been observed or corrected.

Aluminium, - - -	46.7
Oxygen, - - -	53.3
	100.0

If the atomic weight of aluminium be calculated, supposing Berzelius' numbers in the composition of Alumina, to have been accidentally transposed as suggested above, we find it to be 0.876172; for

	Oxygen.		Aluminium.		Oxygen.		Aluminium.	
i′	100	:	x	::	53.3	:	46.7	whence $x=0.876172$

This number is a little more than one half that of Berzelius. $2x=1.752344$, and Berzelius' number calculated from a sesquioxide composed of 46.7 ox. and 53.3 al. is 1.71166. The correspondence of the oxygen in the water of the hydrates of alumina with that in the base, and a similar principle in reference to some other compounds appear to have weighed with that distinguished chemist in confirming him in the composition of alumina, and the atomic weight of aluminium as given by him, but the compositions by transposing his numbers in alumina still correspond with definite proportions.

The composition of *alumina* from my experiments is,

Aluminium, - -	46.7859
Oxygen, - - -	53.2141
	100.0000

	Alumina.		Oxygen.		Alumina.		Oxygen.	
for	100	:	x	::	.2975*	:	.1583118*	$x=53.2141$
	Alumina.		Aluminium.		Alumina.		Aluminium.	
j	100	:	y	::	.2975*	:	.139188*	$y=46.7859$

The atomic weight of *aluminium* deduced from my experiments independently is 0.87920118 for

	Oxygen.		Aluminium.		Oxygen.		Aluminium	
j′	1.00	:	x	::	53.2141	:	46.7859	whence $x=.87920118$

To ascertain whether alumina be an oxide or a sesquioxide, we will deduce the atomic numbers for alumina, 1st, upon the supposition that the chloride analyzed was a neutral chloride, (vide k.) and 2d, that it was a sesquichloride, (vide n.) The correspondence of the atomic numbers, will also demonstrate whether the chloride be neutral in composition or a sesquichloride.

---

* Vide table a.

	Alumina.		Aluminium.		Alumina.		Atomic weights of Aluminium.	
k	1, 0.2975*	:	0.139188*	::	x	:	1.25000†	x=2.67174
	2, 0.2975	:	0.139188	::	y	:	1.71166†	y=3.65849
	3, 0.2975	:	0.139188	::	x'	:	1.23585‡	x'=2.64149
	4, 0.2975	:	0.139188	::	x''	:	1.23620‡	x''=2.64224
	5, 0.2975	:	0.139188	::	y'	:	1.21567‡	y'=2.59836
	6, 0.2975	:	0.139188	::	y''	:	1.21516‡	y''=2.60446
	7, 0.2975	:	0.139188	::	z	:	0.87617§	z=1.87272
	8, 0.2975	:	0.139188	::	z'	:	0.87920‖	z'=1.8792014

These values give respectively the following composition for alumina.

		x	x'	x''	z
l	Oxygen,	1.42174	1.40564	1.40604	0.99655
	Aluminium,	1.25000	1.23585	1.23620	0.87617
	Alumina,	2.67174	2.64149	2.64224	1.87272
		y	y'	y''	z'
	Oxygen,	1.94683	1.38269	1.38930	1.00000022
	Aluminium,	1.71166	1.21567	1.21516	.87920118
	Alumina,	3.65849	2.59836	2.60446	1.87920140

The oxygen in x x' x'' y' and y'' makes a distant approximation to a sesquioxide; y approaches a deutoxide; but that of z deduduced from Berzelius' reversed numbers, (vide i' and k,) and of z' deduced the results of my experiments, approaches very near to the ratio of that in a protoxide.

The atomic weight of aluminium, upon the supposition that the chloride is a sesquichloride, would be

m { in No. 7 of k=1.31425
and " " 8 " k=1.31880

We can now calculate the atomic weight of alumina, considering the chloride a sesquichloride.

	Alumina.		Aluminium.		Alumina.		Atomic weights of Aluminium.	
n	2, 0.2975*	:	0.139188*	::	y	:	1.71166††	y=3.65849
	3, 0.2975	:	0.138188	::	x'	:	1.85377‡‡	x'=3.96222
	4, 0.2975	:	0.139188	::	x''	:	1.85430‡‡	x''=3.96336
	5, 0.2975	:	0.139188	::	y'	:	1.82350‡‡	y'=3.89754
	6, 0.2975	:	0.139138	::	y''	:	1.82274‡‡	y''=3.90669
	7, 0.2975	:	0.139188	::	z	:	1.31425§§	z=2.80908
	8, 0.2975	:	0.139188	::	z'	:	1.318801§§	z'=2.81880

---

* Vide table a. † Vide table b. ‡ Vide table g. § Vide table i′.
‖ Vide table j′. †† Vide table b. ‡‡ Vide table h. §§ Vide table m.

These results give the following values for the composition of alumina.

		x'	x''	z	z'
o	Oxygen,	2.10843	2.10906	1.49496	1.5000004
	Aluminium,	1.85379	1.85430	1.31425	1.3188017
	Alumina,	3.96222	3.96336	2.80921	2.8188021
		y	y'	y''	
	Oxygen,	1.94683	2.07404	2.08395	
	Aluminium,	1.71166	1.82350	1.82274	
	Alumina,	3.65849	3.89754	3.90669	

The values of x', x'', y, y', y'', make a distant approximation to the ratio of a deutoxide. More confidence is placed in the values of z and z', than in the others, for reasons already explained. z is calculated from the results of my own experiments, and the atomic number for aluminium, deduced from the inverted numbers of alumina, as given by Berzelius, (Vide tables i, i′ and k.) The value of z' is calculated from the results of the preceding analysis and the atomic number deduced from those results independently. (Vide tables a, j, j′, and k.)

The values of z and z' in tables k and l, calculated upon the supposition that the chloride analyzed was a neutral chloride, approach, very near to the ratio of a protoxide while in tables n and o calculated upon the supposition that the chloride was a sesquichloride, the values indicate a sesquioxide. It follows then that if alumina be considered a protoxide, the chloride analyzed, was a protochloride, if a sesquioxide, the chloride is a sesquichloride.

The atomic weight of aluminium, is then, according to these experiments 0.87920118, or 1.31880177 according as we consider alumina a proto, or sesquioxide.

From the circumstance that alumina is isomorphous with the oxide of chromium and the peroxides of iron and manganese it may be supposed a sesquioxide, and its composition would be

Oxygen,	1.5000004 = $1\frac{1}{2}$ atoms	= 53.2141
Aluminium,	1.3188017 = 1 atom	= 46.7859
Alumina,	2.8188021	100.0000

Hydrogen being taken as the unit, and oxygen called 8, the composition would be

Oxygen,	12.0000 = $1\frac{1}{2}$ atoms.
Aluminium,	10.5504 = 1 atom.
Alumina,	22.5504

II. *Hydrated Chloride of Aluminium.*

(A) A phial containing chloride of aluminium was closely corked; but this did not entirely exclude the access of moisture, and during three years that it had been thus enclosed, enough water had been absorbed to cause a portion to deliquesce into a thick, oily liquid of a deep lemon yellow color.

The liquid covered a portion of the solid yellow chloride, which is probably the hydrated chloride mentioned by Berzelius in his Traité de Chimie. The hydrated liquid chloride does not hiss in water like the anhydrous chloride, but sinks to the bottom without easily mixing. When mixed with water and agitated to make them unite, the color disappears and the solution becomes perfectly colorless and transparent.

A drop of the liquid chloride when heated in a small bulb with a capillary neck, gave off no water separately, but only in combination with muriatic acid, and alumina remained in the bulb.

Analysis.—A quantity of the liquid hydrated chloride of aluminium weighing 129 grains, was mingled with water enough to make the solution rather dilute. Ammonia was added to the solution and a gelatinous precipitate of alumina was thrown down. After standing some hours, the supernatant liquid, which was perfectly limpid, was drawn off, and pure water added to wash the precipitate. The clear liquid was again drawn off, and the precipitate repeatedly washed in the same way, being well stirred with a glass rod, each time that water was added. The precipitate was thrown upon a double filter of equal weights, the same precautions being used as in the preceding analysis, and washed until there was no longer a trace of cloudiness by adding nitrate of silver to the filtered water. The precipitated hydrate of alumina was dried on the sandbath, very gradually, for several days, that the drying might be uniform through the mass and the filter was loosely covered by paper to prevent the access of dust.

The hydrate of alumina weighed 25.25 grains. 23.125 grains of this hydrate weighed after ignition 16.13 grains, whence the alumina contained in the 25.25 grains of hydrate was 17.6559 grains.

(B) The solution from which the alumina had been precipitated, was evaporated, and the washings were added as there was room for them in the evaporating dish. When reduced to the bulk of 2 or 3 gills, nitrate of silver was added in excess, to precipitate the muriatic acid. The chloride of silver was treated as in the analysis of chloride of aluminium, and when dry weighed 138.125 grains. A quantity of this chloride weighing 135.5 grains was fused, and then weighed 131 grains, when the 138.125 of dry chloride,=133.537 of fused chloride,=32.932 grains of chlorine.*

(C) The alumina obtained was 17.6559 grains. If the combining proportions determined in the analys is of chloride of aluminium be adopted, 17.6559 of aluminia, and 8.261 of aluminium are chemical equivalents. The hydrated chloride analyzed weighed 129 grains, and the water must be=87.807 grains=129—(8.261 al. +32.932 cl.)

The liquid hydrated chloride of aluminium is then composed of

Chlorine,	(B)	32.932	25.52=1 atom.
Aluminium,	(C)	8.261	6.40=1 atom.
Water,	(C)	87.807	68.08=10 atoms,
		129.000	100.00

The balance used in this analysis was not a delicate one, like that used in the analysis of chloride of aluminium, but it would weigh $\frac{1}{25}$ grain.

The ratio of the chloride of silver and alumina obtained in this, is not exactly the same as that in the analysis of the chloride of aluminium.

In the former it is Cl. S. : A̶l̶. : :100 : 13.22.

In the latter it is Cl. S. : A̶l̶. : :100 : 14.47.

III. *Crystallized Tin from solution.*

During the month of March last, having occasion to form a solution of muriate of tin, some pure muriatic acid was poured upon an excess of spongy grain tin. The solution was formed on the sand

* 2.054974cl.s.† : 0.506795cl.† : : 133.537cl.s. : x and x=32.932.

† Vide table a in the analysis of chloride of aluminium.

bath, and it was so concentrated as to be oily in its consistency. The solution being more concentrated than was desired, it was diluted and allowed to stand on the sandbath, exposed to the air. In a short time the undissolved tin was observed to be coated with *crystals of metallic tin.* Some of the crystals were small and granular, having many facets; some were long acicular prisms; and others were in foliated plates and plumose, like the precipitated lead of the *arbor Saturni.* One of the acicular crystals, of the diameter of a horse hair, was mounted on the reflective goniometer. It had four brilliant planes, giving distinct reflected images, and each face inclined to the adjacent ones at angles of 90°. The experiment of crystallizing the tin was repeated many times with the same result, using not only the spongy, but also the columnar grain tin. In the latter, the acid developed a crystalline structure, and probably it is owing to this crystalline structure, that tin emits a peculiar crackling noise when bent.

If the solution containing the crystals of tin be set aside, in a cool place, for 24 hours, they redissolve. The concentrated solution, when set aside until cool, and then diluted with water, will also vegetate, but the crystals form more slowly than when the *hot* solution is diluted. The crystallization can be shown before a class in the lecture room, and it is more beautiful than that of the *arbor Dianæ.*

The explanation of the crystallization of the tin seems to be, that one portion of the protoxide of tin in solution gives its oxygen to the other, forming a permuriate, while the metallic tin derived from the decomposed protoxide separates, and its molecules having freedom of motion in the liquid, arrange themselves according to the laws of crystallization.

IV. *Georgia Gold.*

The Gold analyzed was clipped from a gold piece, used as a coin in the gold mining districts of the Southern states. This piece was stamped, "*Georgia Gold*"—"*Ten Dollars*"—*Templeton, Assayer.*" These pieces are made of the native gold, refined in the fire.

The pieces weigh 249 grains, which is equal to the weight of fine gold in an American eagle, coined prior to 1834. The specific gravity is 19.46, at 51° F. The gold is not fine, but an alloy of gold and silver, about 23 carats fine. Ammonia indicates a mere trace of copper in the nitro-muriatic solution. The analysis was made by solution in nitro-muriatic acid, separating, washing, and reducing the chloride of silver, then evaporating the gold solution very slowly to dryness, and finally igniting the muriate and fusing the reduced gold. The balance is accurate to $\frac{1}{300}$ grain.

3.958 grammes gave	Gold,	3.783	95.579
	Silver,	0.175	4.421
		3.958	100.000

V. *Silver of Lane's Mine.*

The silver analyzed below was obtained, by cupellation, from the galena of Lane's mine, in Munroe, Connecticut. The metal has all the characters of fine silver, except that it is rather harder.

(*a*.) 1.01 grammes of the metal, when treated with nitric acid, dissolved, except some brown flocculi, which were gold. The gold was collected, washed and fused into a globule, with a little borax, on charcoal, by the blowpipe. The globule weighed 0.004 grammes.

(*b*) The silver was precipitated by copper, washed, and fused into a globule with borax, on charcoal, by means of the blowpipe. The silver weighed 0.991 grammes. The copper was precipitated by iron, fused, and dissolved in nitro-muriatic acid. The silver held in solution by the nitrate of copper in the first precipitation, was thus changed into a chloride. This chloride of silver, during its fusion, fumed like antimony, and by reduction gave a globule of silver weighing 0.010 grammes.

(*c*.) The solution of silver in nitric acid, when tested for copper by ammonia, indicated a mere trace.

The silver then of Lane's mine contains

Silver, - -	(*b*.)	0.991 0.010	1.001	99.109
Gold, - -	(*a*.)	0.004	0.004	0.399
Antimony ? and loss,	(*c*.)	0.005	0.005	0.492
			1.010	100.000

The galena* of Lane's mine is remarkably rich in silver, and the silver contains enough gold to make the separation an object of some consequence. It is to be regretted that there is too little of the ga-

* Prof. Silliman had before observed this, vide this Journal, Vol. I, pp. 312, 316, 405, and Vol. IV, pp, 52, 187.

lena to warrant an exploration. Should the mine ever be wrought, it will yield a rich treat to the mineralogist. I found there *crystallized* and massive* yellow oxide of tungsten, crystallized and massive tungstate of lime, crystallized and massive wolfram,* native bismuth,* massive oxide of bismuth, acicular sulphuret of bismuth, and native* and auriferous tellurium. These are all in very small quantities. Magnetic and common pyrites are abundant, and galena and pyritous copper more rare. The gangue of these minerals, and of many others not mentioned, is a white fetid quartz, which does not seem to form a vein, but a bed of considerable extent, overlying gneiss. Gneiss is the prevailing rock of the country around, and it is often traversed by quartz and granite veins. The granite of the veins is the variety called graphic granite, and precisely similar to that of Goshen, Chesterfield, Willimantic, &c. and like those veins contains Cleavelandite, beryl, tourmalines blue and black, smoky quartz, &c. A bed of limestone overlies the gneiss within a few miles, and is traversed by veins of fluor spar, containing lepidolite, topaz, and some other fine minerals. The country in this vicinity offers all the mineralogical and geological associations of tin ores in Europe, but no tin ore has as yet been found.

I have some grains of gold, presented to me by the proprietor of the mine, which he said were picked out of the cavities in which pyrites had decomposed.

VI. *Iodide of Potassium and Platinum, or Iodo Platinate of Potassium.*

This compound has been prepared by M. Lassaigne, by the direct union of the biiodide of platinum with iodide of potassium.†

It may be more conveniently prepared by adding muriate of platinum to hydriodate of potassa in solution, leaving a slight excess of the latter, evaporating nearly to dryness, and then washing with alcohol as long as any color is communicated.

The double iodide of platinum and potassium, remains in black crystalline grains. It is soluble in water, and gives a fine deep red solution, as M. Lassaigne says, but the color is not permanent according to my experiments, for in a few minutes a black powder begins to

* Prof. Silliman had before observed this, vide this Journal, Vol. I. pp. 312, 316, 405, and Vol. IV, pp. 52, 187.

† Annales de Chimie et de Physique, Tome li, p. 125.

precipitate, and the solution is finally left colorless. This change is owing to the precipitation of the biiodide of platinum, while the hydriodate of potassa remains in solution.

M. Lassaigne may have observed this fact, as the principle is involved in the formation of the biiodide of platinum by his process, but he does not mention it.

Some of the iodoplatinate of potassium weighing 2.26 grains, was put into a small dry quill-glass tube, hermetically sealed at one end, and drawn down to a small beak at the other. The tube was heated to redness, and iodine vapors escaped in abundance. The loss of weight was 1.110 grains.

Adopting Thomson's and Berzelius' numbers for iodine, platinum, and potassium, upon the supposition that the compound is analogous in composition to the ammonia muriate of platinum, the loss would have been for Thomson's numbers, 1.08 grains, and for Berzelius' numbers, 1.109 grains. From the near approximation of the loss observed to the hypothetical composition, by the numbers of both Thomson and Berzelius, and particularly the latter, there is no doubt but it is composed of biiodide of platinum, 1 atom—iodide of potassium, 1 atom, or by

	Thomson's numbers.	By Berzelius' numbers.
Biiodide of platinum,	67.71	67.86
Iodide of potassium,	32.29	32.14
	100.00	100.00

VII. *Chloriodide of Platinum.*

This compound and the preceding, were observed by me in the winter of 1830. The iodoplatinate of potassium, had been observed by several persons; but not examined. Several years since Profs. Silliman, Torrey, Berzelius and others had observed the red color on adding hydriodate of potassa to muriate of platinum.

The chloriodide of platinum, is easily formed by adding an excess of hydriodic acid to muriate of platinum, evaporating to dryness, and heating the dry mass to about 300° F. The excess of hydriodic acid with some chloride of iodine, pass over into the receiver, while the chloriodide of platinum remains. It is a black powder, stains the fingers, is insoluble in water, slightly soluble in alchohol, soluble in potassa giving a red solution from which it is precipitated unchanged by sulphuric acid. At a temperature between 400° and 600° F. it is decomposed, brownish yellow vapor of chloride of iodine, and violet vapor of iodine are evolved, leaving the platinum in a spongy form like that obtained by heating the ammonia-muriate of platinum.

Some of the chloriodide of platinum was decomposed by heat. The loss of chlorine and iodine in the successive experiments was,

1. - - - - - -	67.20 per cent.
2. - - - - - -	70.50 " "
3. - - - - - -	67.22 " "
4. - - - - - -	68.50 " "

The variation in the amount of loss by vaporization, is due to the vapor carrying off some of the finely divided platinum, when the vaporization was rapid. On dissolving the iodine and chloride of iodine, which were condensed in the cool part of the tube in which the experiment No. 2 was performed, by solution of potassa, a residue of platinum was observed.

Synthesis of Chloriodide of Platinum.

Ten grammes of spongy platinum, recently prepared from the chloride manufactured by Robiquet and Boyeau of Paris, were treated with dilute nitromuriatic acid, that the iridium, palladium, &c. might remain undissolved. A black powder remained, and the solution being allowed to stand some days, that which had been held in suspension was deposited. It proved to be iridium. It was separated by careful decantation and washing, the washings after being allowed to stand on the powder a day each, were drawn off by a glass syringe and added to the solution of muriate of platinum. The iridium weighed 0.095 grammes. The solution of muriate of platinum was evaporated, so that when cold it was of the consistence of honey. Lest there should be some free nitric acid, which could not be separated by heat, without decomposing the muriate of platinum, some muriatic acid was added, to decompose any nitric acid that might be contained in the solution. The solution was then evaporated until it solidified in cooling. The solid muriate, or hydrated bi-chloride of platinum, was crystallized in long acicular crystals, radiating from the center to the circumference of the capsule, and weighed 24.64 grammes.

This muriate or hydrated bi-chloride of platinum was then dissolved in water, and hydriodic acid in excess added. The solution was evaporated to dryness. Hydrochloric acid passed over until the mass was dry, and then yellowish fumes of chloride of iodine in small quantity, until the heat was raised to near 300° F, when the fumes ceased to be evolved.

The chloriodide of platinum weighed 30.28 grammes. As the iridium separated from the platinum by solution, weighed 0.095 grammes, the platinum in the 30.28 grammes of chloriodide was 10.000 — 0.095 = 9.905 grammes. The chloriodide of platinum is then composed of

Chlorine and Iodine, - - - -	20.375	67.289
Platinum, - - - - - - - - -	9.905	32.711
	30.280	100.000

Analysis of Chloriodide of Platinum.

(a) One gramme of chloriodide of platinum was mixed with dry carbonate of potassa in a glass tube, and covered to some depth with the same. It was then decomposed by heat, chloride and iodide of potassium being formed.

(b) The contents of the tube (a) were dissolved in water, except the spongy platinum, which was separated by decantation, washing, and filtration upon a double filter of equal weights as in the preceding analyses. The dry platinum weighed 0.315 grammes.

(c) The decanted and filtered liquid (b) was treated with nitric acid, to drive off the carbonic acid from the carbonate of potassa.—A yellow tint was given to the liquid by chloride of iodine, which was formed by the nitric acid liberating its elements from their previous combinations. The odor of iodine was perceived as long as carbonic acid was evolved. There was thus a loss of iodine and perhaps also of chlorine.

(d) Nitrate of silver was added to the liquid (c) to throw down the chlorine and iodine, as chloride and iodide of silver. An abundant yellow precipitate fell, and this was separated from the colorless solution by decantation, washing and filtering. The precipitate was washed on the double filter as long as the washings gave any cloudiness to muriatic acid, (nitrate of silver having been used in excess as a precipitant.)

(e) The moist precipitate on the filter (d) was digested in ammonia, to dissolve the chloride of silver, and afterwards ammonia was made to pass through the precipitate as long as it left any residue by evaporation.

The ammoniacal solution of chloride of silver was evaporated to dryness, and the chloride fused and reduced.

The silver from the chloride weighed 0.20 grammes.

The iodide was also reduced and gave 0.50 grammes. These weights of silver are equivalent to 0.065 chlorine and 0.563 iodine if Thomson's numbers be adopted.

(f) One gramme of the chloriodide of platinum was heated, to see if it had absorbed any hygrometric moisture. The heat was raised to 300° F. Water condensed in the cool part of the tube, and the loss of weight was 0.03 grammes = 3 per cent.

Recapitulation.

Platinum,	(b) - - - - - -	0.315	31.50
Chlorine,	(e) - - - - - -	0.065	6.50
Iodine,	(c) - - - - - -	0.563	56.30
Water,	(f) - - - - - -	0.030	3.00
Loss,	- - - - - - - -	0.027	2.70
		1.000	100.00

There was an evident loss of iodine and probably of chlorine, vide (c). To remove this source of error, another analysis was made, the same method being used as before, except that in (c), nitrate of silver was added to the solution of carbonate, muriate and hydriodate of potassa; and carbonate, chloride and iodide of silver were precipitated. Nitric acid was then added to decompose the carbonate of silver, while the chloride and iodide remained. Two grammes of chloriodide of platinum previously heated to 300° F. to drive off all hygrometric moisture, were operated on. During the decomposition by heat, a little iodine vapor was perceived to escape above the carbonate of potassa, but the quantity must have been very minute.

The results of this analysis are

Platinum, - - - - - - -	.6500	32.50
Iodine, - - - - - - - -	1.1922	59.61
Chlorine, - - - - - - -	0.1406	7.03
Loss, - - - - - - - -	0.0172	0.86*
	2.0000	100.00

* If the loss, 0.86, be divided in proportion to the numbers indicating the proportions of chlorine, iodine and platinum, and added to those numbers respectively, the result of the analysis would be,

Platinum, - - - - - - - - -	32.78
Iodine, - - - - - - - - - -	60.13
Chlorine, - - - - - - - - -	7.09
	100.00

If we assume the relative proportions of chlorine and iodine in the above analysis as correct, the synthetical composition of iodochloride of platinum is

Platinum, - - - - - -	32.711
Iodine, - - - - - - - -	60.191
Chlorine, - - - - - - -	7.098
	100.000

Adopting Thomson's numbers for platinum, iodine, and chlorine, the atoms of these bodies in the above compound are nearly in the ratio of 7 : 10 : 4. From this we may conclude that it is composed of

Biiodide of platinum, - - -	5 atoms.
Bichloride of platinum, - - -	2 atoms.

VIII. *Crystallized perchloride of Platinum.*

Dr. Thomson after describing the perchloride of platinum, says, "It would not be easy to analyze this chloride; but it enters into combination with the chlorides of potassium, sodium, and ammonium, forming double chlorides which constitute regular salts. By the analysis of these chlorine salts it has been ascertained that the perchloride of platinum is a compound of

1 atom platinum, - - - - -	12
2 atoms chlorine, - - - - - -	9
	21*"

The synthesis of the chloriodide of platinum in the preceding article, affords the means of calculating the composition of the crystallized hydrated perchloride of platinum. It was there shown that 9.095 grammes of platinum, gave 24.64 grammes of crystallized hydrated perchloride of platinum.

Adopting Thomson's numbers for chlorine, platinum and water, the 9.095 of platinum would have 6.7874 of chlorine combined with it as a bichloride.

$$\overset{\text{Pl.}}{9.095} + \overset{\text{2 Cl.}}{6.7874} = \overset{\text{Pl.} + \text{2 Cl.}}{15.8824}.$$ The water of crystallization in the hydrated bichloride of platinum $= \overset{\text{Pl.}+\text{2 Cl.}+\text{Aq.}}{24.64} - \overset{\text{Pl.} + \text{2 Cl.}}{15.8824} = 8.7576$. The compound then contains

* Thomson's "Chemistry of Inorganic Bodies," London edition, 1831. vol. i. p. 664.

Platinum, - - -	9.0950	36.912
Chlorine, - - -	6.7874	27.546
Water, - - - -	8.7576	35.542
	24.6400	100.000

The atomic proportion of the water can now be determined.

$$\overset{\text{Pl.+2Cl.+Aq.}}{24.64} : \overset{\text{Pl.+2Cl.}}{15.8824} :: \overset{\text{Pl.+2Cl.}}{21} + \overset{\text{Aq.}}{x} : \overset{\text{Pl.+2Cl.}}{21} \quad \text{whence } x = 11.57$$

Thomson's atomic number for water is 1.125. The number of atoms of water there in the hydrated bichloride of platinum is $10.\frac{39}{100} = \frac{11.579}{1.125}$. The compound when crystallized, was not observed to be moist, but the atoms come out so near to 10, that it may be considered as composed of

Platinum,	1 atom,	- - - -	12	37.21
Chlorine,	2 atoms	- - - -	9	27.90
Water,	10 atoms,	- - - -	11.25	34.89
			32.25	100.00

IX. *Amalgam of Platinum.*

Muschin Pushkin describes an easy method of forming this amalgam. It may be more conveniently and quickly formed by heating the chloriodide of platinum with mercury in a tube. The iodine and chlorine combine with mercury and sublime, while the platinum in its nascent state combines with mercury, and remains in the bottom of the tube. The heat should be high enough to make the mercury boil. The amalgam after having been pressed in soft leather, to remove the excess of mercury, is a soft solid, having the same kind of feel, and emitting the same sound when pressed between the fingers, as the amalgams of gold and silver. It is several times heavier than the platinum of which it was formed.

X. *Iodide of Mercury.*

The iodide of mercury may be dissolved in hydriodic acid, which I have found a good solvent. Hydriodate of potassa is mentioned in some chemical authors, as a good solvent for iodide of mercury.

Iodide of mercury when fused, is of a dark color, volatilizes of a beautiful yellow, when the fused portion is congealing it is of a fine red, and when cold yellow. Solution of potassa changes the yellow to red, but does not decompose it. It seems from what precedes, that the color of the iodide of mercury, is dependent on the state of aggregation.

XI. *Solubility af bitungstate of Ammonia.*

(a) Fifty grains of crystallized bitungstate of ammonia were boiled with 200 of water. A part only was dissolved, and more water was added at intervals until the solution was complete, and the boiling was continued until nascent precipitation. The flask was then found to contain 800 grains of water.

(b) 100 grains of the same, required for its perfect solution 1600 grains of water, at 212° F.

(c) 50 grains of crystallized bitungstate of ammonia were repeatedly agitated with 900 grains of water, at a mean temperature of 60° F. 17 grains only of the salt were dissolved.

Hence the bitungstate of ammonia requires 16 parts of water at 212° F., and 53 parts of water at 60° F., for solution.

The bitungstate of ammonia was made by digesting moist recently prepared tungstic acid, with caustic ammonia, evaporating tbe solution to dryness, at a regulated temperature, then dissolving in hot water and crystallizing. Thomson, in his Elements of Chemistry, Vol. II, p. 66, in speaking of the action of reagents on bitungstate of ammonia, mentions that metallic tin and a drop of muriatic acid cause white flocks at first to separate, which gradually become blue, and a deep blue color covers the tin. I find tin to act more distinctly as a reagent *without the acid*, on the bitungstate of ammonia. The tin becomes almost instantly of a splendid blue, like that of a fine sword blade, and a blue precipitate soon begins to form, finally concealing the tin. The precipitate, by long standing, becomes white on the surface.

Muriate of cobalt is a good test of bitungstate of ammonia. It gives a voluminous precipitate of a lilac color, and a lilac colored solution, which, when dry, becomes blue, and when heated to drive off the muriate of ammonia, it changes to a green.

XII. *Disulphuret of Bismuth.*

A notice of this compound was published in this Journal, Vol. XXIV, page 189, with its synthesis. Afterwards the experiment was repeated: 720 grains of pulverized bismuth were well mixed with 240 grains of flowers of sulphur, and put in a covered crucible weighing 1706 grains. The crucible had been recently ignited to drive off hygrometric moisture. It was at first moderately heated, and after half an hour the heat was raised, first to a dull red, and then a cherry red for half an hour. The disulphuret weighed 719 grains. Bismuth is volatile at a bright red heat, which would account for the loss. To ascertain whether this mass was a definite compound, the following analysis was made.

Analysis.

(a) 176 grains of the disulphuret of bismuth were treated with nitric acid, a little diluted. Nitrous acid fumes were evolved in abundance for a little time, and after a few hours the action had entirely ceased. More acid was added, to be sure that all the bismuth was oxidized and dissolved, but no further action was observed.

(b) The solution (a) was carefully decanted from the lumps and sediment of sulphur and sulphate of bismuth, and these latter repeatedly washed with water acidulated with nitric acid, to prevent any precipitation of subnitrate.

The sulphur and sulphate of bismuth, when dry, weighed 23.3 grains.

The sulphur and sulphate by ignition lost 8.8 grains of sulphur.

The remainder, which was sulphate of bismuth, contained

Sulphuric acid,	4.833 = 1.933 sul.	Acording to Thomson's atomic numbers.
Oxide of bismuth,	9.667 = 8.700 bis.	
	14.500	

(c) The solution and washings of (b) were precipitated by solution of carbonate of ammonia. The precipitate fell in abundance after the excess of nitric acid was neutralized. The carbonate was washed and dried, on its double filter, for several days, and the heat for the last 48 hours was such as to begin to char the paper of the filters. The dried carbonate of bismuth weighed 183.5 grains.

(c′) To ascertain the proportion of oxide of bismuth in the carbonate, 33.7 grains of the carbonate were gradually heated in a tube to redness. Carbonic acid, water, and nitrous acid fumes were evolved. The nitrous acid was small in quantity, and evolved at a red heat, so that there must have been some subnitrate precipitated with the carbonate. The loss of weight was 3.85 grains = 11.424 per cent. In another experiment, 6.8 grains lost 0.78 grains = 11.470 per cent. The mean of these two losses is 11.447 per cent. Had the whole 183.5 grains of carbonate been heated, the loss would have been 21.005; hence the 183.5 grains of carbonate of bismuth contained 162.495 grains of oxide of bismuth = 146.245 of bismuth.

(d) The filtered solution and washings from which carbonate of bismuth had been precipitated, vide (c), was treated with muriate of baryta to precipitate the sulphuric acid, which had been formed by the oxidation of a part of the sulphur by the nitric acid, during the solution of the disulphuret of bismuth. The precipitated sulphate of baryta was washed, dried, and ignited. It weighed 40 grains =5.423 grains of sulphur.

Recapitulation.

Sulphur, free, - - - -	(b)	8.800	
Do. in sulphate of bismuth,	(b)	1.933	16.156
Do. do. baryta,	(d)	5.423	
Bismuth in sulphate, - -	(b)	8.700	154.945
Do. in oxide, - -	(c′)	146.245	
Loss, - - - - - - -			4.899
			176.000

The disulphuret of bismuth operated on, weighed 176 grains, and so great a loss as 4.899, equal to about 3 per cent., indicates a solubility of the carbonate of bismuth, either in the water used in washing it, vide (d), or in the carbonate of ammonia used as a precipitant.* Some sulphur was also probably carried off in the fumes of nitrous acid, as sulphurous acid, causing a small loss.

If we calculate the atomic proportions from the numbers of sulphur and bismuth obtained, there would be $2\frac{1}{8}$ atoms of bismuth, combined with 1 sulphur, for $9x$ bis. : 154.945 bis. : : 2 sul. : 16.156 sulphur, whence $x = 2\frac{1}{8}$. This comes so near to 2 atoms of bismuth to 1 sulphur, that there can be little doubt that the compound formed by melting 3 bismuth and 1 sulphur, and keeping the mass at a red heat, is a true combination of

Bismuth, 2 atoms, - - - - - -	18
Sulphur, 1 do. - - - - - -	2
	20

* Since the above was written, I find that Stromeyer has noticed the solubility of this carbonate of bismuth in alkaline carbonates. Vide Annales de Chimie et de Physique, Tom. li, p. 272.

ART. VIII.—*On the methods of determining and calculating the specific heats of certain solids, with some precautions to be observed in the experiments;* by WALTER R. JOHNSON, Professor of Mechanics and Natural Philosophy in the Franklin Institute of the State of Pennsylvania.

From the Journal of the Franklin Institute.

THE practice which formerly prevailed, of presenting to the public, statements respecting the *results* of philosophical experiments without a detail of the exact methods adopted for their attainment, and the precautions employed to avoid error, has in many instances involved the necessity of *repetition*—long and laborious, of what ought, once for all, to have been definitively settled. The *verification* of a philosophical truth, by a method unlike any previously employed, is a matter entirely different from the processes just referred to; and however well we may be satisfied of a truth, established in one manner, there will always be found both pleasure and profit in attaining the same general conclusions, by methods and considerations independent of each other. There is not perhaps a better illustration of this remark than the variety of methods which may be employed for determining the specific heat of solids. The earliest was that of *mixture*, and consists in immersing the solid at a known temperature, in water (or some other liquid,) at a temperature either above or below its own. The temperature lost by the hotter body, and that gained by the cooler, will, with proper corrections, give, when compared, the specific heat of the body under trial.

The next method, that of Lavoisier, employs, instead of the rise or fall of temperature in water, the latent heat of *water passing from a state of ice* and the weight of this solid, which any other given solid will melt while cooling from any known temperature down to the melting point, is the measure of its specific heat, which, being referred to the quantity of ice which a mass of water, equal to that of the solid, would have melted in cooling the same number of *degrees*, gives us the numerical expression of the specific heat of the solid.

The *third method* employs the cooling power of air, and the *times* which will be required to depress the temperatures of the different solids through a fixed range of the thermometer are taken as the indices of the specific heat. This is the method employed by Professor Meyer on the woods and by Prof. Leslie and Mr. Dalton on other bodies.

The *fourth method* employs the heat which becomes latent when water is rapidly converted into vapor at its *boiling point*, by the direct and sole agency of the solid, heated to a known temperature *above* that point. This method may be successfully employed to determine the latent heat of melting metals as well as their specific heat from 212° to their melting points, and also their change of capacity, if any, after they have passed into the liquid state. The weight of boiling water which they will under different circumstances convert into vapor, compared with the effect of the same amount of water, conceived to be heated to the same temperature as the solid, gives again the numerical expression of the specific heat.

It is evident, that if this fourth method be adequate to give the specific heat when the temperature is known, it is also competent to give the temperature when the specific heat is known; but in order to remove all doubt as to its applicability to the latter purpose, it is well to ascertain by different and independent methods the exact index of the specific heat, whether uniform or variable, of the solids which may be employed for this purpose. Among the substances adapted to this end, are pure malleable iron and pure platina. They are both highly indestructible, when heated without the access of foreign ingredients, such as oxygen, sulphur, carbon, silica, &c., and though the specific heat of the former is represented by some writers as increasing pretty rapidly, with the temperature, yet this increase is not by any means in so great a ratio, as that of its dilatations, which other authors have proposed to employ as standards for measuring very high temperatures. As to platina, its specific heat is low, and its increments of rate, both in dilatation and specific heat, are represented as very moderate. I may here remark that the experiments of Dulong and Petit on this subject appear to have been erroneously stated in one part of their prize memoir, which has doubtless led to the supposition that they discovered no increment of capacity in platina by the elevation of temperature. In their table of the specific heats of the different metals at 100° and at 300° Centigrade, as originally published in the Annales de Chimie, Vol. VII, we find .0355 placed under both of those temperatures against *platina*. The same numbers are transferred into every English edition of works in which I have seen that table, with the single exception of Turner's Chemistry, in which the number is .0335 both for

100° and 300°. Yet in a subsequent table of the memoir, Petit and Dulong have given the indications of thermometers formed of the different metals, on the basis of their specific heats, compared with those of an air thermometer at 300°, and they have put down that of platina 317.9, which it obviously could not be, if its specific heat were invariable, but supposing that heat to increase from .0335 at 100° Cent. to .0355 at 300°, the indication ascribed to it would be correct. In a recent edition of Turner's Chemistry, by Dr. Bache of this city, this error has been corrected.

But, to return to the subject of iron, we find, in the various works of philosophers, a remarkable discrepancy between their statements of the specific heats of this metal. The following are among the results obtained by the different individuals whose names are annexed.

On iron of sp. gr. 7.876, the specific heat was found,	.1260	by	Wilcke.
" soft bar iron, sp. gr. 7.724, - - -	.1190	"	Gadolin.
" sheet iron, - - - - - -	.1090	"	Lavoisier.
" iron, of what quality not specified, - -	.1250	"	Kirwan.
" do. do. do. - - -	.1269	"	Crawford.
" do. do. do. - - -	.1450	"	Irvine.
" do. do. do. - - -	.1300	"	Dalton.
" cast iron, abounding in plumbago, - -	.1240	"	Gadolin.
" white cast iron, - - - - -	.1320	"	do.
" iron, (kind not specified,) between 32° and 212° F.	.1098	"	Petit and Dulong.
" do. do. do. do. 32 " 392	.1150	"	do. do.
" do. do. do. do. 32 " 572	.1218	"	do. do.
" do. do. do. do. 32 " 662	.1255	"	do. do.

The mean of these thirteen numbers is 0.12377. The wide discrepancies are probably owing to the circumstances under which the authors respectively operated, and to physical differences in the metal. Nor is the disagreement confined to these results; for while Crawford and Irvine contend that the specific heats of bodies remain constant, at all temperatures, Dalton, Dulong and Petit maintain that they increase with the increase of temperature. But it seems difficult to reconcile this supposition with another result of Petit and Dulong, viz. that the specific heat of all bodies is inversely as their atomic weight, unless we could suppose what is manifestly absurd, that the atomic weight varies with the temperature, or that in different bodies the *rate of increase in specific heat* varies always inversely as the atomic weight. Thus, if H were supposed the specific heat of any body and A its atomic weight, and if dH were the increment of specific heat for a given rise of temperature, then not only must AH = the constant C, but also A(H + *d*H) must = C′, and of course A*d*H = C″,—in order that another body having the atomic weight *a*, and a specific heat *h*, should give $ah = C$, $a(h + dh) = C'$, and $adh = C''$. Let us observe how far their table of the increase of specific heat between 212° and 572° Fahr. will bear out this supposition. The atomic weights are those given by Petit and Dulong themselves, with the exception of those of mercury and antimony, which are derived from Dr. Thomson.

Metals.	Atomic weights.	Petit and Dulong's difference of specific heats between 212° and 572° F.	Values of C″ from these data.
Mercury,	12.5	.0020	.025000
Antimony,	5.5	.0064	.023100
Platinum,	11.26	.0020	.022520
Silver,	6.75	.0054	.036450
Copper,	3.957	.0064	.025280
Iron,	3.392	.0120	.040704
Zinc,	4.03	.0088	.035464

To attribute the character of "*constants*" to such numbers as are found in the fourth column of this table, would be little satisfactory to any who were not prone to uphold a theory at all hazards. Even the apparent correspondencies between mercury and copper, antimony and platina, silver and zinc, are probably mere accidental coincidences. Iron, on which the authors to whom I have referred, appear to have bestowed most attention, gives a result far removed from all the rest and nearly double to some of them.

The foregoing considerations, together with the use to be made of the specific heat of iron and platina in generating vapor for pyrometrical measurements have induced me to attempt a re-examination of certain parts of this subject, and for this purpose I have taken the method originally adopted by Wilcke and Black, viz. that of immersing the hot metal in cold water, in connection with the fourth method above described, that of using the latent heat of vapor to ascertain the specific heat when the temperature of the solid is known.

In experiments of this nature several precautions are to be observed, and a considerable number of sources of error anticipated, against which, if we cannot directly guard, we must provide for them the necessary corrections.

1. *We must attend to the character and condition of the metal,* its freedom from alloys or impurities, its specific gravity, its freedom

from foreign matter on the surface, particularly from *vaporizable* matters, which may, by being converted into vapor in passing from the source of heat to the cold water, essentially diminish the temperature, or, if in any considerable quantity, may aid in elevating that of the water, and thus give a result too high. I have been sometimes embarrassed by this source of error. In a series of eight experiments, made by heating in a bath of oil on a given mass of wrought iron, at a mean temperature of 236° Fahr., the temperature of the room being 76° and that of the water at commencement 74.86° in a glass vessel of known specific heat, containing at every trial the same weight of water, and measuring the temperatures every time by the same thermometers, I obtained as the mean result .12332,—the lowest being .12131, when the iron was immersed at 192°, and the highest .12920, when the metal was at only 190°.

To ascertain how far this source of error would be obviated by adopting a bath of mercury, I made eight experiments in the same glass vessel, on the same piece of iron, and with all other circumstances corresponding to the former set, except that the temperature of the metal at immersion was at a mean of 323¾°, and of course the specific heat, according to Dulong and Petit, ought to have come out higher than in the other series, instead of which it was at a mean of .12217, the lowest being .12119 at 338°, and the highest .12499 at 350°, the higher temperature giving the higher result.

2. *The second precaution relates to the condition of the water used in the experiment.*—The specific heat of saline solutions and earthy mixtures being different from that of water, care should be taken that only pure water be employed. That which has been recently distilled should be preferred as it is less likely to be charged with air than that which has been long exposed in open vessels. If any considerable quantity of air contained in the liquid be suddenly expanded it may rise to the top and escape carrying with it the portion of heat which has given it so much enlargement of bulk. This would cause an error *in deficiency.*

3. *The temperature and hygrometric state of the air in which the experiment is conducted*, require attention. It is obvious that if we commence the experiment at a temperature below the dew point of the air, the vessel will be accumulating moisture *before* and *during* the experiment, and if it remain but for a short time at the initial temperature before the hot body is immersed, the consequence will be, that the latent heat of the vapor being employed in elevating

the temperature of the water, the latter receiving from 1000 to 1200 degrees of heat, for every unit of water condensed, will cause an error *in excess*. If however the vessel have remained in its cold state for some time, and then received a considerable elevation of temperature from the hot body, the whole exterior of the vessel will act as the wet bulb of a thermometer, and tend to keep the temperature of itself and its contents down to the *evaporating point*. This would cause a serious error *in defect*. Both these errors are obviously to be avoided by not allowing the temperature of the vessel to sink below the dew point. In regard to the relative temperatures of the vessel and the surrounding air, we must observe that as the latter part of the process, when the solid and the water are approaching an equilibrium, goes on very slowly, it will be necessary to commence our experiment with the water nearly as much below the actual temperature of the apartment as the increase of temperature is expected to be, in order to terminate as little as may be above the surrounding air. These two conditions of beginning above the dew point and never ending much above the temperature of the air can be complied with only when the air is tolerably dry. Such should therefore be the state of weather selected for experiments of this nature.

4. *The construction, magnitude, and specific heat of the thermometer*, used to measure the temperature of the water, is an object of some consequence in the determination of this delicate question. To carry entire accuracy into the subject it will be necessary to know the separate weights of the materials which compose it, and their several specific heats, and further to allow for an amount of water precisely equivalent to that part of the thermometer which is immersed during the experiment. In obtaining a thermometer for this purpose I caused the tube to be carefully measured and weighed before the bulb was blown, to ascertain its weight per inch in length, then knowing the length used to form the bulb it was easy to ascertain the number of grains of glass *immersed* in any given experiment. By again weighing after the thermometer was filled, the weight of mercury it contained was exactly known, and by weighing the *scale* separately and knowing its specific heat, the *equivalent in water* was found answering to any portion of the whole instrument, which may be entered along the scale near the thermometric degrees. The necessity of allowing for a *scale* may however be obviated by using a naked-bulb thermometer provided the *range* be sufficient without including the naked part of the stem. But to attain this end and at

the same time possess the requisite subdivision of degrees the bulb must be large, or the stem very long. Could we employ a cylindrical metallic containing vessel, fitted up with an apparatus to measure its own longitudinal expansions with perfect accuracy, it would perhaps be the best kind of thermometer for such experiments. The specific heat of mercury, at least within the range where a thermometer for our present purpose would be used, is, according to the four independent determinations of Lavoisier, Kirwan, Crawford and Dulong, .0327. The specific heat of glass given by six different philosophers is at a mean .18511, that of Irvine being .2000, and that of Kirwan .1740 at the extremes. By three trials on flint glass in a method hereafter to be referred to, I obtained a mean of .17854, which is *less* than the above mean result by .00657 and *more* than that of Dulong and Petit by .00154.

