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NOTICE TO SUBSCRIBERS AND AGENTS.

The Editors will pay $1 00 in cash per No. for the following numbers of the American Journal of Science. Or if preferred, they will credit them to the account of any subscriber at the rate at which recent numbers are charged. Or they will exchange for them such other numbers as may be desired of which they have a supply. The Nos. wanted are shown below in a tabular form. If any No. is sent by mail, the word RETURNED must be put on the envelope.

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ERRATA.

P. 63, line 28, for carboniferous, read *carboniferous*—p. 64, l. 6, for that, read *that ;*—l. 27, for *marble*, read *rubble*—p. 65, l. 12, for *Ernest*, read *Calus*—p. 69, l. 19, for *their*, read *thin*—l. 29, for *Clair*, read *Plain ;*—p. 70, l. 8, for *Beeraft*, read *Becraft*—l. 16, for *lydian*, read *Lydian ;*—l. 17, for *bluffs*, read *bluff ;*—l. 26, for *equivalent*, read *equivalents*—p. 83, l. 11 from bottom, for *cholorate*, read *chlorate*—p. 85, l. 20 from bottom, for *crop-cleavage*, read *cross cleavage ;*—l. 13 from bottom, for *in a a*, read *into a*—p. 128, l. 18, 19, and 22, for *ounces*, read *ounce*—l. 2 from bottom, for *experimenters*, read *experiments*—p. 130, the letters A, B, and G. on fig. 2, are misplaced—p. 132, l. 20, after *latter*, read *describe*—l. 31, for *tinning*, read *turning*—p. 189, top, for *Mastodon Giganteum*, read *Mastodon giganteum*—p. 325, title, for *Dr.* BROWN, read *Dr.* BRONN.

Cover, for 32 Paternoster row, London, read 35.

Correction.—Since the communication of Dr. Sager was struck off, he has observed that the description of the Salamandra agilis had previously been published under another name. In the descriptions of the dental formulæ on p. 321, the reader will substitute the specific name *erythronota* for *agilis*, and *rubra ?* for *erythronota*.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Citations from, and abstract of, the Geological Reports on the State of New York, for* 1837–8, *being State Document No.* 200; *communicated by* Gov. W. L. Marcy, to the Assembly at Albany, Feb. 20, 1838.

We have already mentioned the former Report, Vol. xxxii, p. 186. The present contains three hundred and eighty four pages, and is illustrated both by wood cuts and by a quarto atlas of lithographic drawings, maps and sections fifteen, in number.

The communication contains—

1. A letter from James E. De Kay; 2. the report of Lewis C. Beck; 3. of T. A. Conrad; 4. of W. W. Mather; 5. of E. Emmons; 6. of L. Vanuxem; and 7. of James Hall.

The document now before us, being a full octavo volume, hardly admits of condensation. The facts are very numerous, and many of them of great importance. From the mass, we can do little more than to select a few of the most prominent.

1. The letter of Dr. De Kay refers to a verbal report made to a joint committee of the senate and assembly, and to an ultimate report to be presented when the labors of the botanical and zoological departments shall be closed—ably and happily, as we cannot doubt, from the well known character of the gentlemen charged with the care of those departments.

2. The report of Dr. Lewis C. Beck, on the mineralogical and chemical department of the survey.

In Orange county, near the village of Monroe, is magnetic iron ore, at the Wilks or Clove mine, and at O'Neil mine, in the vicinity, are beautiful octahedral and cubic crystals. There are other deposits of iron within a mile, as at Forshee's mine and the Rich iron mine. Near Forshee's mine, there are plates of mica from nearly two to three feet in diameter.

The attention of Dr. Beck has been mainly directed to the mineral springs.

1. *Brine Springs, or Salines.*

The brine springs are chiefly in the middle and northern parts of the State. They occur with little interruption from the county of Otsego to Orleans and Genesee—nearly one hundred and seventy miles east and west, and from Broome county in the south, to near Lake Ontario, being about eighty miles. Still, among all these, only the springs near the Onondaga lake (a fine bed of water six miles by one) are wrought with much advantage.

This region is nearly in the centre of the length of the State, and is intersected by the great Erie Canal, at the distance of thirty to forty miles south of Lake Ontario.

These springs all contain the muriate of lime and magnesia, besides carbonate and sulphate of lime, and a little carbonate of iron. Bromine has been detected in the Salina spring. The spring contains fourteen to fifteen per cent. of saline matter, and of sea water three to four.

Prof. Beck inclines to the opinion that these springs are impregnated by solution of solid salt below; but we have no room to state the grounds of this opinion, except that the absence of known beds of fossil salt in our territory is not decisive against this origin, since, in France, where there are numerous brine springs, there is only one known locality of fossil salt, namely at La Meurthe, around which, brine springs had been wrought from the time of the Christian era. It is thought that the strength of the brine is influenced by the height of the Onondaga lake, the brine being strongest when the water of the lake is the highest. Dr. Wright, superintendent, states, that in the spring of 1836, when the water of the lake was unusually high, the brine had a density of 79° by an instrument on which the point of saturation was 100°; whereas ordinarily it does not exceed 63° or 64°. The higher column of water in the lake is supposed to raise by its superior pressure a stronger brine from below; thus bringing it within the action of the pumps. This is supposed to favor the hypothesis, that the impregnation arises from solid mineral salt beneath.

The Onondaga lake is fresh water, and is secured from impregnation from the surrounding saline marshes, by a stratum of marl, from three to twelve feet thick, below which is a bed of marly clay.

These salines are under the direction of the State authorities, and four wells are worked—one at Salina, one at Syracuse, one at Geddes, and a fourth at Liverpool, on the Oswego canal, all upon the borders of this little lake.

The Salina spring affords more salt water than all the others; it is seventy feet deep, and the water is raised by forcing pumps to such a height as to supply occasionally all the works in the vicinity. Temperature of the well, 50° Fah., brine limpid and sparkling, with carbonic acid gas: specific grav. 1.11060 at 60° F.: has remained of uniform strength for at least thirty six years. It contains—

Carb. of lime, - - - - -	.17
Sulph. of lime, - - - -	4.72
Muriate of lime, - - - -	1.04
" magnesia, - - - -	.51
Common salt, - - - - -	140.02
Oxide of iron, with a little silica and lime, -	0.04
Carbonic acid, with a little lime and iron, -	0.09
Water, with a trace of bromine and organic matter,	853.41
	1000.00.

This brine contains 1130 grains of pure and dry salt in a wine pint, and 9045 grains or 1.29 pounds avoir., in a gallon, and 43½ gallons yield a bushel of salt weighing 56 pounds, and 41½ gallons give a bushel of merchantable salt, which contains about five per cent. of water.

The Syracuse water gives a result almost identical—it is apparently a very little weaker, but the difference is so small, that it may be accidental; the same may be said of the Geddes well, and of that at Liverpool, which is indeed a little stronger: the average yield of the four wells is 136.48 grains in 1000 of water, or nearly $\frac{1}{7}$, whereas sea water affords an average of only $\frac{1}{33}$, and these waters are therefore about twelve times as strong as sea water.

In 1830, of 3,804,229 bushels of salt manufactured in the United States, 1,291,220 were obtained from the Onondaga springs, which in 1835 yielded 2,222,694 bushels; and if the other salt works in the United States have increased in the same proportion, the Onondaga springs still yield more than one fourth of all the salt manufactured in the country.

Dr. Beck, to provide against loss of salt water, allows fifty gallons for a bushel of salt, and estimates that if the pumps of the Onondaga salines were to work three hundred days in the year, at the rate of 44,700 gallons in an hour, they would yield 6,445,400 bushels in a year. It appears that in 1836, 100,000 gallons of brine were lost at Onondaga, as the salt made was only 2,000,000 of bushels. The brine of this region is the strongest hitherto discovered in the United States, unless it may be that on the Holston, Virginia, which, according to Prof. Rogers, yields about twenty per cent. of saline matter. The brine of the Kenhawa springs in Virginia, contains no sulphate of lime ; and fuel, in the form of mineral coal, is on the spot.

No saturated water, like that of Northwich in England, containing twenty six per cent., has yet been discovered in the United States.

According to Dr. Beck, good quick lime added to the brine, facilitates the obtaining of the salt, by decomposing and precipitating the bicarbonate of iron and lime, and decomposing also the muriate of magnesia—while the muriate of lime previously existing in the water, as well as that formed in this process, is in its turn decomposed by sulphate of soda—thus adding to the product of common salt, and precipitating the lime in the form of sulphate of lime.

By solar evaporation, all difficulties are avoided (except delay,) and a pure salt is obtained in hard white crystals, which are scarcely affected by the air. Evaporation by steam applied in tubes, is next in point of advantage to that by the sun; and Dr. Green, at Salina, employs this method with much success.

Syracuse is in the centre of the saline district, and combines many advantages: it is on the Erie and Oswego canals and the great western rail-road. There are in the vicinity excellent agricultural tracts, and vast quarries of the best limestone for construction, and of gypsum for fertilizing; the best marls are also found in inexhaustible quantities.

Table, showing the composition of various specimens of Onondaga and foreign salt in 1000 *parts.**

KINDS OF SALT.	Carbonates of lime and magnesia.	Sulphate of lime.	Sulphate of soda.	Chlorides of calcium and magnesium.	Pure chloride of sodium.	Total.
1. Salt made by solar evaporation at Syracuse, - -	-	7.00	-	2.00	991.00	1000
2. do. do. Geddes, by Mr. Brewster,	1.00	6.50	-	Trace.	992.50	1000
3. Table salt, prepared and put up by A. Woodruff, Salina, N. Y.	0.20	6.61	-	1.46	991.73	1000
4. Salt, labelled 'extra good,' made by Buel and Foote, Salina,	0.38	5.78	-	3.50	990.44	1000
5. Salt made by boiling saturated brine, at the works of Dr. Green, Salina, - - - - - - -	-	8.92	-	1.64	989.44	1000
6. Salt made by slow evaporation, Syracuse, Mr. Byington,	-	9.00	-	2.50	988.50	1000
7. Salt made by boiling, at Salina, - - - -	0.40	20.09	-	3.26	976.25	1000
8. Salt condemned at Salina, - - - - -	4.32	14.88	-	6.36	974.44	1000
9. Salt do. do. - - - - - -	5.52	17.51	-	-	976.97	1000
10. Turks Island salt, - - - - - - -	2.80	13.16†	-	-	984.04	1000
11. Liverpool fine salt, - - - - - - -	0.23	8.77	2.01	-	988.99	1000

* All the specimens, previously to the analysis, were brought to a state of perfect dryness, by a heat of 400° or 500°. The loss in weight was from one half to twelve per cent. In both specimens labelled "condemned salt," the proportion of water was very great. It was probably the imperfect manner in which the drying process was performed, rather than the amount of saline impurities which they contained, that subjected them to the condemnation of the inspector.

† And sulphate of magnesia.

The brine at the Montezuma springs is much weaker than at Onondaga, yielding only ninety three parts of salt in one thousand, instead of one hundred and thirty six, and seventy gallons of the water are necessary to afford a bushel of salt.

Table, showing the composition of various Brines, from Onondaga and Cayuga counties, N. Y.

Locality of the well or spring.	Total amount of solid matter in 1000 grains of brine.	Carbonic acid.	Oxide of iron and silica, with a trace of carbonate of lime.	Carbonate of lime.	Sulphate of lime.	Chloride of magnesium.	Chloride of calcium.	Chloride of sodium, or pure common salt.	Water, with a trace of organic matter, &c.	Total.
ONONDAGA.										
From the well at Geddes,	138.55	0.06	0.04	0.10	4.93	0.79	2.03	130.66	861.39	1000
From the well at Syracuse,	139.53	0.07	0.02	0.14	5.69	0.46	0.83	132.39	860.40	1000
From the well at Salina,	146.50	0.09	0.04	0.17	4.72	0.51	1.04	140.02	853.41	1000
From the well at Liverpool,	149.54	0.07	0.03	0.13	4.04	0.77	1.72	142.85	850.39	1000
CAYUGA.										
From a well at Montezuma,	101.20	0.08	0.02	0.18	5.25	1.00	1.40	93.35	898.72	1000

Inflammable Gas.—Carburetted Hydrogen.

Disengaged in many places—at Albany, from a boring in the slate, where a saline carbonated water is discharged—at the Oneida springs in Vernon—in the Ontario gas springs, on both sides of the Canandaigua lake—in Bristol, nine miles from the village, and within three miles of it—in the Niagara gas springs near Lockport, and so abundantly in a particular place, that it has been called Gasport.

Most remarkable in Fredonia, Chautauque county, three miles south of Lake Erie, from the bituminous slate under Canadanea Creek. Bubbles of gas every where rise through the water, and most abundantly at and below the bridge. The gas burns with a white flame, tinged with yellow above and with blue below the burner.

"The illuminating power of this gas and its abundant supply, suggested the idea of its employment in lighting the village. A copious discharge of the gas was observed issuing from a fissure in the rock which forms the bed of the creek, which it was thought could be diverted to a boring on the bank. A shaft was accordingly sunk through the slate about twenty two feet in depth, which occasionally passed through layers of the bituminous substance already described, and the result was, that the gas left the creek and issued through the shaft. By means of a tube, the gas was now conducted to a gasometer, and from thence to different parts of the village. The gasometer had a capacity of about two hundred and twenty cubic feet, and was usually filled in about fifteen hours, affording a sufficient supply of gas for seventy or eighty lights."

Besides the bituminous slate, burning with a flame like that of the gas, there is an alternating sandstone, containing every where small cavities filled with petroleum, and giving out a bituminous odor. This liquid substance appears to have been every where originally diffused through both the slate and sandstone, and thus to have imparted the peculiar characters.