If the scale be of brass we have its specific heat by the mean result of Wilke, Crawford and Dalton's determinations .11276, but as the conducting power of that metal is high as well as its rate of expansion it ought if possible to be avoided as a part of the immersed thermometer.

The thermometer which measures the heat of the solid before immersion, should be faithfully compared with that which is used in the water. Thermometers of extensive range are often found inaccurate from containing minute portions of air. It would for this reason be desirable to compare their indications with the fusing points of tin and lead, as well as the boiling points of water and mercury. To be sure of at least two points in the temperature of the hot body it will be well to place it in an iron vessel containing mercury, immersed in boiling water, for *that* point, and in a bath of melted tin immersed in boiling mercury to get the utmost range of temperature measurable by that liquid. By forming a suitable covering for the bath of mercury, and providing for the exit and condensation of its fumes we may operate with perfect convenience in the method just described.

6. I have already mentioned the necessity of confining the range of temperature taken by the water during these experiments. If we terminate the experiment but one or two degrees above the actual temperature of the room the loss by radiation and conduction on one side will in general be so nearly counteracted by the gain on the other, as to influence very little, the actual result. But if we employ too small a vessel the high temperature of our solid may give too

great an elevation, and then we shall have not only the radiation and conduction of the vessel but the tension of vapor at the surface of the water, and the latter will be greater or less according to its greater or less distance from the dew-point. The actual absolute loss may be found by a separate experiment on exposing the vessel and water for some hours to the same temperature as that at which the trial took place and in an atmosphere having the same hygrometric tension. The weight lost during the longer exposure compared with its length of time ought to be proportionate to the loss and time in the other case. The number of grains of vapor would then be multiplied by its latent heat at the generating temperature, to obtain the absolute effect in cooling the mass from which it rose. This error like that occasioned by the escape of air and that by the evaporation of dew from the surface of the vessel will be *in defect.*

7. The nature of the vessel containing the water, its surface, specific heat and the space it leaves open to the air. It should be of such dimensions as to be completely filled when the thermometer and the body under trial are immersed in the water. If of metal, its perfect homogeneity is to be attained, and if of glass the specific heat should be separately ascertained.

8. To guard the hot body from loss of heat in passing from the source of heat to the cold water I make use of a thick sheet-iron cylindrical shield which is kept constantly immersed in the melted metal with the piece under trial and conveys it to the very mouth of the water vessel into which it is lowered by a fine wire or thread enabling the operator to move it from one part of the vessel to the other.

9. The vessel and its contents must be weighed with the greatest attainable accuracy at every trial. No reliance should be placed on the apparent levels of the fluid. Graduated measures are entirely out of the question in trials of this kind. To adjust the weight with readiness I employ a dropping tube with a fine point and instead of a piston use a species of micrometer screw, to force out the liquid or draw it in at pleasure. Drops weighing one third of a grain may be easily obtained by this instrument. The method of *substitution* is adopted in weighing to avoid all inaccuracy in the beam of the balance.

10. A result is not to be taken as established until it can be reproduced, at least, within the limits of the errors of observation. I feel assured that much of the erroneous matter which has been published on this subject has arisen from a want of due care and patience

in repetition. Before closing these observations it may be proper to add, that when in any given experiment the thermometer which measures the temperature of the water is withdrawn to insert the hot body and afterwards returned to the liquor, it will, under certain circumstances of the air, be found to have changed its indication, the moisture remaining upon its surface causing it to take the "*evaporating point*" as its stationary position. In this case it must be noted on again immersing the bulb, and the change it has undergone recorded and subsequently multiplied by the *equivalent* of the immersed part of the thermometer to obtain the requisite correction.

The table exhibiting the data, calculations and results of experiments to determine specific heats in the manner above described, will contain the following particulars. 1st. The number of the experiment; 2d. The kind of heating liquid employed; 3d. The dew point of the apartment; 4th. Its evaporating point; 5th. The weight of solid under trial; 6th. The temperature at which it is immersed; 7th. Temperature of the water; 8th. Temperature of the thermometer when immersed; 9th. Temperature of the air; 10th. Resulting temperature of the water; 11th. Gain of temperature by the water containing vessel and thermometer; 12th. Loss of temperature in the solid; 13th. Time occupied by the experiment; 14th. Weight of water in grains; 15th. Equivalent of the containing vessel in grains of water; 16th. Equivalent of the part of thermometer immersed; 17th. Sum of the equivalents in water, containing vessel and thermometer; 18th. Product of the preceding column by the gain of temperature; 19th. Product of the weight of solid by its loss of temperature; 20th. Correction obtained by multiplying the equivalent of the thermometer by its variation from the *initial temperature* of the water. (This correction will be either positive or negative, according as the evaporating point is below or above the initial temperature.) 21st. Specific heat obtained by dividing the 17th column, *corrected*, by the 18th. Other corrections may be inserted when necessary according to the observations already made. To present the several cases to which we have referred in the preceding remarks, the following formulas may be adopted.

1. When the specific heat of the containing vessel is to be ascertained by first filling it with water of a known temperature and letting it stand until we are sure that a stationary point has been attained, then emptying it and instantly refilling with water of a different tem-

perature; if the expansion of the vessel could be made to measure its own increase or diminution of temperature we should have the simplest of all possible cases; for calling

w= the weight of water in grains,

T= the degrees of change in temperature which it undergoes,

g= the weight in grains of the containing vessel,

t= the change of its temperature by the experiment, and

x= the specific heat of the material of which the vessel is composed, that of water being unity, we shall have $TW = gtx$ or $x = \frac{TW}{gt}$ (1). This supposes the experiment to be made with such regard to the thermometric and hygrometric state of the air as to require no correction on that account.

2. If we introduce a mercurial thermometer, with a brass scale, to measure the change of temperature, putting

b= the weight of brass immersed,

m= the weight of mercury,

c= the weight of the glass bulb and that part of the stem which sinks into the water, we have, for the equivalent of the thermometer in grains of water, the following expression, $.11276\,b + .0327m + .18511c$, and as by suspending the thermometer or otherwise fixing it in a certain position for many experiments, we can always use the same part of its length, we may substitute for this complex term the simple expression e for the thermometrical equivalent in grains of water; then the formula (1) will become $x = \frac{T(W+e)}{gt}$ (2). It was by this method of trial and calculation that the three experiments before mentioned, gave .17854 for the specific heat of glass, though in the expression for the thermometer I have chosen to use the mean of six other determinations until I can repeat and vary the experiment, so as to be satisfied which is nearest to the truth.

3. The specific heat of the containing vessel being known, we proceed to that of any other solid, wrought iron for example, putting its weight in grains $=i$, and its specific heat $=z$. T will now represent the change of temperature not only of the water and thermometer but also of the containing vessel, and t the change of the solid, i, g, x and e being the same as above, then will $itz = T(w + gx + e)$ and $z = \frac{T(w+gx+e)}{it}$ (3), or the formula may be simplified

by representing the three terms $w+gx+e$ by W′ whence $z=\frac{TW'}{it}$, (4). To this, as before stated, we must apply a correction if the thermometer be not at the same temperature when immersed, as the water was when the solid was plunged into it. Calling the difference d we have the correction $\pm de$, as before stated, according as the thermometer was below or above the water, and hence the formula becomes $x=\frac{Tw'\pm de}{it}$ (5).

4. If the specific heat of the solid under trial and of the containing vessel be the same, (as when a vessel of untinned sheet iron is employed to hold the water,) we may then if the *specific heat* be supposed not to vary within the limits of our experiment, employ the following expressions in which z is the specific heat of both, the solid and the water vessel; T, w, and e remaining as in (3), we obtain the equation $itz=T(w+e+gz)=T(w+e)+Tgz$, and by transposition $itz-Tgz=T(w+e)$, whence $z=\frac{T(w+e)}{it-gT}$, (6).

5. But if, instead of making the container of the same material as the body under trial, we choose to form it of any other kind, even of one whose precise specific heat is not yet known, we may, by using vessels of *different* thicknesses and the *same* liquid content, ascertain by successive experiments under otherwise similar circumstances, the specific heat of the material which composes the vessel. Thus two jars capable of containing the same weight of water may be formed of glass from the same melting pot, but one possessing two or three times the thickness of the other. We may then heat the same mass of iron twice (or any number of times) to the same temperature, and immerse it in water at the different trials in each of the two vessels at the same temperature. Then putting

$w=$ the weight of water contained in each glass,
$g=$ the weight of the thicker glass,
$g'=$ that of the thinner,
$x=$ the unknown specific heat of glass,
$T=$ the change of temperature of water and glass when g is used,
$t=$ the change of temperature of iron when g is used,
$T'=$ the change of temperature of water when g' is used,
$t'=$ the change of temperature of iron when g' is used,
i, as before, $=$ the weight of iron,

$z =$ its specific heat,

$e =$ the equivalent of the thermometer.

Then, as the temperature of the water, the air, and the iron, are supposed to be the same in both cases, we shall have by the two expressions,

$$1.\ z = \frac{TW' \pm de}{it} = \frac{T(w+e+gx) \pm de}{it},$$

and $$2.\ z = \frac{T'w' \pm de}{it'} = \frac{T'(w+e+g'x) \pm de}{it'};$$

from which we derive

$$3.\ \frac{T(w+e)+Tgx \pm de}{t} = \frac{T'(w+e)+T'g'x \pm de}{t'}.$$ Hence

$$4.\ Tt'(w+e)+Tt'gx \pm det' = T't(w+e)+T'tg'x \pm tde,$$ and by transposition,

$$5.\ Tt'gx - T'tg'x = (T't - Tt').(w+e) \pm (t \mp t').de,$$ and by division,

$$6.\ x = \frac{(T't - Tt').(w+e) \pm (t \mp t')\,de}{Tt'g - T'tg'},$$ which, if there be no correction for thermometric variation, will be reduced to the simpler form,

$$7.\ x = \frac{(T't - Tt').(w+e)}{Tt'g - T'tg'},\ (7).$$ And as the value of x is now found, we may substitute it in either the first or second equation, to enable us to find the value of z. The first would give, (omitting the correction $\pm de$.)

$$8.\ z = \frac{T(w+e)+Tg\left(\frac{(T't - Tt').(w+e}{Tt'g - T'tg'}\right)}{ti}.$$ Had we taken the second equation in which to substitute the value of x, the value of z would have been $$= \frac{T'(w+e)+T'g'\left(\frac{(T't - Tt').(w+e)}{Tt'g - T'tg'}\right)}{t'i}.$$ From either of these we may obtain

$$9.\ z = \frac{TT'(g-g').(w+e)}{i(Tt'g - T'tg')}.\quad (8.)$$

The necessity of applying the correction $\pm de$, arises from the liability of the warm current of liquid ascending from the hot metal to elevate the temperature of the thermometer above that which ought to be exhibited by the liquid when the maximum effect of the solid has been attained. By taking the thermometer out of the water at the instant the metal is immersed, and keeping it out till near the conclusion of the experiment, we not only have a better opportunity to agitate the liquid, but also avoid the deception just referred to.

If the experiment be commenced precisely at the *evaporating point,* the bulb of the thermometer covered with a film of water will be retained at that point and no correction required.

The formula for the fourth method of determining specific heat, which may serve as a *verification* of the one just presented, is founded on the fact that the *weight of vapor* generated by a given weight of metal is proportionate to the *weight, temperature,* and *specific heat* of the metal employed. The experiments in this case all terminate at the *boiling* point, but may commence at any known *superior* temperature. The result obtained will therefore be the mean specific heat between the temperature of boiling water, and that at which the metal enters the liquid. Calling

$i =$ the weight of metal employed,

$t =$ its temperature above boiling point at immersion, and

$z =$ its mean specific heat, from boiling point to the temperature at which it is immersed; also,

$v =$ the weight of vapor produced by the action of i, and

$l =$ the latent heat of vapor from water boiling in the open air at the time and place of the experiment.

Then, by the above statement, we have (supposing no heat lost by any other means than vaporization) the *effect* $=vl$, and the *cause* $=it$. The latter is on the supposition that the experiment ceases, and the loss of weight in water is ascertained, the moment the metal has come down to the boiling point. Hence $itz=vl$, and $z=\frac{vl}{it}$. (9.) Also, as above stated, the temperature t can be found when z is known; thus, $t=\frac{vl}{iz}$. (10.)

Collecting the foregoing formulas into a single view, we have the following table.

No. of the formula.	Purpose of the experiment and calculation.	Expression in terms above explained.
(1.)	To find the spec. heat of a container, measuring temperature by its own expansion.	$x=\frac{Tw}{gt}$.
(2.)	To find the same when a mercurial thermometer is used.	$x=\frac{T(w+e)}{gt}$.
(3.)	To find sp. heat of a solid, and correcting for the water vessel.	$z=\frac{T(w+e+gx)}{it}$.
(4.)	To express the same, reducing water, thermometer, and container to W′.	$z=\frac{TW'}{it}$.
(5.)	Do. corrected when the thermometer differs from initial temperature.	$z=\frac{TW'\pm de}{it}$.
(6.)	Do. when the container is of the same material as the solid under trial.	$z=\frac{T(w+e)}{it-Tg}$.
(7.)	To find sp. heat of the container, by trials in two vessels of unequal weights,	$x=\frac{(T't-Tt').(w+e)}{Tt'g-T'tg'}$.
(8.)	To find sp. heat of the solid from the same trials as the preceding.	$z=\frac{TT'(g-g').(w+e)}{i(Tt'g-T'tg')}$.
(9.)	To obtain the sp. heat of a solid from its vaporizing power.	$z=\frac{vl}{it}$.
(10.)	To find the temperature of the solid by vaporization when the specific heat is known.	$t=\frac{vl}{iz}$.

Numerous experiments on all branches of the subject have already been made, and others are in progress, the whole of which will in due time be laid before the public.

Art. IX.—*On the condition of Vesuvius in July*, 1834; by James D. Dana, of the U. S. Navy.

TO PROFESSOR SILLIMAN.

U. S. Frigate United States, Smyrna, July 12th, 1834.

Sir—Supposing it possible, that a statement of the present condition of Vesuvius,—which I had the pleasure of visiting when at Naples, a few weeks since,—may be of some interest to you, I take the liberty of addressing to you, an account of my observations.—The volcano for many years has almost incessantly shown some signs of activity; but since the summer of 1832, it has been, on the whole, and still is, in what is considered a tranquil state. This was very much the case, when we first arrived, May 29th,—and hence, in my first view of Vesuvius, I was disappointed. I saw a mountain rising before me, to the moderate height of three thousand six hundred feet, from a broad base and with an acclivity by no means steep, and having nothing, at a distant view of eight miles, peculiarly bold or rugged in its outline. Some variety was afforded by its double summit, *Somma*, standing near by to the north, and nearly equalling Vesuvius in height. The crater was enveloped in a light cloud, such as is usual about elevated peaks, whose cold soil condenses the vapor of the atmosphere. In this instance however, I suppose the cloud to have been the vapor condensed, as it issued from the crater. Yet there was nothing in the appearance, to convince one, that such was the case. Vesuvius resembled a volcano, no more than other summits bounding the horizon to the south of it, except in its brownish black sides, which alone told its real nature. Thus it was, till favored by the darkness of the evening, when it began to exhibit some evidences of its real nature. The vapory cloud which shrouded the summit, was then bright with the light reflected from the crater; and there were ejections, yet not very frequent, of melted lava and heated cinders, to a considerable height in the air. The succeeding day, owing to the eclipsing light of the sun, it again assumed a non-volcanic aspect. But at night, the eruptions were seen to occur every five or eight minutes. It was in the following night, that, with a party of the officers of the ship, I ascended the mount.

At Resina near the foot of the mountain, we were provided, by *Salvatore Madonna*, the principal cicerone for this excursion, with the necessary equipments, guides, horses or jackasses, and torches; and, being dressed in suits of clothes for the occasion, about two hours after sunset, we commenced the ascent. We had selected the night for the excursion, because at that time, the lava can exhibit more clearly its own light, and also to view the rising sun, a splendid sight, as we had been informed, heightened as it is by the beautiful surrounding scenery. With but the light of our torches, I could not, of course, examine the nature of the soil, over which we were passing. When ascending in the morning, I observed that our road ran along a strip of land, elevated above the general level of the side hill, and hence inaccessible to the lava, coming in this direction, as it would naturally take its course, in the valley to one side of it. This elevated land, named *Monte Cantaroni* may be considered as connecting *Somma* with the cone of Vesuvius. It is intersected by three vallies, the most northerly of which, Vallono della Vetruva, received the current of lava of 1785. For a considerable distance, there were cultivated fields and vineyards, on either side of our road. Part of the way it was cut through a bank of pebbles and sand. A ride of five miles brought us to the hermitage, at the top of Mount Cantaroni, an usual place of recruit for travellers, indeed a half way house: not wishing to ascend immediately, we rested here for three hours. At two o'clock A. M. we again mounted our horses, and in half an hour reached the foot of the cone. After leaving the hermitage, vegetation grew more and more scanty, as we proceeded,—here we find but a barren waste of lava, which continues up the cone, there, however, composed also of loose cinders and volcanic ashes. —This lava is the current of 1822.—It was a tedious walk up the cone, both because of the steepness of the acclivity and of the yielding nature of the material over which we travelled. In three quarters of an hour, we were relieved by arriving on a plain, the principal summit, near the center of which was situated a small cone, the present aperture for the smoke and ejected stones and lava. This plain is the old crater, which but four years since was reached by a descent of two thousand feet*—the bottom of "an immense and frightful gulf."—In 1829, a person, when he had reached the summit, stood upon a narrow ridge, and could but look down to this seat

* *Two Years and a Half in the Navy.*—As the volcano now appears, it may be as near the truth, to diminish the above statement by one fourth.

of volcanic fires. In 1830, the descent to the interior was barely practicable; but it continued nearly the same as in '29, till the summer of 1832, when it assumed very nearly the form and appearance that it now has. There was, at that time, a falling in of the walls of the crater, and also judging from appearances, I should say that the lava, as it boiled up, had cooled, and thus closed all the view to the burning furnace. I have heard it said, that the change in its appearance is so great that it can hardly be recognised as the same mountain. At the eruption of 1832, a stream of lava descended the mountain towards Portici. In the description of every eruption, that I have read, there is noticed some change in the form of the crater. In 1822 the walls of it were so much broken off, as to lessen the height of the mountain one hundred feet; and thus it appears, that, by an examination of its present state, there can be obtained scarcely any idea of the volcano, as it was thirty or forty years since. The present circumference of this plain, is nearly four miles, more than twice that of the mouth of the crater in 1830. Part of the old walls exist on the north east side, and there only.

As I walked over the plain—rather a rough one—I noticed in the numerous fissures in the lava, on this the western side, that the rocks were heated to redness within two or three feet of the surface; and from many places the sulphurous vapors issued freely. These fissures were too shallow to allow any far insight into the interior of the mountain. The volcano, at the time, was in considerable action. The smoke, mostly sulphurous acid, issued in a dense cloud from the small crater, and was carried by a strong wind from the north east, across the path we were about to take. After one or two fruitless attempts, the danger of suffocation driving us back, we gained the windward side of the cone. It was south of east of this *small* cone, (I so call it to distinguish it from the old and larger one,) about twenty rods from it, that the grandest sight was presented us. During the preceding few moments, we had moved along with rather a hastened step, on account of the heat of the lava under our feet—for a red heat was frequently seen, within ten or twelve inches of the surface, and the rocks were yellow with an incrustation of sulphur. We were soon on the borders of what was, apparently, a fountain of melted lava, which making its way from under the solid lava, at the slow rate of a mile an hour, ran down the back side of the mountain towards Pompeii, not proceeding far enough however, to injure an uninjured country. It resembled much a stream of fused iron. Its width was from four to five feet. From the form of the surface of the surrounding lava, I concluded that, not long since, its place of exit was higher up, and that by the solidification of its surface, the change had been produced in the situation of its source, a process which now appears to be going on—we approached it within four feet. I cannot say that I felt disposed to try the experiment which *Dolomieu* states to be safe, that is, *to walk over it*, the heat of the surface, as he says, not being sufficient to burn. It is certain, that the *reflected heat* was sufficient to induce me to preserve the distance abovementioned. With one of our rough canes, we took some of the red hot viscid fluid from the stream and into it pressed some coins. I have one specimen, impressed on one side with the name of our cicerone *Salvatore Madonna*, and on the other, the time and the year when thus enstamped. The lava cools rapidly, hardening into a black scoriaceous vesicular mass, without the usual crystals of leucite, hornblende, or pyroxene. May not this absence of crystals, be owing to the fact that they were taken from the surface, where these minerals not under pressure, are decomposed by the heat? The same is the nature of the solidified lava which covers this part of the old crater. This stream is the only present outlet for the lava of the volcano. The crater is not in sufficient action to force it over its sides.

There yet remained to be seen the interior of this crater. Our guides spoke to us of the danger, and perhaps more from disliking the trouble of ascending than from fear, at first refused to accompany us. It was not usual to climb it on this the eastern side; but there was no other alternative; for the opposite side, where was the beaten track, was rendered impassable by the thick volumes of suffocating smoke. They at last consented, as we had determined on going. Its elevation is two hundred and fifty feet, the whole of which has been formed within the past five years; in 1830 there was but a small mound. Its elevation is owing to the cinders and small pieces of lava, with perhaps occasionally a current, which are thrown out and fall down its sides. Its sides incline at an angle of 40°, as great an inclination, considering the manner in which they are formed, as they could have. When making the ascent, I perceived very sensibly, a tremulous motion, and when on the summit I observed that this trembling took place at each of its slight eruptions. There were no subterranean sounds. The eruptions were of heated cinders, melted lava and sulphur, which were darted to the height of twenty or thirty feet in the air, every four or five minutes. The greater portion of them fell back into the crater. I noticed that some small pieces of lava, which had fallen one side were cooled by the time they had reached the cone.

After all, we were prevented from viewing the internal operations by the thick smoke, continually issuing from the part of the crater directly beneath us, and obscuring the whole of the interior. Occasionally, it was partially cleared away by the wind, and we perceived some unheated rocks within twenty feet of the top on the side opposite us. The diameter of the nearly circular opening was not more than one hundred feet. The ridge forming the circumference was besprinkled with sulphur, which had been thrown out in a fused state. The specimens were very delicate and beautiful; unfortunately too much so to be handled. We were on the point of descending, when an eruption took place somewhat greater than we had before seen, and a shower of lava fell on all sides of us, causing us to hurry, and soon we were again upon the heated, though solid lava of the *plain* or *old crater*. On our return we went around to the north, thus making the circuit of the cone. In this direction, there were numerous fissures, freely emitting smoke and showing a red heat to the surface. The walls of the old crater which here remain, are a perpendicular bank of rock exhibiting the edges of alternating layers of compact lava and loose scoria with disintegrated lava. The compact contains numerous small imperfect crystals of leucite and hornblende.

The time before us, would not permit me to make many examinations with regard to the volcanic minerals here to be obtained. The following I purchased of our cicerone, who collects and keeps for sale Vesuvian specimens. He pointed out to me a large box, that he had just closed for Professor Buckland of England. Some of the specimens, have passed through the fires, without the least change. Their well known names will distinguish them among the following:—Granite, mica, one specimen and aggregation of black scales, another of a brownish yellow color, crystallized calcareous spar or limestone, idocrase in a micaceous gangue, spinelle with the green mica, sommite, iceland spar in tabular crystals, dolomite, calcareous mesotype, in irregular spheroidal masses, cemented together by carbonate of lime, stilbite in the cavities of the lava, leucite in crystals with twenty four trapezohedral faces, from $\frac{1}{8}$ to $\frac{3}{4}$ of an inch in diameter, muriate of copper incrusting a specimen of lava, specular iron, in flat lenticular crystals covering lava, a compound of chloride of sodium and muriate of ammonia similarly situated, and a specimen of recent calcareous conglomerate, containing petrifactions among which there is a species of the genus pecten, also of cardium and what appears to be a donax, and in addition some small turreted univalves. I have other minerals, but I cannot state with certainty their names. The labels of many that I purchased were evidently wrong. We descended the cone at a rapid rate along a steep declivity of loose cinders and volcanic sand.

Not till the fifth of June, was there any change of consequence in the state of the volcano. On this day, (Friday) a slight earthquake was perceived near Pompeii. There was a considerable swell on the sea during the day, which, as there had been calm weather for several days, I had imputed, without a knowledge of the earthquake, to a distant gale. Possibly the earthquake was the cause. At night the bursts of incandescent matter from the crater were far more brilliant and extensive than on former nights. At many of these expirations, (if I may use the term; it seems to convey better than any other, an idea of these slight eruptions, which are not unlike the spouting of some huge leviathan in a fiery liquid,) small streams of lava run down the northern side of the small cone. On Saturday, smoke was continually rolling from the crater to the north. In the evening, I observed that a new source of light had arisen to the north of the small cone, and towards the southeast, a line of light extended partly down the mountain towards Pompeii, arising probably from the same stream of liquid lava that I saw when there, now enlarged. The crater itself was far less active than usual. During Sunday Vesuvius was in quite a dull state. At night, but little light was to be seen, and the fiery expirations were not frequent. As we were leaving the harbor on Monday, June 8th, a blacker and more abundant smoke issued from the crater, and at night the stream to the south east shone with increased brilliancy. The next morning Vesuvius was far below the horizon. It would have been a source of no little gratification, could I have witnessed Vesuvius exhibiting her immense fireworks on her grandest scale. However the slight exhibitions of the past few days were, as seemed to me full of grandeur, and they made a faint impression of the power, which now is nearly dormant. They passed off entirely unnoticed by the mass of the inhabitants of the country. It is astonishing with what an absence of fear they rebuild their destroyed cities, whence just before they ran for their lives, driven by these tremenduous torrents of fire. Thus *Torre del Greco,* although mostly buried by the fiery torrent of 1794 has again risen from its ruins, and now contains 15,000 inhabitants. The foot of the mountain is crowded with towns, and it would be difficult now for a current to reach the sea, its usual course, without destroying some buildings.

While contemplating Vesuvius, it is natural to dwell upon the volcano, its nature, depth and extent, and to enquire whether it is not connected with Stromboli and Etna and whether this grand bed of fire does not extend throughout Italy, which every where bears evidence of former volcanos and of present subterranean fires. However this may be, it appears that it may be said with considerable confidence, that at least fifteen or twenty miles on each side will not more than include this burning furnace. Twelve miles from Vesuvius, beyond Naples, are the vapor baths of San Germano. An old stone building covers a spot of earth, whence issues this heated vapor. There is but a slight smell of sulphur, but the heat throws one immediately into a profuse perspiration. The walls inside are covered with an incrustation of alum from half to two inches thick. Here then is sufficient evidence of subterranean fires. A short distance from these baths, is the *Grotto del Cane,* a small partly artificial cave, but twelve or fifteen feet deep and six high, in the side of a hill of Tufa. It is noted for the carbonic acid it contains. The smoke of a taper settling upon it, ran out of the entrance like a liquid, thus showing that there is an incessant fountain of the gas. I stepped in, and besides the increased pressure perceived also an increase of heat. This heat, and the continual reproduction of gas seem sufficient to prove its igneous origin. This cave and the bath, are situated on the borders of a small lake, (Lago d'Agnano) which, from its circular form, great depth, (500 feet,) and the volcanic nature of the surrounding country, is supposed to be an ancient crater. A mile from the lake, is the famous Solfatara, a volcano, not long since in action, abounding in sulphur, alum, and other volcanic productions. Near by, is a rivulet of boiling water. Not far distant is the crater of another extinct volcano, (Astroni,) four miles in circumference, and just north of the bay of Baia is another hot spring. Nine miles west of Naples is the island of Procida, with a volcanic soil; fifteen miles is *Ischia,* whose extinct volcano, currents of lava, once the destruction of its town, and hot springs are sufficient to prove its volcanic origin. South of these the plain of *Sorrento* bears evidence of a former volcano.—Thus Vesuvius is nearly surrounded with volcanoes, now apparently extinct, but whose fires, as is proved by the hot springs and vapor baths, yet burn.

A mountain which has ejected such immense quantities of lava as has Vesuvius, must necessarily have a great extent of volcanic fires.

If, as says Braccini, and from experiment the descent to the internal plain in 1631 was by a rapid declivity of three miles, and consequently its situation was far below the level of the sea, what limits ought to be assigned to the fires, which as they were then latent, must have been far below the plain he reached? It will not therefore require much credulity to believe a radius of six or eight miles necessarily to include the fires of Vesuvius, even supposing that there are no others in the neighborhood. But others do exist, and judging of their probable limits by the size of the old crater, is there not reason to believe that they also extend six or eight miles, and thus meet those of Vesuvius, or rather that there is but one great source, or furnace of which Vesuvius is the present spiracle! We passed Stromboli Tuesday evening, June 16th, a more extensive mountain than Vesuvius; its red fiery expirations had more breadth and height, but they were less frequent than those of that volcano, happening not oftener than once in fifteen or twenty minutes.

Etna was in sight the next day, but she gave us not the least evidence of her volcanic character, except in her external appearance.

Art. X.—*On the Propagation of Fruit Trees, Vines, &c.*

To the Editor of the American Journal of Science.

Sir—In the April number of your valuable Journal, I observe, on page 183, a translation of a French "Memoir upon Fruit Trees," in which some enquiries are suggested into the cause of fruits raised from the seed being different in quality from those from which they were derived, and proposing certain experiments to ascertain it, particularly transplanting and change of soil. These, I humbly conceive, will not be alone found to furnish the remedy, and it must therefore be sought elsewhere.

I must honestly premise, that I am not much of a horticulturist myself, nor have I made many satisfactory experiments, owing to my not being situated favorably for the purpose; but I have often remarked the inferiority of melons, peaches, pears and cherries, the seeds of which had been selected from the finest specimens, and reflecting upon the probable cause of it, have come to the conclusion that it is chiefly, if not solely, owing to our not imitating, or rather following, the process of nature, in her works of reproduction, where every thing is perfect. If I do not mistake in this, and experiment should justify my opinion, better fruit than we have heretofore had will be the consequence; if, on the contrary, my theory turns out to be erroneous, it will only be one other which has failed when reduced to practice.

I believe that no one views the oak, the hickory, the chestnut, and other trees of our magnificent forests, as the *degenerate* offspring of their parents, and yet the mode nature which adopts in their production is of the simplest kind; the acorn, or the nut, is left to ripen in its *envelope*, and on its stem, till the fit time arrives for that envelope to burst, and drop its dry nut on the ground, where it lies until the frosts open the earth to receive it, when it germinates in due season and sends forth a plant likely to rival its size. This is no doubt the reason why fruits from trees accidentally discovered growing wild, have generally proved finer than cultivated ones, as the author of the memoir justly remarks, while the latter are found "degenerate," and "acid and unpalatable." In the former case, whether a peach, a pear, or a cherry, it remains unplucked by the hand of man, ripens, falls, rots, and finally dries up, liberating the seed in a fit condition to enter the earth when the frost prepares a place for it to drop into, which probably is not so deep as the hole we make to plant one in. That it should not produce a fruit in all respects like its parent would be more surprising than the contrary.

But how different is the course pursued by us in endeavoring to produce a fruit similar to the one we have been enjoying, which, although its flavor may be exquisite, was probably, when gathered, not as perfect as it would have been had it been left until it was about to drop: in many cases, peaches, pears and cherries are plucked before they are ripe, and most of those brought to market are very unripe, especially pears, which are commonly pulled green, and ripened afterwards in a closet. We select the stone of a fine peach, or the seed of a fine melon, after stripping them of their delicious pulpy covering, which was destined to supply nourishment, until the seed is ready for the ground; it encounters suddenly the keen action of the air, (the effects of which at such a moment no man can better estimate than yourself,) and is given perhaps to a careless servant to put away to *dry*, and in due time it is planted, produces a tree or vine, and likewise fruit, but alas! how different from that whose fine flavor and luscious taste induced us to preserve its seed! Our gardeners pursue a more rational plan with their cucumbers, squashes, peas and beans, &c. The cucumber is left on its vine to turn yellow, rot and perish, before its seed is considered fit for use; the pea pod is permitted to hang until it turns yellow, dries, and is about to drop its seed, before it is gathered. Nobody complains of these vegetables not proving equal to their predecessors. The husbandman likewise lets his wheat, rye and oats remain on their stalks until the time arrives when to leave them longer would be to lose such small grain by the opening of the husk; but it is still preserved in its husk till dry enough to be threshed out; yet notwithstanding this close approach to nature's process, it is a common remark that wheat degenerates, and requires to be planted in another soil to recover something of its original character; this is no doubt owing to the necessity of separating the grain from its stalk before the final operations of nature bring it to perfection. In the case of Indian corn, however, it is different; the grain is left upon the stalk sometimes until the snow falls, and is never gathered until it is perfectly hard and dry. I never heard of its degenerating.

If my theory then is correct and supported by facts and experiment, the course to be pursued to obtain fine fruit of every kind would be this, and I will give only two examples as they will serve for all. If I had a tree of fine peaches, I would select half a dozen or more of the finest individuals on it, and those free from all blemish; mark them in some way not injurious, and suffer them to remain till they fall off themselves; I would then place them on the ground in an inclosure which would protect them from cattle, and let them rot and perish till the stone was fairly liberated; I would either let them still remain, or remove one half to a spot which should shelter them from rain and sun, (although I am not sure it would be the best.) Should any of these be attacked by worms, they would be rejected; all the rest should be planted, and each division noted. I am not sure that it would not be well to let them receive the winter snow to keep them in a proper temperature, and as soon as the ground is broken by the frosts in the spring, plant them lightly, marking each by a stick and number. Whether the natural planting of fruit stones and nuts is in the fall or spring I am unable to say. The experiment of both might be tried.

If I had a vine producing high flavored melons, I should adopt a similar plan. I would select fine specimens and leave them to perish, preserving the seeds in several ways, to ascertain the best, and some I might allow to remain all winter in their native situation, not knowing how far the dead covering might afford protection against snow, cold, rain and sun. I should like to see such experiments tried, and the results given in this Journal for general information.

There may be advantages in transplanting, as soils have frequently an influence on flowers and probably may have also on fruits, but according to my theory it would not be likely to change the *identity* of the fruit, although it might lessen or improve its quality. This is, however, matter for experiment.

While on this subject, allow me a few words on the cultivation of the grape, which is widely different from the course pursued by nature, who trains up her vines to the top of trees, and there forms an umbrella-shaped canopy of leaves, curiously arranged to turn off the rains and screen from the scorching sun of our climate the rich clusters which hang *under its shade*. The foreign grape introduced into America is certainly a more palatable one than our wild fruit, but when the varieties in our woods are better known, and the kind selected are trained on insulated trees, beyond the influence of the damp and gloomy forest, who can tell the change that may not take place in it for the better. Every body must remark, that the finest and most numerous branches of our cultivated grapes hang from the leaf-covered roof of the trellis in our garden alleys. In the northern climates of Europe, where the power of the sun is weak, the plan there adopted, and which we appear to have borrowed, may answer; but all travellers speak of the *festoons* of vines loaded with fruit, hanging from tree to tree over the plains of Tuscany and Naples.

Should these observations be deemed worthy of a place in your Journal, and lead to any satisfactory experiments, which should give us finer fruit than we now obtain by the ordinary mode of planting, my object will be answered. POMONA.

Art. XI.—*On the construction of the Barometer, and other Philosophical Instruments in this country;* by James Green, Philosophical Instrument Maker in Baltimore.

TO PROFESSOR SILLIMAN.

Dear Sir—Early after the publication of No. 1. Vol. xxvii of your very valuable Journal, my attention was directed to an article on the construction of the Barometer; and although interested in all improvements of the means of making philosophical observations, I felt particularly so in the present instance, from having received an order on account of the public service to construct a Barometer, that would furnish accurate indications of atmospheric pressure on any plan which my experience in this branch of manufacture might approve.

In perusing the article I was particularly attracted by the coincidence which existed in the construction of some parts of Mr. Durant's instrument and a modification of Gay Lussac's Barometer by M. Bunten, a favorable report of which was read before the French Institute, by Messrs. Savart and Arago, and which subsequently received a favorable notice from Baron Humboldt, who after having used the instrument during a travel through Germany of several months, testified to its efficiency in preventing the admission of air into the mercurial column. The *Globe Portable Barometer* of Mr. Durant seems to present all the advantages derivable from that arrangement with some additional securities. However, I must freely confess that the gratification which a Philosophical Instrument Maker might be presumed to derive from such a circumstance was in some measure diminished by discovering the writer to be under the impression that there existed an indifference to all efforts at the perfection of so important an instrument as the Barometer, on the part of the manufacturer, who I hope may be often found both "able and willing" to resort to all the precautionary means necessary to insure as perfect an instrument as practicable, when such an instrument is wanted.—In so far as the accuracy of the instrument may depend upon the boiling of the mercury in his tube, it is a very common thing with him to take the "patient care" required in this operation. Indeed, it has been my uniform practice to observe this precaution in all instances, where such accuracy was desirable, and also to use mercury that had been redistilled.

I have been induced to state these facts, because from the tone of the article alluded to, an individual who might desire a perfect instrument would be brought naturally to the inference, that in as much as good Barometers are constantly being made somewhere, if he cannot obtain one here, he can do so abroad.

I do not suppose however that either yourself or the writer would wish to increase the already unfavorable prepossession which to some extent exists, to the prejudice of the instrument makers of this country. They labor it is true under disadvantages in the manufacture of some parts of a philosophical apparatus, which are not experienced elsewhere. But the Barometer does not belong to this class. In its construction nothing is wanting but a proper knowledge of the principles it involves, and that facility of manipulation which experience usually yields.

On visiting London and Paris in the years 1830 and '31 for the purpose of availing myself of the great advantages which those cities afford for improvement in mechanical skill, as well as the collation of philosophical facts, and while there, being engaged in some experimental observations on the construction of the Pyrometer, I had frequent intercourse with one of the most deservedly distinguished instrument makers of the former city, who I found entertained a more favorable opinion of the extent of the demand for good instruments in the United States than my experience authorized; that opinion doubtless arises from the frequent orders he received to furnish such for this country. It may be proper to remark that many of these were of a character that could have been readily furnished here, had there existed that confidence which many of our own workmen are entitled to receive.

Conceding however the imperfections of the ordinarily manufactured Barometer, I cannot join with the writer in attributing to this circumstance mainly the existing neglect of so useful an instrument, when used as a weather glass; but would rather refer it to the *lengthened* series of observations it is necessary to make in every particular place, before such satisfactory general rules can be deduced as will enable us to infer from specific movements in the barometric column definite changes of weather, few persons being found willing to make periodically precise observations.

In conclusion I may be allowed to remark, that in view of the advancement of meteorological science, the want of uniformity both in the principle and construction of the various instruments used throughout this extensive country, in order to furnish correct meteorological tables, is certainly to be regretted, and any plan that could be suggested, which might obviate this difficulty, by establishing such uniformity would doubtless materially enhance the value of these records in promoting the advancement of Natural Science.

Baltimore, Oct. 10th, 1834.

Art. XII.—*On the Existence of the Bi-malate of Lime in the Berries of the Sumach; and the mode of procuring it from them in the Crystalline form;* by William B. Rogers, Prof. of Chemistry, and Natural Philosophy in William and Mary College.

The berries of the Rhus glabrum and Rhus Copallinum, the two species of Sumach common in Virginia, have long been remarked for their acidity and are still used in some places as a substitute for lemons in different forms of beverage as well as for various other purposes in domestic economy and medicine. In some experiments made more than two years ago upon the acid liquor obtained by macerating the berries in warm water, I found it to contain a large quantity of an acid salt of lime which I have since determined to be the *bi-malate.* At the same time too a microscopic examination of the berries of the R. glabrum enabled me to discover the pure crystals of this salt on the outside of the berries mingled with the down. To observe the form of the crystal distinctly the berries should be slightly moistened and then allowed to dry. The crystals may then be readily seen by the naked eye, and when viewed through the microscope they appear as beautiful hexagonal prisms of the most perfect symmetry.

The existence of this salt in the berries of the Rhus is a fact which appears hitherto to have escaped attention. The only experiments relating to the acid of these plants which I have met with, are those of Mr. I. Cozzens of New York, published in the 1st volume of the Annals of the Lyceum of that city; and that chemist seems to have regarded the infusion of the berries of the Rhus glabrum as containing malic acid uncombined with any base but "merely contaminated with a small portion of gallic acid which probably proceeds from the pulp of the berries." In his paper on the subject he does mention having tested the acid liquor for lime, which he would have discovered at once either by evaporating a few drops in a platinum capsule and then igniting, or by adding to the liquor a little oxalate of ammonia.

So abundant is the bi-malate of lime in the infusion of the berries both of the R. glabrum and copallinum that when reduced by evaporation the whole liquid has the appearance of a thick light varnish and is almost *insoluble* in alcohol, two characteristic properties of the bi-malate. The process of Mr. Cozzens for preparing a pure malic acid from these berries is therefore liable to the objection that by using alcohol as the solvent, the operator will lose all the malic acid which exists in the bi-malate, and this I am inclined to think is nearly all the malic acid of the infusion. From the very small portion of acid matter which alcohol imbibes by standing for some time over the inspissated infusion, it is obvious that little uncombined malic acid can be present. In fact, nearly all the acid in the Rhus exists as a bi-malate in combination with lime. In procuring malic acid from the juice of the Sorbus in which it exists in an uncombined state, the alcohol acts as a solvent of the acid, and is therefore employed with advantage to separate it from mucilage and the other substances with which it is mingled. But it is entirely inadmissible when the acid is to be procured from the bi-malate of lime.

The Bi-malate of Lime is readily procured from the berries in considerable quantity and *perfectly pure* by the following process:

A quantity of hot rain water or distilled water is poured over the berries in a clean wooden or earthen vessel. After allowing the berries to macerate for a day or two, the liquid is poured off and evaporated carefully in an earthern or porcelain dish until it becomes intensely acid. It is now filtered through animal charcoal or bone black, repeatedly washed with muriatic acid. The liquid passes through almost colorless having only a slight amber tint. If the evaporation has been carried sufficiently far, a large deposit of crystals will form in a few hours. The liquid being poured off and further reduced by evaporation an additional crop of crystals may be obtained and in this way nearly all the bi-malate may be separated. The salt thus procured will often be slightly tinged with coloring matter, in which case it should be re-dissolved in hot water and crystallized anew. It is then perfectly pure.

When the crystallization of the bi-malate has been rapid the mass presents the pure and shining white of the sulphate of quinine.—When more slowly conducted, hexagonal prisms of the most beautiful proportions are obtained. The largest of these have generally two of their parallel faces much broader than the rest, so that when placed upon any smooth surface they have the appearance of rectangles, slightly beveled at the edges. In the salt suddenly crystallized the crystals are much more slender, and are perfectly regular hexagonal prisms with beveled extremities. They are frequently in pairs crossing at right angles, and in groups formed of several of these pairs. The variety of proportions among the different crystals and the exact symmetry which each presents are matters of very pleasing observation through the microscope. The great facility with which this salt crystallizes from the infusion of the berries, led me at first to doubt whether the acid contained in it was really the malic, for it would appear from the remarks of Berzelius and Thomson on the bi-malate that hitherto it had not been procured in the crystalline form from the juices or infusions of plants. The former chemist in the fourth volume of the Traité de Chimie, speaking of this salt under the title of Sur-malate Calcique observes, "Il ressemble à la gomme par son aspect," and again, "Ce qui vient d'être dit ne se rapporte qu'au sel tiré des plantes; d'après Braconnot celui qu'on prépare à l'aide de l'acide, cristallise en prismes hexagones." Dr. Thomson does not speak of it as crystalline and states that "when the supermalate of lime is evaporated to dryness it assumes exactly the appearance of gum arabic."

A very careful examination of the crystalline salt shows it to be a true bi-malate and I am therefore disposed to think that the uncrystallizable character of the bi-malate procured from the Sorbus, Sempervivum, &c. arises from the admixture of mucilage and other impurities.

The salt procured as above is intensely but agreeably acid. It dissolves abundantly in water but in very small proportion in alcohol. At a low heat it fuses and parts with its water of crystallization, assuming at the same time a gummy aspect. A little below redness the acid is decomposed, the mass swells very much, and if the heat be increased, every thing is driven off but the lime which remains in a bulky form, perfectly pure and white. A single crystal placed on a slip of platinum foil and held over a spirit lamp presents a very curious appearance, first melting and in a moment after shooting up in a white column of pure lime. This phenomenon is quite characteristic of the salt.

In investigating the nature of this salt of which as already stated I at first entertained some doubts, I made the following experiments.

1. A portion of the salt was heated to bright redness in a platinum capsule so as to drive off all the water and acid. The white

spongy mass remaining was strongly alkaline. It was dissolved in dilute muriatic acid. The solution was divided into two portions, of which one was tested for potash, the other for lime. None of the former base could be detected, but an abundant precipitate of oxalate of lime indicated the presence of the latter.

2. A portion of the salt was dissolved in distilled water in a test tube. Upon adding a few drops of liquids oxalic or citric acids, a white precipitate was formed. Liquid tartaric acid being added to a similar solution produced, after some time, brilliant octahedral crystals of tartrate of lime, which adhered to the sides of the tube. It appeared therefore that the base of the salt was *lime.*

3. To a solution of the salt in distilled water, a few drops of the solution of acitate of lead were added. A beautifully white flocculent precipitate was abundantly produced. This precipitate was insoluble in ammonia, and therefore could not be a citrate of lead.—Indeed neither citric, tartaric, or oxalic acid could be suspected in the salt, inasmuch as neither of these acids are known to form acid salts with lime.

4. The precipitate procured by the acetate of lead was well washed with distilled water, and then heated in the same to the boiling point. It almost entirely disappeared. But upon allowing the liquid to cool, the salt of lead separated and formed upon the surface and around the edges of the liquid, groups of the most brilliant satin like crystals. The crystals in these groups were extremely slender, diverging from the common center of the group with the most perfect regularity. Solubility in hot, and insolubility in cold water are characteristic of the malate of lead. But the novel and very peculiar crystallization just described made me hesitate at first in pronouncing this precipitate a malate. Berzelius describes it as collecting "Sous la forme d'écailles blanches ayant l'éclat de l'argent." Afterwards however meeting with Wöhler's process for obtaining malic acid, I found that the pure malate of lead crystallizes as I have described. It is not necessary for the production of this peculiar form of crystallization, that the precipitate should be washed and re-dissolved, for I have since found that the usual flocculent precipitate if heated in the supernatant liquid, and then left for some time undisturbed, is transformed into an assemblage of radiating groups such as have been described.

5. Ten grains of the salt obtained from the berries were exposed to a white heat, in a platinum capsule, until the water and acid were

entirely expelled. The lime remaining weighed 1.25 grains. This result accords very closely with the composition of bi-malate, as determined by Braconnot.* According to that chemist, as quoted by Thomson, the constituents of the bi-malate are

2	atoms	malic acid, - - - - - -	17.00
1	"	lime, - - - - - - -	3.5
6	"	water, - - - - - - -	6.75
			27.25

This would give in 10 grains of the salt 1.28, differing by three hundredths of a grain from my determination.

6. With the view of repeating some of the experiments of Lassaigne upon the acids produced by the destructive distillation of malic acid, I introduced several grains of the bi-malate into a glass tube, about one third of an inch in diameter and ten inches long. One end of the tube being hermetically closed and the salt all collected in that extremity, the tube was bent at two points, in a zigzag form. The closed end was then held in the flame of a spirit lamp, to expel and decompose the acid. In the angle of the tube remote from the flame, an acid liquid mingled with empyreumatic tar collected, and near the flame, adjacent to the salt, needle formed crystals of an amber color collected on the surface of the tube. The liquid being removed from the tube was evaporated gently, and then suffered to cool. Numerous scaly crystals formed, resembling the flat figures which snow sometimes assumes. These crystals were intensely acid, and soluble in alcohol and in water. Heated in a test tube, they were partially decomposed, and needle shaped crystals sublimed, resembling those deposited near the closed end of the tube in the first operation. Thrown upon burning charcoal, they exhaled a white smoke, of a suffocating odor. A solution of this pyro-malic acid in water, added to a solution of lead, produced a precipitate, at first flocculent, but afterwards becoming gelatinous. The sublimate was much less soluble than the acid just described. These substances agreed in properties with the pyromalic acids described by Lassaigne, and thus another proof was furnished of the true nature of the acid existing in the salt of the sumach. As but a small quantity of the sublimate was procured, I was prevented from examining its properties extensively. Little is yet known concerning it and I am at present preparing to give it a more complete examination.

* Vide Thomson's Inorganic Chemistry, Vol. II.

The attention of the French and German chemists having lately been much directed to the constitution of the vegetable acids, various improved methods of obtaining the malic acid in a pure form have been devised and published. In all these however the acid is extracted either from the Sorbus or Sempervivum. As in the former of these plants it exists almost entirely uncombined, while in the latter it is united with lime as a malate, a separate process is necessary for each. In procuring the acid from the Sempervivum the malate is converted into a bi-malate by the addition of so much sulphuric acid as will remove one half of the lime, and then other operations upon the crystallized bi-malate are necessary to separate the malic acid. From the comparative ease with which the bi-malate may be obtained from the berries of the Rhus, and the purity of the salt when procured in this way, there is no doubt that this fruit may be very advantageously employed in preparing malic acid for chemical purposes. I have as yet made no experiments to ascertain the amount of bi-malate which a given weight of the ripe berries of each of our species of Rhus will furnish, but I have no doubt that it would be found very considerable. Of the medicinal properties of the salt I believe little or nothing is known. Should it have any value in this respect, or should its pleasant acidity bring it into general favor as an ingredient in our summer beverage, the great abundance of the plants in which it exists would no doubt make it an object of extensive manufacture.

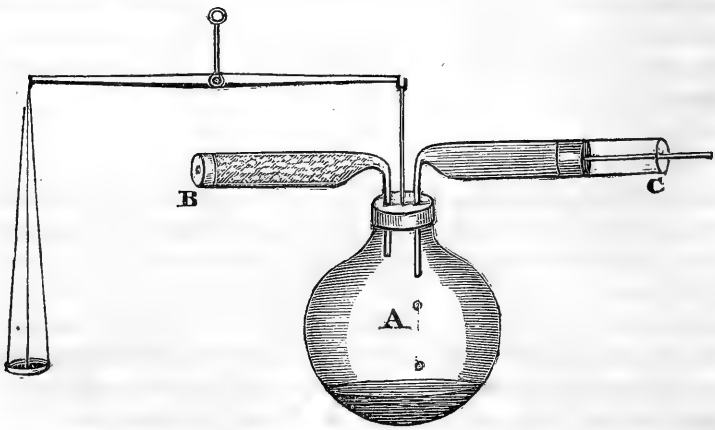
Art. XIII.—*Apparatus for Analyzing Calcareous Marl and other Carbonates;* by William B. Rogers, Professor of Chemistry and Natural Philosophy in William and Mary College.

In consequence of the extensive use now made of the marls of of our tertiary strata in the agriculture of the state, I am frequently called upon to analyze these substances with the view chiefly of determining the proportion of carbonate of lime. In doing this by the method generally employed, viz. disengaging the carbonic acid by chemical action and then estimating the carbonate by the weight which is lost, I have found the instrument of Rose so cumbrous and difficult of management that I have abandoned it altogether, and am now in the habit of using the little apparatus about to be described, which gives with comparative facility far more accurate results.

From the construction of Rose's instrument its weight must always be so great as to render an exact estimation of the carbonic acid impossible by means of any but the most accurate and expensive balances. Besides which I have found the contrivance for bringing the acid and carbonate together very difficult to regulate and liable to accidents which often make it necessary to repeat the analysis.

From the subjoined figure and description it will be evident that the apparatus here recommended is free from these objections. The accuracy of its results and the facility with which it may be used in the analysis of marl and the carbonates generally, will I think entitle it to the notice of the practical chemist.

The balance I employ with this apparatus is of the kind sometimes used by goldsmiths, having a light beam, and turning readily when unloaded with $\frac{1}{200}$ of a grain. This is accompanied by a set of weights extending to tenths and hundredths of the grain. One of the scales is removed to admit of suspending the apparatus by a double thread over the hook of the beam. The other is made of something light, as a piece of card, or which is better, a thin sheet of mica. In this way all unnecessary weight upon the beam is avoided and its sensibility preserved.



A is a light bulb of glass, blown very thin from a piece of tube, and about one inch in diameter. A cork is fitted to its mouth, and through this the tapered ends of the bent glass tubes B and C are passed air tight, the extremity of the latter extending some distance into the vessel. The tube B through which the gas escapes is filled with fragments of muriate of lime or with dry carded cotton. If the former be used the end of the tube must be partially closed with a perforated cork. The tube C which contains the muriatic acid is furnished with a light piston of cork or cotton, in the center of which is fixed a rod or handle made of a small stiff straw. This instrument when charged with the usual quantity of marl and acid does not weigh more than 120 grains. The whole load of the beam is therefore about 240 grains, and it is still sensible to $\frac{1}{100}$ of a grain.

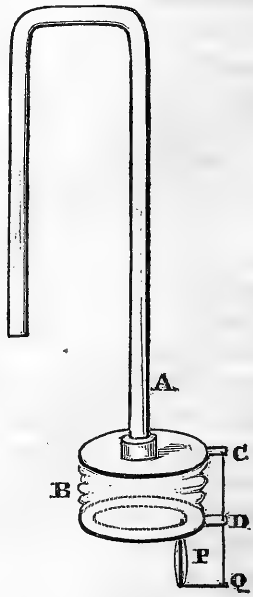
The mode of proceeding with the analysis is as follows. Five or ten grains of the finely pounded marl or other carbonate are introduced into the vessel A, and then two or three drops of water added, to assist the diffusion of the acid. The small end of the tube C, now removed from the cork is dipped into muriatic acid in a wine glass and the piston moved backwards and forwards until the necessary quantity of acid has been drawn in. The tube is then replaced in the cork and in this state the instrument is counterpoised by weights in the opposite scale. The piston being then gradually forced in, the acid is injected drop by drop upon the marl or other carbonate, and the gas escapes by the tube B, depositing the moisture in its passage on the muriate of lime or cotton. Allowing the apparatus to rest in a dry place until the gas has entirely escaped, and the decomposition is complete, the equilibrium is restored by placing weights upon the top of the cork, or by removing weights from the scale. In this way the weight of the disengaged gas is accurately determined and the proportion of carbonate thence computed.

The following analysis of a specimen of marl from James city, Va. may serve as a useful illustration of the method, to such of your readers as are interested in the application of calcareous manures. Ten grains of the finely powdered marl were introduced with a little water into the vessel A, the instrument was then charged and equipoised. The acid being injected, the whole was allowed to rest.—The weight lost was 2.91 grains. Increasing this in the ratio of 100 to 44 gives 6.61 grains of carbonate of lime in the ten grains of marls, or almost precisely 66 per cent.

The bulb of this apparatus is very readily formed of a common test tube about $\frac{3}{8}$ of an inch in diameter, the lower end of which admits of being blown out into a thin sphere of the proper size.—The neck is then filed off short and a cork adapted. Any ordinary worker in glass will construct the instrument, and skill in manipulating with it may be soon and easily acquired.

Art. XIV.—*Self-filling Syphon for Chemical Analysis;* by William B. Rogers, Prof. of Chemistry, and Natural Philosophy in William and Mary College.

In Chemical analysis and other operations of the Laboratory, where a large amount of liquid is to be removed from a vessel without disturbing the precipitate which has collected on the bottom and sides, a small syphon of glass may be very conveniently employed. To commence the action however, as every one knows, the syphon must be previously filled, and the introduction of it in this state is apt to agitate the liquid and thus disturb the precipitate. Moreover where accuracy is an object, the Instrument must be filled either with a portion of the liquid to be removed or with distilled water, and sometimes it would be inconvenient to do either. Having recently had much occasion for the syphon in analysis, the following contrivance was adopted for obviating these little difficulties. Perhaps others may find it useful and in that hope I send you a description of it.



To the long leg A of the syphon is cemented or fastened by a cork a circular plate of thin, hard wood about one inch in diameter furnished with a little projection at C. This plate is perforated and embraces the end of the syphon.—Another similar plate placed below is connected with the former by some flexible material such as oiled silk, or thin bladder, so that when the lower disk is drawn down a hollow cylinder is formed. The oiled silk or other material may be secured around the edges of the two disks by any good cement, but of course the joinings should be air tight. A wooden valve P opening downwards and about half an inch in diameter is attached to the lower disk and closes an aperture in it of rather smaller size. This valve is acted upon by a cord C D Q, fastened to the projection at C, passing through a hole in D and fastened to the end of the limb Q which is at right angles to the valve. By drawing down the lower disk to a certain distance it is evident the action of the cord will open the valve and the length of the cord may be so adjusted as to cause this to happen in various positions of the disk and to occur always before the liquid arrives at the lower end of the syphon.

In the rude sketch I send you, the exhausting apparatus is much larger than necessary. It would answer for a syphon four times as large as that in the figure.

Art. XV.—*Some properties of a Rampant Arch*; by Thomas Gorton, Civil Engineer.

TO PROFESSOR SILLIMAN.

Sir—Having had occasion of late to make the necessary calculations for describing what is sometimes called a rampant arch, it being formed by the intersection of a parapet wall with an oblique descending culvert, I reduced these calculations to a problem which will admit of a general application to arches of this description: and thinking it might be of some service to Architects and Engineers, it is herewith submitted for publication in your Journal.

Suppose a plane to cut a semi-circular vault in such a manner as to make an acute angle with a plane passing through the axis and crown of the vault, and also with the springing plane of the same. It is required to find the length and positions of the transverse and sémi-conjugate diameters of the semi-ellipse thus formed by the intersection of the vault and cutting plane.

Let the acute angle formed by the axis of the vault and the intersecting line of the axal and cutting planes be put $=$A; and the acute angle formed by the axis and the intersecting line of the springing and cutting planes be put $=$B; also put the radius of the vault$=r$.

Then by Trig. rad. : log. $2r$: : cot. B : log. a. (See Fig. 1.)

And put $\sqrt{2r^2+a^2}=b$.

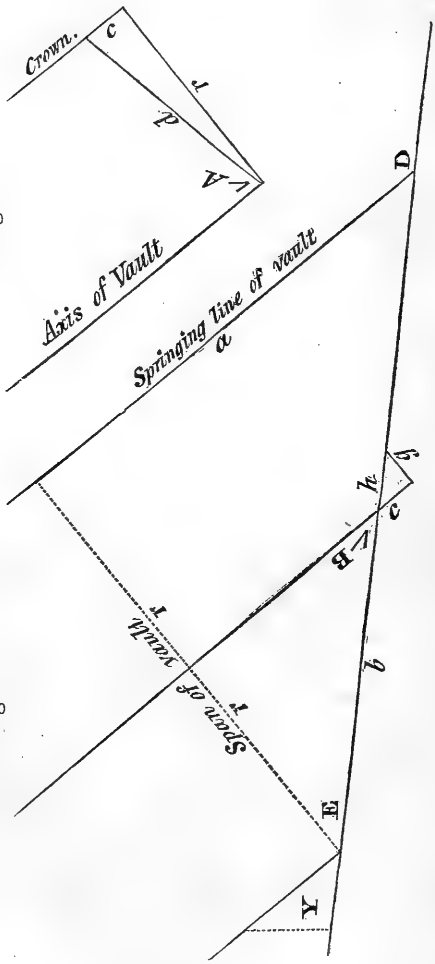
Again by Trig. rad. : log. r : : cot. A : log. c. (See Fig. 2.)

And put $\sqrt{r^2+c^2}=d$.

Then by sim. tri. $d : c : : a : e$; and put $\sqrt{b^2-e^2}=f$.

Again by Trig. rad. : log. c : : tang. B : log. g.

Then put $\sqrt{g^2+c^2}=h$, and $\sqrt{r^2+g^2}=i$; also let $i-r=j$.



Axal plane of vault.
Fig. 2.

Springing plane of vault.
Fig. 1.

Again by sim. tri. $r : d :: g : k$.

and $\sqrt{(e+2k)^2+f^2}=m$.

And by sim. tri. $i : \frac{m}{2} :: j : l$.

Then $m-2l$=the transverse diameter required.

The figure may then be constructed as follows.

Draw any line L′L′ on which lay off the line f from C to D, through C and D draw lines at right angles to CD. Then lay off the line e from C to E, and the line k from E to F, and the same line k from D to G. Bisect CD in H, and through H draw a line HI parallel to CF and DG. Join ED and FG which will intersect and bisect each other on the line HI at J. Lay off the line d from J to K; and parallel with the line ED lay off the line h from K to L, then join JL which is i. Also lay off the line r from J to M, or the line j from L to M. Again on the line FG lay off the line l from F to N, and again from G to O. Then NO is the transverse diameter, and JM the semi-conjugate, both in length and position.

The length of the transverse diameter may also be found by another method, it being$=\sqrt{b^2+2d^2-2r^2}$, from the well known property of the ellipse, that the sum of the squares of every pair of conjugate diameters is equal to the same constant quantity, namely, the sum of the squares of the two axes.

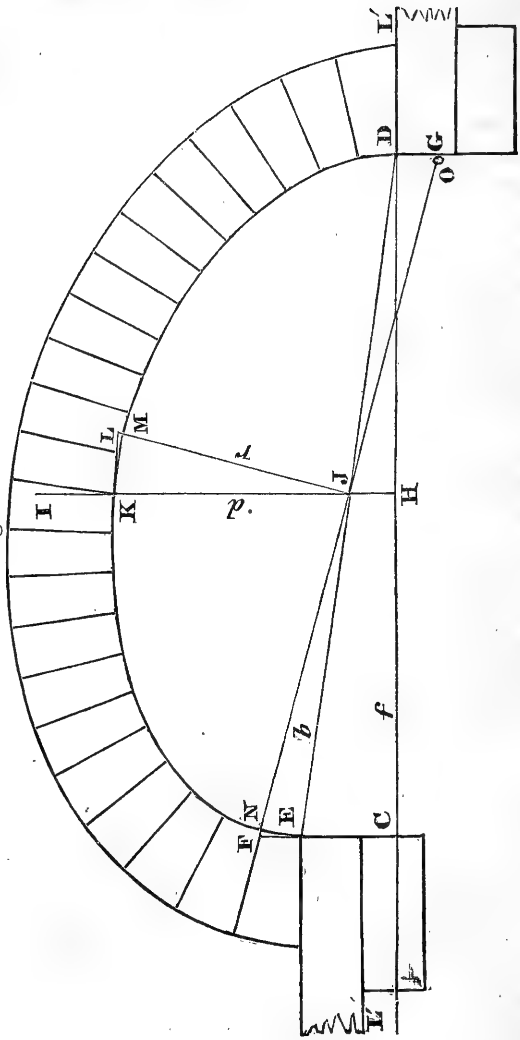
In the case here alluded to r was five feet.

The arch ELD was traced on a platform by means of a chord fixed at the two foci of the ellipse, and the ring-stone being all laid out, patterns were made for the face of each. These patterns together with a model were then given to the stone-cutters who were enabled to cut all the stone by them so as to fit in their proper places.

The beds of a few of the ring-stone near D Fig. 3, were increased somewhat in width so as to form a shoulder at the back corner, and in this manner be better supported by the adjoining stone in the parapet. The ring stones did not diminish in depth on the face as they approached the crown, but were all of the same depth; this form giving a much better bed for that part of the parapet directly over the crown of the arch.

Such an arch, where the obliquity and descent are considerable, is much weaker than a right arch, and therefore could not be adopted with safety where the span was large. The stone at Y Fig. 1, presents a sharp angle, on which account this is found to be the weakest part of the arch. Its strength might perhaps be increased by cutting off this sharp corner as represented by the dotted line, and thus increasing this half of the span.

Pennsylvania Hospital, Oct. 6, 1834.



Cutting plane of vault.
Fig. 3.

Art. XVI.—*A live Snake suspended by Spiders.*

Batavia, N. Y., Sept. 20, 1834.

TO PROFESSOR SILLIMAN.

Sir—In the "Spirit of the Times" of this village, of the date of Aug. 26, 1834, I published over the signature of "A Witness" an account of a *snake* found suspended by spiders' web, by the tail, in the wine cellar of a gentleman in this village.

A gentleman who also saw and examined the phenomenon, promised to send you a drawing and account of it. Whether he has done so or not I do not know. And as the story has been treated as a fable by some of the papers, I send you enclosed, the account above mentioned, and a correct drawing, (though rough and done in haste) made by James Milnor Jr. Esq., a clerk in the Holland Company Land Office.

The gentleman in whose wine cellar the snake was found, is the Hon. David E. Evans, agent of the Holland Land Company, who requests me to forward to you the drawing and account, which he pronounces to be accurate.

Mr. Evans, Mr. Milnor, Mr. Mix, Doct. VanTuyl, and a great number of other gentlemen, examined this subject *critically* on several different days, while the snake was yet alive, and all concur in the accuracy of the account.

I hope you will procure a correct engraved cut of the drawing, and publish it with the account in your Journal. And if you do, you are at liberty to use all the names mentioned in this letter, or to publish it at length if you think proper.

Most respectfully, your ob't servant,

S. Cummings.*

The following is the account alluded to in the above letter.

On the evening of the 13th inst. a gentleman in this village, found in his Wine cellar, a *live Striped Snake*, nine inches long, suspended between two shelves, by the tail, by spiders' web. The snake hung so that his head could not reach the shelf below him, by about an inch; and several large spiders were then upon him, sucking his

* We understand that Mr. Cummings is first Judge of the Court of Common Pleas in his county, and also Post Master of Batavia.

juices. The shelves were about two feet apart; and the lower one was just below the bottom of a cellar window, through which the snake probably passed into it. From the shelf above it, there was a web in the shape of an inverted cone, eight or ten inches in diameter at the top, and concentrated to a focus, about 6 or 8 inches from the under side of this shelf. From this focus, there was a strong cord made of the multiplied threads of the spiders' web, apparently as large as common sewing silk; and by this cord, the snake was suspended.

Upon a critical examination through a magnifying glass, the following curious facts appeared. The mouth of the snake was fast tied up, by a great number of threads, wound around it, so tight that he could not run out his tongue. His tail was tied in a knot, so as to leave a small loop, or ring, through which the cord was fastened; and the end of the tail, above this loop, to the length of something over half an inch, was lashed fast to the cord, to keep it from slipping. As the snake hung, the length of the cord, from his tail, to the focus to which it was fastened, was about six inches; and a little above the tail, there was observed a round ball, about the size of a Pea. Upon inspection, this appeared to be a green fly, around which the cord had been wound as the windlass, with which the snake had been hauled up; and a great number of threads were fastened to the cord above, and to the rolling side of this ball to keep it from unwinding, and letting the snake down. The cord, therefore, must have been extended from the focus of the web, to the shelf below, where the snake was lying when first captured; and being made fast to the loop in his tail, the Fly was carried and fastened about midway, to the side of the cord. And then, by rolling this fly over and over, it wound the cord around it, both from above and below, until the snake was raised to the proper height, and then was fastened, as before mentioned.

In this situation the suffering snake hung, alive, and furnished a continued feast for several large spiders, until Saturday forenoon, the 16th when some persons, by playing with him broke the web above the focus, so as to let part of his body rest upon the shelf below. In this situation he lingered; the spiders taking no notice of him, until Thursday last, eight days after he was discovered; when some large Ants were found devouring his dead body.

A WITNESS.

As this extraordinary case has been doubted, we think it fair to annex the account of another witness, which will be seen to be similar to that of Judge Cumings, but not identical.—*Ed.*

New York, August 26, 1824.

TO PROFESSOR SILLIMAN.

Dear Sir—Enclosed I take the liberty of sending you a rude sketch of a curiosity, which came under my observation a short time since. A gentleman residing in the village of Batavia, N. Y., on going into his wine cellar, discovered a striped snake, about ten inches in length, suspended by, and from the web of a spider, in a manner precisely similar to the enclosed sketch. From a survey of the premises, it would appear that the snake had taken up his abode upon one of the shelves in the cellar, when the spiders (for there are three which appear to be engaged as partners in the business,) first formed the design of making him their captive. For this purpose they formed a large web upon the under side of a shelf directly above the snake, from which they descended and made fast a large number of fibres to different parts of his body, bracing them in every direction, so as to prevent his escape and render their operations more secure, they next proceeded to muzzle him by winding a web many times around his head, so as entirely to deprive him of the use of his mouth. Having thus secured him, they next set to work to suspend him from their web. You will observe a knot in the tail of the snake. How this was formed I am unable to say, but certain it is, that the spiders took advantage of it and by winding the knot with a web, prevented the possibility of his loosing it. They then apparently proceeded to attach a large number of fibres, running from various parts of the web above, to the loop formed by the knot which they glued and fastened together by winding them with another fibre, thus forming a strong

cord. This done, the most difficult part was yet to be performed, and this was to swing him clear from the shelf. To do this, they procured a large *blue fly,* (2,) which they made fast to the web or cord, and by continuing to roll the fly over in the web or cord, and making it fast at each turn, they were enabled to swing the snake about three inches clear from the lower shelf. The snake was alive and active when discovered, and five days after when I was there last, he was still living suspended in the manner above described. During the day no spiders were visible in or about the web, but at night there were three, much smaller than the common fly, seen feeding upon the body of the snake.

Very respectfully your obedient Servant,

D. Lyman Beecher.

The enquiry has been made, whether the snake might not have fallen by accident into a web previously made, and thus have become inextricably entangled.—*Ed.*

Art. XVII.—*Description of an Instrument for exhibiting a certain Optical deception;* by Prof. E. S. Snell.

In the London Philosophical Transactions of 1825, Dr. Roget describes and explains a curious optical deception, which presents itself, when a person looks through a series of narrow vertical apertures at a carriage wheel, as it rolls along on the ground. The wheel appears to have simply a progressive, without a rotary motion, as though it were sliding, and the spokes seem to be more or less curved. The two spokes, however, which are in a vertical line, and therefore coincident in direction with the apertures through which the observer looks, remain in appearance, straight, while all the others, both on the right and left, have considerable curvature, presenting their concavity upward, or towards the highest spoke.

The illusion is the same, if the wheel revolve on a fixed axis, while the vertical bars have a progressive motion between it and the observer. The direction in which the spokes appear to be bent may, however, be reversed in this form of the experiment. If the bars move in the same direction as the lower part of the revolving wheel, the concavity of the spokes will be upward; if in the same direction as the top of the wheel, the concavity will be downward. The reason why the concavity is invariably upward, when the bars are stationary, and the wheel has both a rotary and a progressive motion, is that these two motions have a fixed relation to each other, the whole wheel in its progression moving in the same direction as the top of the wheel in its rotation.

While I was seeking to devise some simple apparatus by which this phenomenon might be exhibited as an optical experiment, I first met with Prof. Stamphe's amusing invention, called the Phantascope, or Kaleidorama. This at once suggested an easy method of representing the appearance just described. Having covered with white paper a circular disk of pasteboard, nine inches in diameter, I cut 30 or 40 radial apertures from points near the circumference as far towards the centre as the strength of the material would allow. These apertures are an eighth of an inch wide; and on one side of the disk a heavy ink line is drawn from the inner extremity of each aperture to a small black circle at the centre. The disk, thus prepared, has the appearance of being marked with dark radiating lines from the centre to the circumference. It is then fixed on an axis, and used precisely like the kaleidorama. If the observer stand about three feet from a mirror, and hold the disk a foot from his face, so as to look through the highest apertures at the image in the mirror, on revolving the disk, he will perceive the radii remaining fixed in their position, and very much curved. Reversing the direction of revolution occasions no change; the concavity in either case is downward, both on the right and left, while the vertical lines are straight. But on raising the disk, till the eye sees the image through the lower apertures, the whole is reversed; and a change of any number of degrees in the position of the eye produces an equal change in the figure, the outer extremities of the radii being in every case bent away from that part of the circumference which is nearest the eye. As the observer retires from the disk, the curvature rapidly increases, till at length in certain positions he sees but three or four of the lines, and those extending through 180° of the disk, with both extremities at the centre, and bearing a striking resemblance to a system of magnetic curves.

The general explanation given by Dr. Roget will apply to all the varieties of the phenomenon, which this little instrument exhibits, although only the simplest cases were contemplated by him in his communication.

Amherst College, Nov., 1834.

Art. XVIII.—Reply to "*Observations on the Treatise of Mineralogy of Mr. C. U. Shepard, by* Andres Del Rio, *Professor of Mineralogy in the School of Mines of Mexico; Pres. of the Geological Soc. of Penn. &c.* (Read before the Geol. Soc. of Penn., June, 1834," and published in the Transactions of that society August, 1834.) By Charles U. Shepard.

Prof. Del Rio, in presenting to the Geological Society of Pennsylvania a translation of the classes and orders of Breithaupt's Characteristic, takes occasion to remark upon its superiority over that contained in my Treatise on Mineralogy, and which, unlike the Characteristics of Mohs and Breithaupt, is applied to an artificial system. As his observations are of a general nature, and as he has omitted giving the reader a fair opportunity of judging of the matter through the aid of an example from each, by performing the task myself, I may be able to place the subject in a stronger light; although I believe the experiment will prove that the advantage in facility, on which the question turns, will lie quite on the other side. And without attempting unduly to favor myself by the selection, I will take a species which offers as nearly as possible, similar difficulties in both systems. Let the substance for determination be, either crystallized in the form of a right square prism, cleavable parallel to its sides; or massive with large individuals; or finally massive in small, closely connected individuals. Sp. Gr.=4·2 . . . 4·4. Hardness=8·0 . . . 9·0 of Breithaupt's scale, or=6·5 of Mohs. Lustre metallic-adamantine, (common according to Breithaupt). Color reddish brown. Streak pale brown.

Characteristic of Breithaupt.	My Characteristic.
To determine the Class.	*To determine the Class.*
I. Class. *Salts.*	I. Class. *Crystallized Minerals.*
Common lustre.	Minerals crystallized. (i. e. in regular forms.)
H. 0·25 . . . 4·50. But the hardness of the mineral sought being 8·0 . . . 9·0, it is excluded.	If the mineral sought is a crystal, it falls within this class.
II. Class. *Stones.*	II. Class. *Semi-crystallized Minerals.* (i. e. massive minerals in large, easily cleavable individuals.)
Common lustre. H. 0·25 . . . 12·0. G. 1·8 . . . 8·1.	

Characteristic of Breithaupt.	My Characteristic.
Without saline, alkaline, and sweet tasted, or aqueous cooling, solubility on the tongue.*	If the mineral sought is massive and easily cleavable, it is to be sought in this class.
When H. 0·25 . . . 4·0, which is not the case with the mineral sought.	III. Class. *Uncrystallized Minerals.* (i. e. massive minerals, not yielding cleavage forms.)
When H. 4·0 . . . 5·75, which is not the case with the mineral sought.	If the mineral sought is massive and uncleavable, it falls within this class.
When H. 5·75 . . . 8·75 and G. from 2·0 . . . 4·0, except such as have G. 3·5 and more, but the mineral sought has G. above 3·5; it is therefore excluded from Class II.	
III. Class. *Minerals.*	
All those with metallic lustre and G. from 3·2 . . . 22·0 belong here without exception.	
Those with common lustre, having H. from 0·50 . . . 9·0 and G. from 2·2 . . . 8·5 belong here under the following conditions:	
If H. 0·50 . . . 2·50, which is not the case with the mineral sought.	
If H. 2·50 . . . 6·0, which is not the case with the mineral sought.	
If H. 6·0 . . . 7·0, which is not the case with the mineral sought.	
If H. 7·0 . . . 9·0; and G. 3·9 . . . 8·5, which proves the mineral sought to fall within the present class.	

* Prof. Del Rio's translation is, 'soluble on the tongue without salty, alkaline and sweet taste.' The German is, '*ohne salzig, alkalisch und susslich schmeckende auch ohne wässrig kühlende auflöslichkeit auf der Zunge.*'

Characteristic of Breithaupt.	My Characteristic.
To determine the order. Order I. of Class III. *Ores.* Metallic lustre: the mineral is excluded. Common lustre: H. 1·0 . . . 9·0 G. 2·1 . . . 8·1, which brings it here unless excluded by what follows. H. 1·0 . . . 2·5. Excluded. H. 2·50 . . . 4·25. Excluded. H. 4·50 . . . 6·0. Excluded. H. 6·0 . . . 8·0. Excluded. H. 8·0 . . . 9·0: G. 4·1 and more, which proves our mineral to fall within this order.	*To determine the order.* If a crystal, the order is the 7th, of Class I., *the Right square prism.* If a cleavable variety, the order is the 5th of Class II., *the Right square prism.* If an uncleavable variety, it falls in Class III., between Species 221 and 285, which is the order of Rutile for this class, there being 64 species whose hardness is within unity above or below it, in the scale of hardness.
*To determine the genus.** Genus 1st. of order I. Class III. *Gadolinite.* Deuterostatic. It is excluded. Genus 2nd. *Tephroite.* Protostatic. Tetragonal, brachyax. Cleavage lateral. H. 7·0, but the hardness of the mineral sought is 8·0 . . . 9·0. Genus 3rd. *Hard-Ore.* Protostatic. Tetragonal, holoëdric, brachyax. Cleavage lateral, distinct to perfect. H. 7·50 . . . 9·0. G. 4·20 . . . 7·1. It belongs here.	
To determine the species. Species 1st. of Genus Hard-Ore. *Rutile Hard-Ore.*	*To determine the species.* If crystallized, compare in Sp. Gr. the species Nos. 8, 9, and 10.

* As Prof. Del Rio has carried the translation no farther than through the orders, I avail myself, in pursuing the analysis, of the original work.

Characteristic of BRIETHAUPT.	My Characteristic.
Adamantine lustre. Color red, sometimes passing to brown, rarely to yellow. Streak pale brown to nearly isabella-yellow. Primary form, Brachiax, tetragonal Pyramedaedron, P$=\frac{0}{10}$ $\frac{1}{2}$ O$=135° 22' 42''$; $64° 56' 42''$; 2P'$=122° 24' 6''$; $83° 58' 28''$. ($64° 56'$ also $64° 55'$ BR.) Cleavage, parallel with the primary prism, perfect; to its diagonals distinct; with the faces of the primary pyramids in traces. Fracture, uneven to conchoidal. H. 8·0 . . . 9·0 G. 4·249 MOHS. 4·250 to 4·291 BR. which determines the mineral sought, whether crystallized, massive in large individuals, or massive in small individuals to belong to the species *Rutile Hard-Ore* of BR. or Rutile (trivial name,) of English mineralogists.	(order 7, class I.) No. 10=4·2 . . . 4·4, while both the others differ from this by an amount greater than 0·5. It is therefore *Rutile*. If a cleavable variety, the hardness alone decides it to be species No. 8. (ord. 6. class II.) or *Rutile*. If uncleavable, its Sp. Gr. requires it to be compared with Nos. 225, 236, 237, 248, 252, 257; 259, 261, 264, 265, 266, and 268, (Class III.) in Sp. Gr. while its lustre, color and streak decide it to be 264, or *Rutile*.

It is obvious from the foregoing trial of these Characteristics, that, while both are sufficiently certain in effecting the purpose intended, the advantage in brevity is on my side. A single glance at the two columns shows, that the amount of reading and observation required in the two cases is quite different, even leaving it out of the account that my column has embraced the determination of the three varieties, crystallized, cleavable and uncleavable, while what I have given from BREITHAUPT would be necessary for the diagnosis of either one of them. Other trials would exhibit the subject in a similar light.

It is objected, moreover, to my Characteristic that the name of the mineral being determined, the student has still to learn another classification in order to that disposition of the species adapted to a comprehensive survey of the whole contents of the mineral kingdom, whereas that of Mohs and Breithaupt accomplishes both objects at the same time. My Treatise has said of its Characteristic, that being applied to an analytical system, "it is intended solely to effect the recognition of minerals and that the student has no interest in the classes and orders or in the succession observed among the species, except so far as they relate to the naming of minerals. To arrange a cabinet of specimens according to a system invented solely to conduct to their names, would be like preserving the staging about an edifice after its construction was completed." (Preface to Treatise p. viii.) This leads Prof. Del Rio to make the remark, that 'this is a solid objection indeed, since by the method of Mohs and Breithaupt, it is not necessary to destroy the bridge after having crossed the river.' In reply to the figure, it might be enough to say, that the student having crossed the bridge in his onward route to knowledge has no occasion to recross it to his previous state of ignorance; and therefore, while there is nothing in my system to compel him to blow up the bridge if he could, it must be a matter of perfect indifference to him whether it remains or not.

But to examine the disadvantages the pupil actually incurs by being obliged to acquire a knowledge of the natural system by itself and succedaneously, it is quite certain that he can have as little interest as comprehension respecting the nice affinities of mineral species before he has become acquainted with the majority of them. And although in employing the Characteristics of Mohs or Breithaupt, he is continually conversant with the classes, orders and genera of the natural system, yet as it is for the single purpose of learning names, the fact that these express the natural alliances of the species is unheeded. It can only happen after he has made the acquaintance of a large number of minerals, that he is prepared for this new view of their relations; and it makes very little difference whether his attention is directed to it after having learnt the names by an artificial or synthetical system, provided the analytical one does not involve him unnecessarily in the labor of names for its divisions, which surely cannot be charged to mine, since it does not contain a single new word. How many hours does Prof. Del Rio think it would demand of a pupil of common capacity who had determined the names of half the mineral species, completely to put himself in possession of the natural system of Mohs or Breithaupt? At any rate, the advantage in facility of determination, of the analytical over the synthetical system, as evinced by the foregoing experiment, will abundantly compensate the ultimate loss of time experienced in acquiring the natural orders.

To Prof. Del Rio's objection to my frequent division of the species, so that members of one and the same species appear in all the classes, I adduce some remarks contained in the Treatise, which if they had met his eye might have saved him the wholly inapplicable suggestion he has made in relation to the subject.

"It may require an explanation, why a mineralogical method, should, unlike the systems in zoology and botany, make provision for any but perfect or crystallized minerals. In the vegetable kingdom, it is well known, that no object is considered as classifiable, unless possessed of the parts of fructification; or in other words, of the highest degree of perfection in its characters, under which it is capable of appearing. And although the majority of plants, ordinarily under our observation, is imperfect in these respects, no serious inconvenience arises from the fact, since they are all possessed of an active principle, whose operation will at length advance them to maturity; in addition to which, we have no difficulty in finding other individuals of the same species, already in possession of the requisite perfection to enable us to accomplish their determination. But it is otherwise in the mineral kingdom. Semi-crystallized and uncrystallized minerals constitute by far the largest part of those requiring determination, and they are wholly destitute of any tendency towards a higher degree of perfection. As we find them, so they remain, (unless, indeed, they become, as sometimes is the case, more imperfect still, from external agencies;) and unlike the determination of imperfect plants, by the aid of those which are more perfect, it is seldom possible to determine them from their association with crystallized individuals of the same species. From this we see, that a method which should omit to provide for such minerals as are not fully perfect in their properties, would be extremely imperfect in general practice.

"*As a consequence of this necessity of providing means for the determination of imperfect minerals has arisen the frequent division of the species. Thus portions of the species Fluor are found in all of the classes, according as the individuals are crystallized, cleavable, or massive. It is to be remarked, however, that this division within the species (unknown in the other departments of natural history,) never takes place in the crystallized individuals of the mineral kingdom; among which only should we expect to* *find the rule of preserving the species unbroken observed, since they alone correspond to the classifiable objects of zoology and botany.*" p. 140.

But should the foregoing not appear an adequate justification of my logic, I have only to add, that I expect those who call it in question to state definitely what are the objections to any system of tabular arrangements, which confining its distinctive marks to the most important natural properties of minerals, conducts by the shortest route to their names.

But Prof. Del Rio proposes to try my Characteristic by putting himself in the place of the young student, and commences his remarks by saying—" I suppose him at first well informed in the terminology, and I know not how he should be, not being provided with select specimens." Now I have no where said, nor ever imagined, that a person could understand Terminology without the aid of specimens adapted to that purpose. On page 4 of the Treatise, under the head of *method to be followed in acquiring a knowledge of minerals*, it is said, " The course to be adopted by persons aiming at a thorough acquaintance with the inorganic kingdom, consists, in the first place, in studying the properties of these bodies, and in acquiring a knowledge of the terms by which they are designated. This will require as a preliminary, a familiarity with a few definitions in geometry; *and afterwards, access to a collection of minerals arranged on purpose to illustrate the properties in question.*" Continuing his remarks he says, " suppose the student obtains a fine granular Galena, he tries its hardness and its specific gravity, and he finds it by referring to the third class, to be Galena: he gets also a cube, and finds by a second investigation, that it belongs to the first class; and when he gets also a large concretioned Galena, which has three cleavages perpendicular to each other, he finds it to belong to the second class, p. 202, which the author has not quoted. Now, can he convince himself, although they are *toto cœlo* different in their habit, that they are one and the same galena?" I say most certainly. If he has paid the slightest attention to the chapter on Classification, where a species is defined to be an assemblage of identical individuals, and where it is taught that minerals not differing in their natural properties are identical, he will not hesitate to pronounce identical the above mentioned minerals, which he finds to agree precisely in hardness and specific gravity, and in whose systems of crystallization he discovers nothing contradictory. I confess I am at a loss to know what is the signification of *toto cœlo different*, when applied under such circumstances. Does this very commonly occurring diversity of mechanical structure in the members of almost every species constitute them such?

He proceeds to inquire, whether the same end would not be better obtained, and triplicate trouble spared the student by adding to the third table, that Galena is also found in cubes, and has a triple perpendicular cleavage. I think not; for the reason, that of minerals crystallized, or massive in cleavable individuals, a specimen may be determined by the two first classes with the slightest trouble in comparison with what they could be, if they were to be sought for blended up with the entire mass of the species, where the order of succession is first hardness and then specific gravity: not to mention that it would materially increase the labor of determining a massive, uncleavable specimen, if the class appropriated to these was burdened by all the characteristic details of crystallized minerals.

"But granting" continues Prof. Del Rio "the partition into three classes, as it is, Fluor is found most frequently in cubes, and yet the student shall not be able to find it in the first order of the first class, where it should be; it is to be found in the third order, the octrahedron." Where, I scarcely need add to the most careless reader of the Treatise, it could alone be, and where the most inattentive student would not fail of referring it: for the order depends upon the *primary*, which is not always the *actually occuring* form. And can it be imagined that the student would be misled in settling the primary form of Fluor, when a cubic crystal of this species cannot be turned in the hand without the discovery of its octahedral cleavages, not to mention that few crystals can be handled without jarring from their angles the pyramidal fragments which conceal the faces of the primary octahedron.

The suggestion of adding the trapezohedron as a primary form, and of arranging under it the Leucite, Analcime and Garnet, does not appear to offer any advantages: besides the objection which the procedure incurs, that neither these nor any other minerals assuming this form, ever present trapezohedral cleavages, while all which do, either give cubic, octahedral, or dodecahedral ones; and the form in question flows from the cube, the regular octahedron and rhombic dodecahedron by a very simple modification, in coincidence with the law of symmetry.

Nor can any confusion be experienced in the determination of the Leucite, from the fact that it has a dodecahedral cleavage, while I place it under the cube; for it is not likely that the pupil will discover either the cubical or the dodecahedral cleavages, (both of which, however do exist) but will, if he follows the directions of the Treatise,* try the order of the cube first, where he will find it.

I do not agree with Professor Del Rio, who asserts that the Garnet is commonly trapezohedral; though the trapezohedron in combination with a dodecahedron is common, yet the perfect trapezohedron is no more frequent than the perfect dodecahedron.

But Professor Del Rio attacks the validity of crystallography altogether. "For a student, the primary forms are no easy task, which even by the professors, are often differently expressed and frequently they are even doubtful; what Mr. Shepard gives as a square prism is arranged by others as a square octahedron; and what he assigns as an oblique prism is announced by some as an oblique octahedron, and otherwise by others, which is not, and cannot be the same to the student. I will go further in saying that the sulphuret of manganese from Transylvania and Cornwall is an hexahedron for Mohs, and that of Mexico is a rhombohedron for me. Nay, Professor Mitscherlich infers now from his observations, that every simple or composed body is able to take two different forms of crystals, which is the finishing blow even to the scientific classification of minerals by crystallization!" And then, as if out of all patience with what he regards a complicated subject, he goes on to say, "Therefore I propose to make as many orders as there are crystals found in nature, and so the quadrangular and hexagonal prisms, pointed and beveled, should constitute orders, like the regular hexagonal prism; the student per se, will never find in his lifetime, however long, that the quartz belongs to the order of the obtuse rhomboid."

It is undoubtedly true that different views have been taken of the connexion of the regular forms assumed by crystals, and accordingly some have admitted more primary forms than others. But if each writer defines and renders intelligible his own method, so as to enable the student to follow him, it is enough; whether the number be fifteen as with Brooke, (whom I have followed,) or but a single one,

---

* "If the crystal is a trapezohedron, we know it can come only from the cube, the regular octahedron, or the rhombic dodecahedron." p. 77.

as with Breithaupt, who derives them all from the octahedron,* and the reason I have followed the former in preference to the latter, or others who have admitted different intermediate numbers, is because, such a view of the subject is the most simple, and the least encumbered by geometrical constructions and mathematical calculations. Repeated observation moreover has convinced me, that the reference of crystals to their primary forms, according to the system of Brooke, is any thing but a difficult problem.

And respecting the case of the sulphuret of manganese, the forms are indeed incompatible on every view except that of Breithaupt, with whom also they would be irreconcilable as existing in one and the same mineral species. For myself, though I have never seen the Mexican mineral, I should have very little doubt that it constitutes a distinct species; a supposition which is favored somewhat by the fact, that while neither Klaproth nor Vauquelin could find above 17 per cent of sulphur in the European mineral, Del Rio detected 36·77 in that from Mexico.

The statement concerning Mitscherlich's observations, I suppose alludes to his law of Isomorphism, as I know of no other discovery of this philosopher at all affecting the subject. But as it happens, this law instead of affirming that the same species ever assumes two forms, (incompatible ones) declares *that although one ingredient in the composition is replaced by an equivalent portion of some similar ingredient, the form remains the same.* For example crystals of Pyroxene, from different localities, present the same angles, when besides the silica essential to them all, they contain either 49·04 of protoxide of manganese, and 3·12 of lime; or 22·19 of lime 17·38 of protoxide of iron, and 4·99 of magnesia; or 23·57 of lime, 16·49 of magnesia, and 4·44 of protoxide of iron; or 20·87 of lime, and 26·08 of protoxide of iron; or finally, 24·76 of lime, and 18·55 of magnesia.

Or if the angle is not the same among isomorphous compounds, (though the name of the law signifies that it is,) as in the instances of the carbonates of lime, magnesia, protoxide of manganese and of iron, where the primary form is the same in figure, but differing by a degree or two in the dimensions, (homoiomorphous bodies,) in these, the discrepancy in the angle is invariably attended with a difference

* The axis being in the regular octahedron 720, and in other cases greater or less.

in other physical properties, constituting each a distinct species. So that in neither case, can the slightest confusion arise in making the primary forms of Brooke, or indeed those of any crystallographer whose writings I am acquainted with, the grounds of an analytical system.

But while the discoveries of Mitscherlich are thus shown to offer no obstacle to a crystallographical system, I must leave it for Professor Del Rio to reconcile them with the chemical distribution which he has thought fit to adopt in his own recent Treatise on Mineralogy,* or indeed with any other chemical arrangement yet devised, or, (I may add) conceivable.