Gas appears to be generated and imprisoned below. It rises in the banks when they are bored to the depth of twenty to thirty feet, and it bubbles up through the water when it is low, but is repressed when its height produces increased hydrostatic pressure. Many of the wells in Fredonia are strongly charged with this gas, and frequent disruptions of the strata evince the exertion of an expansive force from below. The strata of slate and sandstone are one thousand feet thick. This gas issues at long distances, whose extremes are four hundred miles apart, and from strata from fifteen hundred to 2000 feet thick. It is the opinion of Dr. Beck, that this gas does not rise from coal beds, which by the views now entertained of the geological structure of New York, are excluded from its territory.

Nitrogen Springs.

Nitrogen gas rises from waters, and from the ground in Rensselaer county, six miles southeast from Bennington, Vt., and Chateauguay, Franklin county; but the most remarkable nitrogen spring in the State, is that of Lebanon, county of Columbia.

"This spring is about ten feet in diameter, and four feet deep, and discharges a large amount of water. Its temperature is uniformly 73° F., while that of all the other springs in the vicinity is 52°. The water is quite tasteless. Its specific gravity is scarcely above that of distilled water, as it holds only a minute portion of saline matter in solution. The following is the composition, according to the analysis of Dr. Meade, of a pint of the water.

Chloride of calcium, - - - -	0.25 grains.
Chloride of sodium, - - - -	0.44 "
Carbonate of lime, - - - -	0.19 "
Sulphate of lime, - - - -	0.37 "
	1.25

"Bubbles of air continually rise through the crevices of the rock at the bottom of this spring, which ascending rapidly through the water, occasion an incessant agitation, and appear to break on the surface without being at all absorbed by the water. This air is given out in the proportion of about five cubic inches from a pint of the water, and it consists, according to the experiments of Prof. Daubeny, of Oxford, now on a visit to this country, who kindly furnished me with the results, of 89.4 parts of nitrogen, and 10.6 parts of oxygen, in the hundred. This is equal to nearly fifty parts atmospheric air, and fifty parts pure nitrogen, in the hundred. Prof. Daubeny could not detect any carbonic acid in the gaseous matter given out by this spring.

"So large is the quantity of water at the Lebanon springs, that advantage has been taken of it, and of the elevation of the ground, not only to supply all the baths, but to turn two or three mills erected within a short distance: these mills are kept in action during the severity of the winter."

Acidulous or Carbonated Springs.

The well known springs of Saratoga and Ballston are the most conspicuous of this class in the State.

" *Composition of a pint of the water from the Congress Spring.*

According to the late Prof. J. F. Dana.	Grs.
Chloride of sodium, - - - - -	54.3
Carbonate of lime, - - - - -	18.0
Carbonate of magnesia, - - - - -	4.0
Carbonate of soda, - - - - -	2.0
Silica, with a trace of iron, - - - -	
Total,	78.3
	Cubic inches.
Carbonic acid gas, - - - - -	39.1
Azote, - - - - - - -	0.9
Gaseous contents, - - - -	40.0

According to Dr. Steel.	Grs.
Chloride of sodium, - - - - -	48.13
Hydriodate of soda, - - - - -	0.44
Bicarbonate of soda, - - - - -	1.12
Bicarbonate of magnesia, - - - -	11.97
Carbonate of lime, - - - - -	12.26
Carbonate of iron, - - - - -	0.63
Silica, - - - - - - -	0.19
Hydrobromate of potassa, trace, - - -	
Total,	74.73

	Cubic inches.
Carbonic acid gas, - - - - -	39.00
Atmospheric air, - - - - -	0.87
Gaseous contents, - - - - -	39.87

"The temperature of these springs is said to be uniformly 50° F."

Those of Ballston have proved more variable in their impregnation, particularly with carbonic acid gas.

United States Springs.

"Specific gravity, 1.00611. Temperature, 50° F. One pint of the water contains,

Carbonate of lime, with a small admixture of oxide of iron, - - - - -	3.65	grains.
Carbonate of magnesia, - - - -	0.72	"
Carbonate of soda, - - - - -	2.11	"
Sulphate of soda, - - - - -	0.22	"
Chloride of sodium, - - - -	53.12	"
Silica,* - - - - - - -	1.00	"
	60.82	"

Carbonic acid 30.50 cubic inches."

The mineral waters of Albany City are very similar to those of Saratoga and Ballston, but contain a smaller proportion of carbonic acid gas.

Sulphuretted or Sulphureous Springs.—These are very numerous, and are distinguished by containing free sulphuretted hydrogen in solution, in greater or smaller proportions, (sometimes perhaps saturated,) and sometimes carbonic acid, in addition to various salts, among which are common salt, muriates of lime and magnesia, sulphate of lime, sulphate of soda, sulphate of magnesia, and carbonate of lime; and not improbably the sulphuretted hydrogen is itself combined in some instances with gases. Notices of many of these springs are contained in this Journal, and derived principally from the researches of Professor Eaton. Journal, Vol. xv, p. 335.

* This water probably contains both iodine and bromine, but the quantity upon which I operated was too small to admit of separating them and determining their relative proportions.

The Avon springs are much celebrated, and of them a notice was given in the last volume of this Journal, page 188.

"The waters of all the Avon springs give out powerfully the odor of sulphuretted hydrogen, and have a strong saline taste. They speedily blacken silver and the salts of lead. The solution of arsenious acid is but slightly altered by it until after the addition of an acid; from which I infer that a portion of the sulphuretted hydrogen is in a state of combination with some basis."

We do not observe that particular mention is made of some exceedingly remarkable sulphureous fountains eight miles N. W. of Canandaigua. We visited them some years since, and were saluted with the odor of the gas full half a mile from the fountains. They gush from a hill, in a stream so copious as to turn a mill; they rise also in vast abundance from an extensive marsh at its foot, and sulphur sometimes of a lemon yellow color, is abundantly deposited.

The existence of sour springs containing free sulphuric acid, mentioned in this Journal, Vol. xx, p. 239, is confirmed by Dr. Beck.

"*Genesee Springs.*—In the county of Genesee, we have, near North Byron, a sulphuretted spring, the gas of which is so copiously given out as to be inflamed; and in the southeast part of the same town are springs of a similar kind.

"*Sulphuric Acid.*—A very remarkable locality in this vicinity deserves to be particularly noticed here, as the occurrence is undoubtedly to be referred to the same general agencies which are concerned in the production of sulphuretted hydrogen. I refer to the *Sour Spring*, so called, which exists in Byron, near the canal. The acid is produced from a hillock about 230 feet long and 100 broad, elevated four or five feet above the surrounding plane. According to Professor Eaton, the strength of the acid increases in a drought. He states, that when he examined the locality considerable rain had recently fallen, and the acid in most places was very dilute, but in some it appeared to be perfectly concentrated, and nearly dry in its combination with the charred vegetable coat. In this state it was diffused throughout the whole hillock, which was every where covered with charred vegetable matter to the depth of five to thirty or forty inches, occasioned by the action of the sulphuric acid. Wherever holes were sunk in this hill the acid accumulated, and also in the depressions of the contiguous meadow grounds.

"There is another locality of a similar kind a hundred rods west of Byron hotel, and two miles east of the former, which is remarkable, in consequence of the great quantity of acid. It is a spring which issues from the earth, in sufficient volume to turn a light grist-mill. Such an immense laboratory of sulphuric acid is here conducted by nature, that all the water which supplies this perennial stream possesses acidity enough to give the common test with violets, and to coagulate milk. Besides the above, there are said to be several other sour springs in this vicinity.*

"I have particularly examined both the liquid acid and the brownish vegetable matter subjected to its action.

"The liquid is transparent and colorless; and in the specimen upon which I operated, had a specific gravity of 1.21304 at 60 F. It reddens litmus powerfully, has an intensely sour taste, causes a dense precipitate when added to muriate of barytes, but is not affected by nitrate of silver. When ammonia is added to the liquid to saturation, a slight precipitate of a reddish color is the result, and the clear solution is afterwards also slightly affected by oxalate of ammonia. The oxide of iron and lime indicated by the two latter tests are, however, in very small proportion, as is evident from the fact that when the liquid is evaporated it leaves only a trifling residuum. It is a nearly pure, though dilute, sulphuric acid, and not a solution of acid salts, as has been supposed; for the bases are in too minute proportions to warrant the latter opinion."

"The occurrence of sulphuric acid in nature, in any thing like the pure form which it here possesses, is of great interest, only a few localities, and these rather doubtful, being hitherto known. An earth, somewhat similar to that found in Byron, is said to exist in great quantities at a village called Daulakie, in the south of Persia, between three and four days journey from Bushire, on the Persian gulf. The natives employ it as a substitute for lemons and limes, in making their sherbets, of which considerable quantities are drunk, they being prohibited the use of wine. On analysis the acid was found to be the sulphuric, and this was united to iron; the solution in boiling water, when evaporated, yielding crystals which seemed to be the acid sulphate of that metal."†

Sulphureous waters are found in various places on the Hudson, in the counties of Onondaga, Niagara, Erie, Chautauque, Clinton, and St. Lawrence, at Chitteningo, Sharon, Rickfield, Verona, near Utica, and in many other places.

Petrifying Springs.—These are chiefly solutions of carbonate of lime by means of carbonic acid gas, and its well known effects in the production of stalactites, tufa, and transition, are numerous and conspicuous in this state.

In this Journal, Vol. XXVIII, p. 172, is described a great tufaceous deposit in Schoharie county. In Herkimer county, near the head of Otsquago creek, is a calcareous tufa with impressions

* Eaton in Silliman's Journal, XV, 239.

† Philosophical Magazine for 1824.

of numerous plants, identical with those now growing in the vicinity. There is a single mass on the bank of the creek, about 300 feet long by 50 wide and so on to 40 thick. It has numerous apartments, and at the end are tufaceous petrifactions of logs standing obliquely against a side hill: they are still very perfect, retaining the forms of the shabby scales of the bark, the knots, &c. There are large masses of tufa near Syracuse, and in Marcellus and Camillus are many calcareous petrifactions of leaves, roots, and trunks of trees: such petrifactions are numerous near Rochester and Ithaca; and at the falls of Niagara and Genesee they are incrusted with carbonate of lime from the running and dashing waters. Near Chitteningo such appearances are numerous, and a large trunk of a tree is conspicuous on the left hand, as the traveller enters the village from the east; it is imbedded in a hill near its foot. Professor Beck found the petrified wood to consist almost entirely of carbonate of lime, with small and variable proportions of silica, alumina, and oxide of iron; in some specimens there were traces of vegetable matter, and in others none.* Water issuing from the superincumbent hills afforded to Professor Beck, in 1000 parts, 998.06 of water, and 1.94 of carbonate and sulphate of lime; still no sulphate of lime could be found in the petrifactions.

Paleontological Department, by Timothy A. Conrad.

This department has been organized since the former report, and Mr. Conrad was detached from the geology of the third district, for the purpose of fulfilling this duty, which is very important to science, although it may not make so conspicuous a figure in the reports as some other departments. Mr. Conrad, whose high qualifications for this duty are well known, has made it a leading object to compare and identify as far as possible the formations of the state of New York with those of Europe, at least so far as to ascertain their geological equivalents.

"There are some geologists who wish to establish in every island and continent, a peculiar system of rocks, independent of other remote countries; but when we consider that in the earlier eras of our planet, the temperature was uniform and the seas comparatively very shallow; should

* We have seen in situ near Fredricksburg, Va., siliceous petrifactions of trunks of trees, in which were ligneous fibres, not only not petrified, but retaining their combustibility, while all around was stone, copying the original organization.

we not expect to find all the organic remains of such periods to consist chiefly of one group of species over the whole globe, especially when we find the flora of the carboniferous era to have been every where nearly the same? Are not rocks of the oolitic group in South America, the cretaceous, and even the eocene of North America, mere extensions of European systems, deposited in seas of the same periods, and containing the same groups of shells? Deeper oceans and greater variation of temperature have cast more uncertainty over the upper tertiary formations, but the transition affords us the converse of this proposition; greater uniformity of temperature, a more perfect identity of organic remains, and rock masses of more uniform character. That the sea of one of these ancient eras was shallow, is proved not only by its universality, but by the ripple marks and fucoides which every where pervade the strata. A negative evidence is also supplied in the nature of the fossils. Dr. Buckland has shown how admirably the complicated chambers, and the exterior surface of the Ammonites were constructed, to resist the pressure of deep water. But shells of this genus were not created until more profound seas had resulted from changes in the configuration of the earth's surface, subsequent to the deposition of the coal formations. The Goniatite, which has a plain exterior, and septa simply angulated, is unknown in that part of the transition we have termed the Trenton group; and in the upper part of the series it is among the rarest of the univalves, abounding only in the carboniferous epoch. The cephalapods, which flourished in the lower transition, were reduced to the simpler structure of the genera *Cyrtoceras*, Gyrthoceras, and a few kindred forms, with plain arched septa, like the nautilus. There is also reason to believe that the brachiopods of the transition, so different from the prevailing form of the superior strata which constitute the genus Terebratula, were, unlike the latter, denizens of very shoal water. Immense numbers lived and were entombed with the remains of terrestrial plants on the margins of islands in the carboniferous epoch. The bituminous shale of the coal measures is in some places stored with a species of *Producta* with long filiform spines, all the specimens having the two valves in their natural position, and the spines broken off from the shells simply by pressure of the superincumbent strata. They were never subjected to the action of a stormy surf, and yet land plants grew in the vicinity of the living shells; hence we infer a quiescent state of the waters around the islands of the transition eras. But one exception has been noticed, which occurs at Rochester, in a thin layer of limestone full of broken *Pentamera;* in other places, single valves of bivalves occur, but the entire shells are so remarkably abundant, that whatever may have been the force of currents originating the breccias and conglomerates, the waters were remarkably quiescent during the deposition of shales and limestones."