Of the proposition to have every secondary form the ground of an order, I have only to remark, that it is as extravagant, as is unnatural the concluding member of the sentence containing it, and which relates to the impossibility of the student's ever discovering that Quartz belongs to the order of the rhomboid, of the truth of which my early experience in referring the rhombic crystals of the species in question, from the albite granite of Chesterfield, Mass. to this order, may perhaps afford a suitable comment. But with respect to the correct reference of uncleavable, regularly six-sided prisms, terminated by pyramids, to which I suppose allusion is mainly had in the remark, any person who has studied the operation of the law of symmetry in producing new forms from the primaries, would be able to know that these must have for their system of crystallization, either the rhomboid, or the regular hexagonal prism.

Of the correct reference of Harmotome to the order of the right rectangular prism, I have by no means felt certain; but of the fact that the pupil would with the utmost difficulty be led to place it under either of the other orders I cannot doubt; and indeed the evidence in favor of its being correctly placed where it is, in preference to referring it to the octahedron with a rectangular base as suggested by Professor Del Rio, (if I understand him correctly), is strengthened from the fact that the cleavages are more obvious, parallel with the lateral, than with the pyramidal, faces. The erratum of angles imagined to exist in the Treatise, only existed in the manner of reading, as the angle of 177° 5′ is not set down to Harmotome, but to Comptonite!

But to continue with the observations of Professor Del Rio,—"after all," he says, "the most difficult part for the student is the

* Elementos de orictognosia ó del conocimiento de los fosiles. Filadelfia. 1832.

second class: he must ascertain by the cleavage, if a rhombic prism is right or oblique, since if he mistakes it he will never find the name of the specimen." Instead of never finding the name, I beg leave to substitute, that he would not find it always in the most direct manner; for if the mineral sought should happen to belong to the latter, he would first be led to examine unsuccessfully, the ten species of which the cleavage order of the right rhombic prism consists; (the order of the right rhombic prism preceding that of the oblique,) and if on the other hand it should happen to possess a right rhombic prism as its form of cleavage, it would be, so far as the brevity of the analysis is concerned, immaterial, whether he had correctly settled the direction of the axis, or not. The remark quoted in this connexion from page 70 of the Treatise, "that if we arrive at the knowledge of the lateral faces of a prism, we possess independently of the cleavage, means for determining the base, whether it be horizontal or oblique" is undoubtedly true, as must be sufficiently obvious from what has gone before relative to the symmetrical changes of right and oblique prisms, but has no relation to the subject here, inasmuch as it is intended to apply to simple minerals or regular crystals. And the same inapplicability applies to the light which Professor Del Rio supposed he had obtained from pages 77 and 78, since they treat exclusively of perfect crystals, as the Treatise plainly shows.

He is astonished at my remark that the discovery of a single cleavage would assist in enabling the pupil to distinguish the primary planes in the complex forms belonging to the doubly oblique prism; and adds by way of placing me in the predicament of self nullification, "that cleavage in one direction gives nothing but parallel planes," (quoted from another part of the Treatise) which is undoubtedly true in the general process of obtaining cleavage crystals, but not at all in the present case, where we have beside the parallel planes, natural faces either perpendicular or oblique to them, from all which it is clear, that a regular solid must result.

He says that he "cannot grant him (the student) to know the minutes of broken or imperfect crystals. How can he distinguish Valencianite from Mexico (my chovelia) from the *Perikline*, perhaps better Proskline or the Albite? the crystals of Valencianite are distinct, but so imbedded that my pupil Bustamente thought that P and T was inclined 124° 30′ instead of 122° 30′: he was only mistaken in two degrees; I assure Mr. Shepard that his student will make greater blunders than mine, although acquainted with geometry." As to the Valencianite and Perikline, I believe the evidence preponderates in favor of their being one and the same species; in any case, they are both distinct from Albite; and respecting the mistakes which young students would make with the analytical system, I have only to say, that without calling in question the adroitness of Bustamente, I should hope that persons would abstain from the determination of crystals belonging to the doubly oblique prism, until they had better acquainted themselves with the use of the gomiometer, than to require the limits of error should in no case be narrower than two degrees!

I did not suppose it necessary to add another character, for the distinction of Sillimanite from Jeffersonite (i. e. Pyroxene), when the lateral angles of the one are 92·5 and those of the other 99°; and the hardness of the former = 7·5 . . . 8·0 while that of the latter = 5·0 . . . 6·0. It is quite impossible to confound Kyanite, by my characteristic, with the foregoing minerals or with any other species of the Treatise as Prof. Del Rio appears to imagine, excepting the Fibrolite of Count Bournon which I now relinquish as a species, and shall describe in my volume on Physiography as a variety of Kyanite. As a rule to be observed in the construction of a Characteristic, it is conceded, that the shorter the character is, the greater the facility and certainty it will afford in the distinction.

In regard to synonymes, I adopted the rule to give, in addition to the trivial name, the systematic and the chemical names, and besides, those appellations which had been bestowed upon what were generally regarded as forming separate species. Accordingly, under Spathic Iron and Dolomite are found a number of names, inasmuch as these species have been erroneously divided by different writers; and it appeared to me necessary to indicate to the pupil, that none of these pseudo-species had been forgotton in the Characteristic.

Of Willemite no chemical analysis was within my reach at the time (1832) to inform me that this substance was a silicated carbonate of zinc. Of Poonahlite, I do not, in the present state of our knowledge respecting it, fully agree that it should be referred to Mesotype; and still less can I admit that Dysluite is Pleonaste or Spinel. For Peritimous Lead Baryte and Pegamite, I know no synonymes, believing them to stand for independent species.

In the foregoing reply, I have endeavored not to pass over a single remark of Prof. Del Rio, whose misapprehension of the nature of my Treatise, I am compelled to set down partly to a want of familiarity with our language, and partly to a too hasty glance at the subject of his observations. And in defending myself, I must disclaim any want of respect for the opinions of a veteran in the cause of science, as I willingly accord Prof. Del Rio to be; and would hope that I may not be accused of an overweening fondness for my own performance, of whose faults I am abundantly sensible, and which I yet hope to be able to correct myself, at least, in part. Still, as I employ it with some convenience, and have seen it used by pupils with all the success I anticipated, I may perhaps be excused for yet retaining some partiality towards the invention, and for the present obtrusion of myself on the notice of those, who unfortunately for me, may have formed their opinion of my labors from the observations of Prof. Del Rio.

I should not be inclined to quote the concluding remarks of the observations, except from a willingness to do complete justice to their author, as they form a very unexpected succedaneum to his critique, and as they may appear on the whole too commendatory for me to aid in promulgating. "It is not the fault of the author, whose treatise is in general very correctly written; it is the difficulty of the subject, which as I said in the beginning,* it is very laudable to have endeavored to enlighten,—and I must confess, that I by no means dislike the third catalogue, arranged according to the gradual increment of hardness, but with (as Del Rio would advise) the addition of cleavage, and crystals. I partake with the author the desire to simplify the study of mineralogy, but I prefer the means proposed by Mohs and Breithaupt, especially the last, published in 1832, and which translated by me from the German, I submit to the judgment of the society."

In conclusion, I cannot but express my satisfaction in finding a chemical mineralogist so far deserting his principles, as to be abroad in search of a Characteristic founded on physical properties. If the example set is followed by the members of the respectable society over which Del Rio presides, it will soon appear that we have in mineralogy a pure and well defined study, which hitherto, it must be confessed, has consisted of the blended elements of several independent sciences.

"* The mere attempt to solve a difficult problem is, in itself worthy of praise, although the method be complicated, because it can be subsequently simplified."

Art. XIX.—*On the Falls of Niagara and the reasonings of some authors respecting them;* by Henry D. Rogers, F. G. S. of Lond. &c.

The magnitude of this noted cataract, the circumstance of its being the outlet for the waters of an immense surface and the evidences of its retrograde movement towards lake Erie have made it a subject of much interest and speculation among Geologists. Theories have been framed to explain its origin, and data collected to compute the term of its existence, which, if not always sound have been to say the least, curious.

Believing that the writers who have conferred upon Niagara its celebrity as a geological wonder, have overlooked some particulars in the surface of the surrounding region, essential to be known in speculating upon its origin and age, I venture to state some views which may, I conceive, tend to inspire salutary doubts in the minds of those who are disposed to theorise upon this difficult subject.

The scenery of this mightiest of water falls has been so faithfully and vividly portrayed by both Capt. Hall and Mr. R. Bakewell, Jr., that I shall content myself with referring those who have not beheld it, to the accounts given by those gentlemen.*

The speculations however which these and other geologists have entered into concerning the mode in which the deep perpendicular valley below the falls was formed, and their calculations of the time employed by the cataract in excavating this ravine of seven miles in length, demand, I think, fresh examination.

I am especially desirous of calling the attention of geologists to the true nature of this remarkable valley below the falls, as it has recently been much discussed by foreign writers, some of whom are in danger of misconceiving its theoretical bearings from their imperfect knowledge of the physical structure of the region in which it occurs.

Mr. Fairholme in particular, has indulged in some speculations about the age of the Falls of Niagara, which more precise conceptions of the geology of our lake region would, I cannot but believe, induce him to revise, and perhaps to retract.

---

* The most correct general description of Niagara, its structure and scenery will be found, I believe, to be that given by Mr. Bakewell in the xii number of Loudon's Magazine of natural history.

All who have investigated Niagara as a geological problem, seem to have assumed it as a conclusion nearly self evident, that the Falls have necessarily been once at Queenstown ridge, and that they have reached their present place, seven miles off, by virtue solely, of their own power of wearing away the rock. This opinion (it is but an opinion) is the result merely of a general contemplation of the scene, and not a deduction from any researches of so rigorous and exact a character as seem requisite to determine such a question. In the present meagre condition of our information respecting the structure of the neighboring region, such a doctrine cannot, I conceive, be much more than a mere surmise, and I hold it to be altogether premature, to erect upon such grounds any calculation *in year's* of the probable duration of the cataract.

The following in the words of Mr. Bakewell, presents the prevailing doctrine regarding the age of the Falls. "On viewing this highly interesting scene, the mind is irresistibly carried back to the time when a mighty flood poured over the once united precipice above Queenstown. This fact cannot be doubted by any one who sees its present appearance and who duly reflects on what a falling body of water, so immense, so rapid, and so resistless in its course as the river of Niagara is capable of accomplishing in a series of ages. Taking it for granted that the falls have been once at the ridge, it is a curious question to inquire when were they there? An approximate solution to this enquiry will be given if Mr. Forsyth's statement be allowed, of the falls having receded nearly fifty yards in the last forty years and if it be granted that this has been the constant ratio of their recession. The distance from the termination of the gorge to the fall is *seven* miles equal to 12,520 yards which gives 9856 years for the period in which they have been retrograding to where they now are."

Mr. Fairholme, proceeding upon nearly the same data* endeavors to prove that its retrocession was once much more rapid than at the present day, by supposing that the slope of the land gave the falls originally a less elevation, that the excavation was narrower, and the rocky materials more destructible. In answer to the views of Mr. Bakewell, for whose fidelity of description, so far as it goes, I have a high respect, I would suggest that we are hardly entitled to assume the statement of Mr. Forsyth as a sufficient basis for a calculation so important in its theoretical applications.

---

* See London and Edinburgh Philosophical Magazine for July, 1834.

I hold it to be impossible, with the means of measurement heretofore employed, to ascertain with any approach to precision, the amount of retrograde movement. Does the recession of forty or fifty yards asserted by Mr. Forsyth, apply to both falls, to the whole breadth of the British fall, or only to that portion of the latter which adjoins table rock? To estimate it where the loss of matter is greatest, in the hollow of the great horse shoe, can be done only by means of accurate triangulation, which has not yet been attempted.* To apply the above rate of recession amounting to four feet per annum, to both falls, and to Goat island likewise, as Mr. Fairholme does, is, I conceive, an extension of the same error. He imagined that the whole irregular line across both falls and Goat island recedes at this rate, though it is manifest that the American fall is no part of the *receding* cataract. It enters the gorge, *laterally*, having been left by the other fall at least a *quarter of a mile* in the rear. The true width of the valley at the falls is therefore no greater than its average width below; as neither the American cataract nor Goat island contribute to its breadth. In reply to Mr. Fairholme's argument, I would remark, that although in his appendix, he has, on better information, forsaken the leading feature of his theory, the hypothesis that the ground from the falls to Queenstown is a regularly descending plane by which the section of the trough below the falls would become a triangle, he is still far from giving the ravine its proper profile. The true form of the valley is this. From the falls to the *abrupt* slope at Queenstown the land gently declines, but the bed of the river seems to decline equally, falling in its course of seven miles one hundred and four feet, and making the perpendicular banks maintain throughout their whole length an average elevation of two hundred feet.

If Mr. Fairholme will reconstruct the section in the appendix to his article, taking care to make it a faithful profile of the surface from the falls down to Queenstown, giving it the proportions of a base of seven miles to a height of about three hundred feet he will at once

---

* I observe that Mr. Conybeare entertains the same doubts of the above rate of movement of the whole falls. In the Philosophical Magazine for 1831, new series, Vol. 9, page 267, he says "I must confess my doubts whether the falls actually do recede as far as their general line is concerned at the rate of fifty yards in forty years. I suspect that some partial degradation of the strata has here been mistaken for the general retrogradation." He farther states as his opinion, that Goat island has occupied, from the period of the earliest account, exactly the same relative position with regard to the falls that it holds at the present moment.

discover that the gorge through which the Niagara river flows, approaches much nearer to the form of a parallelogram than to the irregular triangular figure which he supposes. His desire to reduce the solid dimensions of this valley, has led him to represent it with an outline very different from that which belongs to it, and his correction is almost as wide of nature as his first imaginary section.

But suppose for a moment that the cataract has been at Queenstown heights and of a minor elevation, it by no means follows that the erosion of its bed would on that account be effected more rapidly.

The action of the torrent is not expended in wearing away the whole surface of the wall of rock, but in *undermining* it, by the enormous momentum of the ever falling mass of waters which are continually wearing and removing the loose materials at its base. It is reasonable to infer that a certain height of fall is necessary to this result.

Having thus shown the inadequacy of the data upon which the computations of the age of this cataract have been made to rest, I shall proceed to develope some features of the neighboring district which render it very doubtful, whether the Falls of Niagara ever have been at Queenstown.

It is a very generally received opinion and may so far as present evidence extends, be taken for granted, that the country adjacent to Niagara and the lakes was originally covered with a vast lake, or rather inland sea, which some change in the configuration of the region contracted to the still very extensive masses of fresh water now remaining. The passage of such a body of water over the surface would deeply indent all the exposed portions of the land. Rushing in its descent from lake Erie to lake Ontario, from a higher to a lower plain, and across a slope like that at Queenstown, it would inevitably leave a deep and long ravine. But further, the whole of this region has been grooved and scarified by the same far sweeping currents which denuded the entire surface of North America, and strewed its plains and mountains with boulders, gravel, and soil from the north. Such a diluvial valley, of greater or less length and depth was, I cannot help believing, probably the commencement of the present remarkable trough below the Falls.*

* Mr. Fairholme in ascribing to the Niagara the duration which he has, obviously regards it as wholly post-diluvial; he is therefore constrained to grant the pre-existence of the denuding actions for which I contend.

In the present very imperfect state of information respecting the superficial deposits around the shores of our western lakes, it is out of our power to do more than conjecture the geological era of the supposed retreat of the waters which appear to have covered, at one time, the vast plains surrounding them. Whether such an event were caused by the general rush of waters from the north, or whether it is to be viewed as having occurred subsequently, we have no means of judging.*

There is this important fact however, that none of the superior secondary or tertiary formations of our Atlantic coast have been discovered in the region of these lakes, shewing clearly, that all that portion of the continent emerged from beneath the ocean at a very remote period. The drainage of the region has very probably been repeatedly modified since that day, and during some one, or perhaps several of these changes in its hydrography, Niagara acquired its present remarkable shape.

If any credit be due to the consideration here advanced, it must be obviously improper for geologists to aim at computing the time which the Niagara river has consumed in excavating its way to the spot where it now pours off its waters, since to ascertain what *portion* of the ravine below the falls may have resulted from other causes than the cutting power of the stream, is clearly beyond our ability.

It is an observation of Professor Sedgwick, that the existing vallies of any country are generally the result of the joint agency of *many causes* and the remarkable valley of the Niagara river, notwithstanding the simplicity of its present features, may exemplify this principle.

The sides of the Niagara river below the falls present a narrow belt of table land extending back a short distance from the verge of the precipice to the foot of a pretty high and steep bank composed apparently of diluvium.

There are in the class of those who assign to it a greater age, some who would be inclined to consider it as also partly *ante*-diluvian. To these my argument is similar; to wit, that it is not credible that any powerful diluvial current should traverse the surface of this region with the deep valley of the Niagara river previously existing, without materially augmenting the length and magnitude of the ravine.

* Goat island is based upon a fine grained homogeneous clay in horizontal stratification, and of a texture so exquisitely comminuted as to indicate the almost total absence of any currents in the waters from which it was deposited. As one can hardly attribute such a deposition to the impetuous current of the present river it seems very naturally to point to a time when a tranquil lake covered the place of the present rapid Niagara.

These diluvial banks deserve the minutest attention of geologists, inasmuch as they may enable them to detect more clearly than from other data, the former positions of the cataract. It is to be presumed that if they have been washed by the falls throughout their whole distance to Queenstown heights, traces of the fact would be discoverable along their base. I searched in vain a portion of that line for shells, and other river deposits such as are seen on Goat island above the falls. They may, however exist, and it is important that they should be sought for. These banks are described by Mr. Bakewell as curved and water-worn, with large boulders imbedded in them, shewing, he conceives, that the river once flowed nearly on a level with their summits. But all these appearances are just as indicative of *diluvial* action, to which on any hypothesis, the boulders *certainly* belong.

Supposing the existing drainage of this region to have begun immediately after the catastrophe which reduced lake Erie and its sister lake to their present dimensions, or supposing it to have followed that far mightier event which overspread the whole continent with the debris of its rocks; in either case we are bound to make the Trenton falls and the several falls on the Gennessee river contemporaneous. Now an important question arises here: are there any facts in relation to the rate of recession of these falls analogous to those of Niagara? None are I believe at present known, though those streams admit of a much more exact determination as to changes of position in their falls, than is practicable in the vast and irregular horse shoe fall of the greater cataract of Niagara.

Bearing upon this discussion there is a still more important question, namely, what features did the surface of the region present after the transient denuding causes above spoken of had ceased, or in other words when the existing streams, first found their way to the ocean? The surface of the land was evidently what it now is, denuded and every where scooped into a multitude of vallies, the receptacles of course, of the newly formed rivers. This being the case, is it not extremely probable that the depressions into which the Niagara and other rapid streams first fell, were originally vallies of denudation. The existing falls upon these streams have no doubt contributed in a considerable degree to deepen and prolong the gorges through which they flow, but that they *began* these excavations is what I cannot consider established. One has only to explore the vicinity of Trenton falls, of the upper falls of the Gennessee river at Portage, and of

Niagara itself, to perceive that all these interesting scenes are surrounded by the evidences of extensive denudation.

The numerous beautiful cascades which distinguish the first-named scene, descend over a series of steps occupying a trough somewhat similar to the one below Niagara, but much deeper and shorter.—The total descent here is 300 feet, and the length of the ravine about half a mile instead of *seven*. There is a striking analogy between the structure of these falls upon the west Canada Creek, and that of those upon the Genessee river, and there is this resemblance between them both and those of Niagara, that they all consist of perfectly horizontal strata. The Portage falls of the Genessee resemble the falls of Niagara moreover in the great length of the ravine, that of the Genessee being several miles long, and having also a depth in many places of four or five hundred feet.

Mr. Fairholme seems to consider our numerous falls and rapids as the result of what he states to be a characteristic feature of this continent, the arrangement of the surface in several vast secondary planes, principally composed as he conceives, of calcareous rocks in horizontal stratification. This is a misapprehension, for it is well known to all who have examined the physical features of the United States that in the greater number of our streams, particularly those entering the Atlantic, the rapids are created by the passage of the waters through mountain barriers and in nearly all cases over rocks highly inclined. This is so, where the Potomac finds a pass through the blue ridge, where the Delaware traverses the same mountain in Pennsylvania, to form the lovely scenery of the water-gap, and indeed in twenty other cases which might be cited. An arrangement of our plains in successive plateaus is by no means frequent, and neither Trenton falls nor those of the Genessee have resulted from any such structure of the surface.

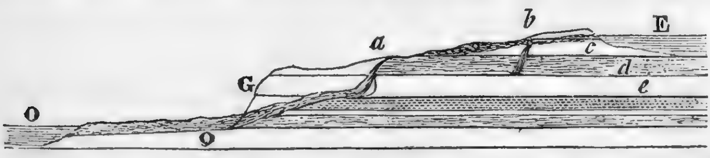
Mr. Fairholme has the following passage, "If this point be admitted, (the recession of the falls,) it is equally obvious that a continuation of the action must occasion a continuance of the effect and that a time must consequently arrive, when the whole barrier between the lakes must be intersected. This period is of course very remote; but is not the less certain and unavoidable, if the causes now in force continue to exist. The consequences will be most extensive and disastrous, more so indeed than any natural event within the range of history. The whole of the upper lakes of North America which more resemble seas than inland collections of fresh water, will then be lowered by nearly three hundred feet and the low countries between lake Ontario and the Atlantic can scarcely escape from being swept at once into the ocean."*

To prove that this is too alarming a picture, it is only necessary to add to the fact that *no barrier*, properly speaking, intervenes between the present cataract and lake Erie, the bottom of which shelves very gently from the shore, and is nowhere deep, averaging only one hundred and twenty feet. The action of discharge must therefore at all times, even long after the cataract shall have *entered the lake*, be extremely gradual as Mr. De la Beche has amply shown.†

Besides, even supposing it possible for lake Erie to empty itself thus suddenly, no similar discharge could take place from the other lakes, inasmuch as lake Huron and Michigan are cut off from Erie by a river eighty nine miles in length and by a difference of elevation of fifty two and a half feet.

As to the *future* rate of recession of the Falls I believe it to be equally difficult to speculate. It is very possible that long before this vast wall of water, advances to the brink of lake Erie, it will have totally altered its shape and aspect. As the falls retreat, they also *rise*, obeying the general ascent of the land towards lake Erie. This circumstance combined with the horizontal position of the rocky beds which they intersect, gradually reduces the thickness of the underlying section of shale, and augments that of the overlying limestone.

The diagram here annexed will elucidate the arrangement of the several strata along the river, and assist in displaying the future positions which the falls must occupy as they enter the uppermost beds.



O Lake Ontario. E Lake Erie. Q Queenstown. G termination of the ravine. *a* the falls seven miles from G. *b* the probable

* The distance being twenty one miles from the present cataract to lake Erie and the rate of action being about four feet *per annum* the time necessary for this great natural operation will be 27,720 years. As the fall will however be higher than it now is when it reaches the top of the rapids, the action cannot be calculated at so much as it now is, and the United States on the coast may therefore safely reckon on a lease of from 30,000 to 40,000 years.—*Fairholme.*

† Third edition of Manual, page 160.

future place of the falls when they will be in the strata *c* and *d*, and not as at present in *d* and *e*. *c* siliceous limestone. *d* geodiferous limestone. *e* friable shale.

The vertical scale is of course greatly exaggerated beyond the actual proportions, it being in all such diagrams, impossible to represent the distances and the heights in their true ratios.

A still further retrogression will bring the cataract altogether *out* of the inferior shale the thickness of which at present is ninety feet, and will cause the escarpment of the falls to consist only of the overlying limestone beds, and ultimately of a still superior stratum, a tough silicious limestone which occupies the surface from lake Erie down almost to the falls. It seems a plausible conjecture, that entering as it thus certainly must, a new series of beds possessing very different relations of hardness, friability and thickness from those which compose the present escarpment, both the *rate* and the *mode* of retrogression will be materially modified. Should the upper stratum instead of being as it now is, the *hardest*, become, as it possibly may before the twenty one miles are travelled over, the *softest*, there can be little doubt that the present single and majestic fall will divide itself into several cataracts at successive elevations. Niagara will then be almost a counterpart of Trenton falls, but with far more magnificent dimensions.

In conclusion it may be well to notice another false impression of Mr. Fairholme. He speaks of the fossil remains of the *Elephant* and *Mastodon* of North America being deposited when the waters of Niagara were first set in motion, that is according to him, when this section of the continent had just emerged from the ocean; and he attributes their position and their *shattered* state to the rush of waters simultaneous by his account with that emergence. To make in this manner those races of animals equally ancient with our bituminous coal-fields, may consist with Mr. Fairholme's peculiar views of celerity of deposition in strata, but no geologist who examines the features of this continent can acquiesce in such a theory. The diluvial or more properly *alluvial* deposits in which such organic remains invariably occur in North America, cover alike all our formations, even the newest tertiary, and are of course separated from the *coal* formation as to time by a vast series of intervening periods.

It is therefore quite erroneous to consider as contemporaneous, two events so distant as the appearance of the coal and the formation of the diluvium.

About the *shattered* state of these remains it may be observed that in the majority of cases, the skeletons of the mastodon have been found remarkably little broken or displaced, sometimes standing *erect*, with all the bones in their natural relations, in the morasses where the animals perished. Now these morasses overlie the true diluvium. In a report on the geology of North America lately made by the author to the British Association at its request, an attempt has been made to prove that those races perished on this continent, not by the general deluge but by catastrophes and accidents of a still *more recent* date.

* * * * * *

Remark by the Editor.—Among the causes that may produce the drainage of the upper lakes it is obvious that even a moderate heaving by an earthquake might at once crack the strata that now form the barrier of lake Erie, and over which the Niagara flows, and thus produce a fissure, (not without many examples in other countries) which might, in a few days, or possibly hours, precipitate a large portion of the upper lakes upon the nether country, thus producing a debacle of vast sweep and resistless energy, and leaving the present bed of Erie a tertiary valley.

Mr. Fairholme by a strange geological anachronism, places the coal formation above the chalk for the sake of bringing it nearer to the deluge; it is difficult to meet a writer, however respectable and intelligent who takes such liberties with facts—liberties that are equally unwarrantable and useless, for no sudden, short, and violent flood could possibly produce the regular coal beds with their vast and various stratifications and alternations.

Art. XX.—*Meteoric observations made on and about the 13th of November*, 1834; *by* A. D. Bache, Professor of Natural Philosophy and Chemistry in the University of Pennsylvania.

TO PROFESSOR SILLIMAN.

Sir—On Saturday the 5th inst. my notice was drawn to a paragraph which I supposed to be from the pen of our mutual friend Professor Olmsted, calling attention to the Zodiacal light then visible for some hours before sunrise, and suggesting a query in regard to its connexion with "Falling stars" and to a change in its appearance on or about the 13th of November. This induced me at once to commence a series of observations, which were continued until the

19th inst. and on the morning of the 13th, the number of observations and their duration was increased.

Having witnessed the remarkable meteoric phenomenon of the 13th of November, 1833, and having been engaged during the summer, in conjunction with my friend Mr. Espy, in observing meteors, I felt competent, as far as experience could render me so, to the task which I had undertaken. The conclusions to which my observations have led, and in which I feel entire confidence, are, that *at the city of Philadelphia there occurred on the* 13*th of November,* 1834, *no remarkable display of meteors of the kind witnessed in* 1833, *and that there was probably no similar occurrence on those mornings which were clear, just before and after the* 13*th inst.*

The observations upon which I base these conclusions are as follows.

Sunday morning, Nov. 9, 3 A. M. at Holmesburg 10 miles N. E. from Philadelphia, I observed the Zodiacal light which extended as described (in the paragraph to which I have before referred) from the horizon, in an illy defined, nebulous light. The night was cloudless, and the moon had set. Wind S W.

Monday morning, Nov. 10, at Philadelphia. I observed at about 3 A. M. and again at 4 A. M., but there was a haze which obscured the zodiacal light. After the sun rose the sky clouded over. One very brilliant meteor to the west at the time of the second observation.

Tuesday, Nov. 11, was cloudy, and there was rain with the wind at S W.

Wednesday, Nov. 12, about 3½ A. M., a low stratus occupied the place of the zodiacal light. At 4½ A. M. the sky was clear and the light brilliant, its general appearance as on Sunday. No meteors in S E part of the sky in 15 minutes.

Thursday, Nov. 13, 12*h* 10′ A. M., air 41° Fahr. Dew point 37½° sky clear. No meteors. Wind N W slight.

1*h* 5′ A. M. at the close of the observation. Air 40°, sky more hazy to W.

2*h* 40′ a 2*h* 55′ A. M. Air 38½, dew point 35, sky very clear, no haze. Three meteors in ten minutes looking to S E out of the way of the moon. Moon sets at 3*h* 49′.

3*h* 50′ to 4*h* 10′ A. M. Air 34°. The whole *lower* air is near to the dew point, and therefore hazy. The zodiacal light is obscured. Seven meteors in fifteen minutes. Moon has set.

5*h* 15′ a 5*h* 30′ A. M. Air 34° dew point 31° Twilight has begun. Five faint meteors in half a minute, and then very rare.—Three after those five in about fifteen minutes.

The appearance of these five meteors in such rapid succession impressed me with the idea that an unusual meteoric display might be about to commence or had commenced; the paths of three of these when produced seemed to meet nearly, two of them I could not bring to the same point with the other three. After waiting some time for other meteors to confirm or refute the impression made as to direction, by those just referred to, a meteor passed considerably to the S of the zenith, its track, when produced, passing very much below the apparent radiant of the first three, and subsequently one to the north of the first three, its track passing also below the same point.

In reviewing the observations of this morning, the only remarkable occurrence of meteors is that noted between 5*h* 15′ A. M. and 5*h* 30′. But this was neither *in degree, nor in kind like a portion of the meteoric phenomenon noticed in November*, 1833. The lowest estimate which could be made with any probability of accuracy, of the number of meteors falling in half a minute in one third of the heavens, on the 13th of Nov. 1833, so far exceeds the number observed on this occasion, as to admit of no question in regard to degree; and again, including the five which fell in rapid succession, there were but eight meteors seen in fifteen minutes, a number entirely insignificant when compared with the numbers which fell in that time a year since; and further there was not even a sensible uniformity in their rate of fall, since after those five were seen, but three occurred in fourteen and a half minutes. These meteors were not similar to those of Nov. 1833 in kind, for the paths of two of the five did not meet at what appeared to be the approximate radiant of the other three, and the tracks of two passed very much below this approximate radiant point.

These meteors were similar both in degree and kind to ordinary meteors. In the observations made by Mr. Espy and myself, we noticed frequently that meteors succeeded each other so rapidly that one observer could not *distinctly* trace their courses; sometimes appearing to come from the same point, at others in paths very variously directed. To a circumstance of this kind the five quickly succeeding meteors, two of which had not a common radiant point with the others are to be referred. In regard to the average frequency of eight meteors in fifteen minutes, as shown before half past 5 A. M. our observations made in the summer, and during the early part of the evening, when meteors are comparatively rare, have given six meteors in nine minutes and a half, five in ten minutes, four in ten minutes, &c. And this in about one fifth part of the sky to which we purposely limited our view, whereas on the 13th of Nov. my view was extended over at least one third of the hemisphere.

They were also similar in kind in their paths being in directions which when produced appeared to meet in very different parts of the heavens.

I continue the detail of observations, which are however, from the generally unfavorable state of the weather, of inferior interest.

At 10 *P. M. on the* 13*th.* Air 46°, dew point 35½°. Wind W. Light fleeces over the moon.

Nov. 14*th.* From about 3*h* 40′ to 4*h* A. M. a haze obscured small stars to about 20° from the horizon, those of 3rd and 4th magnitude were however distinctly visible. Moon up. Two meteors in twenty minutes. At 4 o'clock the haze thickened and mottled clouds (dark cumulus) came over from the west. Wind W faint. At about 8 A. M. began to rain. At 10¼ P. M. Rains, wind W and N W. Air 50°, dew point 45°.

Nov. 15*th.* 3 A. M. A white and very thick haze obscured the sky. 11 P. M. Snowing, air 24° dew point 15½°.

Nov. 16*th.* 3½ A. M. Snowing.

Nov. 17*th.* 5 A. M. Cloudy. At 8½ A. M. Hailing, air 31°, dew point 23½, wind N E.

Nov. 18*th.* 1½ A. M. Raining.

Nov. 19*th.* 1½ A. M. Sky clear, moon up, no meteors visible to S E. in ten minutes. Horizon clouded. Clouds coming up from N W. 3 A. M. Sky covered with dark cumulus.

The foregoing observations are extracted from my journal, and the comments upon them are introduced for the sake of showing as far as is necessary the train of reasoning which has led to the conclusion stated in the beginning of this note.

It will be interesting to have information on this subject from different quarters of our country as having a direct bearing upon the explanation of the meteoric phenomenon of last year.

Philadelphia, November 21, 1834.

ART. XXI.—*Meteors on the morning of November 13th, 1834;* by ALEXANDER C. TWINING, Civil Engineer.

TO THE EDITOR OF THE JOURNAL OF SCIENCE.

Sir,—For a few days previous to Nov. 13th, of the present year, I was on the watch for extraordinary phenomena in the atmosphere and sky; without however observing more than this one, that on the morning of Nov. 9th, the zodiacal light was more brilliant in the east, than I remember ever to have seen it before. This was perhaps owing to the great clearness of the atmosphere. I noticed it at twenty minutes before 5 o'clock, A. M., and it extended at that time, as high as the nebula in Cancer.

On the morning of the 13th I made observations in the open air, for a part of the time between one and two o'clock. Although I saw in the moonlight, one meteor of considerable brightness, I was satisfied very soon that nothing uncommon was visible at that hour, and ceased observing. Again, soon after four o'clock, the moon having set, I took a station out of doors. At that time there was evidently an unusual number of meteors. They appeared, for the most part, lower in altitude than 30°; they might be seen in either quarter of the hemisphere; their color was reddish, and their apparent magnitude very uniformly about that of the planet Mars. Their flights were generally not more than 8° or 10° in length; but one which passed nearly in my zenith, shot through as much as 20°.—They were generally attended with trains of several minutes in breadth. Of these I observed but one that continued as long as three seconds. In the course of twenty five minutes, as nearly as I could judge, I counted thirty of these meteors; and I estimated, from this time and number, and the portion of the hemisphere which my sight took in, that they were appearing at the rate of four in a minute.

Besides the meteors thus described, there were two or three which evidently formed a part of the assemblage. These were different from the first in their courses, crossing their paths at irregular angles, and differing also from them in magnitude and color, being very minute white points, precisely like the multitude of common shooting stars, without trains. But the meteors first described, which seemed to constitute the peculiarity of the scene, were not only alike in magnitude, brilliancy, and as a general thing, in the intervals between their appearance, but their flights were evidently directed, like those of the meteors of 1833, from *a fixed point;* and not a single meteor that I saw, except the two or three stragglers mentioned above, deviated from this regimen. There could be no question also, that this fixed point was in the constellation Leo, and was either in the same spot with the "radiant" of last year, or in the vicinity of it: but as no meteors described their paths very near to the constellation Leo, I was not able to fix the point within several degrees.

I have not formed a decided opinion whether this whole display is to be considered a slight recurrence of the meteoric phenomenon of November 13th, 1833, or not. It certainly possessed, on a greatly diminished scale, the same general character. There was, to say the least, upon this latter morning, such a regularity and *unity* in the assemblage of phenomena as, when coupled with the magnitude of the meteors, to give the impression of an uncommon and remarkable display.

The zodiacal light was all the time visible, about as high as the neck of "the Lion," but far less bright than on the morning of the ninth.

West Point, December 2nd, 1834.

Art. XXII.—Lowell.

Geological Facts.

Lowell is a flourishing manufacturing town, situated upon the Merrimack river, in Massachusetts, twenty four miles north from Boston. Although it has grown up within twelve or thirteen years, it contains as many thousand inhabitants, and is constantly increasing.

During a residence there of a few weeks, in the months of August and September, 1834, the following observations were made on the geology of Lowell and its vicinity.

This region is based upon primary rocks—among which granite, gneiss, mica slate and other varieties of slaty strata, are the most conspicuous.

Within ten or fifteen miles of Lowell, we find all these rocks, *in place,* besides innumerable boulders, among which all the primary rocks are observed.

At Groton, sixteen or seventeen miles west from Lowell, are extensive beds of soapstone, (steatite,) and one large quarry is opened and wrought. Among various uses, it is applied to the fabrication of pumps for water. They are neat in their appearance and are stated to be very effectual in drawing water from wells or cisterns, and conveying it into chambers or other apartments in which the pumps are placed; the pistons are made of wood. The soap stone quarry at Groton presents some interesting geological appearances. It forms vast beds in mica slate, and presents decisive indications of having been forced in among the strata by violence.

While the beds of soapstone are unstratified, they have apparently thrown the strata of mica slate into positions highly inclined, and even occasionally vertical; these strata have been evidently, much disturbed, bent and lacerated, and if we concede this power to trap, porphyry and granite, it would be difficult to assign a satisfactory reason why soapstone should form an exception. We are aware that along with serpentine it is admitted by Mr. Brongniart among the igneous rocks, and we can discern no other solution of the appearances at Groton than that of internal igneous action, throwing up the steatite among the strata of mica slate, and thus elevating them, and at the same time impressing upon them indubitable marks of violence. A few miles west of Lowell, there are beds of white crystalline limestone; they lie among strata of gneiss, and although the limestone is quarried with considerable difficulty, it is profitably burned for lime. In this quarry are fine fibrous asbestus or tremolite and various other minerals usually found in primary limestone. Granite is wrought in immense quantities in all the region around Lowell, and especially north of this town. The greater part of it is in boulders, which are split for the purposes of architecture. There are however some quarries of granite, and more of gneiss and mica slate, where these rocks are found in place. In Lowell itself, and its immediate environs mica slate is the prevailing rock. It is accompanied however, by many other varieties of slaty rocks, passing from common slate through siliceous or flinty slate, hornblende slate, &c. In some of these dark slates, are delicate veins and knobs, and spots of white calcareous spar. Most of the stratified rocks are highly inclined, some of them almost or quite perpendicular and numerous sections having been made for canals, roads, buildings, &c., and the Merrimack itself flowing through a vast natural canal discloses the strata standing nearly on edge, and rounded and worn by the waters.

At one place half a mile from the river, where the strata have been denuded of the soil and diluvium, there are cut in the rock numerous furrows, such as are usually called diluvial scratches; their direction appears to be mainly N E and S W; this rocky ledge is near to the place where the rail road enters the town.

But the most remarkable geological feature in Lowell remains to be mentioned. The great rail road from Boston, just before its termination, passes through the solid rocks in a cut, which is a quarter of a mile long, and in some parts it appears to be forty feet deep. The rocks are mainly mica slate, the strata of which are inclined at very high angles of elevation, and in many places they are nearly or quite perpendicular. Here are exhibited, on a great scale, the most decisive proofs of the intrusion of rocks by force from below. The intruding rocks are chiefly trap, varying in quality between greenstone and basalt, and sometimes inclining a little towards the character of hornblende slate. It is evidently unstratified, but still, from its having been forced in between layers of a stratified rock, it has to a certain degree, copied the appearance, and in some places has a little false show of stratification which, at a small distance from the principal rock, vanishes and it becomes massive and amorphous.

The strata of mica slate, enormous as they are, appear to have been heaved from their beds and raised from their horizontal position, by the same effort which injected among them the ignited and melted trap. The latter has not here, as in many other situations in various parts of the world, broken across the strata, and intruded itself between their jutting ends, thus dissevering the parts, so as to form dykes or walls of trap bounded by the parted rock—the trap has on the contrary, been here shot in between the strata and has taken the direction of their beds, at the same time that the vast heaving power which melted and threw up the trap, also raised the enormous ledges of mica slate into their present elevated position.

The trap has therefore, in this case, been wedged in between the strata, and has produced the following effects.

1. It has, in many instances, completely severed the strata of mica slate, passing through between them often with undiminished thickness, and appearing at their upper edges.

These intruding walls are of various thickness from a few inches to a foot, to several feet or several yards; the thickest mass is eighty feet in its cross diameter, and there were several from ten to fifteen, twenty and twenty five feet.

2. Some of the intruding masses do not go through to the upper surface; they are literally wedge shaped, having separated the layers of mica slate below, and then in their ascent dying away between them, and terminating in a point or an edge, the mica slate closing in, resuming its continuity, and continuing upward unbroken.

3. The reverse of this arrangement is observed in a few cases, the broad part of the wedge-shaped mass being upwards, sometimes at the surface, and dying away downward. In this case, the melted trap probably overflowed from a concealed vent or was driven laterally in, and thus filled fissures in the mica slate, which were formed by the heaving from below, and were left gaping upward and ready to receive the molten flood.

4. The contortions of the mica slate, produced by the fiery invader are very numerous and striking; they are such as we might suppose would arise from a mighty force exerted from below, elevating, severing, bending and tearing the stratified rocks among whose peaceful beds, the melted trap was rudely injected.

This confusion, every where remarkable, is particularly conspicuous in the deepest part of the cut, where, on both sides, the mica slate is in vast disorder, and the intrusive trap is interlocked among the lacerated strata, holding them fast as with an expiring grasp.

5. The injected trap is seen on both sides of the cut, towering to the topmost cliffs, on the right and left, and continuing unbroken across the bottom of the cavity. The strata of mica slate also accompany the trap on both sides.

6. There are, at the junctions of the two rocks, indisputable marks of igneous action; in many places the mica slate is much indurated by the heat, and there is an undefinable blending of the two rocks, portions of both being united by mixture as well as by partial and hasty fusion or thoroughly assimilated by a full melting.

7. There are numerous dissevered masses of mica slate, often of considerable magnitude, which have evidently been torn off by the violence and heat of the injected trap, and borne along in the melted mass; there are also detached portions of trap mixed with the mica slate, and whose connexion with the main currents cannot be, in every instance, traced in the actual section of the ledges, but which without doubt, exists threaded and contorted in devious fissures, in the interior of the broken rocks.

On the whole, this section presents very interesting and instructive appearances, and such as can be understood only by attributing them to the action of fire.

Had the whole arrangement been the peaceful effect of water, there is no reason why all the masses should not have been equally stratified, nor why any of the strata should have been elevated, contorted, broken and altered. These views derive confirmation from similar appearances which are observable in the vicinity, and some of which have been described by Professor Hitchcock in his excellent geology of Massachusetts. We have already mentioned the appearances of the soapstone quarry in Groton. We may add that on the road between Billerica and Lexington,* and near to the latter town, we observed several very perfect trap dykes, intruding among the primary strata and crossing the road from side to side.

On the coast also at Marblehead and Nahant are numerous injected veins and dykes which, in connexion with the facts now mentioned, and with others detailed by Professor Hitchcock, go to establish the opinion that a vast subterranean igneous agency has been exerted in this region in an early geological era.

If we return to the rail-road cut at Lowell, we find other very interesting and remarkable appearances.

In that part of the section which is most remote from Lowell, after the cliffs have declined and descended below the soil and the diluvium, they again rise into view, but not to so great an elevation as in that portion of the cut which has been already described.

In this place, the section has disclosed *granite masses* intruding among the strata of mica slate, exactly as the trap does in the other portions of the cut. The granite is perfectly well defined entirely distinct from the mica slate, and stands in vertical walls among its vertical strata; the granite is, in no case, more than a few feet in thickness; the minerals of which it is composed (the quartz, felspar and mica) are much larger, and more conspicuous than those of the architectural granite which is every where observed loose or in fixed rocks, all over this region. Gneiss is found in one place interposed between the mica slate and the granite or alternating with the former. From all the circumstances, it appears unphilosophical to assign a different origin to the trap and to the granite in the cases that have been stated. The same causes that produced and injected the one, probably produced and

---

* The same that was so memorable in the American Revolution.

injected the other; it is however beyond our power to assign a reason why the igneous action below, should produce trap abundantly in one place, and granite in another, and at a very short distance.—On the Red Mountain in New Hampshire near Lake Winnepiseogee we have seen a powerful dyke of trap traversing granite, which of course proves that whether contemporaneous or not, the materials of the two rocks must have been concocted in, and ejected from, the same igneous focus. The instances at Lowell go far to demonstrate that the causes which have generated granite and trap are the same, operating under unknown circumstances of difference, and indeed we shall probably not go too far if we regard all igneous rocks as mere modes in the operation and result of one and the same cause, due allowance being made for variety of circumstances and of materials upon which the fire has operated.

It is worthy of observation, that at the rail road section near Lowell, there are numerous veins of quartz, some of them of great thickness which are found both among the trap and the mica slate, but principally among the strata of the latter, pursuing the course of the structure of the rock excepting where the veins or portions of them have been detached by the trap, and are found intermingled with, or cut off and surrounded by it. The quartz veins were doubtless, originally component parts of the mica slate rock, to whose constitution they indeed essentially belong.

On various parts of the ledges through which the rail road section passes, but especially, at the entrance near the village of Lowell, there are considerable diluvial deposits—gravel, sand and bowlders mingled in confusion; among the bowlders are many transported rocks unlike the ledges below, but lying in juxta-position with their ruins, which have been detached in the progress of time by meteoric causes and perhaps by convulsions.

Indeed, in every part of Lowell, the observer is struck with the great abundance of bowlders and detached and travelled masses both lying on the surface and buried in the gravel, clay and sand. In digging into hills and into the earth, in other situations, they find such great numbers of bowlders that they appear as if they had been congregated by design and the laborers arrange them—for convenience, in immense groups.

It gives us pleasure to state that a very correct and graphic delineation of the rail road cut, was kindly furnished to us by Mr. Duesbury of Lowell, in which the great features, which we have attempted to describe are distinctly and strikingly exhibited, as may be seen in the engraving.

Miscellaneous Remarks.

Were this the proper occasion, many considerations connected with Lowell, not less interesting than its geology, might be stated. The statistics of its vast manufactures, are too well known to need a place in this work, and it is necessary for a stranger only to inspect the establishments, in cotton and woollen and other branches, to perceive that it would not be easy to find their rivals in the world —for perfection and beauty of machinery, neatness, method and quiet in the interior of the houses, ingenious and efficient securities against fire, means of personal safety and escape, civility, intelligence and prevailing good morals among the laboring manufacturers, and a high order of mind and principle both among the gentlemen, who superintend, and those who (chiefly in Boston) sustain these flourishing establishments, by their freely bestowed millions.

The proprietors and managers of the manufactories, the professional men in Lowell, and a large number of intelligent and liberal minded mechanics, and other citizens have united their efforts to create and sustain a high intellectual, moral, and religious standard, among the many thousands whose labors give Lowell its fine productions in the useful and ornamental arts, and its well deserved celebrity.

Numerous churches of various denominations, with pastors acting cordially together in doing good, evince, that greater interests than those of manufactures, are not neglected; a vigilant and efficient magistracy watch over the quiet and security of the citizens, which is sometimes invaded by the worthless and abandoned, who always seek a nestling place in manufacturing towns.

Public lectures are given on various topics of useful knowledge, not only by resident citizens but by persons invited from other places, and sometimes from other states.

A large Hall is now in the course of being created, by the associated mechanics of Lowell, and their friends, who intend, there, to furnish ample accommodations for public lectures, for a public library, for collections in natural history, for apparatus, and for every thing else which may contribute to the public good. This spirit is widely diffused in the manufacturing districts of New England, but more conspicuously in Massachusetts, than in any other state, and the general experience hitherto, affords great encouragement to hope, that manufactures may be sustained in this country, consistently with pure morals and enlightened intelligence. Success must, however, under God—depend entirely, upon wise and continued effort sustained with sleepless vigilance and with untiring energy.

Art. XXIII.—*Notice of the Transactions of the Geological Society of Pennsylvania*—August, 1834, Part I.

This publication contains much valuable information and we trust it is only an earnest of more to come.

1. *Fossil Marine Plants.*

The notice of fossil marine plants of the family Fucoides, presents an acceptable addition to our geological knowledge. The existence of marine plants in the region on the Juniata, was first announced, several years ago, by Dr. Harlan.*

Mr. R. C. Taylor, F. G. S. now confirms the existence of very extensive deposits of fossil fuci, in the grauwacke group of central Pennsylvania. Several species have been observed in the brown sandstone of Tussey mountain, near Alexandria in Huntington County, and farther south, in Bedford County.

In the white sandstone of the Swan mountains in Centre County, the fossil fuci prevail seventeen hundred or eighteen hundred feet above the level of the sea. At Muncey Ridge in Lycoming County, fine specimens were obtained in white sandstone; at this place and at Lewiston they occur four hundred and fifty feet above tide-water; also on the eastern slope of the Alleghany Ridge, fossil fuci are associated with Productæ, at points more than one hundred miles apart.

In the narrows of the Juniata, that river flows between cliffs of sandstone seven hundred feet high, and in the lower strata in the Shade mountain, the strata containing the marine plants are brought into view by the cuttings for the road and for the canal. They are found in shale, in sandstone, &c. In one place, the fucus beds are laid bare to the height of nearly fifty feet, and here seven courses of

---

* Jour. of the Acad. of Phil. Vol. vi. p. 289.

the plants are comprised within a thickness of four feet. In another place, below Lewiston, eight or ten beds were counted within six feet.

At the western end of Shade mountain, in a quarry, one hundred courses of marine plants are distinguishable within a thickness of twenty feet; they are crowded with obscure plants and occasionally crossed by the larger fucoides. In a third place, there are twenty layers of fucoides within the thickness of three feet, and it is supposed that the entire thickness, is not less than two hundred feet.

At the west end of Shade mountain, the fucus beds extend without interruption, to a height of from three hundred to three hundred and fifty feet; those containing the obscure algæ, reach two hundred and fifty feet, and at three hundred there are numerous surface slabs exhibiting the Fucoides alleghaniensis in situ.

It is justly inferred by Mr. Taylor, that there existed various epochs in which numerous surfaces of the shallows of the ancient ocean, were covered by marine vegetation. The fucus beds are composed of argillaceous, slaty and siliceous rocks, laminated and parted by shale.

Some of the fuci had long flexible and flattened stalks with few branches: the breadth of the stalks, was sometimes over half an inch.

On the western side of Shade mountain, there are hundreds of beds, some of them not an inch in thickness, but making an aggregate of two hundred feet, and the quarries within a mile of Lewiston, furnish an inexhaustible supply of excellent paving stones, in which the vegetable forms, especially in the weathered specimens, are very prominent. This is perhaps the most remarkable locality of fossil marine plants that has any where been observed.

2. *Gold Region of the U. States.*

A report is made upon this subject by James Dickson, F. G. S. London, by whom the fully ascertained gold region of the United States, is considered as extending from the Rappahannock in Virginia to the Coosa in Alabama—while, at the same time, it is stated, that gold has been found as far south as the Gulf of Mexico, and that it is probable it will untimately be found to extend to Vermont, Canada, and perhaps the Arctic regions.

Amidst many failures and discouragements, fresh attempts and discoveries are making, along the vast region bordering on the Blue

Ridge from Virginia to Alabama. Mr. Taylor regards the gold region of the United States as richer, than the similar regions of Brazil, Mexico and Russia, while the security to persons and property, the abundance of food, the mildness of the climate and the practicable surface of the country, present important adventitious advantages, not enjoyed in South America, nor all of them in Russia.

In Georgia, the richest mineral belt is in the talcose slate and granite formations, alternating with hornblende slate, gneiss and chlorite slate; parallel mineral belts are found also near Augusta, but they cease with the termination of the primitive region.

The most productive researches for gold have been made in the branch mines or stream mines, in the beds of rivers, rivulets and ravines.

In such cases, little capital is needed and few machines except rockers, and the return is almost immediate and daily; from five to ten penny weights per day, for a single hand are not uncommon, and one hundred and twenty have been obtained. In the loose deposits, the gold is found in a bed of gravel from nine inches to three feet in thickness, and from three to six feet from the surface of the ground; it rests on slate, generally talcose, and is evidently the result of the destruction of a vein or veins crossing a watered ravine or taking the same direction with it.

Mr. Taylor considers the process of washing, as superior to that used in any country; the *Burke rocker* of North Carolina will wash a Cwt. (seven hundred to one thousand bushels of gravel) a day, and the machine costs, when complete, but twenty five dollars. "In working the trenches or pits of a branch mine, numerous veins, partially decomposeed, are to be seen in the soft bed of the talcose slate, where the superincumbent strata have been removed." "The gravel strata are composed, entirely, of the broken fragments of the quartz veins, which are to be met with outcropping on the banks of the ravine. The ore itself, sometimes undecomposed, is met with in the bed, and all the characters of the mineral, found in the vein, are also to be met with in the branch gravel. The gold also is similar—for gold in some mines is entirely distinct in character, from that of others. There was not a mine in Georgia, the gold of which could not be distinguished from any other of the same district; so distinctly marked were the characters of each."

Branch mines have led to the discovery of many valuable vein mines, for when they worked until the gold seemed to fail, they would come back and open into the sides or banks of the ravine, guided by the gold, and at last, discover valuable bodies of gold ore. Many instances of this kind are notorious in North Carolina and Virginia." The branch gold mines of the U. States, are supposed to have yielded 6,000,000 of dollars, most of which is worked up in jewellery, and not in coinage.

Three deposit mines in Georgia have yielded 500,000 dollars, and Mr. Taylor confidently anticipates that the gold deposits of the United States will yield far larger returns than those of Brazil, Colombia, and the Urals united.

The explorations for gold have not, as yet, been carried to a great depth, the greatest not exceeding one hundred and fifty feet, and few of the shafts are over one hundred feet, and most do not exceed twenty or thirty. These excavations are too shallow to afford satisfactory information respecting the gold, and the digging is often abandoned upon the slightest unfavorable appearance such as the narrowing of the vein, its dislocation, or its becoming shattered, for there is much appearance of disorganization in the veins and rocks. Pyritical ores constitute the mass of the ores in Columbia, the Brazils, and the United States; above the depth of one hundred feet, they have been, in this country, partially decomposed; the yellow ores have been converted into brown, red and purple hydrates of iron, and a portion of the gold they contain having thus become uncovered, is accessible to amalgamation, while a large portion more is, or can be developed by the assay by fire.

Most of the gold is extracted by amalgamation, after stamping under water, and the residuum still contains gold.

Messrs. Andres Del Rio and John Millington, as a committee from the Geological Society of Pennsylvania, have investigated the Rappahannock gold mines in Virginia, situated on the river, about ten miles from Fredericksburgh; the tract is about two hundred and thirty yards wide by an average length of upwards of nine hundred yards.

The metalliferous veins consist of hard quartzoze rock between walls of decomposed talcose slate. A portion of loose red soil by washing two handfuls of it gave a considerable quantity of minute granular gold, and similar results were obtained by washings in other places. A principal auriferous quartz vein is from two feet six inches to three feet six inches wide: it stands vertically between walls of talcose slate; there is also, on either side, a vertical bed of auriferous red earth from two to three and a half feet wide, and bounded also by talcose slate. The auriferous quartz vein has been exposed to view for six hundred and twenty seven feet with a width of thirty inches, and it would appear that this is only the beginning. By a rough process of washing, amalgamation and evaporation of the mercury, three and a half grains of gold were obtained from four pounds of the ore taken indiscriminately from all parts of the vein, and in another experiment five grains of gold were produced from four pounds of pure milk-white quartz, which had no appearance or indication of containing any metal at all.

Messrs. Del Rio and Millington think that each pound of the ore may be made to yield one grain of gold or five pennyweights to the one hundred pounds of ore; this would much more than pay the expense, which cannot exceed one dollar on one hundred pounds of the crude material. It appears that by heating the quartz red hot and throwing it into cold water, eight grains of gold were obtained from five pounds of ore. In the opinion of Mr. Dickson, the Rappahannock mines perfectly resemble all the others in Virginia. On the whole the gold region of the United States is very extensive, rich and promising, and there is every adventitious advantage of fuel, food, climate, cultivation and security.

We have seen a decisive experiment of this kind made upon white quartz from Virginia which yielded a considerable quantity of gold by simple pounding and washing without amalgamation.—*Ed.*

3. *New Trilobite, &c.*

Dr. Jacob Green whose excellent monograph on the trilobites of this country, illustrated by beautiful plaster models is well known, has described in the Geological Transactions of Philadelphia, a new trilobite found by Dr. C. T. Jackson in Nova Scotia, in magnetic iron ore which is beautifully impressed by various organic bodies, among which the present trilobite, called by Dr. Green Asaphus crypturus is conspicuous. For the description and drawing we must refer to the Transactions.

Dr. Green has also given an account of the chemical examination of a sulphated ferruginous earth from Kent county, Delaware, with a view to ascertain its commercial value.

4. *Fossil Zoology and Comparative Anatomy.*

Dr. Harlan has communicated a good paper on the structure of the teeth in the Edentata, fossil and recent; and this is followed by a critical notice of the various organic remains hitherto discovered in North America.

Of this very important paper it is difficult to give an analysis, as it is drawn up in a very condensed form, and will be read with much advantage by all those who are desirous of accurate information on this very interesting but imperfectly explored department of American Geology. In comparative anatomy and fossil zoology we have great need of zeal, science, and discriminating tact. On these subjects Dr. Harlan is justly regarded as a high authority, especially in facts relating to this country.

The great Mastodon.—He justly remarks that "in most instances there is sufficient evidence that these animals died and left their bones to become fossilized in the precise situations in which they are now found; not only are the teeth and bones of this animal unworn by the action of running waters, but the skeleton is not unfrequently discovered in a standing position, just as the animal had sunk in the marsh or mud, clay and sand, and therefore that they have been destroyed subsequently to the action of those causes which formed the beds of gravel or detritus in and upon which they are frequently found." Dr. Harlan quotes from Baron Cuvier the remarkable fact furnished by the late Professor B. S. Barton, of the discovery in the remains of a Mastodon found in Withe county, Virginia, five and a half feet below the soil, of a kind of sack supposed to be the stomach of the animal, containing the identical substances which he had devoured, namely, semi-masticated small branches, grasses, leaves, &c. among which it was thought a species of brier, still common in Virginia, was recognizable. Cuvier remarks that he had rarely seen any remains of shells or zoophytes or the bones of the great mastodon, and therefore he infers that the sea had not long sojourned over them.

Dr. Harlan thinks that there is no evidence of the existence of the great mastodon, prior to the last general cataclysm, and that they may have disappeared, together with the fossil elk, or moose of Ireland, since the creation of man.

Mr. William Cooper of New York, who is also a high authority on subjects of Natural History, after a very full examination of many bones of the mastodon is of the opinion, that there is but one species among the great quantity of their bones found in the United States which have come under his observation.

Dr. Harlan remarks that the fossil bones of the elephant, although found with those of the mastodon, rhinoceros, megalonyx, ox, deer, &c., would appear to have belonged to a geological period more ancient than that of the last named animals, which, according to Cuvier, are dispersed every where, and often have marine animals attached to them, thus proving that they have been, for a considerable time, covered by the ocean.

Although there is an immense mass of the fossil bones of the elephant scattered through the world, there is only one perfect skeleton, namely, that in the museum of Petersburgh. It was found encased in an ice cliff on the shores of the Northern Ocean.

Bones of that very extraordinary animal, the megatherium, were found, some years ago, in Skidaway Island, Georgia, and described by the late Dr. Mitchill and Mr. Wm. Cooper; a complete skeleton was obtained in 1789, on the borders of the River Suaan in South America, and is now in the museum at Madrid. This animal has considerable resemblance to the sloth—it is of a gigantic size, the bones of the feet being more than a yard long by twelve inches wide. The bones of the megatherium are still to be obtained at the above named place in great quantity, by some labor and expense, and also at two other places in Georgia—the White Bluff on the Sea coast and some distance up the Savannah River.

The megalonyx is, in the opinion of Cuvier, allied to the megatherium, and as yet there are only three places known where the bones are found—Green Briar County, Va. and Big Bone lick and White Cave, Ky. The bones sent to Philadelphia by the late President Jefferson, were from Green Briar County; they were found buried two or three feet deep in the saltpetre earth of a cavern, and are still in excellent preservation, completely fossilized and very dense and heavy.

The fossil Saurians promise to make a considerable figure in the geology of this country. Bones of a fossil crocodile and a vertebra of a plesiosaurus, have been found in the marl pits of New Jersey—and fragments supposed to be those of an Ichthyosaurus, near the Yellow Stone and Missouri Rivers. Teeth and probably a femur of the Mososaurus have been found in a marl pit near Woodbury, N. J., and a tooth and part of the jaw of the Geosaurus at Monmouth, N. J. A new genus, the Saurocephalus from Missouri, was described by Dr. Harlan about ten years since, (Jour. Acad.

Phil. Vol. III, p. 331, pl. xii.—1824); a distinct species of this genus discovered by Mr. Lea in a marl pit in New Jersey, was named by Dr. Hays, Saurocephalus Leanus, and he had also called it Saurodon.

Dr. Harlan has named a new Saurian Basilosaurus; it was found on the banks of the Washita or Ouachita river, Louisiana. (Amer. Philos. Trans., Vol. IV. New series, p. 297, pl. XX.—1834.

One of the vertebræ weighs forty four pounds, and is fourteen inches long by seven broad. Allowing the animal sixty six vertebræ, like the Plesiosaurus, Dr. Harlan estimates the weight of the skeleton as being over two tons, and that the individual must have been from eighty to one hundred feet in length. Its geological position was in the Atlantic tertiary. To the localities of fossil fish quoted from Professor Hitchcock, and cited by Dr. Harlan, we can add one at Southbury, Ct. twenty four miles north west of New Haven. We saw but a single specimen; it was from a bituminous shale in a basin of six or eight miles in diameter, of red sandstone, sustaining ridges of trap, and surrounded by primitive rocks.

5. Professor Del Rio's Critique on the Mineralogy of Mr. C. U. Shepard.—Upon this subject we shall make no remarks, as Mr. Shepard has spoken for himself in the present number, in a distinct article.

Professor Rio's Observations on the conversion of sulphuret of silver into native silver may be read with advantage and instruction.

6. Notice of the gigantic mastodon, the elephant, and the megalonyx jeffersonii in Tennessee, by Professor G. Troost.

Numerous bones of the Mastodon were found about eleven miles south east of Nashville imbedded in a rich black mould, resting on a stiff ferruginous loam which the bones partly penetrated; the bones are in general pretty sound, and very heavy, being impregnated by hydrated oxide of iron. There were vertebræ of at least two individuals.

Another skeleton was found near the same place a few years ago about six feet under ground.

Dr. Troost has a tooth found near Dandridge in East Tennessee, and still another with a part of the jaw bone attached: this was from the vicinity of Natchez.

Molar teeth of the extinct elephant have been found in Tennessee.

Bones, supposed to be those of the megalonyx, have been found in a salt-petre cave in Tennessee.

Mr. Thomas G. Clemson, (whose skilful analyses have several times appeared in this Journal,) has analyzed a copper ore from Flemmington, N. J. and finds it to consist of copper .540, iron .134, insoluble matter .082, sulphur .244=1000.

In concluding our citations from this important volume, we take the liberty to remark, that a spirit of courtesy and forbearance towards those who may differ from us, or who perchance may have committed errors to which all are liable, and from which few are exempt, forms, in our view, a bright ornament of scientific and literary labor. We regret to see any indications of an opposite spirit, in a city not less distinguished for courtesy, than for science, and whose very name rebukes every thing unamiable. The present volume, excellent as it is, contains an article which proves that the most acute may err, and that it is better frankly to retract an error once committed, than to attempt its perpetuation in the face of decisive eviden ce.

We confess also, that we have great reverence for the ancient maxim, *nil de mortuis nisi bonum.*

ART. XXIV.—*Notice of the discovery of the remains of the Iguanodon in the Lower Green Sand Formation of the South-east of England. Communicated for this Journal, by* GIDEON MANTELL, Esq. F. R. S. LL. D., &c. &c. of Brighton, England.

MAIDSTONE one of the most beautiful and important towns in the county of Kent, is situated on the banks of the river Medway, about thirty five miles S. E. of London. The immediate subsoil of the district is a rich diluvial loam, in which bones and teeth of the horse, deer, and elephant have been discovered. This loam overlies and conceals extensive beds of limestone and sandstone; but in many places the loam has been removed, and quarries opened for extracting the stone which is principally employed in architecture and for road-making; the calcareous varieties being converted into lime.—This arenaceous limestone is well known in England by the provincial term of "*Kentish Rag.*" In a quarry of this kind, situated at a short distance to the south-west of the town, some laborers employed in extracting the stone, observed numerous fragments of bones in the ruins of a large mass which they had just blasted to pieces, and upon this fact being made known to the proprietor of the quarry, Mr. Binsted, that gentleman directed all the portions to be collected together and carefully preserved, and finally succeeded in replacing the greater part of the block. He then proceeded to chisel away the surrounding stone, until he had exposed those bones which were superficially situated. The story of the discovery of the bones of an antediluvian giant quickly spread abroad, and an imperfect notice of the circumstance found its way into the London papers; curiosity was thus awakened, and many of the gentry of the neighborhood flocked to Mr. Binsted's house to see this so called "*homo diluvii testis;*" but among his numerous visiters, Mr. Binsted could find no one capable of giving him any satisfactory explanation of the nature of these remains, or probable conjecture as to the kind of animal to which they belonged. He therefore addressed a letter to Mr. Mantell of Brighton, (late of Castle Place, Lewes,) and informed that gentleman of such particulars as an intelligent person, unacquainted with comparative anatomy, could communicate. When the specimen was still further cleared, Mr. Mantell visited Maidstone, and proceeded to a scientific investigation of these interesting remains.

They consist of the greater number of the bones of the posterior portion of the skeleton of a reptile of enormous magnitude, distributed without any order or regularity in the stone, scarcely any two of them being in juxta-position: they are much broken and splintered, but are not water-worn. The stone in which they are imbedded is an arenaceous limestone, that abounds in the usual marine shells of the lower green sand strata, namely, *Trigoniæ, Turritellæ, Gervilliæ, Ammonites, teeth of fishes, &c.* The following bones were sufficiently developed at the time of Mr. Mantell's visit to admit of being determined; and there were many others that were only partially exposed, but which may hereafter be brought to light.

Two femurs or thigh-bones: one so entire as to show both extremities, and also indications of a process or *lesser trochanter,* situated on the *tibial* aspect of the shaft of the bone. Length thirty three inches.

A *tibia,* about thirty inches long.

Fragment of a *fibula,* lying near the tibia.

Several *metatarsal* or *phalangeal* bones.

Two *unguical* or claw-bones, somewhat of a flattened form, and resembling those of a land tortoise. The largest is four inches in length, and two and a half inches wide at the base.

Fragments of large flat bones, which may probably belong to the pelvis.

Vertebræ both caudal and lumbar; these are of the usual fossil saurian type, having both faces slightly depressed. The largest vertebræ are very greatly flattened by compression.

Numerous portions of ribs; one possesses a double termination like that of the fifth rib of the crocodile.

A portion of one tooth, and the impression of another, decidedly of the *Iguanodon.*

One bone, twenty eight inches long, similar to that figured on the *clavicle* of the Iguanodon, in the Geology of the south-east of England, Plate IV. figs. 1, 2; a portion of another bone of the same kind is also partially exposed.

With the exception of the unguical bones, all those above enumerated resemble those of the Iguanodon, which have been dug up in Tilgate Forest; and the circumstance of the teeth being imbedded with the bones, serves to confirm the inferences that have been deduced from the previous discoveries of detached portions of the skeleton. It is not a little remarkable that no traces of the jaws of the Iguanodon have been observed; sooner or later, however, as M. Cuvier remarked in a letter to Mr. Mantell, "il est impossible qu'on ne trouve pas un jour, une partie du squellette rèunie â des portions de machoires portant des dents."

Mr. Mantell estimates the probable length of the individual whose remains are above described, at about seventy five feet.

POSTSCRIPT.

To THE EDITOR.—*Dear Sir*—As none of the specimens are figured to which I alluded in my late communications, I enclose a few sketches in outline. The caudal vertebræ, briefly described in Geol. Suss. p. 333, are probably of the Hylæosaurus, you will at once be struck with the enormous height and size of the spinous processes, and length of the chevron bones; Fig. 1, represents these six caudal vertebræ in connexion, and having three chevron bones, from the end of which, as they lie in the drawing, to the top of the spinous processes, is twenty seven inches. The original must have had a very upright and thin tail, enormously high in a vertical direction, and as the vertebræ, when in place, could have but little intervertebral substance, the spinous processes must have almost touched each other, and the tail have admitted of motion only laterally. I know of no reptile with such enormous spinous processes.

Fig. 1.

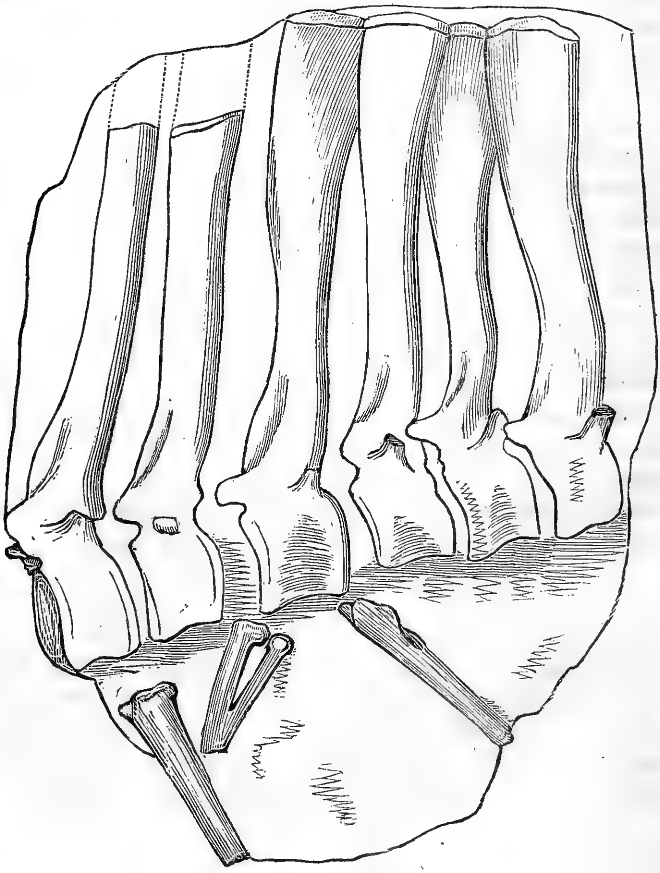


Fig. 2, represents one of the four enormous caudal vetebræ of the Iguanodon, one fourth the size of the original, of which I have an interesting specimen consisting of four caudal vertebræ with one chevron bone; the largest vertebra is twenty four inches in circumference: these vertebræ belonged about the middle of the tail of the Iguanodon: if the vertebræ in this part were eight inches in diameter, what would they have been when invested with their muscles and integuments, and we may well exclaim—what a monster!

Fig. 2.

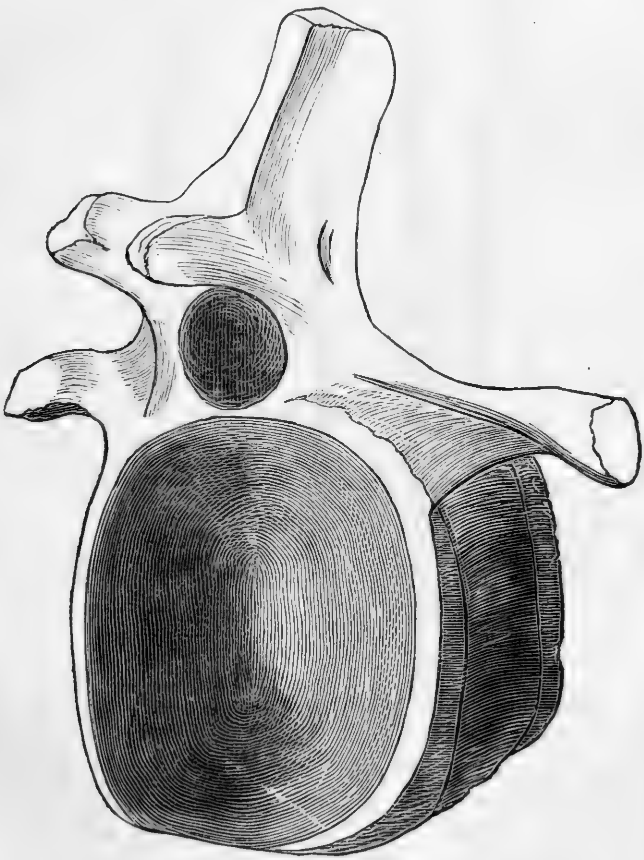
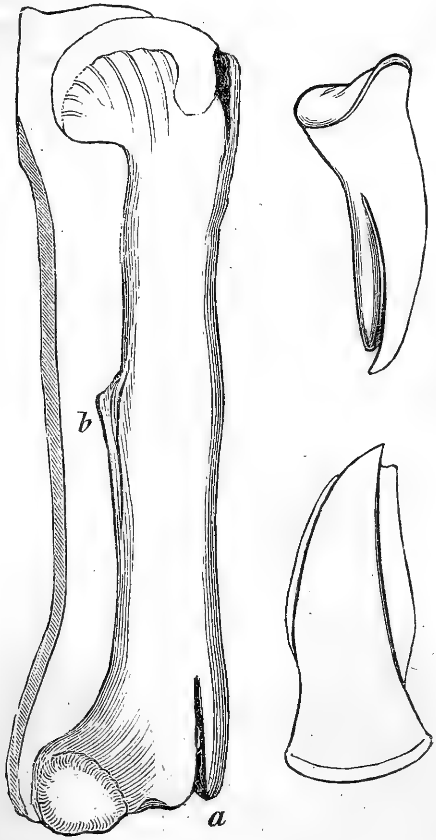


Fig. 3. This represents the thigh bone of the Iguanodon, which is very peculiar; the two processes or trochanters are most remarkable: do we know any thing like them? The cleft between the

anterior part of the condyles is very narrow, as if for the passage of a very strong tendon. The original was, thirty three inches long; *a*, is the trochanter major—*b*, the trochanter minor.

Fig. 3.



The pointed figures represent the claw-bone of the Maidstone Iguanodon, which is here exhibited laterally and anteriorly; it is the smaller of the two specimens. You will perceive how much it differs from the unguical bone represented in Geol. S. E. of England. This one is more like the nail-bone of the foot of a tortoise. If the Maidstone animal were furnished with such bones to all its claws, it may belong to a different species to that of Tilgate Forest: or the Iguanodon may have had flat claw-bones to *the hind feet*, and curved ones to the fore feet.

ART. XXV.—*Microlite, a New Mineral Species.;* by CHARLES U. SHEPARD, Lecturer on Natural History in Yale College.

Primary form. Regular octahedron.

Secondary forms. 1. The primary with its edges truncated.—2. The primary with its edges truncated, and its angles replaced by four planes resting on the primary planes.

Cleavage. Imperfect, parallel with the primary faces. In other directions, there is conchoidal fracture passing to uneven. Surface of the primary faces generally dull; those of the trapezohedron, also; dodecahedral planes too minute for observation.

Lustre resinous. Color straw-yellow to reddish brown. Transparent to translucent. Streak white, except when the color of the mineral is brown; it then resembles the color.

Brittle. Hardness=5·5. Sp. gr.=4·75...5·00.

Observations.

1. Alone, before the blow-pipe, it remains unaltered. It is slowly dissolved in glass of borax, to which it communicates a yellow color, which grows paler on cooling, but remains transparent unless subjected to flaming, when it instantly becomes nebulous, and presents on cooling, a pale yellow enamel. It is not readily acted upon by carbonate of soda, at least in the mass.

2. This mineral, named in allusion to the diminutive size of its crystals, from μικρος *small,* attracted my attention many years since; and a specimen of Albite from Chesterfield, (Mass.) has been preserved in my cabinet on account of its presenting a portion of the pyramid of this substance, which, however, I had suspected, principally on account of its color, to be Zircon. Having lately been called to examine it anew, I perceived that the inclination of the faces indicated a regular octahedron, instead of an octahedron with a square base, as its system of crystallization. The crystal was accordingly freed from its gangue, when I instantly recognized it to have the figure of modification 2, in the above description. The size of the crystal was about $\frac{1}{12}$ of an inch in diameter, and it weighed 0·4 of a grain. I immediately examined other specimens of the Chesterfield rock in my possession, and had no difficulty in discovering a number of crystals, all of which were smaller, disseminated through the Albite, and rarely imbedded in the Tourma-

line. From among them, I selected an exceedingly minute, transparent, yellow crystal, whose faces were sufficiently brilliant to afford me its angles with the reflecting goniometer. It uniformly gave the inclination of faces united by edges=109° 30′.

3. The specific gravity was determined by means of two of the largest crystals I could obtain, one of which was that first observed, and the other, smaller, by 0·1 of a grain. The water was at 60° F., and the balances so delicate as to oscillate on the addition of 0·01 of a grain. The largest crystal gave the Sp. Gr.=5·00; the smallest =4·75.

4. Its place in the natural system, if the specific gravity can be relied on, is within the genus Tungstic-Baryte, whose limits of hardness are 4·0...5·5, and those of specific gravity are 4·5...6·1; and its specific designation will therefore be, *Octahedral Tungstic-Baryte.*

5. The only substance with which the Microlite can be brought into comparison, of which we have any mineralogical account is the *Phosphate of Yttria,* of Berzelius,* the *Xenotime* of Beudant,† which according to the observations of Haidinger, belongs to the pyramidal system of Mohs, and moreover possesses hardness=4·5... 5·0, and Sp. gr.=4·557. It is therefore sufficiently excluded from coalescence with this species.

6. I have additional pleasure in bringing forward the present mineral, from the persuasion that every mineralogist has but to examine his specimens from Chesterfield, to find it already in his cabinet. I would apprise such as search for it, however, that the naked eye is not always sufficient for its discovery; the microscope will generally have to be employed; and the most likely part of the specimen to meet with it, will be the line of junction between the vein of smoky Quartz, (which contains the Tourmaline,) and the Albite.

7. My next visit to the locality will, I trust, supply me with specimens sufficient to attempt a more detailed chemical examination of it than is contained in the present notice, and which is barely adequate to furnish the conjecture, that its principal ingredient is *oxide of cerium.*

---

* Kongl. Vetenskaps Acad. Handlingar for 1824, p. 334, and Poggendorf's Annalen der Physik, 1825. II. p. 203.

† Traité elementaire de Mineralogie, II. p. 552.

ART. XXVI.—*On the Strontianite of Schoharie, (N. Y.) with a Notice of the Limestone Cavern in the same place*; by CHARLES U. SHEPARD, Lecturer on Natural History in Yale College.

THE announcement of Strontianite in the last number of this Journal, (p. 182.) has probably excited the wish for farther information relating to its mode of occurrence. During the absence of Prof. SILLIMAN last autumn, I was entrusted with the care of publishing Dr. EMMONS' letter, and took advantage of his suggestion to the Editor to make application to Mr. BONNY of Schoharie, for the circumstances respecting the locality of the Strontianite, and for illustrative specimens; in consequence of which, I have received two communications, each accompanied by a case of minerals, from whence the following particulars concerning the mineral in question, are derived. The account of Ball's Cave is abstracted from a newspaper communication, also forwarded by Mr. BONNY.*

From Mr. BONNY's first letter, dated Schoharie Court House, Sept. 7, 1834, I make the following extract: "Your favor, dated August 30th, was duly received, and agreeably to your request, I have put up a box containing all the varieties yet discovered, together with a draft by Mr. JOHN GEBHARD, jr. showing as nearly as possible, the locality and situation of the rocks in its vicinity."

The place described, is situated a quarter of a mile east of the Court House. The following remarks are capable of giving an idea of the subject, approximatively correct, without the diagram.

1st. stratum, twenty five to thirty feet in thickness, consists of shelly limerock, and contains the Asaphus, Orthoceratites, Spirifer, Terebratula, &c.

2nd. stratum, one to two feet in thickness, consists of clay-slate, and contains the Lily, and Stag's horn, Encrinite.

3rd. stratum, five feet in thickness, consists of stratified limerock, containing Asaphus.

4th. stratum, ten feet in thickness, consists of a similar rock, but destitute of Asaphus.

---

* I regret that the letters of Mr. BONNY do not enable me to give the names of the first discoverers of these interesting localities, in such a manner, as to do those persons complete justice. I therefore leave it for Mr. BONNY, or some other individual on the spot, to acknowledge in a future communication (and which, I trust will supply all other deficiences of this,) their meritorious services.

5th. stratum, ten feet in thickness, consists of a dull argillaceous limestone, which resembles, (judging from the specimens sent,) the water-limerock. It is without fossils, but contains the Strontianite, and its associated minerals.

6th. stratum, five to ten feet in thickness, consists of a compact limestone, and contains Favocites.

The base of the ledge is strewed over with debris, and the whole formation is bottomed on a siliceous limestone destitute of organic remains.

Without attempting to pronounce upon the geological age of the rocks above enumerated, whose period however, is not encumbered with much doubt, from the fossils mentioned, I shall confine myself to a description of the varieties of the Strontianite, which, on account of the widely different appearances they assume, are with some difficulty recognized.

The most obvious variety is that in acicular crystals, and massive in long, straight, divergent individuals. It occurs, occupying irregular cavities, from half an inch, to several inches across; the crystals and fibrous masses being implanted upon a dark blue Calcareous Spar which is granular in large individuals, or crystallized in obscure scalene dodecahedra, whose apexes are replaced by three, six, nine or twelve faces. The envelope of Calcareous Spar is sometimes of considerable thickness, and is itself often included within a layer of Heavy Spar, massive in large lamellar individuals, some of which penetrate the Calcareous Spar. But the Strontianite constantly reposes upon the latter mineral. The crystals are often three quarters of an inch in length, and from the diameter of a pin to that of a hair. The aggregated, columnar individuals frequently exhibit at the extremity where they diverge most, crystalline faces. Some of these fibrous aggregations are two inches in length, and bear a striking resemblance to certain varieties of Arragonite. Minute crystals of Iron Pyrites, crystallized in the form of the pentagonal dodecahedron, are scattered here and there through the Strontianite and Calcareous Spar. The color of the Strontianite is white, or slightly tinged with grey or blue; and it is semi-transparent or translucent.

A second variety quite different in general appearance from the first, and one which I should imagine, does not occur at the same place with that above described, is massive, indistinctly lamellar, and approaching to impalpable. Color, milk white, rarely with a delicate and almost imperceptible shade of green. This variety occurs in veins, from a quarter of an inch, to two inches wide, and is embraced directly by clayey limestone. Rarely, it is traversed by large lamellæ of Heavy Spar, which are easily distinguishable by their crystalline texture. Very small quantities of Calcareous Spar attend this variety occasionally, but it is not of a blue color. The circumstances of its deposition appear to have been different from those of the first variety. The two varieties described were forwarded in the first box.

A third and more interesting variety came in the second box, of which Mr. Bonny remarks, that it was discovered since the date of his first letter. From the specimens before me, it appears to form a vein of considerable size, the mass of which resembles the last variety in structure and color, as well as in being traversed occasionally by lamellæ of Heavy Spar. But upon one side of the masses, tabular crystals of Strontianite single and compound, an inch in length, and one third of an inch wide, are thickly implanted on a surface of transparent crystals of Calcareous Spar. The Calcareous Spar is in large crystals of the form of the *metatastique*. The Strontianite is partially coated by a white powder, as if it were suffering decomposition,* and the crystals of Calcareous Spar are covered completely by little fissures and cavities, where the Strontianite once penetrated them. It is observable however, that the large crystals of Strontianite still remaining are connected among themselves, as also to the mass of massive Strontianite below. Small transparent crystals of Quartz are also disseminated through the Calcareous Spar, but no Iron Pyrites is present. Figure 1, represents the form of these crystals. o on $o = 160°$. It will be observed that the edge between these faces corresponds to P, or the terminal plane of the primary prism; while the horizontal edge between c c corresponds to M of the same figure.

Fig. 1.

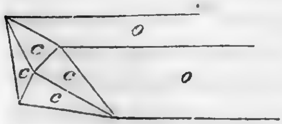


Fig. 2.

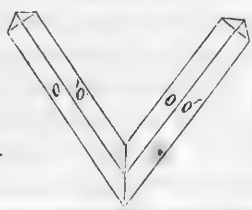
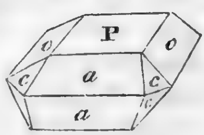


Fig. 3.



* The only suggestion that offers itself to my mind in explanation of this incipient decomposition is, that sulphuric acid may have been produced from the oxydation of the sulphur in the Iron Pyrites, and have formed a slight coating of sulphate of strontita upon the crystals of the Strontianite.

The compound crystals, (and they are nearly all such) are represented by fig. 2. The face of composition is apparently parallel with the vertical edges between *c* and *c*, fig. 1. The individuals project beyond the face of composition only on one side; but the composition is very often repeated in parallel laminæ.

Still another variety of Strontianite comes, apparently from the same place. It occurs in cavities or geodes, surrounded by blueish Calcareous Spar, but without the Heavy Spar; and offers the largest and the best pronounced crystals I have yet seen. The form of the most perfect is represented by fig. 3, though planes *c c* are rarely very distinct. They are an inch in length, (in the direction of the edge between *a a*,) and nearly half an inch in thickness: color, bluish or reddish grey; translucent. Surface, P is streaked parallel with its edge of combination with *o*. The inclination of *a* to $a=120°$ and that of *a* to $P=120°$. I have not seen cavities containing above four or five of these crystals at once.

The most singular crystallization, and one most likely to be overlooked from the smallness of the crystals, and their want of lustre, is that in octahedra with rectangular bases, the longer edges of the base being to the shorter as five to one. The smaller pyramidal faces, I take to be the lateral planes of the primary form, and the broader ones to be the secondary faces, arising from the truncation of the oblique angles of the primary crystal. These crystals vary in length from $\frac{1}{6}$ to $\frac{1}{4}$ of an inch, are dull, greyish white, and with rough faces, often covered by crystals of Iron Pyrites. They are so thickly disseminated through the clayey limerock as to form two thirds of its mass, and render it very difficult of fracture. The form of its crystal can scarcely be detected, except at the surface of those masses which have been weathered, when their rough and dull faces appear, resembling the crystals of Fontainbleau Limestone.

The last and the most interesting variety, if we consider the ambiguity its determination presents, and the immense quantity in which it exists, is the milk-white, massive variety. Mr. Bonny enclosed a large sample in his second case, accompanying it with the label "Marble. In great quantities. From the gravity I think it is Sulphate of Barytes." It was certainly natural from its color to call it Marble, and from its weight to suspect it to be Heavy Spar.—And I confess I should have been slow to pronounce it Strontianite, except that the cleavage indications of Heavy Spar and of Celestine were both wanting, and that it closely resembled a massive variety, accompanying the compound crystals above described. It somewhat resembles the purest white variety of Petalite, although the particles of composition are occasionally arranged in a manner to give a broad reflection, and its lustre is more resinous than vitreous. Sp. gr.=3·5.

I could not detect with the microscope the smallest particle of Calcareous Spar, or Heavy Spar, or indeed any other substance, intermingled with the mass. But to make sure of the absence of the latter mineral, a small fragment was pulverized and introduced into a glass flask, upon which dilute muriatic acid was affused. It was immediately dissolved with effervescence, without leaving the slightest residue.*

The letter of Mr. Bonny, informs me that he has been acquainted with this locality about three years, and that it is distant two miles from the Court House. I consider it an important discovery, inasmuch as it promises to afford to the experimental chemist an abundant supply of this hitherto rare earth; for although the Celestine is not difficult to obtain, yet the trouble of procuring from it the strontita in a soluble form is so great, as very much to abridge it use in chemistry. And besides, I think it may furnish a very beautiful alabaster; at least, one quite suitable to combine with the handsome, and quite unique variety of Heavy Spar of Jefferson county, (N. Y.).

A fibrous Heavy Spar in delicate, parallel fibres about half or three quarters of an inch long, forming veins, has been known from Schoharie for many years. Mr. Bonny informs me that it was not discovered in place until about three years ago. The deposit exists in a bluish slate beneath the limestone. It is said to be very abundant. The spot is seven miles north of the Court House.

The same place likewise affords veins of Arragonite, very liable to be confounded with the Heavy Spar. The fibres have about the same diameter, but double the length. They exhibit more lustre, however, and possess a Sp. gr.=2·92.

Among the samples of Strontianite, I noticed also, a bluish Heavy Spar in fibres like those above described, and bearing a strong resemblance to the fibrous Celestine of Jena.†

---

* The solution was evaporated to dryness, alcohol added, and the solution inflamed: it afforded the characteristic red flame of strontita.

† As these fibres instantly separated on being immersed in water, I could not take its specific gravity with convenience, and in order to insure its correct deter-

Very handsome crystals of Iron Pyrites were contained in Mr. BONNY's box, which he informs me have been known for many years as occurring at a place one mile from the Court House, in bluish clay and limestone. They are in single crystals of the form of the pentagonal dodecahedron, and in compound crystals forming globular masses coated by small crystals.

The same neighborhood also affords narrow seams of purple Fluor, embraced between layers of Calcareous Spar.

NOTICE OF BALL'S CAVE, SCHOHARIE, (N. Y.)

The first intimation of the existence of the cave was derived from Mr. BALL, upon whose land it occurs. He had observed a conical depression in the soil to the depth of twelve feet, which terminated in an irregular, perpendicular fissure in the lime rock, ten feet in length and six in breadth. In September, 1831, Mr. JOHN GEBHARD, a gentleman to whom the taste for Mineralogy and Geology in his neighborhood appears to be principally due, in company with Mr. HUBBARD and Mr. BRANCH made arrangements for ascertaining the extent of the cavern. The two latter gentleman were lowered by ropes down a perpendicular descent to the distance of seventy five feet; where the opening assumed an oblique direction to the south, although it still continued somewhat precipitous. Having disengaged themselves from the ropes, and prepared the necessary lights, they descended about fifty five feet, through a passage varying in width from four to ten feet. Here the descent became perpendicular for fifteen feet, after which they proceeded, as before, about thirty feet, when they reached the bottom. The cavern here is only about ten feet in width, but of great height, on one side of which is a small stream of pure and limpid water, running in a southerly direction. Passing under an arch so low as scarcely to enable them to stand upright, they followed the stream about twenty feet, when they penetrated by an opening just large enough to admit a man of ordinary size, into an apartment twenty feet in diameter, and above one hundred, in height. Its sides were covered by crystalline masses of Calcareous Spar and the roof by stalactites, dripping with water. The effect of the torches upon this apartment is de-

---

mination, Prof. SILLIMAN was kind enough to subject a fragment to the action of the compound blow-pipe; the result of which was, that it gave the color of baryta, unattended by the slightest tinge of red.

scribed as being very brilliant. The skeleton of a fox (as it is supposed) was subsequently found in this place; it must have fallen through the opening above and found its way here, where it probably perished from hunger. Leaving this apartment, they pursued the course of the stream for about twenty eight feet, through an opening from eight to ten feet in width, when their progress was checked by a considerable body of water, into which the brook emptied. These adventurers were now compelled to return to the surface.