"The course of our investigations having resulted in the conviction, that the rocks of New York, with the exception of the upper part of the Catskill mountains, terminate with the upper Ludlow rocks of Murchison, we have an additional argument in favor of the universal nature of ancient formations, and the contemporaneous deposition of our coal strata with those of Europe. This correspondence, Professor Eaton has inferred from the identity of the fossil flora, but the proof does not end here. While the same kind of plants flourished upon the islands where now are the continents of Europe and America, the same species of shells existed in the waters which girded them. Thus in the ironstone layers beneath the coal of Tioga county, the common European bivalve, ***Producta scabricula,*** abounds just as it does at Coalbrook dale in the same rock. Specimens from both countries, if accidentally mixed, could not be separated by any mineral or conchological difference."

"Limestone containing these fossils is not of frequent occurrence in Pennsylvania or Ohio; the shells being chiefly imbedded in bituminous shale and ironstone, and in Ohio, in chert."

"1. The first group of strata, in the descending order, below the sandstone which contains impressions of terrestrial plants, consists of rocks which are seldom calcareous, and appear to be equivalent, as mentioned in my report of last year, to the Ludlow rocks of Murchison. In Mr. Vanuxem's report will be found an accurate account of the characteristic species of each group."

"2. The second group consists chiefly of limestone. Two intercalated strata of sandstone occur, characterized by a species of fucoides, which we have named *F. Cauda-galli.* No other organic remain is found in this rock. The group is undoubtedly equivalent to the celebrated Dudley limestone, the Wenlock and Dudley rocks of Murchison."

"3. The third group has been termed 'calciferous slate' by Eaton. It is a gray limestone shale, containing all the gypsum beds of the State. Organic remains are very rare, except on the Genesee river, where no gypsum occurs. The lower part contains a thin stratum of limestone, made of broken valves of a Pentamerus. This is the only instance of shells broken by attrition that has come under our observation throughout the whole transition order. Above the Pentamerus, the well known trilobite *Asaphus caudatus* is abundant. The group is equivalent to the 'dye earth' of Shropshire, which is characterized by the trilobite above mentioned."

"4. 'Saliferous sandrock' of Eaton. Red sandstone and shales occurring in the banks of Niagara river, are admirably developed at the falls of Genesee river. The organic remains consist chiefly of Fucoides Harlani, nobis (F. Brongniartii, Harlan.) Veins of fresh-water shells occur in it at Medina. I obtained very perfect casts of the hinge of the

Unio, showing the cardinal and lateral teeth so distinctly as to remove all doubt of the generic relations of the shell."

"5. The fifth group consists of olive sandstone and slate, cut through by Salmon river, in Oswego county. Intercalated strata of limestone occur in the lowest portion of the series, full of brachiopodous bivalves. This and the preceding red sandstone group correspond in geological position with the fourth group in the slate system of Wales, described by Professor Phillips."*

"6. Black limestone and shale of Trenton Falls, embracing the 'birds-eye limestone' and 'calciferous sandrock' of Professor Eaton, and the graywacke and slate of the Hudson river. The group clearly represents the 'black shale inclosing beds of graywacke, flagstone and calcareous slate, which, prolonged to the southwest, join themselves to the trilobite beds of black limestone and calcareous flagstone at Llandeilo.'† In Mr. Murchison's table, this group is termed 'Llandeilo flags.'"

"It is a curious fact, that whilst the Calymene Blumenbachii, ceased to exist in New York after the final deposition of the Trenton series, it escaped into remote seas, and lived in the era of the Dudley limestone. The Cryptolithus tessellatus, on the contrary, seems to have existed, and to have become extinct, at the same periods in the seas which deposited the rocks of Llandeilo and Trenton Falls. The plants and crustacea are peculiar to this group, and of the testacea, I have observed but two species in a superior formation; *Delthryris striatula*, and a small Orthis resembling O. crumena, but having invariably four plaits or ribs on the mesial elevation. Of the Polyparia, one only has been noticed above the present series; *Cyathophyllum ceratites*. All these fossils occur in the second group, in the limestone of the Helderberg mountain."

We are obliged to omit the illustrative catalogues of fossils and the description of new species.

Report of W. W. Mather *of the First Geological District.*

Mr. Mather remarks: "Details and facts, belonging strictly to pure scientific geology, will not be made public until the publication of the final report. The object of the annual reports is to give publicity to such facts and localities as may be of practical utility, so that benefit may be derived from a knowledge of them, during the progress of the survey."

The great mass of valuable facts adduced by Mr. Mather scarcely admit of condensation, and all we can do is to make a few selections illustrative of different heads.

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* Encyc. Metrop., article Geology, p. 568. † Ibid.

Queens, Kings, and Richmond Counties.

Peat.—This important but comparatively neglected combustible is abundant in the state of New York. Peat has been dug near Newtown, Long Island, for more than fifty years, and there is an extensive and probably deep peat marsh, called Cedar Swamp, near Jamaica: it is supposed to contain thirty thousand cords.

The inferior peats, including those of marine origin, make a valuable manure. Many of these swamps, although covered with vegetation, and it may be with moss and cranberry bushes, are soft and tremulous, and admit of having a pole run into them.

The salt marshes it appears are, in the aggregate, steadily increasing.

"A combination of several of the causes producing salt marshes, is particularly favorable to their rapid increase; such, for instance, as the alluvion washed down by streams; the fine materials swept from the headlands and carried into the bays and reenterings of the coast by the flood tide where they are deposited; the fine earthy matters, formed by the surf grinding the pebbles on the coast, being transported by the tidal currents into the bays and marshes and deposited there; the growth and decay of multitudes of marine animals; the accumulations of marine plants, drifted sea weeds, and other refuse of the ocean; and clouds of drifting sand; all of which concur to shoal the water more or less rapidly in situations where it is protected seaward by beaches and islands."

The salt marshes produce valuable crops of grass.

"The salt marshes of Suffolk county are estimated to cover an area of 55 square miles; of Queens county, 40 square miles; Kings, 12 square miles, and Richmond, 9 square miles; making an aggregate of 116 square miles, or 74,246 acres, of marsh alluvion of the south coast of New York, exclusive of the extensive marshes on the south coast of Westchester county, which would probably swell the aggregate to 125 square miles, or 80,000 acres."

Encroachments of the sea.—The maritime parts of New York, chiefly on the southern shore of Long Island, present interesting examples of tidal and oceanic action, both destructive and accumulative. Capes, headlands, and islands, are washing away,—take the following example.

"Several examples of the encroachments of the sea on the land in Suffolk county were mentioned in my first report. Others equally interesting and instructive, and as important in their bearing upon economical and topographical geology, occur in Queens, Kings, and Richmond counties. Hog Island, as it has been called, or Middle Island, the name given by the coast surveyors, is gradually wearing away in many places by the action of the waves during storms and high tides; but the N. N. E. and N. W. parts, are exposed to the waves of Long Island Sound, and are wearing away more rapidly. The materials of which this peninsula, as well as nearly the whole of Long Island, is composed, is a series of beds of sand, gravel, loam, and clay. Boulders and erratic blocks occur in one of the beds in great numbers, and as the surf undermines the cliffs, they tumble down, and all the finer materials are swept away by the tidal currents, and the oblique action of the surf on the shore. The headlands, generally, of the north shore of Queens county, are washing away. The blocks of rock which were once imbedded in the loose soil of the island are seen on the beach, extending out far beyond low water mark."

"Sands' Point, on which a lighthouse has been long built, was washing away so rapidly some years since, that it became necessary to protect it by building a strong sea-wall along the shore. A reef of rocks, (the remains of ancient lands,) extends out some distance from the shore. The wall has afforded a protection against the encroachment of the sea, and about an acre of land has been added to that belonging to the United States, in consequence of the alluvial action of the surf depositing the sand and shingle in the eddy on the south side of the point. Mr. Mason, the keeper of the lighthouse, communicated these facts, and many others of much interest. The broad and extensive sand beach, south of Sands' Point, a mile or more in length, was, since his remembrance, a salt marsh, covered with grass. Mr. Mason is nearly eighty years of age. The materials swept from Sands' Point and deposited on the edge of the marsh, have been drifted and washed over its surface.

"At and near Kidd's Rock, three quarters of a mile eastward of Sands' Point, the wasting of the cliffs from the effects of the waves is very evident. The cliffs present mural escarpments towards the Sound, but the hills slope down gradually on the other side towards the salt marsh. This elevated land was formerly an island, but alluvial causes have formed a salt marsh where the water was sheltered from the sea. The wasting of the cliffs has caused the formation of long beaches, one connecting Kidd's Point with Sands' Point, and the other connecting with the high grounds S. E. of the marsh on the W. side of Hempstead Harbor. A small inlet through the N. end of this beach allows the tide to communicate with the marsh. Boulders and blocks are seen imbedded in the strata forming the mural escarpments, and the shore below is also strewed with them. They also extend some distance from the coast, indicating that a considerable breadth of land has been washed away. The boulders protect the shore for a time, but the smaller ones and the shingle are gradually ground up by the action of the surf, and washed away, and during storms and high tides, fresh inroads are made. The beach between Kidd's Point and Sands' Point covers a part of the marsh, the ooze and marine peat of which, may be seen at the foot of the beach at ebb tide. This indicates that high land, or else a beach, was once farther seaward, to afford protection for the formation of that part of the marsh. Only a few acres of high land remain at Kidd's Point, and if it should continue to be washed away as heretofore, (and much expense would be necessary to prevent it,) a century or two would be sufficient to effect its entire removal.

"Kidd's Rock, as it is called, is a remarkable erratic block which was imbedded in the loam of the tertiary formation. It has been undermined by the action of the sea, and has slid down to the shore and cracked in many large fragments. Viewing it from a little distance, one does not realize its magnitude, but by climbing over and wandering among its fragments at low water, it seems to grow upon the imagination. Its fragments probably weigh at least 2,000 tons, and several sloop loads of it have been shipped to New York for building stone. It is hornblendic gneiss, and some of its masses abound in epidote. It is a durable stone, and will stand any exposure unchanged."

Coney island is washing away, as is the high bank near Brown's point, on Staten Island. "Here a bank of shells, about two feet thick, is exposed, within eight or ten inches of the natural surface of the ground." Mr. Mather attributes them to the natives; if our impressions are different, they are founded on similar facts which we have observed elsewhere, as in Nantucket, where a stratum of shells, but a little under the surface, extends apparently through the Island, and must have been an oceanic deposit, the last work of the tertiary epoch of that region.

Beaches are universal on the shores of Long Island, and spits are numerous.

"The beaches and spits are trifling in extent and importance, when compared with the Great South Beach of Long Island. This is a line of alluvial sand and shingle, extending from Nepeague, in East Hampton, to the mouth of New York Bay, a distance of 104 miles, and having a direction of about W. S. W. It is not continuous, but is divided by inlets communicating with the bays which are situated between this and Long Island, and through these inlets the tide ebbs and flows. At Quogue, and several places east of this, Long Island communicates with the beach, either by marshes or by the upland; but westward, for about 70 miles, a continuous line of bays, from half a mile to six miles broad, extends uninterruptedly, and separates the beach entirely from Long Island. This Great Beach is a line of spits and islands. One of the islands is about 25 miles long, with a breadth of a few hundred yards. They are all narrow and long, and when above the reach of the surf, they are covered by a labyrinth of hillocks of drifted sand, imitating almost all the variety of form which snow drifts present after a storm.

"Rockaway Neck is the only locality west of Southampton where the upland of Long Island approaches near the alluvial beach. The land through this distance is increasing in area by constant depositions. The beach at Far Rockaway, and for many miles east and west, is undergoing frequent local changes. The surf frequently washes away several rods in width, during a single storm, and perhaps the next storm adds more than had been removed by the preceding. The sea frequently makes inlets through the beach to the bays and marshes, and as frequently fills up others.

"The inlet to Rockaway Bay, called Hog Island Inlet, is continually progressing westward by the oblique action of the surf driving the sand, gravel, and shingle in that direction. The deposit of these materials on the west end of the island beach, tends to obstruct the inlet to the bay; but the strong tidal current, during the flow and ebb of the tide, washes away the east end of Rockaway beach, as rapidly as the other forms. The inlet is thus kept open. Mr. Edmund Hicks, of Far Rockaway, has been long a resident here, and to him I am indebted for the fact just mentioned. He knows Hog Island Inlet to have progressed more than a mile to the west within fifty years."

"The encroachments of the sea on the east end of Long Island, were discussed in my first annual report. Vast masses of the cliffs of loam, sand, gravel, and loose rocks, of which Long Island is composed, are undermined, and washed away by every storm. The water on the ocean coast, to some distance from the shore, is almost always found to have more or less earthy matter in suspension, much of which, except during storms, is derived from the grinding up of the pebbles, gravel and sand, by the action of the surf. This earthy matter is carried off during the flood tide, and in part deposited in the marshes and bays, and the remainder is transported seaward during the ebb, and deposited in still water. After a close observation, I have estimated that at least 1,000 tons of matter are thus transported daily from the coast of Long Island, and probably that quantity on an average is daily removed from the south coast, between Montauk Point and Nepeague beach. This shore of 15 miles in length, probably averages 60 feet in height, and is rapidly washing away. One thousand tons of this earth would be equal to about one square rod of ground, with a depth of 60 feet. Allowing this estimate to be within the proper limits, more than two acres would be removed annually from this portion of the coast. It is probable that any attentive observer would not estimate the loss of land there at less than this amount. Nearly one half the matter coming from the degradation of the land, is supposed to be swept coastwise in a westerly direction.