In October, the investigation was renewed by Mr. Gebhard, Dr. Foster and Mr. Bonny, who had prepared a boat to navigate the water which had checked the progress of the first expedition. Fixing a light upon the prow, they commenced their voyage by passing through an arched passage in the rock so low as not to admit of their standing erect in the boat. Having proceeded about fifty feet in a southerly direction, they altered their course to the left around an angle in the rocky passage, and found themselves in water about thirty feet in depth, and so limpid that the smallest object might be seen at the bottom. The course of the water was varied by the projections of the passage, which gradually expanded to twenty feet in width, being of a height sometimes not discoverable, and at others only sufficient to enable them to pursue their way. They thus proceeded about three hundred feet, when they arrived at a rugged shelving ascent, on the right shore of the lake, and beneath which its waters disappeared. Leaving the boat, they landed upon this sloping ascent, and advancing twenty feet, they entered an aperture in the rock resembling a door, when they found themselves within an amphitheatre, perfectly regular and circular in form. Its diameter is one hundred feet, and its height is supposed to be still greater. The floor descends on all sides gradually to its centre, while the roof is apparently horizontal. Its walls are described as rich in stalactitic decorations. Great numbers of bats, disturbed by the intrusion of the adventurers, were seen flying about the cavern.

Subsequent visits led to the discovery of five additional apartments, communicating with the amphitheatre, all of which however are small, and none remarkable, excepting one in which the circulation of currents of air or of water, or probably of both, produces sounds like the Æolian harp.

Returning to the lake, where the adventurers landed, it was noticed that upon the north side of the perpendicular entrance to the amphitheatre, there existed a low and narrow aperture, through which a small stream issued. The opening above the surface of the water was only fourteen inches high; but its dimensions were seen to be greater within. A boat was constructed to suit this opening, through which it was pushed containing a single person in a recumbent posture. After a few feet, the passage enlarged enough to allow the navigator to assume an upright position; and he proceeded to the distance of a quarter of a mile, the width of the passage varying from, five to twenty feet. Here the water was thirty feet in depth, and losing sight of the light he had left at the commencement of his voyage, in consequence of a turn in the passage, he advanced in a new direction for about sixty feet, when he encountered a semicircular dam of calcareous tufa, over which the water broke with a slight ripple. Drawing his boat over the obstruction, he proceeded as before, when he soon met a similar barrier. In this manner he passed fourteen of these dams, which varied in height from two to twelve inches above the surface of the water. The obstructions being passed, he soon reached the extremity of the water, where quitting the boat, he entered a low and narrow passage, which soon became connected with a spacious room, at least fifty feet square. The rock is represented as here passing into a kind of greywacke, in consequence of which few incrustations were visible in this apartment. The floor was covered by large masses of rocks, which had been apparently precipitated from the roof; and the sound of a distant waterfall, was heard from this place.

The foregoing sketch describes the extent of this interesting cavern so far as it is yet known. The apartments, have been subjected to examination agreeably to the method of Dr. Buckland, but without leading to any discoveries, similar to those of the Kirkdale cavern. In addition to the columnar and stalactitic varieties of Calcareous Spar, Arragonite is said to have been found in some parts of the cave.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Observations on the Genus Unio, together with descriptions of new genera and species in the Families, Naiades, Conchæ, Colimacea, Lymnæana, Melaniana and Peristomiana, with colored plates; by* Isaac Lea.—The present splendid memoir is intended to conclude the series, which, in 1827 began to appear in the Transactions of the American Philosophical Society. Its contents sufficiently evince, that Mr. Lea, to whom American naturalists appear very judiciously to have consigned this extraordinary genus in conchology, did by no means exhaust his subject, when in the last previous contribution, he carried the list of indigenous species to seventy four.* We are now to follow him in the annunciation of the following new species, to which we shall simply append their *habitat*.

Unio capillaris. Ohio.
sub-globosus. Bayou Teche. La.
capsæformis. Cumberland River.
Ravenelianus. French Broad River, N. C.
Haysianus. Cumberland River.
Hildrethianus. Near Marietta, O.
Schoolcraftensis. Fox River. Green Bay.
geometricus. Bayou Teche. La.
Taitianus. Alabama River.
globosa. Ohio River.
Cooperianus. do.
Conradicus.
Sowerbianus. Tennessee.
dromas. Harpeth River, Tennessee.
Troostensis. Cumberland River..
perdix. Harpeth River.
pictus. do.
Shepardianus. Altamaha River, near Darien.
fulvus. South Carolina.
modioliformis. Santee Canal, S. C.
Kirtlandicus. Mahoning, O.

* For a notice of the memoir referred to, see Vol. xxii. p. 169. et seq. of this work.

Unio Nashvillianus. Cumberland River.
Blandingianus. St. Johns, Florida.
camelus. Ohio River.
Griffithianus. South Carolina.
confertus. Santee Canal.

They amount to twenty six, in all;—thus carrying the number of American Uniones to the round number of *One Hundred* and presenting us with a singular coincidence in American botany, with the genus Carex, where the described species is also about one hundred; and where the difficulty of distinction is quite analogous.

Mr. Lea has also described the following foreign species of Unio: viz.

Unio Nicklinianus. China.
Murchinsonianus. do.
parallelopipedon. River Parana, South America,
lacteolus. Rio de la Plata.
emarginatus.
divaricatus. Egypt.
Corrianus. India.
Grayanus. China.
Burroughianus. River Parana.
Paranensis. do.

We likewise enumerate the species of other genera belonging to the Naiades, brought forward in the present paper.

Symphynota globosa. Ohio River.
Woodiana. China.
magnifica. do.
discoidea. do.
Benedictensis. Lake Champlain.

Anodonta Ferussaciana. Ohio River.
incerta do.
Stewartiana. Bayon Teche. La.
plana. Near Louisville.
lato-marginata. River Parana.
Blainvilliana. Chili.
tenebriosa. River Parana,
Mortoniana. do.
Burroughiana. Island Luconia, near Marietta.

Margaritana Raveneliana. French Broad and Swananoe Rivers, N. C.

A very important part of Mr. LEA's memoir is formed by his remarks upon the specimens in the Parisian cabinets, which afforded LAMARCK the characters for the species of the Naiades in his *Histoire Naturelle des Animaux sans Vertèbres.* It is universally allowed that no parts of the writings of the great naturalist whose labors are here criticised, are so unintelligible as those relating to the present family. SWAINSON has said, that "although LAMARCK has described so many (species,) the short descriptions he has given and the want of figures to illustrate them, render it impossible to determine accurately, one half the species which he has enumerated." Nor does it appear surprising that this should be the case when it is recollected, that his materials were wholly inadequate for the task, and moreover that he labored under a distressing ophthalmia while engaged in this part of his labors.

The observations of Mr. LEA, therefore, made, as they appear to be with much candor, and with a proper regard for the reputation of of the deceased conchologist, will be thankfully received by every cultivator of this department of Zoology. We shall present them in the utmost brevity.

Unio sinuata. KLEIN first called it *crassissima.*

U. elongata. The true *Mya margaritifera* of LINNÆUS. It inhabits the north of Europe.

U. crassidens. Is the *cuneatus* of BARNES. var. *a* is the *trapezoides* of LEA. *crassidens* will have precedence of *cuneatus.*

U. Peruviana. The *plicatus* of SAY.

U. purpurata. LAMARCK supposed the specimen to have come from Africa, but it probably came from New Orleans. The *ater* of LEA coincides with the *Peruviana.*

U. ligamentina. The *crassus* of SAY.

U. obliqua. The *undatus* of BARNES.

U. retusa. The *torsus* of RAFINESQUE.

U. rarisulcata. The *complanatus* of SOLANDER.

U. coarctata. do.

U. purpurascens. do.

U. radiata. The true *radiatus.*

U. brevialis. The resemblance to the U. littoralis is so great that Mr. LEA thinks the shell came from Europe, and not from the Isle of France.

U. rhombula. A young individual of the *complanatus* of SOLANDER, and from the United States.

U. carinifera. The *complanatus* also.

U. Georgina. do.

U. clava. The *scalenia* of Rafinesque, and the *modioliformis* of Say.

U. recta. The *praelongus* of Barnes: *recta,* therefore, has precedence.

U. naviformis. The *cylindricus* of Say, whose name has precedence.

U. glabrata. The *complanatus.*

U. nasuta. A young specimen of the *gibbosus* of Barnes. It is not the same with the *nasutus* of Say. As Lamarck described the shell before Barnes, he has a claim for the species; but having employed a name already applied in the genus, he loses it. The name of Barnes must therefore stand.

U. ovata. The *ovatus* of Say. var. *b* is supposed to be the *occidens* of Lea.

U. rotundata. The *suborbiculata* of Lamarck. The *globulus* of Say, and the *sub-globosus* of Lea.

U. littoralis. The *semirugata* of Lamarck from Bagdad, and the *incurvus* of Lea, from Gibraltar, belong to this species.

U. nana. Supposed to be *littoralis* also.

U. delodonta. Suspected to be the *lacteolus* of Lea.

U. sulcidens. A compressed *complanatus* from Connecticut River.

U. rostrata. An elongated variety of the *pictorum.*

U. Batava. This is distinct from *pictorum.*

U. nodulosa. A young individual of the *ovata* of Donovan. It is a European shell, and Lamarck's *habitat,* Lake Champlain, is an error.

U. varicosa. A young specimen of the *Alasmadonta marginata* of Say.

U. granosa. A true species.

U. Virginiana. A poor specimen of the *radiatus.*

U. luteola, The *siliquoides* of Barnes. Lamarck is in error respecting the locality. His name has precedence.

U. angusta. A distinct species.

U. manca. A *pictorum.*

U. cariosa. The two specimens described are, the one a bad specimen of the *cariosus* of Say, and the other a bad one of the *Alasmadonta marginata* of Say. One of the habitats, Lake Erie, is an error.

U. spuria and *australis* do not exist in any cabinets examined by Mr. Lea.

U. anodontina. The *marginalis* which is found only in India.

U. suborbiculata. The *rotundata.*

Hyria avicularis. This is the *Mya syrmatophora* of Gmelin and Dillenius: *avicularis,* should therefore, be given up.

H. corrugata. A distinct species.

Anodonta cygnea. The *Mytilus cygneus* of *Linnæus.*

A. anatina. Resemble the *cygnea.*

A. sulcata. A variety of *cygnea.*

A. fragilis. A distinct species.

A. rubens. Deshayes places it under *Iridina.*

A. crispata. A distinct species.

A. uniopsis. do.

A. Pennsylvanica. The *undulata* of Say and *rugosus* of Swainson.

A. intermedia. A variety of *anatina.*

A. trapezialis. The *giganteus* of Spix.

A. exotica. A distinct species.

A. glauca. do.

A. sinuosa. do.

A. Patagonica. do.

Iridina exotica. do.

I. Clappertoni. Is a young *nilotica.*

The geographical distribution of the Naiades in the United States has received the attention of Mr. Lea; and he offers some very interesting remarks upon this subject. He finds the Alleghanies to be a dividing line of the species so perfectly that "it is matter of doubt if there be more than two or three species of all the genera of this family existing in the eastern waters which have their analogues in the Western States." Respecting the extremities of this range, the shells of the River Mohawk and its tributaries, appear to be the same with those of the Delaware, Potomac, &c., with the exception of the *Symphynota compressa* Lea and which is also found in the Ohio. "The tributaries of the lakes Erie, Michigan, &c., with few exceptions, produce the western species, and consequently the lakes do also." Lake Champlain which empties into the St. Lawrence contains the *Symphynota alata*, the *Unio occidens* and the *Unio rectus* with other western species. In the southern extremity of the Alleghany ridge, where the sources of the rivers are situated in the high lands of the range, the character of the shells of these rivers is completely the same with those of the western waters. In respect to the land shells, this law of distribution does not hold; the species of the eastern side being every where equally common on the western. "If it be demanded," says Mr. Lea, "why the line of demarcation should not be as perfect for terrestrial as fluviatile shells, we might say in answer, that the barrier of a mountain could in time be overcome even by the slowly travelling snail. Surely in the lapse of time, the progeny of those which accidentally began to climb the steeps, might descend into the valleys of the opposite side."

The memoir contains descriptions also of the following new species (and one new genus) of other families, which we enumerate, with their localities: viz.

CONCHÆ.

Cyrena rotundata.
Jayensis. Batavia?
Woodiana. Canton.
Aphrodite columba.

COLIMACEA.

Helix muscarum. Society Islands.
purpuragula. Java?
ovum-reguli. do.
monodonta. do.
cyclostomopsis.
mamilla.
diaphana.
Himalana. Himalaya Mountains.
vesica.
cincta. Java?
Woodiana. Near Canton.
globula. do.
Helicina lens. Feejee Islands.
pulcherrima. Java.
virginea. do.
Achatina Vanuxemensis. Mexico.
Succinea retusa. Ohio.
Auricula fuscagula. Brazil.
Cyclostoma striata. Peru.

LYMNEANA.

Physa elliptica.
Lymnæa acuta. Near Philadelphia.
exilis. Ohio.
imperialis. South America.

MELANIANA.

Melania aculeus. Java?
Melanopsis princeps. Cape of Good Hope.
maculata. Peru.

PERISTOMIANA.

Paludina bi-monilifera. Alabama River.
Burroughiana. Island of Luconia.
Georgiania. Hopeton, Georgia.
Ampullaria Hopetonensis. Hopeton, Georgia.

CANALIFERA.

Io spinosa. Holston River, Virginia.

Every species described, is accurately figured; and the drawings are rendered as perfect as possible by coloring,—that Mr. LEA cannot be accused of not placing the reader in a fair condition to form an opinion of the value of his distinctions, as well as of the truth of his descriptions. No one, can peruse the work without the conviction that it is one of great labor, of nice discrimination and good taste; nor without wishing that other lakes and rivers may send their Naiadian occupants to the author's cabinet, where their names and family claims are likely to be so well determined.

2. Dr. MORTON'S *Synopsis of the Organic Remains of the Cretaceous Group of the United States*, (Illustrated by 19 plates.) 8vo. pp. 88. Philadelphia, 1834.—This volume presents an amended and more elaborate view of the valuable labors of the above named active and acute geologist. The substance of the work was communicated to the public, through the medium of the Journal,—(Vols. XVII, XVIII, XXII, XXIII, and XXIV.) Of the present undertaking, the author says, that in consequence of fresh facilities, several genera of organic remains are now for the first time noticed as occurring on this continent, and it will be observed that many new species of Testacea have been added to this edition; that he has

corrected some inaccuracies in the former papers, and that good artists have been employed to furnish the accompanying illustrations, consisting of one hundred and sixty figures. We give some new facts respecting the distribution of the Calcareous strata of the older Cretaceous group in Alabama, derived from observations of Mr. CONRAD. The counties of Pickens, Bibb, Greene, Perry, Dallas, Marengo, Wilcox, Lownes, Montgomery, and parts of Clarke, Monroe, and Conecuth are composed chiefly of this formation. In Clarke county the newer Cretaceous rock predominates. The older Cretaceous rock constitutes the long and perpendicular bluff at Demopolis, where it has been ascertained by boring, to be five hundred feet in thickness. The more elevated bluff at Erie is composed of the same rock, which is well marked by the presence of *Pecten quinquecostatus*, and *Exogyra costata*. Following the Black Warrior river, the Cretaceous rocks terminate a short distance north of Erie; and at Tuscaloosa, the bed of the river is formed by red sandstone, and bituminous coal. The Tombeckbe and most of its tributaries traverse the Cretaceous formation, although it is believed that their sources are situated within the Carboniferous limestone supposed to occupy the north-eastern section of Mississippi. The counties of the Chickasaws and Choctaws, and indeed by far the greater part of the whole state of Mississippi, is to be referred also to the Cretaceous group. All the prairies of Alabama and Mississippi have a substratum of the older Cretaceous rock; while the newer Cretaceous strata prevail only in the southern portion of Alabama, and are never covered with a prairie soil.

The Nummulite limestone is found near Saggsville, where it constitutes the hills. It is porous, or contains spheroidal cavities formed from the decomposition of organic remains. These hills occur at intervals all the way from Claiborne to the vicinity of Jackson on the Tombeckbe. On Bassett's creek one of these hills attains an elevation of three hundred feet. Myriads of the *Nummulites Mantelli* are scattered over the surface of this decomposing rock.

We now proceed to indicate briefly, the new species of fossils mentioned in this work as well as such as have been more fully determined since the author's previous publications.

The tibia of a bird belonging to the genus *Scolopax*. In friable green marl near Arneytown, N. J.

Fossil beaks of *Sepiæ*.

Nautilus Alabamensis, near Claiborne, Ala.

Ammonites Conradi, a beautiful species, externally resembling an Argonauta. Prairie Bluff, Ala.

Ammonites syrtalis, Greene county, Ala.
Ammonites vespertinus, Arkansaw.
Baculites columna, Prairie Bluff, Ala.
carinatus, do. do.
labyrinthicus, do. do.
Hamites arculus, Greene county Ala.
torquatus, do. do.
trabeatus, Prairie Bluff, Ala.
Bulla, a large ventricose species, Ala.
Trochus leprosus, Prairie Bluff, Ala.
Delphinula lapidosa, do.
Turritella vertebroides, New Jersey and Alabama.
encrinoides,
Scalaria Sillimani, Prairie Bluff, Ala.
annulata, Gloucester, N. J.
Rostellaria pennata, Prairie Bluff, Ala.
Natica petrosa, do.
abyssina do.
Cirrus crotaloides, Erie, Ala.
Conus gyratus, South Carolina.
Ostrea cretacea, Erie, Ala. and South Carolina.
Pecten craticula, New Jersey.
Poulsoni, near Claiborne, Ala.
Plagiostoma dumosum, St. Stephens, Ala.
Placuna scabra,
Plicatula urticosa, New Jersey and Ala.
Inoceramus Barabini, Greene co. Ala.
alveatus,
Avicula laripes, Delaware,
Pinna, (resembling P. *tetragona*,)
Pectunculus hamula, Prairie Bluff, Ala.
australis, New Jersey.
Arca rostellata, Ala.
Cucullæa antrosa,
Trigonia thoracica, Prairie Bluff, Ala.
Crassatella vadosa, Ala. and New Jersey.
Pholadomya occidentalis, Chesapeake and Delaware Canal.
Clavagella armata, Prairie Bluff, Ala.
Terebratula floridana, Prairie Bluff, Ala.

Hamulus onyx, (generic character as follows; tubular, regular, involuted; volutions distinct; aperture circular.) Lynch's Creek South Carolina.

Astacus, Delaware.

Cassidulus æquoreus, Prairie Bluff, Ala.

Scutella Rogersi, Monroe county, Ala.

Ananchytes cinctus, New Jersey.

fimbriatus,

Flustra sagena, New Jersey.

Eschara digitata,

Alveolites cepularis,

Vermetus rotula, New York.

Dr. Morton relinquishes his *Scaphites Cuvieri*, on the ground of its identity with the *S. hippocrepis* of Dr. DeKay, previously described.

In concluding the Synopsis, Dr. Morton remarks upon the similarity between the testaceous mollusca of the eastern and western shores of the Atlantic ocean; and gives, with the assistance of Mr. Conrad, a list of the recent shells known to both continents. They are as follows: *Purpurea lapillus, Buccinum undatum, Natica canrena, Fusus islandicus, Cyprena islandica, Saxicava rugosa, Lucina divaricata, Pholas crispata, P. costata, Solen ensis, Mya arenaria, Mytilus edulis, Modiola papuana, Mactra deaurata, Spirorbis nautiloides, Thracia convexa, Solecurtus fragilis, Glycimeris siliqua, Cardium grœnlandicum, C. islandicum, Strigilla carnaria, Tellina punicea, Pecten islandicus, Balanus ovularis.*

To this catalogue he subjoins the fossil shells common to the strata of Europe and America. Thus in the Upper Marine or older Pliocene, we have the *Lucina divaricata* Lam. *Cerithium melanoides*, Sow. *Ostrea virginiana* Gmel. *Bulla acuminata* Sow. *Venus rustica?* Sow. *Pectunculus subovatus* Say. *Panopæa Faujasii*: in the Eocene or London Clay, the *Corbis lamellosa* Lam. *Cardita planicosta* Blain. *Bulimus terebellatus* Lam. *Solarium canaliculatum* Lam. *Fistularia elongata* Desh. and in the Cretaceous Group, the *Pecten quinquecostatus.*

In view of the resemblance in existing species between the two coasts, Dr. Morton asks, is it not probable that this accordance was formerly as great as at present? Although the identical species are not numerous, yet the similarity in the general type is most evident, both in the Testacea and in family of Saurians. He therefore very justly infers, and the conclusion is a fine exemplification of the interesting nature of geological deductions, "that when the chalk fossils were living inhabitants of the seas of Europe, the organic relics of this synopsis were alive in the oceans of America,—in other words, that they were contemporaneous beings. Whatever cause laid bare the eastern portion of the series, appears to have acted simultaneously on the western mass: not a rush of currents, but either a subsidence of the sea, or elevation of the land, which has left the fossils in their original beds unbroken, and, as to their external form, unaltered."

Dr. Morton's present beautiful work is illustrated by numerous fine lithographic drawings, and embodies information of great value in elucidating an important portion of the vast upper secondary of the United States, which, with the tertiary, scarcely less extensive, and the diluvial, is to furnish hereafter a rich reward to the geological explorer of this portion of the United States, which was until recently, a *terra incognita.*

3. *Large Mass of Native Copper.*—The cabinet of Yale College has been recently enriched by a magnificent piece of Native copper, presented by Mr. J. Mortimer Catlin of New York. In a letter to the editor, dated October 9, 1834, Mr. C. mentions that this piece of copper was found at or near the river On-ta-naw-gaw of lake Superior; and, as we are informed, above the rapids marked on the map of the river. Those who brought it away, were allured by the vain hope of finding in it gold or silver. Its weight was one hundred and thirty seven pounds, but is now somewhat less, as a few ounces have been detached. It has, all the characters of native copper; the perfect color and lustre of that metal; the occasional incrustation with green carbonate of copper; numerous rudiments of crystals of copper with triangular faces; occasional cavities, swellings and knobs, and great malleability. Its form is rudely plano-convex, with an irregularly elliptic base, arched below, and standing upon two projections, thus allowing it a rocking motion; it is fifteen inches long and fifteen broad—in the narrowest place twelve inches; it is nine inches high, and it bears strong marks of having been entangled in a vein stone, or a rock. Mr. Catlin has been credibly informed, that "there lies in the bed of the On-ta-naw-gaw a mass equally pure, weighing a ton!

Whether this is the celebrated copper rock described by Mr. Schoolcraft, Vol. iii. p. 205 of this Journal, we have no means to determine, but the numerous and important facts mentioned by Mr. Schoolcraft, render it certain, that native copper is frequently found in that region, and lead to a strong presumption of the existence of valuable mines of copper.

4 *Great mass of Meteoric Iron from Louisiana.*—The history of this iron was given in Vol. viii, at p. 218 of this Journal. The first notice of it was published in Dr. Bruce's Journal in 1810, and it was there stated that it contained no nickel; a subsequent examination by Professor Silliman detected that metal, and a more exact analysis by Mr. Charles U. Shepard ascertained the existence of 9.67 per cent. of nickel in this very remarkable mass. See this Journal, Vol. xvi, p. 217. It was, for many years, deposited in trust, in the Museum of the Lyceum of New York, by the late Col. Gibbs who had, early, purchased the specimen. That gentleman's lamented death was mentioned in this Journal Vol. xxv, p. 214. Recently, his respected lady, Mrs. Laura Gibbs, with the approbation of those concerned, has generously presented this magnificent mass to the Cabinet of mineralogy of Yale College, thus causing it to be associated with the splendid collection, the Gibbs Cabinet, which was amassed by the labor and munificence of him whose name it bears, and to whose memory we trust, it will long continue to do honor. In this collection, unrivalled in the United States, and surpassed, in few other countries, the Meteoric iron of Louisiana, is without doubt, the most important specimen.

A more particular notice of it may be given on another occasion. Its length is three feet four and a half inches, its greatest breadth, two feet four inches, and its greatest height, sixteen inches. Its weight is sixteen hundred and thirty five* pounds, being more than that of the mass found by Professor Pallas in Siberia, which is now in the Imperial Museum at St. Petesrburgh.

The Gibbs meteoric iron, is, therefore, the largest piece in any collection in the world, although there are masses many times larger lying in the wild regions of Mexico aud Peru, and perhaps elsewhere.

5. *Soapstone or Steatite, of Middlefield.*—This very useful material, is found in many places in our primary regions. Middlefield, in Massachusetts, eighteen miles from Northampton, has long been known as affording it in abundance. A new quarry has been recently opened there, by Mr. William H. Butler, from whom, we have received slabs and fragments. The quality is excellent, the substance is principally compact talc, and it is, (as far as we can

---

* The weight was reported in Dr. Bruce's Journal, to be over three thousand pounds, which exaggerated statement, has been often repeated, and was probably derived from the adventurers who brought it from the Red River.

judge from the specimens sent us,) remarkably free from foreign minerals. It gives a surface of uniform level and finish, and is cut with great ease. When varnished, fine colors are brought out, not unlike those of the Verd antique marble of Milford, near New Haven, but less vivid. It is, however, sufficiently handsome to be used for the facings of fire places.

We should be glad to receive information of all remarkable masses of soapstone in this country, that we may contribute to make them still further known. The utility of soapstone is immense, and is only beginning to be realized among us. It is an admirable building material—cut with almost as much ease as timber, and readily shaped to any form for utility or ornament; it is as handsome as granite and marble, and houses constructed of it would not be injured by fire, as it resists that powerful agent, even in furnaces,* for which it forms an excellent lining.

Anthracite furnaces, when lined with it, instead of fire bricks, do not accumulate the slag and scoriæ, and the walls remain perfectly clean; this arises from the infusibility of the soapstone, which prevents the slag from adhering to it; the slag consists of the earthy and metallic impurities of the coal, which melt in the intense heat of the anthracite furnaces, and then adhesion takes place in consequence of the softening of the fire bricks at their surfaces, where they are in contact with the slag. Soapstone, on account of its infusibility, is also an excellent ingredient in pottery and porcelain; and magnesia, which is its characteristic ingredient, may be extracted from it by very easy chemical processes.

6. *Prof. Hitchcock's Geology of Massachusetts.*—Extract of a letter to the Editor, dated Brighton, England, June 18, 1834, from Gideon Mantell, Esq.—The volume and atlas on the Geology of Massachusetts reflect great credit on the author and on the enlightened government which patronised the undertaking.

Mr. Robert Bakewell, near London, under date of July 16, 1834, writes—that Prof. Hitchcock's Geology of Massachusetts does high credit to the writer and to the government which promoted the undertaking.

Mr. De La Beche in his new work, entitled Researches on Theoretical Geology, has spoken highly of Prof. Hitchcock's Geology of Massachusetts, and has mentioned with particular approbation, his account of the bowlder stones and other transported masses.

---

* It is said however not to stand in the furnace for smelting iron.

7. *The Asclepias Syriaca or Milk Weed a substitute for flax, &c.*

Salem, Mass., Dec. 10, 1834.

To Professor Silliman.—*Sir*—Some information on the article inserted in a late No. of the American Journal, stiled a "substitute for linen," being inquired for, it is with pleasure given.—The plant there referred to, is the Asclepias Syriaca, or common silk or milk weed—and the material itself, is the exterior and interior barks; the exterior, however, is considered of the most importance. If the structure of this plant be examined, the body of it, when in full growth, will be fonnd to envelope three sets of fibres, two of which are contained in, and in fact constitute the barks; the third set adhering to and covering the stem, being of no value, is not patented. This invaluable plant grows spontaneously, abounds throughout this country, and being a perennial, would not require, as flax, hemp, cotton, &c., &c., to be renewed annually, but with a top dressing, it is said, it would yield abundantly for many years. In all my researches among trees and plants in pursuit of a vegetable silk, none have been observed to compare with this, for beauty, strength, and abundance of fibre and milk—to which it probably owes its superiority of strength and beauty, over every other known fibre. This new and beautiful material, so very valuable for the many purposes to which it can be applied, we cannot but hope will receive attention; for we are not prepared to believe that it is destined to linger, from century to century, as was the case with some of the most favored fabrics of the present time, in consequence of the darkness of the age in which they were produced. When a whole nation and that the most enlightened then on earth, could not be induced to believe in, or profit by the discovery of one of them, its consequent slow progression through many subsequent ages to the present unrivalled state of perfection to which it has attained, need not occasion surprise. Neither would it be deemed extravagant in us, perhaps, considering the present advanced state of knowledge, should we venture to predict that the fibres of the asclepias will rank among the most favored fabrics of the present day, if they do not wholly supercede some of them. Very respectfully yours,

Margaret Gerrish.

It is worthy of remark that the milk of the plant above named, contains a quantity of caoutchouc or elastic gum, which, at our suggestion, was extracted, some years since, by Dr. Grosvenor of the Medical Institution of Yale College, who made this plant the subject of his inaugural dissertation.—*Ed.*

8. *On the variation of the Magnetic Needle*, by Prof. Bache.—The observations were made at West Chester, twenty one miles to the west of Philadelphia, during ten days in the latter part of August and beginning of September 1832; they were continued generally during the whole night as well as the day, the needle being observed every hour except when circumstances connected with the phenomena showed such attention to be unnecessary. The series of results, though limited, is valuable on this account. The actual westerly variation, of the place of observation was 3° 25′. The occurrence of two maxima and two minima of westerly variation, is shown distinctly, by the results of each day's observations, confirming for this place of observation the results of Canton obtained at London, when the variation was 19° W., the subsequent deductions of Gilpin, and the still later ones of Colonel Beaufoy obtained when the variation was between 24° and 25° W. In regard to the hours of occurrence of these maxima and minima, there is not the same agreement. Mr. Christie gives from Canton's results the times of maximum westerly variation, at half past one P. M. and near midnight, and the times of minimum, at nine A. M. and nine P. M., and from Col. Beaufoy's observations the first maximum and minimum at times rather earlier, than those deduced from Canton's observations, and the second maximum about eleven P. M. During the time embraced in the series by Prof. Bache, the first maximum of westerly variation, occurred between two and half past four P. M. and the second between eight and a quarter, P. M. and twelve and two thirds, A. M., varying with meteorological circumstances. The two minima of westerly variation occurred, the first, between eight and nine A. M., and the second between six and seven and a quarter, P. M. The night maximum was frequently greater than the day maximum. The observations are represented by broken lines which enables the eye readily to trace the results. The mean times of maximum variation west, are three P. M., and twelve midnight, and of minimum, nine A. M. and six P. M. The mean midnight maximum is four minutes and a quarter higher than the day maximum, and the morning minimum, one minute and a quarter less than the evening minimum.

The author concludes that ordinary meteorological phenomena, such as the formation and dispersion of clouds, the occurrence of showers and gusts, of fogs, &c., have a powerful modifying effect on the diurnal variation: in one remarkable case of a shower followed by a thunder-gust, the observations show singular and rapid changes of the variation. These results agree, the author remarks, with a single deduction made by Mr. Christie from observations of his own, but which had not been followed up, and was contradicted by the results obtained at Port Bowen, by the late Lieut. Foster; a contradiction which he endeavors to explain.

9. *Notice of the late Eclipse.*

Baltimore, 3d December, 1834.

To Professor Silliman.—*Sir.*—Being desirous of recording my observations of the late Solar Eclipse, and as a subscriber to your valuable Journal, I beg leave to communicate the following.

The place of observation in Baltimore, is about one mile from the monument square or center of the city. The latitude of the former by close observations, is 39° 17′ 12″ N.

The time was observed minutely on a chronometer by Parkinson and Frodsham, whose rate has been for some time back, at 0.5″. slow.

The local Mean time was ascertained by sets of altitudes of the Sun, accurately taken on the forenoons immediately preceding and succeeding the eclipse.

The contacts were observed by two persons, with a Dollond Achromatic Telescope of eighty five power, assisted by a smaller one of about thirty, the two observations agreed so nearly, as not to admit of any distinction.

Beginning 12h. 51′ 58″, Mean time at Baltimore.
End 3h. 31 29 30‴.

Temperature by Fahrenheit's Scale.

	Exposed to the Sun.	Exposed to the north.
at 12 noon	66°	50°
1 P. M.	66°	51°
2 "	55°	49°
3 "	62°	50°

Very respectfully, your most ob't serv't.

Lewis Brant.

10. *To the Entomologists of America.*—Having at length sufficiently arranged the large entomological collections made during my researches in Tropical America, by which the duplicates are separated from the series placed in my own cabinets; I am now prepared to

offer the former, on the principle of *mutual exchange* to entomologists in general. For this purpose, I shall be happy to enter into correspondence with those gentlemen of the United States, (more particularly of Georgia, Louisiana and the Southern provinces,) to whom such a plan would be acceptable. All the North American species, of all the orders will be acceptable, provided they are in good preservation ; and where fine and bred specimens can be procured, six or seven of the same species will not be too many. It will be more satisfactory to me if any boxes of insects, intended for this purpose are sent in the first instance to some friend or correspondent of the sender in London, who is to give them up to me upon receiving in return, a collection of an equal number of good specimens; thus all fear of procrastination, mistakes, &c. will be prevented. The *minute* Coleoptera, are not so much desired as the larger species, and a preference will be given to the Lepidoptera, Hymenoptera, and Neuroptera. Fine bred specimens of the SPHINGIDÆ, or Hawk Moth, will be very acceptable. If some British Insects are desired in return, they can be also sent. It will not be worth while, to send a smaller collection, than from two to three hundred specimens; but as many of one sort, will be no objection, it might be as well to send between eight hundred and a thousand in one or more boxes at the same time. The boxes of each party to be returned, should be well waxed, or corked, the specimens firmly stuck, and the larger ones secured by additional card braces. A letter by post, containing the name of the vessel, captain, &c., and the party in London, to whom the collection is consigned, should also be sent, addressed to me, at St. Albans, Hertfordshire, Eng., or to the care of Longman, Rees & Co., London.

WM. SWAINSON.

St. Albans, 1st August, 1834.

11. *Travels in the Equatorial Regions of South America, by* ADRIAN R. TERRY, M. D. Hartford, 12mo pp. 290, 1834.—Cooke & Co.—Thirty years ago, books of travels in foreign countries by citizens of the United States, were rare—but within a few years they have become much more frequent, and we are particularly indebted to gentlemen in the United States Navy, and in the Missionary service, for several valuable and interesting works, not to mention several books of this class, whose origin has been accidental. Dr. Terry's little volume, is fairly entitled to rank in this

respectable company. It is a spirited and manly performance, written in a pleasing and attractive style, and abounding with graphic sketches and descriptions. Dr. Terry's voyage began at New York on the 24th of September, 1831—on the 16th of October, he arrived at Port Royal and Kingston, Jamaica; early in November, he reached Chagre on the Isthmus, and about the middle of the month arrived at Panama on the Pacific. On the 5th of December, he sailed for Payta, the most northern town of Peru, where he arrived on the 29th. On the 31st he set sail in another vessel for Guayaquil, which he reached on the 2d of January, 1832.

He made an interesting excursion to Quito, and the mountain region in the vicinity of Chimborazo, Cotopaxi, Pinchinca, and Tunguivgua; this occupied rather more than two months from July 3, 1832. On the 9th of November, he sailed for the United States by the way of Cape Horn, and arrived at New London, February 20, 1833. There is a great amount of important information in this work, but we have been obliged by want of space, to omit all the extracts which we had marked for insertion in the present notice.—Dr. Terry says, that his "book pretends not to science"—still, we find numerous facts, which do honor to his scientific knowledge, and which, men of science, will receive with pleasure and advantage.

12. *New York* Φ Β Κ *Society.*—The members have published an able and judicious circular, proposing investigations under three divisions.

I. A Physical Class,—for physical and medical science.

II. A Literary Class,—for the moral sciences and literature.

III. A Civil Class,—for law and political science.

Meetings are to be held at the Philosophical Hall of Union College, three times in the ensuing year.

After the adjournment of the general meeting, the members of the different classes will meet separately.

It is reported that the Society will publish such of its papers as may appear to possess sufficient interest and importance.

13. *Elements of Psychology.*—This work has been translated from the French of Professor Victor Cousin, by Rev. C. S. Henry of Hartford, Conn. It consists of that part of the lectures of the author which contain his critical examination of Locke's Essay on the Human understanding.

There will be also an introduction, notes and additions.

14. *The New England Magazine.*—The eighth volume will commence on the first of January, 1835.—This magazine has now been published for three years and a half, with a reputation and patronage which have increased, till they are sufficient to insure its permanent success. With the November number it passed into the hands of new proprietors, who have also become proprietors of the *United States Magazine*, and propose to conduct the united work on the following plan:

I. Under the title of *Original Papers*, it will contain articles on the most prominent subjects of domestic politics; Sketches of travel and adventures at home and abroad; Views of foreign and domestic literature; Personal reminiscences of distinguished men and remarkable events; Poetical sketches, essays, tales, and miscellaneous articles.

II. A monthly Commentary on the most important topics of the time.

III. Notices of New Publications.

IV. Historical Record—devoted to the politics and statistics of the States and the Union.

V. Memoirs of distinguished Americans, lately deceased.

VI. Literary Intelligence.

Conditions.—The numbers will average eighty pages each, delivered punctually on the first of every month, at $5 per annum, payable on the delivery of the fourth number.

15. *Professor Joslin's Memoir on Irradiation.—Contents.*—Obvious and well known phenomena of irradiation.—Existing state of knowledge and desiderata in relation to the theory.—The author's first observations in relation to the elongated radiations of stars and distant flames.—Observations on the general figure of a flame. General plan of experiments for determining with more precision the laws of this dilatation.—Appearance of luminous objects surrounded by opake ones.—Appearance of opake objects projected on luminous ones.—Three directions of maximum irradiation in ordinary vision. Proof that irradiation increases with distance—that it depends on nothing exterior to our bodies—that it depends partly, but not chiefly on the combined action of both eyes—that it does not depend upon any of the protecting parts of the eye—and lastly, that it does not depend upon any peculiar affection of the retina.—Relation between irradiation and the structure of the crystalline lens.—Effects of di-

latation of the pupil alluded to.—Additional conclusions, to which the author has arrived, by experiments not yet published; especially by experiments with the pupil of his eye preternaturally dilated for that purpose.

Applications.—1st. Bright objects never appear of their true shape, circumstances which affect this and other illusions. 2nd. Stars apparently situated on the moon—one definite position most favorable for red light; three others favorable under other circumstances. 3rd. Appearance of the new moon. 4th. Reasons why a telescope changes the relative apparent magnitudes of the fixed stars compared with the planets, and of the latter compared with each other.—5th. The scintillation of the fixed stars affected by irradiation, on which their apparent magnitudes chiefly depend.

16. "*The United States Naval Lyceum.*"—This Institution has been recently established at the Navy Yard near New York, and its officers request the favor of an introduction, to the readers of the American Journal of Arts and Sciences.

The objects of the members of this Association, are contained in the following extract from an article prefixed to the Constitution of the Society. "We, the officers of the Navy and Marine Corps, in order to promote the diffusion of useful knowledge, to foster a spirit of harmony, and community of interest in the service; and to cement the links which unite us as professional brethren, have formed ourselves into a Society, &c."

It is hardly possible that an institution created for such purposes, can interfere with the interests or views of any other similar association; but may, and in all human probability, will in time, contribute largely to the cause of "useful knowledge." As mere collectors of specimens in Natural History, and Curiosities, illustrative of the manners and customs of distant nations, which the members in the discharge of their official duties to their country, may be called upon to visit, they possess some advantages, that they are not only willing but anxious to improve. In this way much has already been done, and the evidence may be found in almost every public collection of the kind in the country. But much more by far, of what has been thus procured from abroad, has become almost a total loss to the cause of science, for the want of some place of general deposit.—Such a *depot* now exists, and its utility has already been rendered apparent, by the contributions received from the officers of the U.

S. Ship Falmouth, recently returned from a cruise in the Pacific; and the U. S. Ship Peacock from the China and India seas. Indeed, the return of every National vessel, since the institution has been in operation, has contributed, more or less, to its collections.—These things in most instances, have been obtained abroad, without the knowledge of the existence of the Naval Lyceum, and but for it, would by this time, have been scattered over the country, and in most cases, lost to the researches of the curious. If under such circumstances, the Museum and other departments receive important additions, much more may be expected, when the members of the Society shall go forth for collecting; stimulated to action, by an interest in the success of an institution, which they can feel to be of their own creation.

November 27th, 1833, was held the first "meeting of the subscribers, for forming a Society, with the object of establishing a permanent Library, Reading Room, and Museum of Natural History, Curiosities, &c." And as soon as the Association was known to have assumed "a local habitation and a name," contributions flowed in upon it, with a liberality and profusion, that astonished even its most sanguine friends. All were encouraged, and an increase of confidence marked the proceedings of the Association. Within the period of twelve months, the Society has received upwards of two hundred donations, including over thirteen hundred volumes of books; while the departments of Conchology, Mineralogy, Geology, Botany, Zoology, Numismatology, and the Museum furnish interesting collections. The Reading Room too, owing in a great degree to the liberality of the editors of newspapers and periodicals, has become a source of interest, and advantage, to those members who could find leisure to improve the opportunity thus presented. Advantage was taken of a munificent donation from the Marine Insurance Offices of the city of New York, to the amount of nearly five hundred dollars, to procure such rare and valuable works, principally upon subjects of Natural History, as were of the first importance to such an association, and had not then been supplied to the Library.

Ladies, often appear on the list of donors to the Naval Lyceum, and have received the warmest thanks of the members. The statesmen, the authors, the editors, the benevolent, the good and the great of the country are there too. The Society cherish with feelings of pride, a donation in books from the venerable Ex-President of the

United States, James Madison. From Henry Beaufoy, of South Lambeth, Eng. they have received the very appropriate and valuable donation of "Nautical and Hydraulic Experiments, with numerous Scientific Miscellanies; by Col. Mark Beaufoy." And recently from Col. I. Townsend, one of its corresponding members in Paris, a splendid edition of the "Voyage of the Corvette La Favorite round the World in 1830, '31, and '32." An expensive publication, made by order of tbe Marine Department of France, a copy of which, it is understood, has been officially presented by the Government of France to the Navy Department of the United States.

The funds of the Society, derived from initiation fees, and the annual subscription of seventy five *Resident*, and forty four *Absent members*, have thus far, been sufficient to defray the necessary expenses. Measures have been taken to procure in proper time, an "act of incorporation." And hopes are entertained that at some day, the sciences, and different departments of Natural History may be illustrated by a course of Lectures.

The Society would be happy to receive any communications on subjects of science; or useful information from any source competent to render it, particularly for such directions, as would aid them in making collections while abroad. The gleanings, when received, will be divided among those who with a proper spirit of liberality, know how to value them.

The facilities in the possession of the Society, for communicating with our National ships on foreign stations, are believed to be as great as circumstances will admit of; arrangements have been made for the express purpose, and are freely offered for the public convenience. Letters, *post paid*, by mail, directed to the care of the "United States Naval Lyceum, New York;" and letters or packages of a reasonable size, left at its rooms, will, in all cases, be transmitted free of further expense, by the earliest opportunity.

As a mere *experiment*, the friends of the Lyceum have ample cause for congratulation at the result.

The following members have been elected, since the organization of the Society.

Corresponding.—Col. Joseph Totten, U. S. A.; Wm. Wood, N. Y.; Isaac Lea, Philadelphia; Wm. Cooper, Samuel D. Heap, Consul at Tunis; John P. Payson, Consul at Messina; Capt. Sir Wm. Edward Parry, R. N.; Capt. Sir John Franklin, R. N.; Capt. Ross,

R. N.; Capt. Back, R. N.; Prof. Benedict, University of Vermont; Dr. John Torrey; Major Joseph Delafield; Dr. John C. Jay; Maj. John Le Conte; Prince Charles Bonaparte; Dr. Burrows; Cavalier Laudalier; Prince Buleia; David Offley, Consul at Smyrna; Mr. Joinindy, Douglas Fitch, Major D. Russy, U. S. A.; Gen. Gratiot, U. S. A.; Horatio Sprague, Consul at Gibraltar; Samuel Blodget, Gibraltar; Robert Walsh, Senr. Philadelphia; Col. J. Townsend, Francis Carnes, Paris; Capt. F. A. Fokkis, Hamburg; O. Rich, London; Henry Beaufoy, Eng; Mathew Carey, Philadelphia; C. U. Shepard, Yale College; Wm. Flewelling, Dr. Amos A. Evans.

Honorary.—Andrew Jackson, President of the United States; Martin Van Buren, Vice President of the United States; Lewis M'Lane; R. B. Taney; Lewis Cass, Secretary of War; Levi Woodbury, Secretary of the Treasury; Wm. T. Barry, P. M. General; B. F. Butler, Attorney General; Commodore John Rodgers, Com. I. Chauncey, and Com. Charles Morris, Navy Commissioners; J. Fennimore Cooper; Washington Irving; Edward Livingston, Minister to France; David Porter, Charge D'Affaires at Constantinople; James Madison, Ex-President of the United States; John Q. Adams, Ex-President of the United States; General Lafayette; John Marshall, Chief Justice of the United States; Prof. B. Silliman, Yale College; N. Bowditch, Salem, Mass.; Joseph Bonaparte; James Kent, Ex-Chancellor of the State of New York; General Samuel Smith; George W. Lafayette; Mahlon Dickerson, Secretary of the Navy.

Having seen the library, collection, and arrangements of the Naval Lyceum, we have been much gratified, both with what is already accomplished in so short a time, and with the plan and design of the Institution, which is worthy of all praise. Among its supporters, are gentlemen distinguished not less for their intelligent zeal and liberal views, than for professional discipline and gallantry. Visiting, in the course of their voyages, many distant countries, they will bring home their scientific, antiquarian and historical treasures, and their collection may, perhaps, one day emulate the splendid Mariners' Museum at Salem. We trust that they will receive the warm patronage of the government and the country.—*Ed.*

17. *Obituary.*—Died at New Harmony, Indiana, on the 10th of October last, THOMAS SAY, in the 47th year of his age.