"There are many evidences that the east end of Long Island was once much larger than at present, and it is thought probable that it may have been connected with Block Island, which lies in the direction of the prolongation of Long Island. From Culloden Point, a reef of loose blocks of rocks projects similar to those points on Hog Island, Oak Neck, &c. where they are known to result from the degradation of the land. Jones' Reef, N. W. of Montauk Point, is similar, and Shagwam Reef, a little farther west, projects three miles from the shore. It is ascertained that black fish (Labrus tautoga—Mitchill) are rarely found except about a rocky bottom. It is also known that such a bottom of loose blocks of rock is found wherever the natural soil of Long Island and the adjacent islands, has been washed away by the sea. These facts, with the well known extensive fishing grounds for black fish around Montauk Point, and particularly on the south shore, and between Montauk Point and Block Island, give much probability to the idea, that a great extent of land has been washed away by the sea.

"Even if these evidences were insufficient, the present rapid degradation of the coast in that vicinity, the constant transportation of matter westward upon the Great Beach, and the extent of this beach, (more than 100 miles long, with a breadth of 100 to 1,000 yards,) which is the result of this action, would by most minds be deemed conclusive."

Erratic Blocks.

They are the only wall and building stones on Long Island and the contiguous islands, with the exception of a small tract of gneiss in a place near Hurlgate. The boulders of Long Island are rarely found south of the hills, but on the north side are found both imbedded and on the surface. Many of them weigh 50 tons or more; the fragments of Kidd's rock weigh 2,000 tons or more; a rock called Millstone near Plandome was estimated at 1,800 tons. Limestone blocks weighing from 1 to 5 tons, near Sands' Point, are exactly like the limestone of Barnegat, on the Hudson, in Dutchess county many miles to the N. W.

On Staten Island a boulder, filled with fossil shells, was dug from a well; it resembled the limestone of Buroft's mountain, near Hudson. A similar boulder from another well in the same island, was like the limestone of the Helderberg, west of Albany. It appears, then, that the boulders came from the W. and N. W. and some of them hundreds of miles.

Sands, white and siliceous, are exported largely from the great south beach to New York and the interior, for sawing marble, making glass, &c.

Bricks.—300,000 to 350,000 are made annually near Jamaica.

Water is not abundant on Long Island, and is not permanent on account of the porous nature of the strata, except at about the ocean level. On Hempstead plains the wells are dug from 60 to 120 feet, through beds of gravel and sand, before water is reached. On most of the farms on Long Island, basin-shaped cavities are made in the soil, puddled with clay, and filled by the rain water; they are called watering holes.

Fossil shells and lignite are often found in digging wells on Long Island.

The soils in Queens, Kings, and Richmond counties are dressed with the sand, and the light soils with loam or clay, to produce a soil at once pulverulent and argillaceous, penetrable by roots and retentive of moisture.

Near New York city, many farmers expend from $50 to $70 per acre for street manure, which, with that of the yard composts, mixed with lime, rotten sea weed, ashes, barilla, bone manure, and fish, is in common use.

Lime answers well on the light soils of Long Island and New Jersey, and costs at Barnegat 6½ cents a bushel.

The Clupea Manhaden of Mitchill, (Bony fish, Hardhead, or Marshbanker, or White fish,) is very abundantly used for manure. 100,000,000 are said to be used annually on Long Island.

Marls.—There are immense bodies in the State of New York, particularly in Columbia and Dutchess counties,—in one lake 100,000 loads of fresh-water shell marl, and on a small island in it, many bushels of Uniones and Anodontas were seen in piles, having been carried there by the muskrats.

There are also vast accumulations of peat in places too numerous to be cited, and containing many millions of cords.

Marbles.—It is impossible even to name the numerous places where good workable marble is found; that of Hudson was described in this Journal, Vol. VI, p. 371.

The *primary rocks* we pass without a remark.

"*Iron Ores.*—The iron ore of Columbia and Dutchess county is very abundant, and makes iron of the best quality. The mines are numerous, and in general they are easily worked and free from water. The ore consists principally of limonite, which varies in its state of aggregation from a yellow pulverulent mass to a compact brown ironstone. It is mammillary, botryoidal, spongiform, and with stalactical shapes, some of which have hemispherical and others acicular terminations, others are like bunches of pendant moss. The solid stalactical forms are fibrous, with radii diverging from the center. The specimens are beautiful, and highly ornamental as curiosities and as minerals. The mines yield an aggregate of about 20,000 tons of ore per annum, which is worth at the bed $1 50 to $2 50 per ton. There are ten furnaces, it is said, within twelve miles of Amenia, which make, in the aggregate, about 10,000 tons of iron per annum. They afford employment to about one thousand men as ore diggers, coal men, teamsters, smelters, limestone diggers, &c. Some of these furnaces are in Connecticut, near the line, and it is about as well for New York as if they were within her own limits. All the iron is carried to the Hudson River, and then shipped to various parts. There are two furnaces in Columbia and Dutchess counties not included in the above number, viz. Ancram and Hopewell furnaces. It is estimated that the aggregate annual value of the pig iron made at these twelve furnaces, is $400,000 to $500,000 per annum. Manufactories of malleable iron in various forms, are attached to some of these furnaces, as the Columbia furnace in Kent, the Ancram furnace, and some others. The malleable iron from these furnaces is highly valued for its toughness and softness, and is extensively employed in making anchors, musket and pistol barrels, wire, &c."

"The Amenia and Salisbury ore beds are the most extensively wrought of any iron mines, of this kind, of ore in the United States, and the iron from these beds is considered superior in softness and toughness to that of any other mines in the country.

"The Amenia ore bed yields 5,000 tons of ore per annum, which gives on an average 50 per cent. of pig iron. The mine is worked to the day like an open quarry. A layer of earth and gravel, and broken rocks, covers the ore from five to twenty feet in thickness. This is first removed, and the ore then excavated. They have not yet found the bottom of the ore in any place, although in one pit they have excavated into it 45 feet. It improves in quality the farther they descend. No estimate can be formed of the amount of ore in this bed, which probably unites with the others north and south of it. Estimating its breadth at 100 yards, and its length at 1,000 yards, with 15 yards depth, through which it is open, it is capable of yielding 1,500,000 tons of ore, and at the present rate of working will last 300 years."

Report by E. Emmons, *of the Second Geological District.*

The county of St. Lawrence is 2,717 miles square—larger by 1,000 miles, than any other county in the State; shape triangular—the line on the St. Lawrence being 65 miles long. The observations on the soils of this district, scarcely admit of abbreviation; this is justly treated as an important topic in the various reports. The account of the primitive and other rocks contains many curious and interesting facts, which are illustrated by good wood cuts.

Granite occurs in three modes. 1. In large irregular beds, or protruded masses. 2. In veins branching irregularly into the adjacent rock. 3. In overlying masses, analogous to overflowing lava currents or greenstone. This statement is in accordance with the facts now ascertained to be so numerous in other countries, containing granite, and it appears impossible to explain them without admitting the igneous origin of the rock.

Limestone has not been admitted into that family of rocks, although it is conceded that it has often been greatly altered by fire —altered in situ, even to the obliteration of organic remains and the production of a crystalline structure, while the carbonic acid has been retained by the pressure of superincumbent masses. The famous experiments of Sir James Hall, especially on the fusion of carbonate of lime under great pressure, without losing its carbonic acid, are still very precious to the theory of the igneous origin of many rocks and even of limestone itself. We can easily imagine what exultation would have been produced in the minds of Hutton, Hall, Playfair, and the other eminent advocates of great igneous action in the interior of this planet, could they have known such facts as Mr. Emmons has presented to us respecting limestone.

He is evidently of the opinion, that this rock is not always of aqueous origin and stratified, but that it has been melted and injected in the manner of the igneous rocks. Granting this to have been true, it does not of course follow, that it was not, at least in various cases, of aqueous origin, for fire may melt and inject such a rock as well as any other, and where there are organized remains, water must of course have been the agent of deposition.

Among the facts as to the position of limestone, the following are remarkable. At Holesborough, the limestone, 20 feet wide, traverses a bed of sienitic granite east and west; it is also beneath the granite and projects upward into it in a triangular mass. In Lyndhurst, Upper Canada, the same fact exists, and the limestone is interspersed among the granite. At Gouverneur there are, near the celebrated locality of phosphate of lime, veins of limestone intersecting granite, and branching off from each other; in other cases the veins of limestone alternate with granite. There is in Harmon, near Tales, one lead ore vein a foot wide. There is also a bed of limestone with angular masses of primary rocks projecting from it, and such instances are common. The limestone and granite are in general perfectly distinct, but sometimes they are blended.

The frequent occurrence of plumbago in primary limestone is thought to favor its igneous origin, since it is so often produced by furnaces.

In the vicinity of limestone, quartz is rounded as if from heat, and is converted into hornstone.

Mr. Hall is of the opinion that the limestone of this region is not stratified, and that its veins branching especially from below, have the same evidence of igneous origin as those of granite and trap.

Serpentine of great beauty, some of it being verd antique and soapstone, occurs in this county.

Specular iron is found, and the hearth stones when it is smelted have afforded crystals of metallic titanium. There is also bog ore in abundance.

Lead has been explored at three places in this county—the Rossie, the Black Lake, and the Wilson vein.

"The rock in which these veins are found is gneiss, interlaminated with hornblende. The gangue is carbonate of lime, coarse and crystalline, with druses of beautiful calcareous spar. The dip is nearly vertical, slightly inclining to the north, as may be seen by the diagram exhibiting a view of the eastern termination of the vein, as it was when first exposed by the removal of the rubbish concealing it. The whole width of the gangue is four feet. The whole depth to which the mine has been worked, is 100 feet. At the depth of 40 feet, the average width of the vein of lead, is 2½ feet; at 80 feet, 3 feet; and at 100 feet, 3½ feet; showing a gradual increase in width. It is to be understood, that there is not a width of solid galena of 3, or even 2 feet; but the width at which the lead appears in the vein of spar, is as stated at the various depths. It is every where more or less intermixed with the gangue, even when it is the richest. It is considered, that a vein, 1 foot in width, having the proportion of lead, will pay a fair profit by working. The ore is reduced on the ground, or not far from the mines. The quantity of lead, manufactured since the first of January, 1837, amounts to 2,029,415 pounds. In conducting this process, it is found that dry pine answers a good purpose in smelting. It is a matter of some doubt whether it is as good as coal, especially coal of the hard woods. Still, there is economy in its employment under many circumstances."

"On the Black Lake, at Mineral Point, is another mineral region of some note. The principal vein, at 25 feet from the surface is 2½ feet average width. This resembles very much the Rossie vein, and has turned out some large crystals of lead, similar to those produced at the Nash vein."

"In the other veins of galena, which have been explored to the greatest extent, and which have yielded the most, there is a remarkable freedom from minerals of inferior value, or the sulphuret of zinc and iron, especially the latter. This is a favorable circumstance, and accounts for the great softness of the Rossie lead. This increases its value, as it is more readily converted into white lead.

"An examination of the country, in the vicinity of Rossie, must satisfy any one that it has the character of a mineral region, and that there is much probability that we have but just commenced in the mining business, and that there are many other deposits of lead to reward explorations."

The sandstone of Potsdam reposes on the primary, and appears as the oldest member of the transition series; it is a very valuable quarry stone for building, and for a fire stone.

The geological structure of the opposite shores of the St. Lawrence is very similar, but the strata dip in an anticlinal direction, so as to form the valley in which the river runs.

Temperature of wells,—they afford interesting evidence of the state of the climate.

"The following table exhibits the temperature of the wells and springs along the junction of the transition and primitive districts.

"The temperature of two wells in Hermon:

1st.	52 feet deep,—temperature, - - -	45° Fah.
2d.	20 " " - - -	43° "

"Of two wells in De Kalb:

Temperature of the air 75°, *July* 20, 1837.

1st.	Temperature, - - - - -	44° Fah.
2d.	18 feet deep,—temperature, - - -	41° "

"Of six springs in the village of De Kalb:

1st,	- - - - - - - -	45° Fah.
2d,	- - - - - - -	48° "

3d, - - - - - - - -	48° Fah.
4th, shaded, - - - - - -	46° "
5th, open, - - - - - - -	48° "
6th, - - - - - - - -	40° "

"The springs, the temperature of which I have given, all gush out in the valley in which the village of De Kalb is situated. They properly belong in the class usually called *mineral springs.* Abundance of tufa, oxide and carbonate of iron are deposited on the margin of some of the springs.

Temperature of air 75°, *July* 10, 1837.

"Temperature of two wells in Fowler:

1st, open and exposed, - - - -	50° Fah.
2d, - - - - - - - -	45° "

"Of two wells:

1st, - - - - - - - -	45° "
2d, 15 feet deep, - - - - -	44° "

"Temperature of a covered well 15 feet deep, in Gouverneur, 47°, air 75°, July 16."

The average temperature of thirteen wells was 44° F., which is very low, but the latitude is between 44° and 45° north.

County of Essex.

Surface, mountainous—steep and abrupt—on one side the hills and mountains usually perpendicular, lofty and often pointed in peaks.

The formations are,—1, the primary, embracing granite and gneiss; 2, the transition; 3, the recent tertiary (pliocene of Lyell.) The rock here called granite is composed chiefly of feldspar and hyperstene; the formation being thirty miles wide. In the most perfect specimens of the Labradorite, there are two colors, blue and green, and bronzed in weathered pieces; the colors are very numerous, often of surpassing beauty, and polished pieces are truly gems. The slabs of this rock would form beautiful architectural ornaments.

Iron ore exists in vast abundance in this rock; in Moriah a tract of thirty to forty acres is underlaid by iron at the depth of a spade, and there are numerous beds and veins in the vicinity, forming collectively an immense mass of iron ore. It sometimes branches in the rock like granite veins.

Dykes.—"The mineral character of the dykes may be reduced to four kinds;—1, a well characterized greenstone, with oval cavities, which have been filled with chlorite or carbonate of lime; 2, a compact amphibole, or hornblende; and 3, sienite, or a compound of feldspar and hornblende; 4, a reddish porphyry, in which the crystals of feldspar are small and indistinct. They pursue an easterly and westerly course, and extend a great distance; and, indeed, I have not been able to ascertain their extent in a single instance. This is owing partly to the wooded state of the country. The largest of them is at Avalanche Lake. It is 80 feet wide, and cuts through Mount McMartin, nearly in its center. The gorge formed by the breaking up of this dyke extends entirely or nearly to its summit. A portion of the northern face of the wall may be seen from lake Henderson, a distance of five or six miles. This gorge exhibits, on a large scale, the powerful effects of frost and water, in breaking up the solid crust of the globe. In it are rocks from 50 to 100 feet in length, broken up from their original beds, and carried partly down the declivity; they lie in confusion in all directions, and constitute together a mass of ruins from the base of the mountain to its summit."

In the sandstone of Essex there are ripple marks at the depth of seventy to eighty feet in the sandstone, which, with that of Potsdam, is a part of the grauwacke formation of Europe.

The tertiary formation of Lake Champlain presents some interesting features. Mr. Emmons inclines to the opinion that Lake Champlain, which is ninety seven feet above the ocean and more than six hundred feet deep, was formerly connected with the Hudson on the one hand, and the St. Lawrence on the other. The tertiary deposited when this connection existed, rises in Vermont 200 feet above the lake, and there is reason to suppose, may belong to the same era with the beds on the Hudson. Many good reasons are given for this opinion, and it appears that the ocean overflowed here, as the rocks are deeply water-worn in continuous channels, particularly at West Port, towards Essex, and marine shells are found in the tertiary beds of Essex county and of Lake Champlain, although absent from those on the Hudson. The tertiary strata appear to have been brought into day light, not by drainage, but by an uplift of the land, and there are indications that this is one of the most recent of the tertiary formations.

Mountains of Essex County.—Mr. Wm. C. Redfield gave an interesting account of these mountains in Vol. XXXIII, p. 301 of this Journal. The following citations from the report may, however, be interesting.

"The group, taken as a whole, is more lofty than the White Hills of New Hampshire, though the main summit, Mount Washington, exceeds Mount Marcy by 767 feet; for there remain unmeasured many peaks which will exceed or come up to 5,000 feet, besides those now given in the table."

The heights of the mountains as given in this report, are substantially the same as those stated by Mr. Redfield, Vol. xxxiii, pp. 311—320 of this Journal. It appears that Mount Marcy, the highest mountain, is 5,467 feet above tide, or 267 feet above one mile. Mount McIntyre is 5,183 feet, Dix 5,200, and Dial mountain 4,900; thus four of these peaks differ little from one mile in elevation, while Mount Washington, in New Hampshire, is nearly 800 feet higher than Mount Marcy, and therefore maintains its rank as the highest peak east of the Rocky Mountains.*

Variation of the Magnetic Needle.—This subject, not provided for by the law of the State authorizing the survey, has attracted the attention of Mr. Emmons and his associate, Prof. Hopkins, of Williams College, who makes the following remarks respecting the influence of iron, particularly in this district:

"The extensive iron deposits, which were noticed in the report of the last year, constitute one of the most interesting features in the northern geological section of the State. Considering the importance of these deposits in an economical point of view, nothing which may serve to throw light upon their value or extent, can be regarded as irrelevant to the purposes of this survey. In the present instance, there appears to be a mode of establishing some general conclusions, at least, to which a clue could not be furnished by those indications on which the geologist ordinarily relies. This is to be found in the influence of large ferruginous masses upon the magnetic needle. Deposits, far less extensive than those which abound in Franklin county and Essex, are known to exert a local attraction, sufficient to derange the general directive tendency of the needle, and render it entirely useless as an index to the true meridian. Nor would it be at all surprising, even where no local derangement might be apparent, should the needle be found to deviate some minutes, or even degrees, from the true magnetic north. Such a deviation, ascertained by experiment at different points, might furnish a valuable criterion by which to judge of the proximity of iron, of the direction of the bed or vein, and perhaps its extent. This might especially be expected, were much of the iron (as is the case in this district) of that kind known under the name of the *magnetic oxide.*"

"The variation of the needle in this country at present is *west*, at all points east of a certain line, called the *line of no variation.* This line traverses the western and southern states, and appears itself not to be stationary. East of this line, the variation is increasing; at least this is

* This rank is now claimed for the Black Mountain, in North Carolina; height 6,476 feet. See this Journal, Vol. xxxv, p. 379.

proved to be the case at several points where experiments have been made.

"At Williams College, in 1833, the variation was 6° 15′ W.
" " 1837, " 7° 45′ W.
Showing an annual increase of 22′ 30″.

"The results annexed are deduced from observations made upon the pole star at its greatest elongation, and upon the sun at equal altitudes.

"The first station selected was at Crown Point, about two miles south of the old fortification. As no deposits of iron are known to occur near this point, it was imagined that the needle would be nearly free from the influence of local attraction. The variation from the pole star, at its greatest eastern elongation, was found at this place to be 10° 57′. Making the necessary corrections, we shall find the variation of the needle from the meridian to be W. 8° 47′. This reduction supposes the latitude of the station to be 43° 55′, which can vary but little from the truth. The next observation was made at Cedar Point, near Port Henry, about six miles N. W. from the former station. Variation at this point, 9° 28′. At Moriah Four Corners, about two miles west, 10° 10′. Proceeding still west, to a small pond, estimated at about six miles from the Corners, on the main road to West Moriah, the variation was found to be 7° 18′. The next observation was made at Weatherhead's inn, in West Moriah: variation, 7° 1′.

"By comparing these results, it will be perceived that the variation increases from Crown Point to Moriah Four Corners, and from thence decreases to Weatherhead's, estimated at about 13 miles west of the Corners; so small a number of miles occasioning a deviation of 3° 9′. It will be perceived, also, that at East Moriah (Four Corners) the variation is greater than is due to the general influence of the earth. We should be led, therefore, to infer the existence of some cause of local attraction between Weatherhead's and the Corners, and probably in the vicinity of the latter place, as the variation at Weatherhead's is nearly that which is due to the earth's influence, on that meridian."

Mr. E. ascended a mountain in West Moriah, nearly as high as Mount Marcy. In the woods on their way, they found the variation to be 8° 16′ W. On the top of the mountain, the variation was 9° 33′, indicating a disturbing influence in the region still farther west. It is justly observed that

"The connexion of magnetism with geology, is more intimate than it may appear to be to persons who have not informed themselves of the progress and present state of the sciences. In evidence thereof, it may be stated, that magnetic, and electro-magnetic powers, are active in disposing and arranging the materials composing the crust of the globe; their action, however, being more particularly proved in the transfer of metallic matter, or in other words, the operation of these forces furnishes us with one mode of explaining how mineral veins have been filled."

It is obvious, that the report of Prof. Emmons includes many valuable facts and sound conclusions, which cannot be fully appreciated, without an attentive perusal of the entire document.

Third District—Counties of Montgomery, Herkimer, Oneida, and Oswego.—By Lardner Vanuxem.

This tract stretches from Lake Ontario easterly almost to the Hudson, nearly crossing the State. It is particularly important, from the uplift which a part of its strata have undergone, to form the valley of the Mohawk.

"The series of rock which forms the third district, from the Pennsylvania line to the primary elevated region which separates the waters of the Hudson from those of the St. Lawrence, inclines at a small angle to the southwest, giving rise to that all important practical consequence and fact, that every change of rock going north from the Pennsylvania line to the limits mentioned, brings us to a lower and an older rock; and on the contrary, every new or different rock we arrive at going south, carries us higher in the series, or nearer to the newest, the coal of Pennsylvania, the final member of the great consecutive series of rocks of our portion of the North American continent.

"The different groups, or series, or formations, of the third district, have not all extended continuously over the limits mentioned, but appear, like the coal of the State mentioned, to have been restricted in their progress north within certain limits, by a well defined east and west line.

"From the coal series to the Mohawk valley, the restriction or limit has been confined, so far as observations have been made, to a single series or group; but at the Mohawk valley, throughout Herkimer and Oneida, no less than five series terminate more or less abruptly, according to locality, giving rise to that great depression, the Mohawk valley, or conversely, the high range or great elevation which in these two counties, and to the south of Montgomery, rises for a thousand or more feet above the river.

"The valley of the Mohawk, therefore, forms in all that part which traverses the three above named counties, an all important geological line of division. A high and an abrupt elevation, caused by the appearance of the northern edges of the rocks of which it is formed, characterizes the southern side of the valley; whilst the northern side, being in general formed of the inclined planes of the surfaces of the rocks which pass under and support those of the great escarpment, presents nothing in common with its southern border.

"The rocks, whose appearance commences in the bottom of the valley, and which extend north, are the black shale, (with its overlying green shale and sandstone,) the Trenton limestone, the bird's-eye, the calciferous sand-rock, and the gneiss. The arrangement being in the descending order. Thus the black shale, relatively to the four other rocks, is invariably the upper one, whilst gneiss is as invariably the lowest.

"The black shale, the Trenton limestone, the bird's-eye, and the calciferous, in their course north from the river, at different points, disappear, finally leaving the gneiss, the oldest rock of the district, to form with its primary associates, the great northern elevations, and to cover the greater part of Montgomery, about three fourths of Herkimer as to length, and that part only of Oneida county which forms the town of Remsen, including that small triangle in the town of Boonville, which lies to the east and north of Black river."

There is in this region the most decisive evidence of uplifts, "by an action from E. to W. in accordance with the general character of the great uplifts of the globe, namely, the eastern sides being mural, whilst the western slope off, becoming more or less horizontal. Thus, in the valley of the Mohawk, the uplifts have been invariably protruded through the black shale, at their eastern ends rising like a wall, whilst their western ends gradually slope off, and are lost in the same black shale, which, when the whole series is complete, forms the upper parts of the uplifts, and lies by the side of the gneiss to the east, curving from a horizontal surface towards that rock." Along the Mohawk, there are three great ranges of uplifts; one of them is well known under the name of the *noses*, and exhibits the whole series, from the gneiss upwards. These uplifts have disclosed many excellent quarry stones, and among them there is the bird's marble, so called from the fucoides or sea weed which it contains, being in a vertical position, while in all the other rocks it is disposed parallel to the layers.

The calciferous sand-rock, consisting of sand and lime, often contains siliceous concretions, and among them are rock crystals containing anthracite, the latter derived probably from the fucoides or sea weeds, the only common fossil of this rock.

Mr. Vanuxem supposes, that thermal waters have affected the separation of the coal. These waters he believes to have had their origin in the calciferous rock, and he refers to it the thermal waters of North Carolina, Virginia, the Hoosick, and the Arkansas.

In Herkimer County, there are beautiful rock crystals at Middleville; they are numerous, and, except when they contain some foreign substance, as anthracite, are very perfect both in form and transparency.

In certain shales and sandstones, there are in this county rich beds of iron ore, usually red and oolitic; there are in different situations, one to two or three beds of the iron ore, and it appears to have been deposited as an ore, when it met with an impervious stratum; and when the latter was pervious, the iron was absorbed and colored the rock.

In a sandstone in the town of Starke, *gypsum* was discovered in mining for silver; this gypsum is here white, both before and after calcination.

The water limestone series occurs in thin layers, rarely more than 2 or 3 inches thick, of a uniform drab, and effervescing with acids.

"In the limestone at the Falls of Niagara, and of numerous other places, and in some of the water limes below that limestone, there is at the separation of the layers a singular columnar appearance, presenting itself at right angles to the layers, extending unequally as to length, bearing no small resemblance to the sutures of the skull. When examined they show the impress of a parallel fibrous or striated appearance, which is almost invariably covered with minute scales of coaly matter. In vain I sought last year for the cause of this common appearance. In examining the upper layers of the water lime in Herkimer, the difficulty was solved: specimens were discovered with the striæ, and with carbonate of lime in minute fibres as to thickness, but not in length, clearly proving that the phenomena in question were caused by the crystallization of a saline substance in fibrous crystals at the joints of the rock, analogous to those beautiful productions which all are familiar with, namely, the congelation or crystallization of water in loose and spongy soils. This explanation meets its confirmation in a specimen recently examined, which I brought last year from the Falls of Niagara, in which the striated appearance is finely exhibited, the specimen being exceeding fresh and unaltered; on the top of the black or carbonaceous coating there are two small groups of fibrous sulphate of magnesia, which the force of crystallization has ejected since being in the cabinet, to the height of a quarter of an inch, and for want of a support the ends coil over, as we find in the black part of the banks of our ditches and other low grounds.

"From finding last year the sulphate of magnesia with common salt as an efflorescence, below the upper falls at Rochester, and knowing that the fibrous form is the most common crystalline appearance of Epsom salts, I am disposed to believe that this mineral is the parent of the phenomenon in question, the cause of which has been no small perplexity to others as well as to myself.

"The carbon which invests the striæ was a subsequent action, probably a deposition from the same water which dissolved the mineral, analogous facts being familiar to chemists."

"*Upper limestone.*—The last of the series but one of the rocks of Herkimer county, is the upper limestone, embracing the cornitiferous, the geodiferous and the calciferous masses of Prof. Eaton; distinctions highly characteristic to the western part of New York, but of no application in this; the fossils, relative position and general composition, being the primary characters. In the abundance and great variety of lapideous fossils, such as sea shells, corallines and crinoidea, we are presented with a character which strongly contrasts with the water limestone, the red shale, or any of the lower masses, with the exception of the Trenton limestone and the shales of Salmon river. In this limestone there is a more determinate arrangement of the different fossils, a creation as it were by families, than is to be found in any of the preceding rocks. Thus different species occupy different layers, each in countless myriads, and extending over a considerable extent of country. A whole race, seeming to be limited to a few contiguous layers, disappearing with those layers; to these other fossils succeeded, they in their turn giving place to a new creation, and for many repetitions during the deposition of this rock."