We regret that we have not the materials for the extended notice of Mr. Say, which is so justly due to his memory, and sincerely hope that some one of his scientific friends will favor the public with a detailed biography of this eminent naturalist. We can only state a few of the most prominent facts, and add a list of his scientific papers, so far as they have come under our observation.

Mr. Say early abandoned the mercantile pursuits in which he had reluctantly engaged, and ever after, devoted himself to the study of nature. His contributions to science are very numerous, and evince the most sagacious discrimination and the most laborious industry. It is no exaggeration to assert, that he has done more to make known the zoology of this country, than any other man. Most of his papers were published in the Journal of the Academy of Natural Sciences of Philadelphia, a society of which Mr. Say was one of the brightest ornaments.

Mr. Say, was attached, as zoologist, to the two exploring expeditions made under the command of Major Long, and returned with many important additions to the stock of scientific knowledge.

In 1825, he left Philadelphia, the place of his birth, and fixed his residence at New-Harmony. Here he pursued his favorite studies with unabated ardor, and commenced the publication of a periodical work, devoted to American Conchology, several numbers of which had appeared at the time of his death.

Though cut off in the midst of his labors, at a time when many years of usefulness might reasonably be anticipated; yet he has left behind him enduring memorials of his talents, and will ever be remembered as one who did honor to his country and enlarged the boundaries of human knowledge.

On the Mammalia.—Jour. of Acad. of Nat. Sci. of Phil. (8vo.) Vol. ii, 330—343; with G. Ord. iv, 345—349, 352—355.

Reptilia.—Am. Jour. of Science, (8vo. New Haven,) Vol. i, 256—265.—Jour. Phil. Acad. i, p. 405—407; iv, 203—219, 237—241.—Contributions of the Maclurian Lyceum, (8vo. Phil.) i, 37—38.

Mollusca.—Jour. Phil. Acad., i, 13—18, 123—126, 276—284; ii. 149—179, 221—248, 257—276, 302—325, 370—381; iv, 124—155, 368—370; v, 119—131, 207—221.—Am. Jour. Sci., ii, 38—45. Disseminator of Useful Knowl. (New Harmony,) ii, 244, &c.—American Conchology, (8 vo. New Harmony,) Nos.

Crustacea.—Jour. Phil. Acad., i, 49—52, 57—63, 65—80, 97—101, 155—169, 235—253, 313—326, 374—401, 423—458, 482—485.

Arachnides.—Jour. Phil. Acad., ii, 59—82.

Insecta.—Jour. Phil. Acad., i, 19—23, 45—48, 63, 64; ii, 11—14, 102—114, 353—360; iii, 9—54, 73—104, 139—216, 238—282, 298—331, 403—462; iv. 83—99, 307—

345; v, 32—47, 160—204, 237—284, 293—304; vi, 149—178, 183—188, 235—244, 299—314.—Western Quarterly Reporter, (8vo. Cincinnati,) ii, 71, &c.; 160—165. Annals of Lyc. of Nat. Hist. of New York. (8 vo.) i. 219—268.—Contrib. of Macl. Lyc., ii, 38, 39; 67—83.—Trans. of Amer. Phil. Soc. (Phil. 4to.) i, N. S., 401—426; ii. 1—109.—American Entomology, Roy. 8vo. 3 vols. and Glossary, Phil. 1824—1828.

Radiata.—Jour. Phil. Acad., iv, 289—296; v, 141—154, 225—229.—Am. Jour. Sci. i, 381—387; ii, 34—38.

On various topics of Zoology, in Nicholson's British Encyclopedia, (Am. ed. Phil. 8vo. 6 vols., 1816, 1817.)—Encyclopædia Americana, (13 vols. 8vo. 1830—1833.—James's Account of Long's Exped. to the Rocky Mts. (2 vols. 8vo Phil. 1823.)—Keating's Narrative of Long's Expedition to St. Peter's River, (2 vols. 8vo. Phil. 1824.)

18. *Obituary.*—The Hon. Simeon DeWitt, late Surveyor general of the State of New York, died at Ithaca, Dec. 3, 1834, in the seventy ninth year of his age. He was an eminent patron and cultivator of useful knowledge, and himself possessed high scientific attainments, especially in astronomy, engineering and general physics. This Journal and its editor were honored by communications from him and while we deeply lament his loss not only as a friend of Science but as "a pure patriot, a zealous indefatigable public officer, an estimable citizen and an honest man," we feel that he is among the revered dead, having gone down to the grave "full of years and of honors." We trust that Albany will pay a just tribute to his memory by a full biographical notice.

19. *Modern Trilobites of New South Shetland.*—These crustacea, so interesting to geology, whose families were supposed to be entirely extinct, still have, it seems, living representatives in the cold region of New South Shetland. Dr. Eights has figured and described them with scientific skill in the Transactions of the Albany Institute, Vol. II, No. 1. This paper of Dr. Eights with his interesting description of the island, as well as the other contents of the No. referred to, we intended to notice more particularly, but the work having been mislaid, we have not been able, after much search, to find a copy of it and of course we could not fulfil our design.

20. *Recent Scientific Publications in the U. States.*—Botanical Teacher for North America: in which are described the indigenous and common exotic Plants, growing north of the gulf of Mexico. By Laura Johnson: under the supervision of Prof. A. Eaton. The generic characters are from the descriptions of Prof. Lindley; the

specific are given by signs and abbreviations. These are preceded by a condensed view of the Artificial method, and followed by the Natural one. Albany, Oliver Steele. 12mo. pp. 268, 1834.

Observations on the genus Unio, together with descriptions of new genera and species in the families Naiades, Conchæ, Collimacea, Lymnæana, Melaniana, and Peristomiana: consisting of four memoirs read before the American Philos. Soc. from 1827 to 1834, and originally published in their Transactions: with nineteen colored plates, by Isaac Lea, M. A. P. S., Philadelphia. Printed for the author. 4to. pp. 232, 1834.

Synopsis of the Organic Remains of the Cretaceous Group of the United States; illustrated by nineteen plates, to which is added an Appendix, containing a tabular view of the Tertiary fossils hitherto discovered in North America. By Samuel George Morton, M. D. Philadelphia, Key & Biddle. Roy. 8vo. pp. 104, 1834.

Mécanique Céleste. By the Marquis de La Place. Translated, with a Commentary, by Nathaniel Bowditch, LL. D. Vol. 3, 4to. pp. xxx and 910, and 107 of tables. With a Portrait of La Place. Boston, Hilliard, Gray, Little and Wilkins, 1834.

Transactions of the Geological Society of Pennsylvania. Vol. I, Part I, August, 1834. Philadelphia, Published by the Society. 8vo. pp. 180, with six lithographic plates.

The American Almanac and Repository of Useful Knowledge, for the year 1835. Boston, Charles Bowen. 12mo. pp. xii and 336, 1834.

Ancient Mineralogy, or, an Inquiry respecting Mineral Substances mentioned by the Ancients: with occasional remarks on the uses to which they were applied. By N. F. Moore, LL. D. New York, G. & C. Carvill & Co., 1834, 12mo. pp. 192.

21 *Republications of Foreign Works.*—The Connection of the Physical Sciences. By Mrs. Somerville. Philadelphia, 12mo. pp. 356, Key & Biddle, 1834.

Chemistry, Meteorology, and the Function of Digestion, considered with reference to Natural Theology. By Wm. Prout, M. D. F. R. S., (being 8th of the Bridgewater Treatises.) Philadelphia, Carey, Lea & Blanchard, 1834, 12mo. pp. 307.

Extracted and translated by Prof. J. Griscom.

22. *Progressive increase of the Internal Heat of the crust of the globe.*—For the purpose of ascertaining whether a constant stream of water could be obtained by means of an Artesian well, sunk on the south side of the Jura mountains, at the distance of about a league from Geneva, and at an elevation of two hundred ninety nine feet above the level of the lake, M. Giroud at his country residence at Pregny, bored to the depth of five hundred forty seven feet without success. Despairing of success, he offered great facilities to any persons who might wish to prosecute the enterprize, for the purpose of scientific enquiry.

On this occasion, M M. Aug. De La Rive and F. Marcet made a successful application to the friends of science, and also to the government, and funds were obtained sufficient to enable them to continue the operations during eight months, and to extend the boring to the depth of six hundred eighty two feet. The hole bored, was about four and a half inches in diameter. Water began to appear in it at the depth of twenty feet, and it is worthy of remark, that the height at which the water stood in the opening, as measured from the surface, was lower when the greatest depth was attained than it was at half the depth. At two hundred seventy five feet of depth, the water stood at fourteen feet from the surface ;—at five hundred feet it sunk to twenty two feet—at five hundred fifty, to thirty five feet. It then rose. At five hundred ninety five feet, it stood at twenty four feet six inches, but at six hundred seventy five feet, it again sunk to thirty five feet eight inches. The result of this praise worthy effort must operate as a salutary preventive from any farther expensive attempts to obtain running fountains from the theory of an internal communication with the springs on the summits of the Jura.

Having attained the extraordinary depth above mentioned, the experimenter devised the means of ascertaining the temperature of this opening at different depths. As the common thermometer would not answer the purpose, they contrived a self registering thermometer, constructed on a large scale, and whose accuracy was subject to the most satisfactory tests.

The following table exhibits the temperature of the hole at the depths specified.

Depth below the surface.—Feet.	Corresponding temperature.
30	8°.4 Reau.
60	8 .5
100	8 .8
150	9 .2
200	9 .5
250	10 .0
300	10 .5
350	10 .9
400	11 .37
450	11 .73
500	12 .20
550	12 .63
600	13 .05
650	13 .50
680	13 .80

It thus appears that the increase of temperature below the depth of one hundred feet from the surface, as far down as six hundred eighty feet, is precisely 0°.875 of Reaumur, (=1°.968 or 2° Fahrenheit, very nearly,) for every one hundred feet. It will be observed that the increase, instead of moving per saltum, as in some other cases, moves with remarkable uniformity. This, the experimenters think, may be owing to the care which was taken in this case, to remove and avoid every source of error.

This experiment appears to be the first attempt to ascertain, with any accuracy, the temperature of the earth at considerable depths, among the mountains of Switzerland.

The geological structure of the beds which were bored through on this occasion, was as follows: next to the upper layer of vegetable earth, sand and gravel, was a gravelly and bluish clay, mingled with soft sandstone, (molasse.) Below one hundred twenty feet commenced a succession of beds of marl and soft sandstone, of various thicknesses which continued without interruption to the termination of the boring, six hundred eighty two feet. At two hundred twenty feet, there was a bed of coarse sandstone, (molasse grossiere) two feet thick, with rolled pebbles; a remarkable fact, considering the depth. A strong fetid sulphurous odour was also observed in the layer of yellow marl mixed with sandstone, at the depth of two hundred eighty feet, that is near the level of the lake, and a grain of salt was found in the sandstone at this depth. The sulphurous odor again appeared at six hundred feet, without the presence of any sulphurous compound that would account for its origin.—*Bib. Univ. Mai.* 1834.

Remark.—Upon the data stated above; at a little over two miles below the surface, water would boil; at about ten miles, the earth would be red hot, and probably at the depth of two hundred or three hundred miles, it would be in igneous fusion. There is, however, no certainty, that the heat increases in the same ratio to unknown depths, and the phenomena of volcanoes, prove, that not only the ignition but free fusion approximate to, and actually reach the surface, even in very high mountains.—*Ed.*

23. *Water obtained by Boring.* (J. G.)—*Artesian Wells* have been very successfully constructed in some parts of France. A letter from *M. Jauburt de Passa* to Viscount *Hericart de Thury*, describes a bored well, remarkable for the abundance of water which it supplies. It was made by *M. Durand*, two leagues south east of Perpignan.

The sound after penetrating to the depth of eighty feet, through alternate beds of marl and clay entered a bed of sandy marl, three feet thick, where issued a jet of water, very clear, but from the peculiarity of its taste, unfit for drinking. Its temperature was 14°.5 Reaumur, (=65° Fahrenheit,) and it rose from three to four feet above the surface.

A second boring, undertaken at the distance of six feet from the first, gave, at the same depth, a jet of water, but the first jet diminished, and the quantity of water from both, was less than that which first issued from the former. The boring of the latter was then continued to the depth of one hundred forty five feet, when the sound began to sink of itself, and when precipitately withdrawn, the water rushed up, to the height of five feet, and astonished all by its abundance and force. No obstacle could restrain it. No direct attempt was made to determine the maximum height to which it might rise, but fifty feet was decreed to be fully within the limits of its ascending force.

At the time the letter was written, several weeks after the first issue of the water, it continued to flow with the same violence, and with rather increased quantity. From the dimensions and velocity of the current, it appeared to supply four hundred thirty gallons per minute, or two thousand eight hundred and eighty cubic metres per day. A leaden weight of eight pounds, supported by a string being placed in the tube was rapidly thrown out, by the water.

The water, which at first, had a peculiar taste, but not disagreeable, is now very limpid and insipid, and its temperature 66° of Fahrenheit. The total expense of the well, was two hundred and sixty three francs.—*Bull. D'Encouragement, Sept.* 1833.

24. *On oxalic acid; by Gay Lussac.* (J. G.)—It is well known to chemists, that oxalic acid when heated is in part volatilized, and that the remainder is decomposed, giving rise to a mixture of carbonic acid and an inflammable gas. Desirous of understanding more particularly the nature of the inflammable gas, I put some very pure crystals of this acid into a glass retort and heated it gradually. At 98° C. it was wholly melted, at 110° an elastic fluid was disengaged along with watery vapor, which increased as the temperature of the acid rose by the loss of its water of crystallization. From 120° to 130° C. the disengagement of gas was extremely rapid, and continued so until the entire destruction of the oxalic acid.

This easy decomposition of oxalic acid by a very moderate heat, is the more remarkable, as it was the less to be expected, and among vegetable acids, the oxalic was considered as one of the most stable. Its decomposition, when heated with concentrated sulphuric acid, into equal volumes of carbonic acid and oxide of carbon, was not contrary to that opinion, and was easily explained on the powerful affinity of sulphuric acid for water, by virtue of which it destroys and carbonizes a great number of organic substances.

An examination of the gases which I thus obtained, proved that they were, very nearly, a mixture of 6 parts of carbonic acid, and 5 of oxide of carbon. This proportion did not vary much during the operation, although, towards the last, the carbonic acid somewhat prevailed.

The decomposition of oxalic acid by a moderate heat rendered the agency of sulphuric acid doubtful. I ascertained, that decomposition commenced at about the same temperature, with or without the sulphuric acid, viz. 110° to 115° C. But an essential difference is, that with sulphuric acid, we obtain a mixture of equal volumes of carbonic acid and oxide of carbon, as Döbereiner observed, while by heat alone they are as 6 to 5. The difference suggests the thought that during the decomposition, effected without sulphuric acid, another substance may be formed to explain the loss in oxide of carbon. An experiment to ascertain this, shewed me that the water, abandoned by the oxalic acid, was acid, and that it contained formic acid. This appeared at first in small quantity, because it is disguised in much water, but it distills more and more concentrated, and towards the end of the operation, when the oxalic acid is dry, it has a very penetrating and sharp taste. Agreeably to the proportion found of 6 vols. carbonic acid to 5 vols. of oxide of carbon, supposing that the volume wanting of the latter gas has concurred with the water to the production of formic acid, we find that for 12 proportions of oxalic acid there will be formed one of formic acid. This theoretic result appears to me to be in accordance with the experiment; but I have not directly assured myself of its truth. It is incontestable that the hydrogen is supplied by the water to the formic acid and not by the oxalic acid, for the carbonic acid and oxide of carbon must be produced in equal volumes. It is besides a necessary consequence of the well known nature of oxalic acid as ascertained by the experiments of Dulong and Döbereiner. I ought to remark, that if the decomposition is not urged too hastily, all the oxalic acid is destroyed, no sensible portion being volatilized.

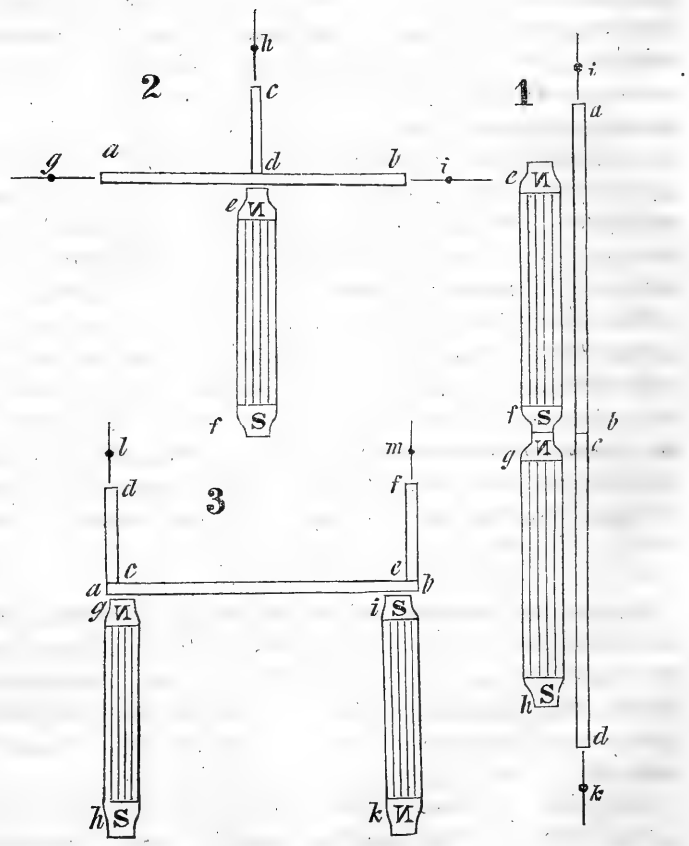
These observations appear to me to render it absolutely necessary, that we should no longer separate oxalic acid from the two other combinations of oxygen and carbon. It may be ranked among the acids whose radicals have two equivalents, and its proper name would then be the hypo-carbonic acid, analogous to the hypo-sulphuric, hypo-sulphurous acids, &c., but it will be better perhaps to defer this change in the nomenclature to some future time.—*Ann de Chim. et de Phys. Fev.* 1831.

25. *On some phenomena of Magnetization.*—(Extract of a letter from M. De Nairac to Prof. De La Rive.)—I placed in a line, end to end, two bars of soft iron *ab*, *cd*, each about two and a half feet long, one inch wide and one half inch thich. At the outward extremity of each bar I placed two small magnetic needles *i*, *k*, turning on a pivot.

Along side and near the bars I placed two compound magnets *e*, *f*, and *g*, *h*, each, including the armature, nineteen inches long and capable when united at their poles, of sustaining from thirty to forty pounds.

The magnetic fluid instantly pervaded the iron bars, producing such an adhesion at *b* and *c* that in drawing one bar, the other followed. Two small keys also would remain suspended at *a*, and *d*, alalthough the magnetism of the bars was stronger at the points of the bars corresponding with the points *e* and *h*, of the magnets.

The needles *i* and *k* proved that in this position the extremity *a* had the same magnetism, (north) as the corresponding end *e* of the magnet *e*, *f*, and *d* the same as *h*. In moving one of the needles along the two bars, united, I found the neutral point to be nearly at their junction *b c*.



But in withdrawing the two magnets in a parallel direction to the two bars, and on removing them entirely the needles *i* and *k* were rapidly reversed, when the magnets reach the distance of about a foot, and the two little keys fell off. Nevertheless the two bars were still magnetic, for not only did they preserve their adherence at *b* and *c* but I could again suspend the little keys at *a* and *d* the poles alone being changed.

In repeating this experiment a moment after, only changing the position of the magnets, that is, putting the pole S towards *a* and the pole N towards *d*, the same phenomena were repeated, but in a contrary order.

I had before discovered that two keys of middling size, subjected to the influence of a strong magnet, and which, after that remain suspended to each other, will preserve their adherence an indefinite length of time, when removed from the magnet, provided it be done with caution. It is evident then, that they remain impregnated while in contact, for at the moment of their separation, the force disappears.

I afterwards tried the arrangements fig. 2, placing against the middle of the soft iron bar another similar one *c d*, but only about six inches long, that the needle *h* might not be too immediately controlled by the magnet *e f*. The three needles in this position, shewed that the extremities *a*, *b* and *c*, had the same magnetism as the nearest pole of the magnet. In withdrawing it the needles *g* and *i* did not vary, but *h* at length, was reversed although less rapidly than in the former experiment.

But the reaction or reversion of the poles was manifested in the most evident manner by disposing the parts as represented in fig. 3, that is taking a single long bar, two short bars and two compound magnets. In withdrawing the magnets simultaneously, not only are the needles *l* and *m* reversed immediately, but the reaction must be so rapid as to keep up a continued magnetism in the bars, for the two little keys suspended at *a* and *b* still hold on, not having, I had almost said, time to fall off, although the needles clearly indicate that the poles of the bar *a b* were reversed. In using but one magnet, (*i k* for instance) the two needles *l* and *m* had their north end towards *d* and *f*, and when the magnet was removed, the needle *m* was reversed, the other remaining stationary.

Must not this reaction be analogous to the secondary piles of Ritter, which assume, when contact with the Voltaic pile is broken, poles opposite to the latter, or to the little needles which have their magnetism reversed, when a Leyden bottle is discharged through a wire situated near them?

Is it not the same cause that acts upon the needle of the galvanometer, when the magnet which has been placed in the helix attached to the two ends of the multiplying wire is removed, in the experiments of Faraday? Or the shock which a prepared frog feels, when the circuit is broken as well as when it was first established,—or, lastly, the magnetic spark, at the end of the spirals, not only at the forming, but at the closing of the connexion?

Allow me also to repeat a remark of Dr. Keil, that if we take a small magnetic bar, and holding it vertically, suspend a key from its lower end, nearly as large as it can support, and while in this state, if we apply to the upper end of the magnet ever so gently, a piece of soft iron, the key immediately falls; and yet keeping the soft iron still in contact with the magnet, the latter may represent the key which it had just allowed to fall and it then takes it up again and retains it even when the soft iron is removed, but lets it fall again on a second contact. I have observed that the same effect does not ensue when the magnet is held horizontally, which induces me to suspect the influence of terrestrial magnetism.—*Bib. Univ. Jan.* 1834.

26. *Necrology.—Dr. J. F. Coindet.*—This distinguished Physician lately died at the age of flfty nine, after a long and severe disease. His talents were manifest in the early part of his medical career. While at Edinburgh, where he prosecuted his studies, he was nominated president of the royal Society of Medicine. Established at Geneva in 1799, he soon become one of the most active practioners of the city, and continued so until his death, having filled with great zeal and success, the various posts of physician to the Hospital, prisons, &c. His numerous occupations did not divert him from study. He prepared for a considerable period, the medical articles for the Bibliotheque Universelle, in which he published a number of original memoirs. Among them was one on *Hydrencephalus* or *Cephalite interne hydrencéphalique.* This memoir was written in consequence of a premium offered by the Royal Medical Society of Bordeaux, in 1815, for the best essay that should "expose the signs, causes, and treatment of internal hydrocephalis, supported by observation, experiment, and post mortem examination." Its importance was sufficiently established by the fact of its being crowned by the Society, and the author elected a corresponding member. In 1820, Dr. C. published his *Memoir on the discovery of a new remedy for Goitre.* This essay contributed much to his repu-

tation. He ascertained that the efficacy of burnt sponge depended upon the Iodine which it contained, and that similar benefit wonld be obtained by using the iodine separately, as in morphine, quinine, &c. Two subsequent memoirs, on the subjcct, established this as the best remedy in goitre, scrophula, and some lymphatic diseases of the system. This brilliant discovery, which the experience of twelve years has sanctioned, was deemed by the Academy of Sciences of Paris to be worthy of their grand prize of three thousand francs, which was decreed to the author in 1832. In 1823, he published in the same journal, a *Note on the properties and use of sulphate of quinine in intermitting fevers.* Dr. Coindet was the founder, and long the president of the Medical Society of the Canton of Geneva. He was twice a representative of the Canton in the General Council. In the midst of his usefulness, he was obliged to leave Geneva, for the milder climate of Nice, where he was taken off by severe disease.

27. *Le Chevalier* John Aldini, formerly professor of Natural Philosophy at the University of Bologna, died at Milan, on the 17th January, 1834, at the age of seventy one. He is known by various useful scientific labors. A relative of the celebrated Galvani, he pursued the train which the new discoveries opened and published in London in 1803, the experiment which he had made upon the dead bodies of criminals. In 1823 he published an Essay on the best means of constructing light houses and lighting them by oil or gas. He was latterly much occupied with the means of preserving fire men and others from the effects of heat and flame, and in 1830, the prize founded by De Montyon, was decreed him by the Academy of Sciences at Paris. A particular account of his methods of preservation will be found in vol. xx, of this Journal. The last labor of this ingenious philosopher, was an apparatus for measuring the smallest fraction of a second, in experiments on the descent of heavy bodies, and in other cases.

28. *Gastric Liquor.*

The subsequent letter relates to a portion of gastric liquor, which, at my suggestion, Dr. Beaumont withdrew from the stomach of the man whose case was mentioned in this Journal, Vol. xxii, pa. 193, and forwarded to Prof. Berzelius, with the hope that it would prove sufficient to enable him to effect a satisfactory analysis of this mysterious fluid. I trust, that this eminent philosopher will consider the publication of this part of his letter to be proper, since it reveals, so forcibly, the intrinsic difficulties of the subject, and indicates, decidedly, that it will be impossible to give a satisfactory result, without daily access to the extraordinary source from which alone, as we suppose, the gastric fluid, can be derived in tolerable purity, and that the research must be prolonged and diversified, before satisfactory conclusions can be obtained. It seems now very difficult for any one except Dr. Beaumont to make this necessary examination.—B. S. Dec. 11, 1834.

Extract from a letter from Prof. Berzilius to Prof. Silliman, dated Stockholm, July 19, 1834. Translated by O. P. H.

My Dear Sir—I had the honor of receiving, some time since, the present which you had the goodness to make me, of three bottles (vials,) filled with gastric juice, drawn from a man—into whose stomach there was an aperture through the abdominal integuments. I am very grateful for the confidence you have had in me, in wishing to engage me in making an analysis of it, and I regret deeply that for the following reasons, I am not able to answer your expectations.

First, the gastric juice sent in April, did not arrive at Stockholm, till towards the close of the month of August. It had not become at all putrescent—but how was it possible to be assured that the animal matters dissolved in it, after a separation of almost five months from the living body, and after an exposure to the elevated temperatue of the months of July and August, were still identical with those of fresh gastric juice.

But this circumstance apart, I could not make this analysis with any hope of success.

I assure you that I commenced, but the difficulties immediately arrested me. On testing the gastric juice with litmus paper, I found it strongly acid. The acids are for the most part volatile.

To obtain them, recourse must be had to distillation—but the operation of boiling would change the animal substances in the residuum. The quantity of gastric juice being only 266.76 grammes, I felt that I ought to sacrifice none of it, and therefore in removing the volatile acids, I evaporated the whole in a vacuum at the temperature of the room.

I had a residum of 3.385 grammes, filled with crystals of chloride of sodium.

Now it was necessary to make a plan of the analysis—but how could I make a plan, the nature of the substances to be separated being unknown.

A single mistake in the plan would destroy the whole, as I had no more of the matter to recommence.

On recalling to myself how many times I have been obliged to recommence the analyses of blood, bile, and urine, &c. because I found it necessary, time and again, to alter the plan, it was evident that I could uot now attain the object with the gastric juice, of which, I possessed only $3\frac{1}{3}$ grammes of dry residuum. I have therefore put alcohol, sp. gr. 0.833, upon it and enclosed it in a vial well stopped, where it waits whatever may happen.

A great number of experiments, chemical and physiological, ought to precede the analysis. These experiments would demand almost daily to renew the supply of gastric juice—e. g. 'Tis said that the gastric juice dissolves the aliments swallowed; but what is this solution? Does it not consist in this, that certain parts are dissolved entirely, and that others insoluble, but in a very divided state, are diluted in the form of a thick bouillie? What are the substances dissolved, and what the part insoluble, but diluted? The fibrine of muscle is very soluble, even out of the stomach, in very dilute acids.

I inquire next, is it by the free acid of the gastric juice, that this solution is made in the stomach?

Would gastric juice, rendered perfectly neutral, lose the power of dissolving muscular fibre?

If not, it must contain another substance which is the true minstruum. This substance ought to be isolated and studied apart, before we could have any means of determining its quantity.

This we could not do without being able often to renew the experiment with fresh gastric juice. It would be necessary even to examine with the fresh gastric juice, the most of the aliments which the man used, each by itself, and by proceeding thus, we should obtain probably some sure and numerous data, that would give a glimpse of what should be sought in the analysis, for that which is unsought, is rarely found. You see then, my dear sir, how much previous knowledge I need, for entering upon this analysis with hope of success.

I request you to make the proper explanations and apology to Dr. Beaumont.

29. *Abstract of a theory of the elevation and depression of the earth's crust, by variations of temperature, as illustrated by the Temple of Serapis.*—From the Proceediugs of the Geological Society of London, Vol. II., letter from Charles Babbage, Esq. March 12.—O. P. H.

The author describes the present state of the Temple, and gives the measurement of three marble columns, which from the height of eleven feet, to that of nineteen feet, (8) are perforated on all sides by the *Modiola Lithophaga* of Lamarck, the shells of that animal remaining in the holes formed by them in the columns. A description is then given of the present state of twenty seven portions of columns, and other fragments of marble, and also of the several incrustations formed on the walls and columns of the temple.

The conclusions at which the author arrives, are:

1. That the temple was originally built at, or nearly at the level of the sea, for the convenience of sea-baths, as well as for the use of the hot spring, which still exists on the land side of the temple.

2. That at some subsequent period the ground on which the temple stood subsided slowly and gradually; the salt water entering through a channel which connected the temple with the sea, or by infiltration through the sand, mixed itself with the water of the hot spring containing Carbonate of Lime, and formed a lake of brackish water in the area of the temple, which, as the land subsided became deeper, and formed a dark incrustation.

The proofs are, that sea-water alone does not produce a similar incrustation; and that the water of the hot spring *alone* produces an incrustation of a different kind; also that Serpulæ are found adhering to this dark incrustation; and that there are lines of *water-level* at various heights, from 2·9 to 4·6 feet.

3. The area of the temple was now filled up to the height of about seven feet with ashes, tufa, or sand, which stopped up the channel by which sea-water had been admitted. The waters of the hot spring thus confined, converted the area of the temple into a lake from which an incrustation of Carbonate of Lime was deposited on the columns and walls.

The proofs are, that the lower boundary of this incrustation is irregular, whilst the upper is a line of water-level, and that there are many such lines at different heights; that salt water has not been found to produce a similar incrustation; that the water of the Piscina Mirabile which is distant from the sea, but in this immediate neighborhood, produces according to an examination by Mr. Faraday, a deposit almost precisely similar; that no remains of Serpulæ, or other marine animals, are found adhering to it.

4. The temple continuing to subside, its area was again partially filled with solid materials; at this period it appears to have been subjected to a *violent* incursion of the sea. The hot water lake was filled up, and a new bottom produced, entirely covering the former bottom, and concealing also the incrustation of carbonate of lime. The proofs are, that the remaining walls of the temple are highest on the inland side, and decrease in height towards the sea side, where they are lowest, that the lower boundary of the space perforated by the Lithophagi is, on different columns at different distances beneath the uppermost or water level line, &c. that several fragments of columns are perforated at the ends.

5. The land continuing to subside, the accumulations at the bottom of the temple were submerged, and Modiolæ attaching themselves to the columns and fragments of marble, pierced them in all directions. The subsidence continued until the pavement of the temple was at least nineteen feet below the level of the sea.

The proofs are derived from the condition of the columns and fragments.

6. The ground on which the temple stood, appears now to have been stationary for some time, but it then began to rise. A fresh deposition of tufa or sand, was lodged for the third time, within its area, leaving the upper part of three large columns visible above it. Whether this took place, before or subsequently to the rise of the temple to its present level, does not appear, but the pavement of the area is at present *level* with the waters of the Mediterranean.

The author then states several facts, which prove that considerable alterations in the relative level of the land and sea have taken place in the immediate vicinity. An ancient sea beach extends near Monte Nuovo, two feet above the present beach of the Mediterranean; the broken columns of the Temples of the Nymphs and of Neptune, remain at present standing *in the sea*—a line of perforations of Modiolæ and other indications of a water-level four feet above the present sea, is observable on the sixth pier of the bridge of Caligula; and again on the twelfth pier, at the height of ten feet, and a line of perforations by Modiolæ, is visible in a cliff opposite the island of Nisida, thirty two feet above the present level of the Mediterranean.

The author considers the preceding inferences as a legitimate induction from the observed and recorded facts; and proceeds to suggest an explanation of the gradual sinking and subsequent elevation of the ground on which the temple stands. From some experiments of Col. Totten, Am. Jour. Sci. and Arts, Vol. xxii, p. 136, he has calculated a table of the expansion in feet, and decimal parts of granite, marble, and sandstone, of various thicknesses from one to five hundred miles, and produced by variations of temperature of 1°, 20°, 50°, 100°, 500°, of Fahrenheit—and he finds from this table, that if the strata below the temple expand equally with sandstone, and a thickness of five miles were to receive an accession of heat equal only to 500°, the temple would be raised twenty five feet—a greater alteration of level than is required to account for the phenomena in question. An additional temperature of 50° would produce the same effect upon a thickness of ten miles, and an addition of 500° would produce it on a bed only a single mile in thickness.

Mr. Babbage then adverts to the various sources of volcanic heat in the immediate neighborhood; he conceives that the change of level may be accounted for by supposing the temple to have been built upon the surface of matter at a high temperature, which subsequently contracted by slowly cooling down, that when this contraction had reached a certain point, a fresh accession of heat from some neighboring volcano, by raising the temperature of the beds again produced a renewed expansion, and which restored the temple to its present level. The periods at which these events happened are then compared with various historical records.

The second part of this letter contains some views respecting the possible action of existing causes, in elevating continents and mountain-ranges—which occurred to the author in reflecting on the preceding explanation. He assumes, as the basis of this reasoning, the following established facts.

1. That as we descend below the surface of the earth at any point, the temperature increases.

2. That solid rocks expand by being heated; but that clay and some other substances contract under the same circumstances.

3. That different rocks and strata conduct heat differently.

4. That the earth radiates heat differently, or at different points of its surface, according as it is covered with forests, with mountains, with deserts, or with water.

5. The existing atmospheric agents and other causes, are constantly changing the condition of the surface of the globe.

Mr. Babbage then proceeds to remark, that whenever a sea or lake is filled up, by the continual wearing down of the adjacent lands, new beds of matter, conducting heat much less quickly than water carries it, are formed; and that the radiation also, from the surface of the new land, will be different from that from the water. Hence any source of heat, whether partial or central, which previously existed below the sea, must heat the strata underneath its bottom, because they are now protected by a bad conductor. The consequence must be that they will raise, by their expansion, the newly formed beds above their former level; and thus the bottom of an ocean may become a continent. The whole expansion however, resulting from the altered circumstances, may not take place until *long* after the filling up of the sea; in which case its conversion into dry land will result partly from the filling up by detritus, and partly from the rise of the bottom. As the heat now penetrates the newly formed strata, a different action may take place; the beds of clay or sand may become consolidated, and may contract instead of expanding. In this case, either large depressions will occur within the limits of the new continent, or, after another interval, the new land may again subside and form a shallow sea. This sea may be again filled up, by a repetition of the same process as before, and thus alternations of marine and fresh water deposits may occur, having interposed between them the productions of dry lands.

Mr. Babbage's theory may be thus briefly stated—

In consequence of the changes actually going on at the earth's surface, the *surfaces* of equal temperature within its crust, must be continually changing their form, and exposing thick beds near the exterior, to alterations of temperature—the expansion and contraction of these strata will probably form rents, raise mountain-chains, and elevate even continents.

The author admits that this is an hypothesis; but he throws it out, that it may be submitted to an examination, which may refute it if fallacious—or if it be correct, establish its truth—because he thinks that it is deduced directly from received principles, and that it promises an explanation of the vast cycles presented by the phenomena of geology.

30. *Mr. Murchison on the Geology of Wales.*—This eminent geologist has occupied himself during the last three years in surveying geologically this principality, and we may expect a work from him on its transition rocks—Mr. Murchison's letter to the editor, dated April 18, 1834.

31. *Mr. De La Beche's Manual.*—A third edition of this valuable work has been published, much enlarged and improved by the author.

32. *Researches on Theoretical Geology, by Mr. T. De La Beche.*—This work, containing an interesting series of reasonable deductions from Geological facts and phenomena and a condensed and luminons summary of them will be read with advantage, by those who have made some progress in the science. We learn from Mr. De La Beche, that he does not intend at present to publish a new edition of his section of the strata above the grauwacke.

33. *Opossum in the Stonesfield Slate, near Oxford, England.*—The Stonesfield Slate belongs to the lowermost beds of the oolite; of the Didelphian, (Opossum) being of that period, there cannot be a shadow of a doubt. Mr. Mantell in a letter to the Editor, June 18, 1834, Brighton, England.

It will be remembered that the remains of the opossum, found in the place above named, present the only known instance of a viviparous vertebrated fossil animal, found lower than the chalk.

This does not however, invalidate any principle of geology; it goes only to prove that viviparous animals appeared earlier than had been supposed.

34. *Mr. Lyell and his Geology.*—We learn by a letter from Mr. Mantell, that Mr. Lyell has gone to Sweden and Norway to examine into the proofs afforded of the gradual elevation of those countries which is supposed to be still going on.

A new and cheap edition of Mr. Lyell's Geology has recently been published in London. It consists of 4 Vols. 12mo. illustrated with 147 wood cuts, and 13 plates and maps, price 24*s*. Sterling. It is added in Loudon's Mag. for October, 1834, that since the publication of the former editions of them, the author has travelled over a large part of the continent of Europe, for the purpose of verifying facts and collecting new materials. In the present edition, he has embodied all his own observations, together with a vast quantity of new facts, brought to light since the first appearance of the work, which has been most materially improved by these corrections and additions. Several new illustrations have been added and the glossary at the end of the fourth volume, will considerably assist those readers who are unacquainted with the elements of geology.

35. *Manual of Mineralogy,* by Rob. Allan, F. R. S. E., F. G. S. L., &c., comprehending the most recent discoveries in the mineral kingdom, was published in Edinburgh, in Sept. last, with 174 figures, price 10*s.* 6*d.*

36. *Notice of the Work of* T. Hawkins, F. G. S.—Memoirs of Ichthyosauri and Plesiosauri, extinct monsters of the ancient earth; with twenty eight plates, copied from specimens in the author's collection of fossil organic remains. 1 vol. large folio, London, 1834. 2*l.* 10*s.*—*Ed.*

A favorable notice of this very extraordinary work, with some judicious criticisms, is contained in Loudon's Magazine of Natural History, for September, 1834,—London. It is supposed to be from the pen of Mr. Bakewell, and we had marked it for insertion in our present number, along with another from the pen of Mr. Mantell; but for want of room, we can insert only a part of the latter, which first appeared at Brighton, England.

"There was a period when reptiles of the most wonderful forms, and appalling magnitude were the principal inhabitants of the earth, ere man and the animals which are his cotemporaries were created. In very early records there are obscure notices of the discovery of these ancient animals, and in more modern times the allusions are more frequent, but not more satisfactory. Even as late as 1726 Scheucher, an eminent physician described, as he supposed a fossil man found in the quarries of Oeningen; he called him *homo diluvii testis;* but Cuvier determined that the bones were those of an enormous Salamander or Saurian. Still it is probable that similar mistakes might be committed in most places in the civilized world, so few persons are there, even among medical men, who are intimately acquainted with comparative anatomy. The splendid work of Mr. Hawkins is confined to fossils which are peculiarly British, namely, the Ichthyosauri or fish lizards, and the Plesiosauri or animals that are much like lizards. These remains were first noticed in the blue shale of the *Lias*, an argillaceous limestone at Lyme Regis in Dorsetshire, and they have been since found in Somersetshire, and other parts of England, and also in the United States."*

"The Ichthyosaurus had a large and long head, with jaws armed with teeth like the crocodile; enormous eyes; a short neck; a large and long body, furnished with four paddles composed of numerous bones; and a short tail. The *Plesiosaurus* is yet more remarkable; the head is very small, and armed with numerous pointed teeth; the neck of an enormous length, and composed of between thirty and forty vertebræ, being nearly double the number of that of any other animal; the Swan, which has the greatest number of cervical vertebræ, having but twenty three; the body, like that of the Ichthyosaurus, has four paddles; the tail is short. Such is a brief description of the wonderful reptiles whose remains are so beautifully figured, and accurately described by Mr. Hawkins from specimens in his own possession, and collected by himself. This collection, which surpasses any in the world, has been made at an expense of several thousand pounds, and with great labor, and ought to be placed in the British Museum."

We have thought it proper that a British Philosopher should be permitted to speak on a work and research peculiarly British.

We have to add, that having been put in possession of this splendid work by the kindness of Mr. Mantell, we are so much gratified by the ample store of facts, and by the delineations and descriptions of forms which it contains, that we are little disposed to criticise the high wrought and unusual diction of the narrative and descriptive parts. Mr. Hawkins may well adopt the good old English proverb,—let him laugh that wins, and we are certainly much inclined if not to laugh, certainly to rejoice with him in his brilliant success. All the bones and skeletons delineated in Mr. Hawkins' work are in his museum. They cover a space of two hundred feet by twenty, and their weight is not less than twenty tons.† One of his Saurians was obtained in six hundred pieces, which were arranged in order, and laid firm in a mass of plaster of Paris, weighing three tons.

---

* See the citations in this Number, from Dr. Harlan's account of our fossil bones.

† We quote these numbers from recollection, not being able, at this moment, to find the passage in the works of Mr. Hawkins.

"The plates of this work are twenty nine in number, and with but one or two exceptions are admirably executed; they are alike beautiful in their general effect, and accurate in anatomical details."

37. *Mr. Witham's trasparent sections of fossil wood.—Ed.*—We mentioned these sections at pa. 108, Vol. xxv, of this Journal, and the very beautiful work of Mr. Witham, which describes them as well as the fossil trees from which they are derived.

We have received from the author, copies of a second edition of his work, much enlarged and improved with additional colored drawings. It is an elegant tribute to the arts as well as to science, and especially to a branch of very difficult investigation.

We have received also from Mr. Witham, a new series of sections of fossil wood, in thin slices, adhering to plates of glass ground down so thin that the structure of the wood is perfectly obvious. This is a great step towards a knowledge of the early vegetation of our planet, and it appears certain that no one ever saw the internal structure of an opake fossil until it was revealed by the sagacity of Mr. Witham, aided by the practical skill of Mr. Magillivray and Mr. Nicoll, who appears to have pursued the same path which was first cleared, with much labor and expense, by Mr. Witham, (See Jameson's Journal, No. 32, page 310.) Mr. Witham's sections are extremely beautiful; in the collection which we have recently received, the Anabathera and the Lepidodendron, are new, some of them are sliced in three different ways—transversely—longitudinarily and obliquely, so as to shew the varieties of structure.

The position of the fossil trees which have been examined by Mr. Witham is not less extraordinary than their structure.

We understand that it is admitted by all who have examined the geological facts, that the position of the Craigleith trees is either in the bottom of the coal fields, or in the mountain limestone group, and that the other are in the grindstone post—a variety of coal sandstone.

It appears that similar trees occur from the earliest periods of vegetation up to the highest part of the coal field, at least as the arrangement exists in this part of Britain. It is obvious, that forests composed of large trees, with firm woody fibre, existed antecedently to and contemporaneously with the deposition of the coal. In many countries, mountains have been piled over the coal strata and over the fossil trees, and in various parts of the world, the great series of sandstone with their beds of salt and gypsum—the immense oolite formation—the chalk and the tertiary, with immeasurable masses of diluvium and alluvium have all succeded, in ages subsequent to the coal.

We beg leave again to recommend the researches of Mr. Witham, to the kind and seasonable aid of American Geologists. He is very desirous of receiving portions of fossil stems from our coal fields, and from the anthracite, and the transition limestone group; that a fair comparison may be made between the fossil plants and trees of this continent and those of Europe.

We have already distributed a few copies of Mr. Witham's work among geologists, whose position and pursuits may probably enable them to promote this very interesting research; and to persons who can act effectually upon this subject, we might have it in our power still to communicate a copy or two more.

It is indispensable that the exact geological and geographical situation of the fossil wood should be made known, or the pieces will not answer the purpose of a comparative investigation, which, as things are now situated, must be made in Edinburgh, as no such experiments are, so far as we are informed, made any where else.—*Ed.*

January 1, 1835.

Zodiacal Light.—We have received from Professor Olmsted the following notice of this phenomena, with the promise of a more extended article on the subject, for a future number of this Journal.—*Ed.*

My attention was first attracted to the appearance of the Zodiacal Light in the morning sky, on the 11th of October. At that time it presented a pyramidal form, resting its broad base on the horizon, and terminating in a faint indefinite extremity near the Nebula of Cancer.

On the 5th of November, I inserted in one of our daily papers, a brief notice of this light, with the hope of directing the attention of astronomers towards it. In the same article were suggested the queries, 'whether this light has any connexion with falling stars, and whether it would sustain any remarkable change on or about the 13th of November?' The "change" contemplated was, that it would about that time pass by the sun, apparently, and become visible in the evening sky after twilight. It continued to be observed in the morning, (but not in the evening) until after the 13th of November. As soon after that time as the absence of the moon permitted observation, namely, on the 19th, the extreme parts of the same luminous pyramid were recognized in the west immediately after twilight; but, owing to the low angle made by the ecliptic with the western horizon at this time, the light was carried so near the horizon in the southwest, as to have its distinctness much impaired. It could, however, be traced a little above the two bright stars in the head of Capricornus. From that time to the present, (Dec. 27th,) it has been seen on every favorable evening, advancing in the order of the signs faster than the sun. On the evening of the 21st December, in a peculiarly favorable state of the atmosphere, it was faintly discernable, from six to seven o'clock, reaching nearly to the equinoctial Colure, and of course almost ninety degrees from the sun, measured on the Ecliptic.