At Trenton Falls the limestone is upwards of one hundred feet thick; the name, Trenton limestone, is in various places applied to the dark, almost compact limestone, and to the light gray or sparry, the latter made up of the remains of crinoidea, besides other fossils. The Trenton limestone is capable of furnishing rare and beautiful black marbles, adorned with the remains of extinct races of animals. The sandstone, called in Eaton's survey of the Erie canal saliferous rocks and gray band, is "thickly covered with fucoides, successive growths of these plants seeming to have been destroyed by the successive irruptions of mud, giving rise to the green shale that covers them."

The red iron ore appears abundantly in Oneida county, in the above named rock, and is mined in many places; its structure is oolitic, or like wheat grains, or elongated sugar plums, frequently containing the joints or disks of the encrinite, fragments of Trimerus, and more rarely Orthis. The beds of this ore are from twelve to twenty inches thick.

Calcareous tufa is extremely common in these counties, as are immense series of water limestones.

Lime is very abundant in this region, and will supply to its agriculture that indispensable ingredient of a fertile soil without which cultivation cannot be permanent. The rocks of this district are *gneiss* at the bottom, much water-worn; *calciferous rock*, reposing unconformably on the gneiss but much posterior in geological age, many rocks formed elsewhere between, being absent here.

Bird's-eye limestone, its beauty being due to the vertical stems of the Fucoides demisus. *Trenton limestone*, its fossils are very numerous; in this are found the well known trilobites, Calymene, Isotelus, &c. *Black shale* forms the floor through which the other rocks have been thrust; abounds in fucoides, &c.; contains no fragment of other rocks. *Green shale and its sandstones.* The upper layers abound with fossils, as Pterinea carinata, modiolario, pholadio, Productus planulata, &c. &c.

Millstone grit, formed of pebbles of glossy quartz; water-worn. *Protean group*, two hundred feet thick; shales and sandstones of many colors, abound in fucoides, crustacea, &c. *Red shale*, no fossils. *Water lime*, no fossils; drab color; thin layers. This rock, with the limestones above it, has furnished all the calcareous tufa of Oneida and Herkimer. *Upper limestone* forms the elevated plain south of the Mohawk; has many fossils, and among them are trilobites. *White sandstone.*

Pyritiferous rock.—This rock is remarkably subservient to man's primary physical wants in agriculture and building, and to his intellectual in geological science, while there is little incentive to mining.

It is probable that these formations have arisen from similar causes with their supposed European equivalents, soon to be illustrated by Mr. Murchison's great work on Wales.

Fourth District, comprising eleven or twelve counties lying on Lake Erie, southern shore, east of Niagara, west of Cayuga, and north of the southern tier of counties; by JAMES HALL.

This district was principally surveyed by Mr. Conrad and Mr. Vanuxem; but some notices may be added respecting its scientific and economical geology.

The rocks are principally limestones, shales, and sandstones. There are no anticlinal or synclinal lines, no appearances of a disturbing force in the line of bearing, the outcrop and elevation being very uniform. The soil is eminently calcareous and fitted for wheat; there is great facility of transportation; much excellent building stone, and a stratum of rich iron ore for twenty or thirty miles.

On the question of coal or no coal, Mr. Hall remarks:

" To those unacquainted with the true character of the coal formation and the relative position of these rocks, there are, indeed, some appearances that would indicate the presence of coal. Bituminous matter, or petroleum, is present in all, except the lowest rocks of the district,* and when we come to the shales above the mountain limestone, thin seams and disseminated particles of highly bituminous coal are of frequent occurrence. The escape of inflammable gas, and the odor of bitumen which accompany most of the rocks, are considered as evidences of coal at no great depth below the surface, and under this erroneous impression the diggings or borings for coal have been undertaken. Although there is no necessary connection between coal and petroleum, yet the presence of this substance and the escape of inflammable gas from so many points in the different rocks is truly remarkable, when we consider that these rocks are so far below the slates and sandstones of the coal formation. It would appear that the causes which produced the bituminous character of the coal of Western Pennsylvania, were in operation at the time the lower rocks were deposited.

" Whatever cause we please to assign for the production of this bituminous matter, we shall readily perceive that it is not essentially dependent upon coal, and that its presence in that mineral is rather accidental than otherwise. The presence or absence of bituminous matter as characterizing different ages or formations of coal, is worthy of little reliance. We here find rocks of great thickness and extent, containing so much bituminous matter as to render its presence observable on percussion; and cavities are often found filled with petroleum. Some of the shales contain so much of this substance that they will ignite; and yet all the fossil vegetables are a few species of Fucoides, the prevailing fossils in all these rocks being marine Testacea. The same rocks, too, that in our district are bituminous, in the eastern part of the State are entirely destitute of this substance: and in the latter place bear the same relation to

* The red marl and sandstone I have not found to be bituminous, though inflammable gas (carburetted hydrogen) issues from the rocks of this formation in many places along the Erie canal, between Middleport and Gasport, Niagara county.

the anthracite that the former do to the bituminous coal of Pennsylvania. I assert this from having carefully observed all the rocks, from the carboniferous or mountain limestone of the Helderbergh, (*not bituminous,*) to the anthracite coal mines of Carbondale, Wilkesbarre, Plymouth, &c. Pa.; and from the same limestone of Black Rock, (highly bituminous,) tracing its connection with the coal of the northern counties of Pennsylvania. The fossil vegetables of the two coals are, many of them, identical, and if they were not it would be no argument in favor of different ages, for in the different or successive beds of anthracite, in the same neighborhood, we almost always find different species of ferns and other fossil plants.

"In general, each bed of coal is characterized by some species of fern, which prevails in that one more abundantly than in any other. I feel confident that further examinations will prove the identity of the bituminous and anthracite coals, which, by some geologists, have been considered as distinct formations."*

Mr. Hall regards these rocks as passing below the proper coal formation of Pennsylvania; fine sections are presented along the Genesee and other rivers, so as to expose the stratification in vertical walls, from two hundred to three hundred and fifty feet high. These rocks are regarded as being above the Silurian system of Mr. Murchison, (transition,) and as belonging to the old red sandstone and carboniferous groups, and therefore below the coal, four thousand feet, according to the section which has been delineated.

While we cannot but admit the soundness of the general conclusions of the New York geologists, we have had occasion to observe during several visits to Alleghany county, on the borders of Pennsylvania, the still unimpaired conviction on the minds of the most intelligent inhabitants, that coal exists along that line, both in the state of New York and in that of Pennsylvania; but we have never had opportunity to visit the places where on the most credible testimony it is said to exist.

The falls of the Genesee river at Carthage, below Rochester, are excavated in sandstone, limestone, and shales, the latter abounding in beautiful fossils. The most remarkable falls are at Portage, forty miles above, where in three leaps of sixty six, one hundred and ten, and ninety six feet, the river descends two

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* Prof Eaton, in his geological text book, published in 1832, suggested that the anthracite and bituminous coals were of the same age, but this appears to have been overlooked by those who have examined this formation.

hundred and seventy two feet within a mile or two. The banks are vertical, presenting the most beautiful sections, and being forest clad, principally with evergreens, the scenery is in a high degree grand and picturesque; at the deepest place the perpendicular banks are three hundred and fifty one feet high.

Proofs of marine currents.—Near Lockport a sandstone "is quarried for flagging stones; it divides into layers of from half an inch to four inches thick. The Lingula are discovered at this quarry, on the surface of different layers, from two to five feet below the top of the stratum. As the layers are removed, these Lingula present a singular appearance, having their mouths all arranged in the same direction, and appear to be disposed, at regular intervals, over a great extent of surface. The direction of the mouth is to the S. E. by S., and the beaks in the opposite direction, or N. W. by N. There is a little ridge of stone extending from the beak, and gradually sloping down to the regular surface of the rock, like a deposit of sand, before some obstacle in a current. On each side of the mouth, or widest part of the shell, there is a depression, evidently produced by the current, and corresponding precisely with what we observe where a current of water meets an obstacle, as it would in this case, in the Lingula attached to the sandy bottom. Their mouths were, doubtless, in the direction from which the current came, for the purpose of obtaining food. It is impossible to avoid the conclusion, that the surface of each of these layers was once the original surface of the sandy bottom of an ocean, covered with living shells, over which a gentle current flowed. There appears to have been a considerable interval between the deposition of one stratum and the next, for we find several successive layers with the Lingula arranged in this manner; and I have never seen them imbedded in the rock, or in any position than the one described.

"The direction of the current is pointed out by the ridges extending from the beaks of the shells, and we thus have evidence of its course in the sea, from which this rock was deposited, as well and as certain as of the diluvial current from the scratches on the surface rocks, or of a recent current from its action on a soft and yielding bed of sand or clay."

In a stratum of iron ore which appears at various places between Little Falls and Niagara, the ore is in some places composed of fragments of encrinital columns and of corallines, with Producta catenipora, &c., all of marine origin.

Hydraulic cement.—Mr. Hall remarks that there is no rock to which the term hydraulic cement is exclusively applicable; the upper strata of the gypseous formations are used for this purpose, and also the silico-argillaceous portions of many limestones; he adds, that substances are in various places used as cement which are inferior to common mortar; and moreover, that one million of dollars have been lost in the construction of the Erie canal from the choice of bad materials.

The geodiferous limestone of Prof. Eaton "is well characterized at Lockport and at Niagara falls: farther east it loses the geodiferous character, and diminishes in thickness. The rock is regularly stratified, compact, of a gray, bluish gray or brownish gray color. It is sufficiently distinguished from all other limestones by its finely granular texture, presenting on fracture numerous shining points: the lustre is vitreous, or resinous. The resinous lustre is produced by bitumen, which colors the small crystalline laminæ. The most striking feature of this rock, in the localities referred to, is the numerous cavities, or geodes, many of them filled with anhydrous gypsum, or lined with crystallized limestone or fluor spar. The beautiful specimens of dog-tooth and rhomb spar, with sulphate of strontian and selenite from Lockport and Niagara falls, are from cavities in this rock. Blende also occurs in the cavities with the minerals mentioned. Many of these cavities present some partially decayed organic body. In some places the structure of the rock is very irregular, presenting curved, contorted and concentric laminæ, as if the mass had been disturbed when partially indurated. The whole of this rock is bituminous, particularly the upper portions; the odor is perceived on percussion.

"At the Niagara falls there are about eighty feet of this rock disclosed; the lower portions are gray, becoming darker, and containing more and larger geodes as we ascend. At the top of the falls it is of a brownish gray color and resinous lustre, containing blende disseminated and in geodes. Above this, there is a thickness of about one hundred feet, which is less geodiferous, and inclining to a bluish color."

Gypsum in the gypseous marls and slates.—"The gypsum in the lower part of the formation, is limited to thin seams or nodules, but after the commencement of the slaty limestones, it is found in large masses, or beds, of a few feet thickness, and limited extent. These masses are of a flattened spherical form, and are from a few pounds to fifty tons weight, commonly from five to twenty tons. The existence of these beds of gypsum is indicated by appearances of the surface, which above the mass is raised into a knoll or hillock. Sometimes the surface, to a considerable extent, is covered with these hillocks, which resemble small mounds of earth. When the soil is removed from one of these elevations, a corresponding convex surface is presented by the limestone beneath, which is cracked and broken in every direction, as if by some elevating force. On removing the stone, further evidence of such force is perceived. The layers of limestone dip upon every side of the mass of gypsum, and as this mass thins off at its edges, the strata of limestone meet those below and assume their original, nearly horizontal position. From such appearances we cannot doubt but the gypsum has been formed since the surrounding rock became indurated; and that the production of these masses has disturbed the overlying strata. The decomposition of large quantities of iron pyrites might, perhaps, explain the formation of gypsum, by a decomposition of the limestone, but there is very little pyrites now remaining in the rock. The masses of gypsum are sometimes stained on their edge with iron, and bog ore is of frequent occurrence in the neighborhood. Hydro-sulphuretted springs are common, and the water of some wells is of similar character. The water of some of these springs corrodes iron rapidly. In the town of Byron, Genesee county, there is a spring arising from this formation, containing free sulphuric acid.

"Immediately surrounding each mass of gypsum we find layers of loamy clay, called ashes by the workmen. This ashes contains disseminated particles, and sometimes scarcely aggregated, friable masses of gypsum. We have in this "ashes" precisely what would remain of the argillaceous limestone, should we abstract the calcareous matter by sulphuric acid, or any other process.

"It is said by the inhabitants, that the small elevations indicating the presence of gypsum are not observed till after the country has been cleared of its forests, or in places where there have never been trees growing. These changes in the contour of the surface are observable from one year to another. In some places a mass of gypsum has formed under a building, altering the level of its foundation and disturbing its equilibrium. Points on the surface which are now but slight elevations, will in a few years become more elevated."

Boulders and diluvial scractches, &c.—Gravel, sand, pebbles, and boulders, are strewed more or less over the country.

"These boulders consist of the various granites and gneiss, together with those of the sandstone from below, and of the limestone from above. Besides this unequivocal evidence we have other, and if possible, more positive proof, in the furrowed and polished surface of the limestone, which is seen wherever the rock is exposed, from the Genesee to the Niagara river. The surface of this rock bears palpable evidence of the wearing action produced by running water, carrying with it heavy materials of sufficient hardness to wear away, and in some instances, actually to polish the surface of the rock over which it passed. Where the rock is exposed we find the surface has been worn, in some instances, till it is perfectly smooth, and in others the original inequalities are but partially obliterated. We often observe that the abrupt offsets from one thin stratum to another, have been worn down to a gradual slope. In some places slight scratches only are perceived, while in others they are numerous and deep, often extending for several feet, and in one case a continuous furrow was observed one hundred feet in length. The general direction of these scratches is N. N. E. and S. S. W.; sometimes there are slight variations from this course. The appearance of the scratches often indicates that they were produced by two boulders coming in contact, when the lighter one was moved out of its course, producing a furrow in the direction of the force applied.

"Where the soil is removed from the polished and furrowed rock, we find resting upon it, in many places, an irregular deposit of pebbles and boulders, some of the latter of large size. These are frequently cemented by a gravel or hard pan, with infiltrated carbonate of lime. Above this stratum we have clay, sand, and loam, with little or no coarse materials. These boulders are of various granites, limestone from the formation on which they rest and from the south, and siliceous sandstone from the north. These materials all attest the action of violent currents, and not of a single and uniform current, but of opposite or conflicting ones. The presence, in the same locality, of boulders from the north, with those from the south, proves that opposite forces have prevailed either at the same or at different periods.

"The extent of these diluvial formations, with the great numbers of erratic blocks, and the evidence of long continued wearing action on the limestone, proves that the force was not sudden and violent, but continued for an indefinite period. If then, we admit the presence of an ocean covering the continent or a part of it, we should also admit the condition of an ocean as we find it at the present time."

"*Lake Ridge.—Ridge Roads.*—One of the most remarkable features of the surface of the Fourth District is the 'Lake Ridge,' which is a travelled highway from Sodus, in Wayne county, with some slight interruptions, to the Niagara river. West of the Niagara river, we find a continuance of this ridge, and it probably passes around the head of Lake Ontario. Throughout the greater part of this distance, the ridge is well defined, being a slight but actual elevation above the general surface of the country. In some places, the descent is abrupt on either side of the ridge, but in general, it is gradual. The elevation of this ridge above Lake Ontario is, in Niagara county, about one hundred and sixty feet, though there are variations of a few feet. The course of the road along the ridge should not be taken as a guide for its elevation, as in some cases the road passes over the point of a hill which projected into the ancient lake, and at which place the ridge is not so well defined. In other cases, the ridge has been partially removed by streams, as a beach now is forming along the lake shore. We often find this ridge divided into three or four parallel ones, which extend for a few rods and then unite in one.

The elevation of the country on the north is exceedingly uniform, and from the foot of the ridge there is a gentle, almost imperceptible descent, to the lake shore. North of the ridge there are no valleys but such as have been worn by the present streams. The country on the south is not so uniform. In many places we find transverse ridges, jutting upon and terminating at the lake ridge. The road in some places is at the termination of such a transverse ridge, and at other times over the top of it.

"The course of this ridge is nearly parallel to the lake shore, and from four to eight miles distant. The width of the ridge at the base is from four to eight róds, narrowing to the top, which is often not more than two rods wide. In many places it much exceeds this width.

"It is the prevailing opinion that this ridge has been the shore of Lake Ontario, at a period when it had a greater elevation than at present. There is indeed sufficient proof of this fact in every appearance of the ridge, its materials, and in the surface of the country on the north and south of it. The soil on either side of the ridge is generally a clayey loam, while the surface of the ridge is of sand or fine gravel. The whole of the ridge is superficial, being composed of sand, gravel and pebbles; the latter of sandstone, or other siliceous rock. All the materials are similar to those forming the beaches along the present lake shore. There is no connexion between the ridge and the rock below, except that the rock supports the ridge without altering its form or course. The elevation of Lake Ontario to the level of this ridge furnishes the only plausible means by which we can explain its present appearances; and however reluctant we may be to admit such a condition, we are forced to do so from the abundant evidence furnished.

"The uneven country on the south side of the ridge is, in many places, strongly contrasted with the uniform elevation and gentle slope on the north. The absence of inequalities in the surface on the north of the ridge, and at the same time the presence of boulders and pebbles, showing the action of currents, can be explained only by supposing some gentle force, like the lake waters, to have reduced the ridges and hills, and have distributed the materials equally over the surface.

"After the subsidence of the ancient lake, the accumulation of water south of the ridge, forced the barrier, and has worn itself a channel to the lake shore. In pursuing these water courses, we find a uniformly narrow channel till we approach the ridge from the south, when there is a sudden expansion, which, after passing the ridge, assumes a narrow channel till near the present lake shore, when it again expands. We sometimes find extensive swamps, limited on the north by this ridge; in some of them there has not been a sufficient accumulation of water to force a passage through the ridge, and artificial outlets have been made for drainage. By this process, large tracts of valuable land are being reclaimed.

"Wherever wells have been dug, or excavations made in this ridge, fragments of decayed wood, bark, and often branches and trunks of trees, are found deeply imbedded in the soil. Shells of the Unio, &c. are also said to have been found, but I have not been so fortunate as to obtain a specimen. In one excavation I obtained fragments of bark, wood, and part of a branch, the latter of which was partially mineralized, presenting the appearance of charcoal, but harder, very brittle, and with a shining luster These specimens were obtained from about six feet below the surface, where there appeared a thin stratum of fragments of wood, bark, &c. as if it might have been accumulated on the surface of still water, and afterwards covered with sand and gravel.

"It has been urged as an objection, that the ridge slopes on both sides; but this, so far from being an objection, is a proof that it was an ancient shore. If we examine the shore of a lake or sea where the inland country is not far above the level of the water, we find there is always a ridge accumulated. This is a natural effect from the action of the waves and of ice, pressing the loose materials onward till they are raised into a ridge, which is still increased by the wind blowing the fine sand upon it, which is deposited along the base.

"The ridge furnishes, perhaps, the best natural road in the country, being from its nature at all times in good condition for travelling; and at such seasons as the other roads are almost impassable, this one is scarcely affected. The surface is commonly of fine gravel or sand, with coarser materials below, which allows the water to be absorbed and pass off beneath. Its convex surface and slope on either side, also prevents any accumulation of water."

"According to estimates made upon streams running from the ridge to Lake Ontario, its height above the lake appears to exceed 200 feet; but upon this point we are not prepared at present to give positive information."

Outlet of small lakes into Lake Ontario.—A glance at a map of the State, shows, in the western district, a large number of beautiful lakes, several of them long and narrow. It is remarkable that all of them, fifteen in number, become confluent in the Oswego river, which discharges through this river into Lake Ontario.

Hardening of Iron.—"When casting plough irons, they run them upon a *hardener*, (which is a piece of cold iron,) so that for two inches or so on the edge, which is liable to wear, the castings are hardened like steel. The effect is, to change the usual granular texture of the casting into one that is lamellar, like bismuth. This difference is perceptible, and the line of demarkation is also very evident when the casting is broken."

Prejudice against pure Gypsum.—"A considerable proportion of the gypsum at Heth's quarry is transparent, and consists of leaves or laminæ. This variety also occurs at the plaster beds in the neighboring counties, associated and mixed with the granular, compact, or slaty gypsum, and is generally known by the local name of *Isinglass Plaster*. A strange prejudice prevails with regard to this variety, which in some places also extends to the *fibrous* gypsum. It is considered an *impurity*, and to be injurious as a manure, and consequently those masses which contain it are excluded and thrown aside. This opinion is entirely erroneous, for the transparent and fibrous varieties are a purer article than the opake, granular or compact forms of gypsum, and their transparency is occasioned merely by their crystalline structure. Nearly one half of the Nova Scotia plaster consists of the transparent, lamellar, and fibrous varieties, which have been excluded at these quarries as an impure article."

Shore of Lake Ontario and Height of the Water.—"The action of the waves, together with the ice, have raised beaches, which in many places protect the land from inundation during high winds. In the eastern part of the county, the banks are abrupt, consisting of gravel, sand, and clay. These banks are gradually worn away by the waves, and the materials carried to points where the banks are low. By this wearing action, the lake encroaches upon the land in some places, while the land is gaining upon the lake in others. In the course of a year, several feet of these banks are abraded by the waves. During some years, the lake is higher than in others, so that the wearing action is not uniform."

"*For the last two years the lake has been higher than for many years before;* this is evidenced by the waves undermining the banks which had become overgrown with trees and shrubs. There is a tradition of a periodical rise of the lake, but it is not verified by observation. Although this rising of the lake is not periodical, it does occur at intervals, and at such times the beaches and sand bars are removed, to be deposited in other places, and to fill up the mouths of streams. It therefore becomes a matter of importance to protect the shores from such effects, and from the loss of land thus sustained. To do this, trees and shrubs should be permitted to grow on the banks, and shrubs with strong roots might be planted to effect the same object."

The waters of all the great lakes have been unusually high, for two or three years past—in some places six to seven feet, and extensive inundations of valuable lands, and of houses, and other buildings have been the consequence.

At Buffalo on Lake Erie, when in September last, we had occasion there to observe the fact, the waters had begun to subside, and this is understood to be generally the case. The best reason which we have heard assigned for the occasional rise of the waters, is the increase of the tributaries, by abundant rains in cold and wet seasons, when also there is little evaporation. Winds make temporary accumulations which may occur at any time, but we believe there is nothing to support the popular impression of a regular or periodical rise of the waters of the lakes.

Boulders of primary rocks are frequently mixed with those of the vicinity. Feldspathic rocks abound, and there are rounded masses of feldspar eight to ten feet in diameter, which are in some places so abundant as to be broken up for building materials.

Waters.—They are all hard, containing muriate of lime.

Calcareous Tufa, is very abundant, and is often found involving great numbers of recent shells. Shell marl is found containing Cyclas, Lymnea, Planorbis, with other species of fresh-water molluscs. There is in Livingston and Monroe counties, a deposit of this nature, three miles long, and half a mile to a mile in breadth; it is supposed to contain 125,452,800 cubic feet, or 2,309,056 loads.

Gypsum is found in various places in this region, and is very beneficial on grass lands, as well as for wheat and Indian corn; one bushel to the acre is generally considered as a sufficient quantity for grass.

The usual remark, that vegetation is promoted by plaster, in consequence of its attracting moisture from the air, appears to be unfounded; it has very little affinity for water, and probably precipitates the vapor only, as stony bodies generally do, and the trifling quantity thus obtained, could hardly bring with it much carbonic acid for the food of plants. Ground plaster is sold for three dollars a ton.

Hydraulic Cement.—"Much of the cement now made is of very inferior quality, and losses are constantly sustained from its use. This subject is one which requires strict and constant investigation, and the State of New York would save large sums in the construction of her public works by procuring a cement of good quality.

"A cement required to withstand the action of freezing water, should contain little argillaceous matter. Clay, in any form, absorbs water abundantly, and if frozen while containing water, the cohesion of the particles is destroyed. By this process, every time it is frozen, a portion of the surface at least is removed, and finally the whole mass. The chemical composition of this rock is so variable in different localities, and in different parts of the same locality, that this test cannot always be satisfactory. The chemical composition of a rock, producing good cement, should be ascertained, and similar external characters may afterwards be relied on.

"A siliceous limestone, with a little iron or manganese in its composition, appears best adapted for hydraulic cement. Limestone of this character can be found at intervals in either of the formations mentioned; but experience is necessary to choose the proper portions, and some localities afford an article far superior to others.

"The formations from which this limestone has been selected, extend across Monroe county from east to west; the one through the towns of Penfield, Brighton, Gates, Ogden, and Sweden; the other through Mendon, Rush, and Wheatland. At one locality in Ogden, this limestone has been burned and used for cement in the locks on the Erie canal, and is said to have been of good quality. The same kind of stone may be found at the upper falls on the Genesee, at Rochester. The best material of the kind, is on the land of Mr. Miller, in Penfield. The strata are from two to four inches thick, compact and siliceous. The location is near Rochester, and if it prove good and abundant, will be valuable."

"Hydraulic cement can be obtained within five miles of the canal throughout the whole extent of the fourth district. The same rocks which furnish the article at Onondaga, continue to the Niagara river, and a few experiments will prove that fifty or one hundred localities can be found to afford good cement."

Building Stones.—There are many places in this region where excellent building stone is obtained, but there is much also that is bad, as appears by the following statement, the truth of which we have had occasion to observe.

"The red sandstone and the indurated marl of the same formation have been used for building stone, but experience has proved what a knowledge of their composition would have foretold, viz. that in Monroe county, they are almost entirely unfit for any useful purpose whatever. Many apparently compact blocks of this rock will, in the course of a few weeks, if exposed, crumble into a loose mass. Where used in buildings, it has in some cases been little affected by the weather, but in most, it has been rapidly destroyed. The aqueduct at Rochester, constructed of this stone, has been for years in a dilapidated state, and will soon be entirely unfit for use. The great objection to the stone, is the presence of a large proportion of aluminous matter, absorbing water and destroying the stone by the same process that the hydraulic cement is removed from the walls of locks. The stone used for the aqueduct now being constructed, is far superior to the sandstone, but still unfit for the purpose.

The compact portions are durable, but there are seams of argillaceous matter, some of them scarcely perceptible, and others where this matter has been removed; all of these will absorb water, which, by expansion in freezing, will finally split the stone. The effect of freezing water on this stone, is illustrated in many of the locks in the vicinity of Syracuse, where every stone in which the seam occurs is split. This objection is a very serious one, and when a work of the magnitude of the Rochester aqueduct is to be constructed, more care should be observed in selecting the material."

Cavity containing Water.—"At Barre, in digging a well, rock occurred at 24 feet; upon passing into the rock 17 feet, a cavity was found, from which a copious supply of water issued, rose to the surface, and is permanent."