This light has also continued to be visible in the morning sky, although evidently withdrawing itself to the other side of the sun. The presence of the moon at this time prevents observations in the morning; but we hardly expect to see it any more in the east for a few days to come, although possibly after transiently disappearing, it may re-appear in the morning sky.

On the morning of the 13th of November, there was a slight repetition of the *Meteoric Shower,* which presented so remarkable a spectacle on the corresponding morning of 1833. Supposing it probable that such appearances might be seen, I had concerted measures with several of my friends to watch for them. The following extract from the account of our observations, published the next day in the New Haven Daily Herald, will comprise the principal particulars worthy of notice.

"The presence of the moon in an advanced stage, until nearly 4 o'clock in the morning, permitted only the larger and more splendid meteors to be seen: it is fairly to be presumed that many of the smaller and fainter varieties, such indeed as constituted last year much the greater part, were invisible from this cause merely.

The writer was assisted in his observations by Mr. Tutor Loomis, and by one of his pupils, Mr. A. B. Haile, of the Senior Class.—On carefully comparing notes, the following appear to be the principal points worthy of notice.

1. The *number* of meteors, though small, compared with last year, was evidently much above the common average. They began to be frequent as early as four minutes past one o'clock, *mean time*, when a fire ball of unusual size and splendor blazed forth in the east as a signal. From this period they were seen to fall at a pretty uniform rate, until the light of day was far advanced. From a quarter past two, until a quarter past five o'clock, we counted, in the eastern view, embracing one third of the visible heavens, one hundred and fifty five. Some meanwhile fell in the south west, and a few in the north west, but the number seen in the eastern hemisphere greatly exceeded that in the western. Were we to estimate the whole number which fell during the night, at one thousand, we should probably not exceed the truth. After intervals of several minutes, three or four meteors would frequently make their appearance in rapid succession. In the eastern view, those south of the ecliptic, and those north, were nearly equal in number, being for a considerable period as twenty seven to twenty.

2. The *directions* of the meteors were more remarkable than their number, and afforded more unequivocal evidence of the identity of the phenomenon with that of last year. They appeared, as before, *to radiate from a common center*, and that center was again in the Constellation *Leo*. In whatever part of the heavens they fell, their lines of direction continued would pass through that point.—The attention of Mr. Loomis was particularly directed towards determining the position of the apparent radiant, having taken the bearings of a sufficient number of the lines of direction, and afterwards traced them on the globe. They meet near the Lion's eye, *Declination* 30° 15′, *Right Ascension* 144° 30′. The radiant point is therefore a little northward and westward of the place it occupied last year, which was near Gamma Leonis, Decl. 20°, R. A. 150°. This point was not observed to vary in position for at least three hours, thus corresponding to the conclusions which were made out respecting the radiant last year, a circumstance from which it was inferred that the source of the meteors was beyond the influence of the earth's rotation, and consequently beyond the atmosphere.

The meteors generally *fell* in the arcs of great circles extending from the radiant point, but four were observed to *ascend* from it.—One, at a quarter before four o'clock shot from near Procyon *towards* the radiant; and three were observed, at different times, moving with extreme slowness, horizontally from west to east, south of Orion, and Canis Major.

3. The *Zodiacal Light*, which we have observed to precede the morning twilight on every favorable morning since the 11th of October, began to be visible as early as four o'clock, and was seen to extend from the horizon upward, terminating near the place from which the meteors emanated."

It will appear from the foregoing statements that the phenomenon, if identical with that of November 13th, 1833, had nothing of the magnificence of that. Those, however, who have watched our sky for a long period, both before and after the 13th, concur in the testimony, that the exhibition of meteors on that morning, in regard to number, brightness and direction, was altogether peculiar, and more remarkable than any similar occurrence before or since. We have not heard, however, that any remarkable fall of meteors was observed on that night any where *south* of this place although the appearances, as observed by Mr. Twining, were extraordinary at West Point, (which is in nearly the same latitude,) and at places *north* of us, as at Andover in Massachusetts. By the following letter, received since that time, from Mr. A. K. Wright, a member of the Theological Seminary at Andover, we learn, not only that the phenomenon in question was seen at Andover, but that a remarkable shower of meteors was witnessed in Ohio on the 13th of November, 1831; which carries us back one year farther than any previous accounts. The statement of Mr. Wright is as follows:

"In a letter dated January 25th, 1834, which I received from my father, who is a physician in the state of Ohio, after some remarks respecting the meteoric exhibition in 1833, as observed in this country, and that in 1832, as observed in Arabia, I find a statement for substance as follows: 'In 1831, on the 13th of November, between three and four o'clock, A. M., I noticed an unusual shower of Meteors, while on my way to a neighbor's where I had been called on professional business.' Knowing the care with which my father's professional journal is kept, I am satisfied there is no room for mistake in respect to date.

"It may be interesting to you to know that the meteoric exhibition was noticed here, this year, as well as in other parts of the country."

P. S.—*Jan.* 1. The Zodiacal Light is still faintly visible in the east. In the west, it reaches nearly to the meridian, but is feebler than at this time last year. Indeed, all its exhibitions have been less striking than they were in 1833–4. D. O.

Yale College, January, 1835.

The Maidstone Iguanodon.—By a letter from Mr. Mantell, dated October 4, 1834, we learn that the fine specimen containing the fossil bones mentioned in his communication, p. 355 has been generously presented to him, by some of his friends, who purchased it in its mutilated state for 25£. It has been chiselled out, and the pieces joined; many new bones have been developed, and it now forms one of the finest specimens in Europe. A particular report of it may be expected, but in the mean time it is ascertained, that the hind feet of the Iguanodon "were very large, flat, and enormously strong, as might indeed, a priori, be supposed. The large metatarsal bones which Cuvier says, so much resemble those of the Hippopotamus belong to the hind feet only; the metatarsal are long and slender, as in the recent Iguana." Mr. Mantell has been able to replace the fragments of the femur, previously broken into one hundred pieces, and to repair and make it quite perfect: this femur is three feet, eight inches long, although shortened somewhat by compression.

A model has been made of the lower extremity of the femur of this Colossus of the reptile world.

On the Chrysomela vitivora.

Prof. Silliman.—*Dear Sir*—By a letter from Dr. T. W. Harris, of Cambridge, Mass., I learn that the insect which Mr. David Thomas described and figured as new in the 26th vol. of your Amer. Journal of Science, and to which he gave the name of *Chrysomela vitivora*, is identical with the *Haltica chalybea* of Illiger. Under this latter name it stands in Dr. H.'s *Catalogue of the Insects of Massachusetts*, appended to Prof. Hitchcock's recent report.

Respectfully yours, E. C. Herrick.

New Haven, Dec. 23, 1834.

P. S. Since the notice on page 384 was printed, we have received the Village Herald from Prince Anne, Somerset County, Md., under date of Dec. 9th, stating that similar observations have been made there by R. H. Winder, on a plant supposed to be that named by Mrs. Gerrish. We have no room to give an abstract of the article.

December 23, 1834.

INDEX TO VOLUME XXVII.

S.

T.

U.

V.

W.

Y.

Z.

ACKNOWLEDGMENTS TO FRIENDS, CORRESPONDENTS AND STRANGERS.

Remarks.—This method of acknowledgment has been adopted, because it is not always practicable to write letters, even in cases where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from me, that I may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still my endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, as now, in part, retrospective.—*Ed.*

DOMESTIC.

United States Military and Naval Magazine, July and Aug. 1834. Exch.

Knickerbocker, New York, Sept. 1834. Exch.

Western Monthly Magazine, Cincinnati, for Sept. and Oct. 1834. Exch.

Med. Mag. Boston, Sept. and Oct. 1. Exch.

Journal of the Geological Society of Philadelphia. 8vo from p. 39 to 112. From Dr. Harlan.

African Repository, Vol. X, No. 7. Sept. 1834, Washington.

Rev. Mr. Vanarsdalen's Discourse on international peace. June, 1834, Hartford. pp. 40.

Cat. of Princeton College, 1834. From Prof. Henry.

Rev. Dr. W. B. Sprague's Oration on La Fayette. July, 1834, Albany. pp. 34.

Transactions of the Albany Institute, Vol. II, No. 1. 1834. pp. 96.

Cat. of Union College. From Prof. Joslin.

Journal of the Franklin Institute, Aug. and Sept. 1834, Philadelphia. Exch.

New Alphabet. From St. Louis.

Flora Columbiana. From J. A. Brereton, U. S. Army.

A paper on Irradiation, by B. E. Joslin, M. D. 1833. From the author.

Prof. A. D. Bache on the diurnal variation of the horizontal needle. Read to the Phil. Soc., Nov. 16, 1832. From the author.

Eulogy on La Fayette, delivered at Faneuil Hall, by Hon. Edw. Everett. From the author.

Palfrey's Sermons on duties of private life. 8vo. pp. 368. Boston, 1834. From Abbot Lawrence, Esq.

Proceedings of the Overseers of Harvard University. Aug. 25, 1834. From the President.

Lecture on the teaching of arithmetic, delivered Aug. 1830, Boston, by the late Warren Colburn of Lowell, Mass. From Mrs. Colburn.

Dr. J. R. Coxe on Dr. Harvey's claims to the discovery of the circulation of the blood—vindication of Hippocrates against charges of ignorance. Philadelphia, 1834. 8vo. pp. 258. To Yale College Library. From the author.

Travels in the Equatorial Regions of South America, in 1832, by Adrian R. Terry, M. D. From the author.

Synopsis of the Organic Remains of the Cretaceous Group of the United States, with 19 plates, by Dr. Samuel George Morton. From the author.

Thoughts on the impolicy of multiplying Schools of Medicine, by Charles Caldwell, M. D. From the author.

On the mode of collecting and preserving objects of Natural History, with a view to the formation of a cabinet, &c., by Dr. Rob. Peter. From Dr. Caldwell.

Sermons from the fowls of the air and the lilies of the field, by Samuel Nott, Jr. Boston, 1804. From Dr. Hale of Boston.

Life and Writings of the Rev. George Herbert, with the Synagogue in imitation of Herbert, Lowell, Mass., 1834. From the publisher, George Woodward.

Documents No. 2 accompanying the President's Message, at the opening of the Second Session of the 23d Congress, Dec. 1834, being the Report of the Sec. of War. 358 pages. Two copies, one from Hon. E. Jackson and one from Hon. Jos. Trumbull.

Ancient Mineralogy, or an Inquiry respecting Mineral Substances, mentioned by the Ancients, with occasional remarks on the uses to which they were applied, by Prof. N. E. Moore of Columbia College, New York, LL. D. G. & C. Carvill & Co. From the author.

Ninth Annual Report of the Board of Managers of the Prison discipline Society. Boston, 1834.

Discourse on the History, Character and Prospects of the West, delivered to the Union Literary Society of Miami Univ. Oxford, Ohio, Sept. 1834, by Dr. Daniel Drake. From the author.

A Manual of Chemistry, by Lewis C. Beck, M. D. Second edition revised and enlarged. E. W. & C. Skinner, Albany, 1834. From the author.

A Manual of the Ornithology of the United States and of Canada, by Thomas Nuttall, A. M., F. L. S., &c.—Water Birds. Boston, 1834. Willard, Gray & Co. From the publishers.

The Republic of Letters a weekly republication of Standard Literature, Vol. I.

President Colton's Inaugural Address, and the first Catalogue of Bristol College. 1834. From the author.

American Advocate of Peace, Vol. I, Nos. 2 and 3, conducted by Rev. C. S. Henry.

Religious Magazine, conducted by G. D. & J. Abbot, Boston, Vol. II, No. 2.

Tract No. 1, of the Connecticut Peace Society—War unchristian, &c. 1834.

Western Monthly Magazine, No. XXIV. Dec. 1834.

History of the Fight at Concord, by Rev. Ezra Ripley, D. D., and others, 2 ed. 1832. From Dr. Ripley.

Oration July 4, 1834, by A. N. Skinner. 1834. From the author.

The Boston Pearl and Literary Gazette, Vol. IV, No. 14. 1834.

Oration commemorative of Gen. La Fayette, by Jas. A. Hillhouse, Esq. From the author.

Rev. Mr. Upham's Account of the Salem witchcraft, in 1692. From the author.

Chinese Repository, 1833 and 1834.

System of Education for the Girard College for Orphans, by a native Philadelphian.

Cyclopedia of Practical Medicine and Surgery, Part III.

North American Archives of Medical and Surgical Science, by Dr. E. Geddings, Prof. of Anatomy, &c. Univ. Maryland.

Journal of the Philadelphia College of Pharmacy, by Dr. R. E. Griffith and others, Vol. VI. No. 3.

Med. Mag. by J. B. Flint, E. Bartlett, and A. A. Gould, No. VII. Vol. III. Nov. 1, 1834.

United States Medical and Surgical Journal, No. II. Sept. Oct. and Nov. 1834.

Report of Experiments on the Navigation of the Chesapeake and Delaware Canal by Steam, by Prof. A. D. Bache, 1834.

New England Magazine, No. 43, Jan. 1, 1835.

FOREIGN.

Prof. Whewell On the Empirical Laws of the Tides in the Port of London, with some reflexions on the Theory. 1834. From the London Phil. Trans. From the author.

Prof. Whewell's Essay towards a first approximation to a map of cotidal lines. 1834. From the London Philos. Trans. From the author.

Col. Mark Beaufoy's Nautical and Hydraulic Experiments, with numerous scientific miscellanies, with plates, royal quarto 700 pages, Vol. I, the entire work to be in three volumes. From the private press of Henry Beaufoy, F. R. S. South Lambeth, who nobly presents the entire work to public Institutions and to individuals at home and abroad.

Col. C. W. Pasley C. B on Measures, Weights and Money, 8vo. 136 pages. London, 1834. From the author.

Memoirs on Ichthyosauri and Plesiosauri, with 28 plates, copied from specimens in the author's collection, by Thomas Hawkins, Esq. F. G. S. &c. &c. &c.—22 inches by 16. This is a splendid work, in large folio. From Gideon Mantell, Esq.

Report of the second and third meetings of the British Association for the advancement of Science, held at Cambridge, 1833. Two Vols. 8vo. London, 1834. These volumes are from an unknown source.

Memoirs of the American Academy of Arts and Sciences, 4to. pp. 595. Boston, 1833. From the Society.

Travels in the U. S., N. America and Canada, by J. Finch, Esq. London, 1833. 8vo. pp. 331.

On the Natural Boundaries of Empires, in connexion with the Geological Structure of the Earth, by the same. 8vo. pp. 120. London, 1833. These two from the author to the Library of Yale College.

Wetherhead's New Synopsis of Nosology. 12mo. pp. 90. London, 1834.

Report on the recent progress and present state of Chemical Science, by Prof. James W. Johnson of Durham, Eng. 8vo. pp. 116. From the author.

Bulletin de la Société Geologique de France, Tome iv, feuilles 6—14. 8vo. pp. 144. Exch.

Phil. Mag., London, July 1834. Exch.

Loudon's Mag. of Nat. Hist. &c., London. Nos. for September and October. Exch.

Annales des Mines, &c. Paris, Mars, Avril, 1834. Exch.

Bibliotheque Universelle, Geneva, Mars, Avril, Juillet, Août, 1834.

London Journal of Arts and Sciences, No. 27 and 28. July and Aug, 1834. Exch.

The Mechanic. Boston, 1834, Vol. III, Nos. 1, 2, 3, 4, 5, 6 and 7, two copies of each. Exch.

Proceedings of the Royal Society of Edinburgh. 1832, 3 and 4. From the Society.

The Journal of a Naturalist, 3d Ed., London, 1834 pp. 432. From G. Mantell, Esq., Brighton, Eng. to B. S. Jr.

Bulletin de la Société d'Encouragement, &c. Paris, Fevrier, Mars, Avril, Juillet, Aout, Septembre, 1834. Exch.

Catalogue of the Museum of Gideon Mantell, Esq., as newly arranged at Brighton, Eng. 1834. From the author.

Journal des Travaux de la Société Francais de Statistique Universelle, Paris. Vol. IV, No. 40, April, 1834. From the Society.

De La Beche's Geological Manual, 3d Ed., 122 wood cuts. London, 1833. From the author, London.

Researches on Theoretical Geology, by H. T. De La Beche, F. R. S., &c. &c. London, 1834. From the author, London.

Report of the Proceedings of the Canada Education Society, &c. 7th year. Montreal, 1834.

Mr. O. RICH, Bookseller, London, Agent to the Library of Congress and to the principal Literary Institutions in the United States, has recently published a Catalogue of Books for sale by him, comprising an extensive collection of Old and New Books in English, Spanish, Italian, French, and other Languages, which are offered for sale at very low prices, and are well worthy the attention of those who wish to replenish their Libraries on advantageous terms. Copies of the Catalogue may be had on application to Hezekiah Howe & Co., Booksellers, New Haven.

We can, with pleasure recommend Mr. Rich, as a very intelligent, attentive, and punctual agent and correspondent, both for individuals and institutions; this is, at least, our own experience, and we have no reason to suppose our case to be peculiar.

The splendid present from the British government, and that of Col. Beaufoy, to several of our Colleges, societies, and to individuals, (the latter, when regarded as a private benefaction to science, being in no degree inferior in munificence, to the former,) passed through the hands of Mr. Rich.

P. S. Jan. 6, 1835.—Of the late very cold weather, we copy the following notice from the Daily Herald, of this city, of Jan. 5, 1835, and having no other room, we insert it in this unusual place.

Cold Weather.—Yesterday and to day, the 4th and 5th of January, 1835, will be memorable days in meteorological history. The degree of cold in this city is unprecedented—greater than ever before noted by scientific observers. The air has been quite calm, with a bright sun, which, however, has no effect upon the frost. There is a heavy body of snow upon the ground, for which the farmers, (and all who eat bread) may be thankful, as a protection to the germed grain.

In preference to any observations of our own, of the state of the thermometer, we give those of our correspondents, including several different portions of the city, from the harbor to the northern extremity, including the high ground of Hillhouse Avenue. Professor Silliman's thermometer, at 8 o'clock this morning, was 23° below 0. A gentleman who has been in the habit of making notations of the weather for forty four years, informs us that he never knew the mercury before more than 16° below cypher. The famed cold winter of '79–80, according to the notes of President Stiles, in the month of January, was only at −19°.

Messrs. Editors—As this is probably the coldest weather that has been known here for a great number of years, I send you the state of my thermometer at different times since Saturday evening. The thermometer is supposed to be correct, but as it has been exposed to the north west wind in a high and exposed situation in the north west part of the town, its range is probably two or three degrees lower than that of thermometers in the more protected parts of the town.

Saturday, 11 o'clock		P. M.	5°	below zero.
Sunday, sunrise,			13	"
"	10 o'clock,	A. M.	7	"
"	12	M.	4	"
"	2	P. M.	2	"
"	4	P. M.	1	"
"	5	P. M.	4	"
"	7	P. M.	13	"
"	8	P. M.	15	"
"	9 to 11	P. M.	17	"
Monday, sunrise,			23	"
"	10	A. M.	12	"

I have kept a thermometer six years, and have never known it so low as this morning by 13 degrees. Nor do I recollect a day when it was so low as zero for the whole day, as was the case yesterday, (and probably will be to-day,) though the sun shone remarkably clear and bright the whole day.

Observations in Water St., fronting the harbor.

Sunday, Jan. 4—	at sunrise,	10	below 0
	10 A. M.	4	do.
	12 to 1,	2	above.
	5 P. M.	7	below.
	9 do.	16	do.
	11 do.	20	do.
Monday, Jan. 5—	at sunrise,	22	do.
	9 A. M.	15	do.

We understand that, at Hartford, the thermometer was at −27°, and that Mr. C. U. Shepard, saw the mercury at his house, near New Haven, stand at −26.5°.

The American Journal of Science and Arts.

THE annexed prospectus is presented to the friends of science, and their aid is respectfully solicited, in promoting its interests, so far as they are connected with this Journal.

Since the 12th volume, its patronage, has been more than sufficient to pay the expenses, but to insure to it, both stability and increasing usefulness, requires renewed efforts on the part of its editor; which will, however, be of little avail, without the cooperation of its friends.

Even England had no Journal of Science till about the beginning of the present century; it is, therefore, encouraging that the first attempts in this country, made only a few years later, have been, thus far, sustained by the American public.

Still, every periodical work must, occasionally, recruit its number of subscribers, or it will fall into jeopardy. The American Journal is not yet in immediate danger, but, *its subscription is far too limited to enable it to do all the good of which such a work is capable; and after a considerable decline, since* 1829, *it would be happy if it could be again increased as it was in that year. The simple expedient then adopted, was, for each subscriber to obtain one more, and in this manner the subscription was soon doubled.*

In this country, such a work, involving peculiar difficulties, can neither be got up, nor sustained, without great effort and perseverance. Avoiding all local, personal, political and sectarian interests and excitements, it thus entirely foregoes the support afforded by popular feeling, and therefore relies, *as it has a full right to do,* solely, upon the intelligent, the interested, the patriotic, and the philanthropic.

For the support of such a work, *it is worse than useless, to resort to indiscriminate solicitations.* The transient subscriptions, obtained in that manner, will produce only a delusive expectation of support, and a certain increase of expense.

Such persons, therefore, and such only, should be addressed, as, from their considerate and correct estimation of the value of useful knowledge, or from their interests and taste, will probably become permanent patrons.

PROSPECTUS.

In 1810, 11 and 12, the late Dr. Bruce, of New York, published his Journal of Mineralogy and Geology in one volume of four numbers.

The American Journal, was, however, the first, that in this country, embraced in its plan, *the entire circle* of the Physical Sciences, and their applications to the arts. It was begun in July, 1818, and has completed its twenty seventh volume.

While it has prompted original American efforts, it has been sustained by them, and being devoted to important national interests, in a great measure common also to all mankind, it is, in that character, known and accredited, both at home and abroad. It has elicited many valuable researches and discoveries, and its miscellaneous department, in particular, has presented a great variety of topics, of general interest. The Foreign Journals, (many of them sent in exchange,) often quote from its pages, which are in turn, enriched by theirs; and it has thus, become identified with the science and arts of the present day.

Terms.—For four quarterly Nos., of not less than 200 pages each, fully illustrated by plates, making, together, two annual volumes, of at least 800 pages; six dollars—*in advance.*

The quarterly *literary* journals, escape the heavy expense incurred by this, for plates and for difficult technical composition; and as they enjoy, from obvious causes, a far more extended circulation, they can be much better afforded at $5 per ann. than this at $6. *With its present patronage, this Journal could not be sustained at five dollars, as the actual receipts would not pay for the paper and the mechanical labor.*

Postage is to be paid on all orders and remittances. Postmasters are, occasionally, patrons of the Journal, when of course their communications are franked.

A number is sent gratis, as a sample, when requested. Names may be lodged with any of the agents, or sent to the Editor or publishers, and the work may be obtained through all booksellers, or from the editor.

A compensation of one third will be allowed to all persons obtaining subscribers, who pay the first year's subscription in advance; and agents and booksellers can, if they choose, retain upon their own books, the names which they may procure; due notice being given to the Editor.

Complete sets are furnished to individuals, and to the trade, at a suitable discount.

The Editor will draw on his agents semi-annually, (that is, on the publication of No. 2, of each volume,) in all cases where payment is not otherwise provided for; the drafts will be usually payable April 1, and Oct. 1. An annual payment in advance is, in all cases, expected from the individual subscribers, and the bills are accordingly forwarded with the Journal.

For single subscribers, the mail is, decidedly, the best mode of conveyance: the postage is about that of a twice weekly newspaper, that is, from $1.10 to $1.32 per annum.

Remarks.—This method of acknowledgment has been adopted, because it is not always practicable to write letters, even in cases where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented.

In many cases, such notices, critical or commendatory, would be appropriate; but it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from me, that I may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still my endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, as now, in part, retrospective.—*Ed.*

DOMESTIC.

American Almanac and Repository of Useful Knowledge, for 1834; from J. E. Worcester.

Travels in the North of Germany, by Henry E. Dwight; from the author. 1829.

Faraday's Chemical Manipulations—edition of Prof. J. K. Mitchell; from the editor.

Hayden's Geological Essays; from the author. 1820.

Eaton's Geological Essay on the District adjoining the Erie Canal; several copies, from Hon. S. Van Rensselaer. 1824.

Thoughts on the Policy of establishing a School of Medicine in Louisville; Is. C. Cross, M. D. 1834.

Prof. A. D. Bache on the Navigation of the Chesapeake and Delaware Canal by Steam. 1824.

American Coast Pilot, &c., by Edmund C. Blunt; from the author.

Chart of Long Island Sound, by Edmund C. Blunt. 1830. From E. & G. W. Blunt.

Oration before the Medical Society of Tennessee, by John H. Kain, A. M. 1831.

Inaugural Address delivered at the opening of Morrison College, Lexington, Ky., Nov. 4, 1833, by Rev. President Peers.

Outlines of Geology, by J. L. Comstock, M. D. 12mo. 1834. Hartford. From the author.

Report of the Committee on the Post Office to the Senate, June 9, 1834; from Hon. Nathan Smith.

Report of the Committee on Indian Affairs to the House of Representatives, May 20, 1834, with a map; from Henry L. Ellsworth, Esq.

Contributions to Geology, by Isaac Lea. Philadelphia, 1833. From the author.

Journal of a Residence in Scotland, and of a Tour through England, France, &c. by the late I. McLellan, Jr. Boston, 1834. From his parents.

Argument of Thomas S. Grimké—the State *ex relatione* McCredy *v.* Hunt, April, 1834; from the author.

Essays on the Materia Medica, 1831, by G. W. Carpenter; from the author. Also, the improved edition of 1834.

Mr. Isaac Lea's Description of six new species of Unio. Nov. 1827. From the author; from the Am. Phil. Trans.

Prof. Eaton's Geological Text Book. 1830. From the author.

Hadad, a dramatic poem, by James A. Hillhouse; from the author. 1825.

The Poetical Works of Rogers, Campbell, J. Montgomery, Lamb, and Kirke White, with vignette portraits. Philadelphia, 1832; from the publisher, J. Grigg.

Sketch of the Geology and Mineralogy of New London and Windham Counties, in Connecticut, by W. W. Mather; with a colored map. 1834. Two copies—one to Prof. Silliman, and another to the American Geological Society; from the author.

Essay on the Interest of Money, by Prof. Th. R. Deer, of the College of William and Mary. 1834. From the author.

The Farmer's Register for 1834. Prince George County, Va.

Descriptions of the Inferior Maxillary Bones of Mastodons in the Cabinet of the American Philosophical Society, with remarks on the genus Tetracaulan, &c., by Isaac Hays, M. D. 1833. From the author.

Document on Steam Boat Explosions; from Hon. Edward Everett, Wm. L. Storrs, and M. Dickerson—from each a copy.

Document on Weights and Measures; from Hon. M. Dickerson and G. Tomlinson—each a copy.

Baccalaureate Address of President Alva Woods, D. D., August 12, 1833; from the author.

Report on the Geology, &c. of Massachusetts, with an atlas of maps and plates, published by order of the government, by Professor Edward Hitchcock; from the author, one copy—from the governor, on behalf of the State, six copies, for distribution in foreign countries.

Dyspepsy Forestalled and Resisted, by Prof. E. Hitchcock; from the author.

Address before the Euphradian Society of the College of Charleston, by the Rev. President J. Adams. 1833.

Remarks on the Mineralogy and Geology of the Peninsula of Nova Scotia, with a colored map, by Charles T. Jackson and Francis Alger. 1832. From the authors.

Observations on the Genus Unio, with descriptions of new genera and species in the families of Naiades, &c., with colored plates, by Isaac Lea; from the author.

The value of the practical investigation of nature, by Prof. John K. Mitchell, M.D. 1834. From the author.

Ninth Annual Report of the American Tract Society; from the Society. New York, 1834.

The Cyclopedia of Practical Medicine, &c., edited by Isaac Hays, M.D.; from the publishers.

Annual Report of the Directors of the American Education Society, May, 1834; from the Society.

American Advocate of Peace, conducted by C. S. Henry. June, 1834.

Essay on the intellectual, moral and religious instruction of the youth of New York by common schools, &c.; read before the Troy Lyceum. 1834.

Address on the power and value of the Sunday School system, &c., by Thomas S. Grimké. 1834. From the author.

Proof that credit, as money, in a truly free country, is to a great extent preferable to coin, by Professor Robert Hare, M.D. &c. &c. 1834. From the author.

American Asylum at Hartford for the Deaf and Dumb, Eighteenth Report. 1834.

U. S. Military and Naval Magazine for March, April, May and June, 1334; from the publisher.

Address of the Erodelphian Society of the Miami University, Sept. 24, 1833, by James Hall.

Seventeenth Annual Report of the American Society for colonizing the free people of color of the United States. 1834. From Hon. G. Tomlinson.

Annual Report of the Trustees of the New England Institution for the Education of the Blind. 1834. From the Principal, Dr. S. G. Howe.

Rev. Orrin Fowler on the evils of using Tobacco. 1833. From the author.

Observations on the Modes of learning Languages, by Mariano Cubi y Soler. 1828. From the author.

First and Second Annual Reports of the Fellenberg Academy; from Dr. Jacob Porter.

Professor Cross's Address before certain societies in the Nashville University; from the author.

Observations on the Education of the Deaf and Dumb; from F. A. P. Barnard.

Topographical Description and Historical Sketch of Plainfield, Mass.; by Dr. Jacob Porter; from the author.

Address to the Fourth Annual Convention of the free people of color of the United States. 1834.

Report on Weights and Measures, by the Managers of the Franklin Institute. 1834. From Dr. Hays, Corresponding Secretary.

An Address delivered before the Charleston Temperance Society, February, 1834, by Thomas S. Grimké; from the author.

Official Army Register for 1834; from Surgeon L. Foot.

The New York Atlas Magazine, Vol. I, No. 2; from the publishers.

Dr. M. Smith's Improvement in the Mariner's and Surveyor's Compass Needle. 1834. From the author.

Elements of Geology, for the use of schools, by W. W. Mather. 1833. From the author.

Letters from the Canary Islands, by D. J. Browne. 1834. From the author.

Many pamphlets and various works, to the American Geological Society, from Dr. Jacob Porter.

Annual Report of the Regents of the University of New York. 1830.

Same Report for 1833.

Same Report for 1834; from Hon. Simeon De Witt.

Report of the Committee on Post Offices and Post Roads, &c. 1834. From Hon. G. Tomlinson.

Report of the Committee of Finance, February, 1834; Hon. N. Smith.

Executive Proceedings of the Senate of the United States, May, 1834, on Bank Directors; the same.

Report on the United States Bank, May, 1834.

Report on Steam Boats, May, 1832; Hon. Edward Everett.

Report on the Public Lands, May, 1834; Hon. N. Smith.

Speech of Mr. Webster on the Bank, March, 1834, and on the President's Protest, May, 1834; N. S.

Speech of the Hon. John Quincy Adams on the removal of the public deposits, suppressed by the previous question. 1834. N. S.

Remarks of the Hon. John C. Calhoun on the removal of the deposits, Jan. 13, 1834; J. C. C.

Report on the Pennsylvania Coal Trade, 1834; from W. Boyd.

The Introductory Discourse and Lectures before the Convention assembled to form the American Institute of Instruction. Boston, 1831. From the Censors.

Introduction to the Grammar of Elocution, by Dr. J. Barber. Boston, 1834. 12mo. From the author.

The Advocate of Science and Annals of Natural History, (monthly,) by W. P. Gibbons. 1834. From the editor.

Manual for Visiters to the Falls of Niagara, by J. W. Ingraham. 1834. From the author.

Report on a Rail Road from Bolton Mountain to Hartford, by Chauncey Barnard, Jr.; from the author. 1834.

FOREIGN.

Memoirs on the Island of Java, by Sir T. S. Raffles and others. 1817. From Jedidiah Huntington, Jr.

Lithographed Signatures of the Members of the British Association for the Advancement of Science, who met at Cambridge, June, 1832, with a report of the proceedings and a list of the members. Cambridge, Eng. 1833. Two copies—one from Dr. Buckland, the other from Mr. Mantell.

Internal Structure of Fossil Vegetables, in the coal and oolite formations of Great Britain, 4to, with numerous and very beautiful colored plates, by Henry T. M. Witham, F. G. S. &c.; from the author—a number of copies of the two editions, intended for distribution in the coal regions of the United States, for the purpose of obtaining specimens of the fossil stems of our coal formations.

Geological Map of England, colored, with a memoir, by G. B. Greenough, F. R. S. and L. S.; to the American Geological Society, from Wm. Maclure, Esq.

Tabellen über die vergleichende Geognosie, by Von Christian Keferstein, Königb. Preuss. Hofrath. Halle, 1825. From Von Verfaffer, for the American Geological Society.

Prof. Berzelius' Traité de Chimie, Vol. VIII; from the author. The first seven volumes acknowledged before.

Transactions of the Society of Arts, &c. London, 1833. Vol. XLIX, Part 2. From the Society.

New Theory of Physical Astronomy, by Alexander Watt. Jamaica, 1825. From the author.

Oration before the Medico-Botanical Society of London, by John Frost, F. A. S. 1827. From the author.

Report of the First and Second Meetings of the British Association for the Promotion of Science, at York in 1831, and at Oxford in 1832, &c. 8vo. London, 1833. From an unknown hand.

M. A. J. M. Brochant, De Crystallization. Strasburg, 1829. From the author.

Thoughts on Materialism, and on Religious Festivals and Sabbaths, by H. B. Fearon. London, 1833. From the author.

Report on the Progress, Actual State, and Ulterior Prospects of Geological Science, by Rev. W. D. Conybeare, F. R. S. &c. 1832. From the author.

On the Excavation of Vallies, as illustrated by the Volcanic Rocks of Central France, by Charles Lyell, Esq. F. R. S. &c. and R. I. Murchison, Esq. F. R. S. 1829. From Mr. Murchison, through Mr. Featherstonhaugh.

Three lectures on the transmission of the precious metals, and on the theory of wealth, delivered in Oxford University, June, 1827, by Prof. N. W. Senior; from the author, through J. Miller. 1828.

Introductory Lecture on Political Economy, by N. W. Senior. Oxford, 1826. From the author, 1827.

On the Relations of the Tertiary and Secondary Rocks on the Southern Flanks of the Tyrolese Alps, by R. I. Murchison, F. R. S. &c. 1829. From the author.

A notice of the Geology of the Environs of Tunbridge Wells, by Gideon Mantell, Esq. F. R. S. &c. 1832. From the author.

On the Bituminous Schist and Fossil Fish of Seefeld in the Tyrol, by R. I. Murchison, Esq. F. R. S. &c. &c.; from the author.

Proceedings of the Sixth Annual Meeting of the Bristol Institution, &c. &c. 1829.

Address delivered at the Anniversary Meeting of the Geological Society of London, February, 1833, by R. I. Murchison, Esq. F. R. S. &c. on retiring from the President's chair; from the author.

Faraday's Experimental Researches in Electricity, Parts 1, 2, 3 and 4. 1832–3.

The London Atheneum or Journal of Literature, &c.; various Nos. in 1832 and 1833, from Mr. O. Rich, London.

The Chinese Repository, Canton, China. Nos. in 1832, 1833, and 1834; from the editor.

General Catalogue of old and new Books in English, Spanish, Italian, French, &c. with the prices; from O. Rich. Also the catalogue of the Botanical Library of Ortega. London, 1833–4.

Fifth, Sixth and Seventh Annual Reports of the Council of the Natural History Society of Montreal, for 1831, 1832, 1333, and 1834; from the Society.

Proceedings of the Geological Society of London, with a catalogue of members, and letters of acknowledgment for the American Journal from 1829 to 1833, inclusive; from the Society.

Travels in the Tarentaise and various parts of the Grecian and Pennine Alps, and in Switzerland and Auvergne, in 1820, 21, 22. Engravings and cuts, by R. Bakewell, Esq. 2 vols. 8vo. 1823. From the author.

Barbadoes, and other Poems, by M. J. Chapman, Esq. London, 1833. From the author.

Traité theorique et pratique de l'art de batir, par Jean Rondelet; from the author.—Prospectus of the sixth edition. Paris, 1830.

Lettre a la Nation Anglaise, sur l'Union des peuples et de la Civilization Compareé, &c. &c. par Marc-Antoine Jullien, de Paris, Chevalier de la Legion d'Honneur, &c.; from the author.

Instruction sur la manière de faire des observations mètèorologiques. Paris, 1834.

Extrait des Mémoires de la Société d'Histoire Naturelle de Strasbourg—Notice sur le Bradford-Clay de Bouxiviller et de Bavillers; from G. Mantell, Esq. 1833.

With a few exceptions, we have omitted to mention Journals, whether foreign or domestic, received in exchange; and among numerous foreign Journals of Science and Literature, which arrive more or less regularly, we have named only those which have recently begun to come, or of which the exchange has been revived, after a discontinuance.—*Ed.*

The American Journal of Science and Arts.

The annexed prospectus is presented to the friends of science, and their aid is respectfully solicited, in promoting its interests, so far as they are connected with this Journal.

Since the 12th volume, its patronage, has been more than sufficient to pay the expenses, but to insure to it both stability and increasing usefulness, requires renewed efforts on the part of its editor; which will, however, be of little avail, without the cooperation of its friends.

Even England had no Journal of Science till about the beginning of the present century; it is, therefore, encouraging that the first attempts in this country, made only a few years later, have been, thus far, sustained by the American public.

Still, every periodical work must, occasionally, recruit its number of subscribers, or it will fall into jeopardy. The American Journal is not yet in immediate danger, but, *its subscription is far too limited to enable it to do all the good of which it is capable; and after a considerable decline, since* 1829, *it would be happy if it could be again increased as it was in that year. The simple expedient then adopted, was, for each subscriber to obtain one more, and in this manner the subscription was soon doubled.*

In this country, such a work, involving peculiar difficulties, can neither be got up, nor sustained, without great effort and perseverance. Avoiding all local, personal, party and sectarian interests and excitements, it thus entirely foregoes the support afforded by popular feeling, and therefore relies, *as it has a full right to do,* solely upon the intelligent, the patriotic, and the philanthropic.

For the support of such a work, *it is worse than useless, to resort to indiscriminate solicitations.* The transient subscriptions, obtained in that manner, will produce only a delusive expectation of support, and a certain increase of expense.

Such persons, therefore, and such only, should be addressed, as, from their considerate and correct estimation of the value of useful knowledge, or from their interests and taste, will probably become permanent patrons.

PROSPECTUS.

In 1810, 11 and 12, the late Dr. Bruce, of New York, published his Journal of Mineralogy and Geology in one volume of four numbers.

The American Journal, was, however, the first, that in this country, embraced in its plan, *the entire circle* of the Physical Sciences, and their applications to the arts. It was begun in July, 1818, and has completed its twenty sixth volume.

While it has prompted original American efforts, it has been sustained by them, and being devoted to important national interests, in a great measure common also to all mankind, it is, in that character, known and accredited, both at home and abroad. It has elicited many valuable researches and discoveries, and its miscellaneous department in particular has presented a great variety of topics, of general interest. The Foreign Journals, (many of them sent in exchange,) often quote from its pages, which are in turn, enriched by theirs; and it has thus, become identified with the science and arts of the present day.

Terms.—For four quarterly Nos., of not less than 200 pages each, fully illustrated by plates, making, together, two annual volumes, of at least 800 pages; six dollars—*in advance.*

The quarterly *literary* journals, escape the heavy expense incurred by this, for plates and for difficult technical composition; and as they enjoy, from obvious causes, a far more extended circulation, they can be much better afforded at $5 per ann. than this at $6. *With its present patronage, this Journal could not be sustained at five dollars, as the actual receipts would not pay for the paper and the mechanical labor.*

Postage is to be paid on all orders and remittances, but not on communications. Postmasters are, occasionally, patrons of the Journal, when of course their communications are franked.

A number is sent gratis, as a sample, when requested. Names may be lodged with any of the agents, or sent to the Editor or publishers, and the work may be obtained through all booksellers, or from the Editor.

A compensation of one third will be allowed to all persons obtaining subscribers, who pay the first year's subscription in advance; and agents and booksellers can, if they choose, retain upon their own books, the names which they may procure; due notice being given to the Editor.

Complete sets are furnished to individuals, and to the trade, at a suitable discount.

The Editor will draw on his agents semi-annually, (that is, on the publication of No. 2, of each volume,) in all cases where payment is not otherwise provided for; the drafts will be usually payable April 1, and Oct. 1. A semi-annual or an annual payment in advance is, in all cases, expected from the individual subscribers, and the bills are forwarded accordingly with the Journal.

For single subscribers, the mail is, decidedly, the best mode of conveyance: the postage is about that of a twice weekly newspaper, that is, from $1.10 to $1.32 per annum.

Cal Met

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. Geol. Soc., Paris; Mem. Roy. Min. Soc., Dresden; Nat. Hist. Soc., Halle; 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. XXVII.—No. 1.—OCTOBER, 1834.

FOR JULY, AUGUST, AND SEPTEMBER, 1834.

NEW HAVEN:

Published and Sold by HEZEKIAH HOWE & Co. and A. H. MALTBY. *Baltimore*, E. J. COALE & Co.—*Philadelphia*, J. S. LITTELL and CAREY & HART.—*New York*, G. & C. & H. CARVILL.—*Boston*, HILLIARD, GRAY, LITTLE & WILKINS.

PRINTED BY HEZEKIAH HOWE & CO.

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. Geol. Soc., Paris; Mem. Roy. Min. Soc., Dresden; Nat. Hist. Soc., Halle; 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. XXVII.—No. 2.—JANUARY, 1835.

FOR OCTOBER, NOVEMBER, AND DECEMBER, 1834.

NEW HAVEN:

Published and Sold by HEZEKIAH HOWE & Co. and A. H. MALTBY. *Baltimore*, E. J. COALE & Co.—*Philadelphia*, J. S. LITTELL and CAREY & HART.—*New York*, G. & C. & H. CARVILL.—*Boston*, HILLIARD, GRAY & Co.

PRINTED BY HEZEKIAH HOWE & CO.

THE AMERICAN JOURNAL, &c.—AGENTS.

MAINE.

HALLOWELL, Glazier, Masters & Co.
PORTLAND, Colman, Holden, & Co.

VERMONT.

BRATTLEBORO', G. H. Peck.

MASSACHUSETTS.

NEWBURYPORT, Charles Whipple.
SALEM, Henry Whipple.
NORTHAMPTON, S. Butler & Sons.
AMHERST, J. S. & C. Adams.
WORCESTER, Clarendon Harris.
LOWELL, D. Bixby.

RHODE ISLAND.

PROVIDENCE, A. S. Beckwith.

CONNECTICUT.

HARTFORD, F. J. Huntington.
NORWICH, Thomas Robinson.
MIDDLETOWN, Luke C. Lyman.

NEW YORK.

NEW YORK, A. T. Goodrich.
WEST POINT, John DeWitt.
NEWBURGH, H. P. Benham.
ALBANY, W. C. Little.
TROY, Wm. S. Parker & Son.
MOREAU, N. A. Angle.
ITHICA, D. D. Spencer.
CANANDAIGUA, Morse & Harvey.
AUBURN, L. Briggs.
ROCHESTER, Hoyt, Porter & Co.
BUFFALO, O. G. Steele & Co.

NEW JERSEY.

NEW BRUNSWICK, Terhune & Letson.

PENNSYLVANIA.

PITTSBURGH, Luke Loomis.

MARYLAND.

BALTIMORE, E. J. Coale & Co.

DISTRICT OF COLUMBIA.

WASHINGTON, P. Thompson.

NORTH CAROLINA.

CHAPEL-HILL, Prof. E. Mitchell.

SOUTH CAROLINA.

COLUMBIA, B. D. Plant.
CHARLESTON, Ebenezer Thayer.

VIRGINIA.

RICHMOND, R. I. Smith & Co.
WHEELING, J. Fisher & Sons.

KENTUCKY.

MOUNT STERLING, Silas W. Robbins.

OHIO.

CINCINNATI, Truman, Smith & Co.
COLUMBUS, I. N. Whiting.

GEORGIA.

SAVANNAH, Wm. T. Williams.

TENNESSEE.

NASHVILLE, Wm. A. Eichbaum.

ALABAMA.

TUSCALOOSA, D. Woodruff.
HUNTSVILLE, Irby & Smith.
MOBILE, Dr. Alexander Jones.

MISSISSIPPI.

GRAND GULF, Wm. M. Smyth.

CANADA.

QUEBEC, Neilson & Cowan.

GREAT BRITAIN.

LONDON, O. Rich.

FRANCE.

PARIS, { J. C. Barnet, F. Astoin.

TERMS.

Six dollars per annum; published in four quarterly numbers, making two volumes a year, of from eight to nine hundred pages for both volumes, which are fully illustrated by plates.

☞Terms of credit to general agents, six months from the publication of No. 1, of each volume.

The Editor will draw on the agents, semi-annually, i. e. *on the publication of No. 2 of each Vol., in all cases, where payment is not otherwise provided for.*

Complete sets furnished to individuals, and to the trade, at a suitable discount.

The price of this Journal, on account of a limited patronage, *of numerous plates*, and *the frequent extra expence of difficult composition*, is, necessarily, more than that of the quarterly Literary Reviews. At five dollars, it would not pay for the *materiel* and the mechanical labor. *It is desired*, that the numbers appear as early as possible in the months of January, April, July and October.

TO CORRESPONDENTS.

The titles of communications and of their authors, to be fully given.
Several deferred communications, will appear in the next No.
When extra copies are desired, the notice should be placed at the head of the MS.
Notice always to be sent of deaths and removals of subscribers.
Return proofs, not to be sealed, or inscribed with any thing except corrections.
No pages to be left blank in communications sent by mail.