Fucoides and Ripple Marks.—"The surface of the layers at some points, as at Medina, is covered with fossil stems of vegetables, chiefly of the family of Fucoides. The most common species is the Fucoides Harlani, (Conrad,) in the form of stems which branch and cross each other, and which possess transverse striæ, and other evidences of an organic nature. Another very pretty Fucoides occurs at the same locality, apparently consisting of short thick leaves, resembling a Cactus, and with no apparent stems. The above are accompanied by other species of an irregular form. The new genus instituted by Mr. Conrad, *Dictuolites* Beckii, occurs in the uppermost layers, and has not yet been seen at any depth in the sandstone. It occurs in the upper layers one mile south of Holley. About forty feet deep in the sandstone occur one or two layers of about two feet in thickness, containing a new species of Lingula, the L. cuneata, associated with fresh-water shells, viz. Unio primigenius, Cyclostoma pervetusta, and Planorbis trilobatus, as described by Mr. Conrad. Associated with the above shells, is a species of Cytherina, very much resembling that which occurs in the bituminous limestone of Wayne county.

"At Medina can be seen, in great perfection, those appearances which have been called *ripple marks.* They consist of parallel furrows, or depressions on the surface of the layers, resembling exactly the tide or ripple marks in the fine sand on the shores of rivers. They are slightly waved, or serpentine, and sometimes run into each other. Near the culvert at Medina, these furrows appear on both sides of the canal, without any interruption, for about one hundred yards. They exist on the upper surface of the upper layer of the sandstone, which is here gray, and very siliceous, and contains the Dictuolites, or net-like Fucoides, which sometimes continue across the furrows, as if they had been inflexible. These furrows are on several of the top layers, and occasionally we observed the marks, not on the upper surface, but having a small portion of rock above them."

"The floor of a mill, or factory, immediately at the falls of Oak Orchard creek, Medina, consists of a thick gray layer of sandstone, about forty feet deep in the rock. This layer presents an extensive surface, covered with large and remarkably distinct furrows. Direction east 20° north.

"On the shore of Lake Ontario, north of Yates' center, and ten miles from Medina, the sandstone is red and variegated, and contains similar marks or furrows, whose direction is north and south, and also north 20° east. These layers are at a depth of more than five hundred feet in the sandstone.

"Similar appearances are presented at Holley, on a layer of sandstone, which also contained an individual of the Fucoides Harlani, which had evidently bent and followed the irregularities. Direction of the furrows not ascertained.

"I have examined similar furrowed surfaces, or water-worn surfaces, of the graywacke at Saugerties, on the Hudson river; they are common in the shales and sandstones of the Catskill mountain; and I have also observed them on layers of a dark, compact limestone, which is quarried at Glasco, three miles west of Saugerties."

"*Limestone.*—Thin layers of limestone are extracted from the bed of Oak Orchard creek, between Medina and Shelby, and used at the former place for flagging. They appear to be of a siliceous character, occur in large slabs, and the surfaces are frequently covered with fossil vegetables of the family of Fucoides; they strongly resemble the petrified stems of vegetables."

In Niagara county, "in descending the terrace on the north, we find hills of diluvial matter, extending from the top and sloping gradually off to the surface below. Where the northern extremities of the hills have been excavated, we find large rounded masses of limestone and shale, from the rocks south, with masses of granite. These are all mixed together in confusion; and the masses of limestone are worn and scratched, as having been tumbled along with blocks of harder rock. From these appearances, and the form of the hills, it is very evident that a current of water flowed from the south. But again, on the summit of this terrace, we find masses of sandstone from the north, often wedged into fissures of the limestone, as if driven there by violent force. Although traces of opposing currents are not so apparent on the surface, their effects are more evident on the rock beneath. In every case where I examined the limestone in this county, it was worn and scratched from diluvial action. This appears to have been effected by a force from the south, but in some places there is undeniable evidence that a powerful force was exerted from a northern direction. The following facts corroborate this opinion. We often find fissures in the limestone having an east and west direction; the rock forming the southern edge of this fissure is broken up in a manner that proves a force applied on the northern side, for a force in any other direction could not produce the same result."

The pebbles on the lake shore are faithful representatives of the rocks of this region, and the siliceous limestone especially, contains corallines, orthoceræ, bivalves, &c.

Boulders are numerous all along the surface of the countries contiguous to the lakes, but they are deposited in different proportion in different places.

"Boulders of granite, and other rocks, are scattered over the northern part of the county, in some places the surface being literally covered with them, while in the southern part they are almost entirely absent. In this respect, Niagara county differs from Monroe, where, in the southern part, boulders are very abundant and of large size. They are more abundant in the eastern part of this county than towards the Niagara river. These boulders appear to follow certain courses, and to extend in great profusion over certain districts; this distribution appears to have been governed by some law, and we may yet arrive at data which will enable us to describe the diluvial and its varying characters with as much, or more precision, than we now do a stratum, or a series of strata, in an older formation."

Clay Stones.—"The gray loamy clay above the blue clay, in Niagara county, sometimes attains the thickness of four or five feet, and in some places occupies the place of the blue clay, where this has apparently been removed. The gray, where it occurs, is entirely distinct from the blue, and appears as if it might have been deposited at a subsequent period. In this clay we find the calcareous concretions, called clay stones, or 'clay dogs;' these substances assume all imaginary forms, sometimes the most fantastic. They are often in the shape of spheres, and sometimes two or more of them attached together. They appear at regular intervals in the strata, and commonly a line of them marks the junction of the gray with the blue clay below. These substances are an earthy carbonate of lime, which is apparently deposited from the water percolating from the surface. Fibres (apparently vegetable) extend from the surface to the depth of three or four (sometimes twelve) feet, and around these fibres, as a nucleus, the deposit is made. The gray loamy clay is pervious to water, while the blue clay is not. The fibres never extend into the blue clay, but always terminate at its surface. We find the clay stones surrounding the same fibre at different depths, and can often trace the connexion of several. Sometimes there are merely rings of calcareous matter, the internal part still being clay. Those formed directly around the fibre, are usually perforated, but others are often attached on every side, which are entirely solid. It appears as if the water was conducted downwards by this fibre, and the solid material deposited on every side, forming a ring. But when the accumulations are large, or when the stratum below is impervious, the calcareous matter is forced out on every side, and produces the fantastic forms which we so often find."

Niagara falls and river.—A fuller account of these is promised in a future report. The strata at Lewiston, where the Niagara river empties into the Lake Ontario, are found in the following order, and thickness from the top downward—limestone twenty feet, shale eighty, limestone twenty, red marl and sandstone seventy, hard gray sandstone twenty-five, red marl to the level of the river, and far below.

Some very judicious remarks are made respecting the possibility of the drainage of the upper lake or lakes, by the process of regular wearing by the current, and although the reasons suggested by Mr. Hall are valid, it does not appear, that the drainage is as he suggests impossible, for, a very moderate heave of an earthquake, such as are common in South America, might at once fissure the barrier, so that the water would flow with irresistible violence, and drain every lake above, to the level of Ontario, sweeping New England, New York, and the middle states, until an equilibrium was established with the waters of the Atlantic.

In concluding our ample citations from these truly valuable reports, we are much impressed by the fidelity, zeal and ability which they so strikingly display. They must be studied with attention, in order to derive from them all the information, both in economics, and in science, which they contain, and of which we have given only the more striking examples.

Remark.

Although it is our wish and intention to give some notice of all the geological surveys and explorations now going forward in the United States, the number of the reports, and the pressure of other matter, and of numerous duties, may cause, as they have already done, more delay than we could wish, and some may be temporarily omitted until more general results can be obtained, than those which depend on observations merely local.—Eds.

Art. II.—*Some account of Violent Columnar Whirlwinds, which appear to have resulted from the action of large Circular Fires; with Remarks on the same;* by W. C. Redfield.

Read before the Conn. Acad. of Arts and Sci., Jan. 22, 1839.

Since my attention was first attracted by the phenomena of our great whirlwind storms, I have found frequent occasions for noticing the points of analogy, and also of dissimilarity, between these great storms and the smaller classes of whirlwinds which are known under the various names of squalls, thunder gusts, tornadoes, water spouts, sand pillars, and the like. While pursuing this inquiry, I received information of a few cases in which whirlwinds of great activity and violence, appeared to have resulted from the action of fires. The facts attending these cases, as then related to me, were carefully noted, and were laid aside with a view, at a future period, to incorporate them with a more general account and examination of the smaller description of whirlwinds, than I have yet found it convenient to undertake. In the mean time, the verbal statement of these cases, both in Europe and this country, through the medium of a friend who is distinguished for his attainments in science, appears to have excited some interest in the minds of meteorologists and others, and has occasioned applications to be made to me for a full statement of the facts. I therefore hasten to give them publicity, without the delay which the execution of my original purpose would necessarily occasion.*

The most recent of these cases, being the first of which I obtained notice, occurred in the year 1830, in the township of Greenbush, near Albany. My account of it was obtained soon after, from William Akin, of Greenbush, an observant and highly respectable member of the society of Friends, on whose farm the phenomenon happened. The facts were carefully taken down in the presence of Mr. Akin, from his statements, and the account thus obtained was by his assistance, carefully revised and corrected.

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* These cases were briefly announced in 1833, in a summary statement of some of the facts and results in meteorology, which had then claimed my attention. *See this Journal*, Vol. xxv, p. 127.

In regard to the brief statements which were comprised in the synopsis here referred to, it will continue to appear, if I mistake not, that the annunciations then made, were something more than the mere expression of opinions or speculative theories.

Statement of William Akin.

"In the year 1830, I had cut the timber from a small tract of wood land comprising about twenty-five acres, and the brushwood throughout the field, had been piled and prepared for burning. Previous to firing it, the brushwood lying near the outskirts of the field was moved inwards, in order to prevent the spreading of the fire to the surrounding woodlands, the materials thus removed forming a circular range or heap around the general mass of combustibles in the area of the field. On a warm and perfectly calm day in the summer, this circle was fired on all sides, nearly at the same time. The smoke and flame soon gathered towards the center of the field, where they whirled and ascended with great rapidity, in a single column. With the strength of this whirl the fire rapidly increased, and the heat and flame from opposite sides, pressing inwards towards the ascending column, the latter continued its spiral or whirling motion with great rapidity and violence. It was a magnificent spectacle; and was attended with a loud, roaring noise, and a sort of crackling and nearly continuous thundering; resembling that which I have heard in a violent hail storm.

This remarkable noise, which I think might have been heard at a distance of several miles, was also accompanied by frequent and loud snappings or explosions, resembling the reports of muskets and pistols, as sometimes heard in an irregular running fire of militia.

This roaring noise and the powerful whirling motion of the column, continued for a period of about twenty minutes, as near as I can now estimate. The swift whirling of the whole, exceeded all my previous conceptions of the velocity of wind. The height of the smoky column seemed almost as great as the eye could reach. At times, the column would assume a sinuous or wavy direction, and would again become straightened into its upright position."

I learned also from Mr. Akin, that he has on several occasions noticed a whirling motion in the clouds during the exhibition of a violent hail storm, and that such storms, according to his observation, are always attended by a continuous thundering roar, not unlike that of the above described whirlwind. One of these hailstorms he described as passing within three rods of the house in which he resided; tearing up trees, scattering their limbs in the air, and desolating a path or track of about fifty yards in width. Another of these storms, of a more extended character, Mr. A. describes as very destructive to the farm on which he then lived, and as having left the ground covered with hail stones, to the depth of four or five inches, and in particular situations, to the depth of even twenty inches. This hail storm acted on a track of near two miles in its entire width, and was also attended with the above mentioned peculiar noise in the atmosphere, during its continuance, and also with heavy thunder and vivid lightning. In this last case, no whirlwind was felt at the surface, but he supposes one of considerable magnitude to have been in action in the atmosphere.

For an account of another interesting case of the same character, and which I received not long after the above, I am indebted to the Hon. Theodore Dwight, now of Hartford, Conn. and formerly a resident of this city. It was related to me more than once by this gentleman, for my gratification, and was, at my request, drawn up by himself, and kindly placed at my disposal.

Statement of Theodore Dwight, Esq.

"In the month of April, 1783, I resided at Stockbridge, in the State of Massachusetts. The season, for a number of weeks previous, had been remarkably dry, and in various places much mischief had been done by fires which were kindled in the woods. Beside other fires, one occurred upon a mountain lying between Great Barrington and Stockbridge, which spread and advanced till it reached the northern termination of the mountain, south of Stockbridge, near the river Housatonic, which runs through the town. Near the foot of the mountain at its northern termination, was an open field, in which a large quantity of bushes and brushwood, that had been cut some time previously, in clearing the field, was lying in rows and heaps for burning, and had become perfectly dry and combustible. The owner of the field, as the fire reached near its border, sent some men to set all on fire around the field, in order to consume the whole together. The weather was mild and serene, and the atmosphere perfectly still and undisturbed. I was residing at this time at the distance of about half a mile from the fire, and my attention was suddenly excited by a loud roaring noise like that of heavy thunder; whereupon, going to the door, I instantly discovered the cause.

Upon the fire becoming general throughout the field, a whirlwind had formed in the midst of the flames, and when I first saw the phenomenon, its appearance was sublime and awful. The flames were collected from every side into a large column, broad at the bottom, but suddenly tapering to a much smaller size, and it stood erect in the field to the probable height of 150 to 200 feet. It was a pillar of living and most vivid flame, whirling round with most astonishing velocity, while from its top proceeded a spire of black smoke, to a height beyond the reach of the eye, and whirling with the same velocity with the column of flame. The noise produced by this whirlwind, was louder than almost any thunder I have ever heard; and being much longer continued, was heard at a greater distance than is commonly the case with thunder. During the whole period of its continuance, the pillar of fire moved slowly and majestically round the field; but generally the air was entirely free from both fire and smoke, except what was collected in the column. The spire of smoke, above the pillar of fire, not only whirled around with the most surprising rapidity, but owing to its great height, waved gracefully in the air, which added much to the beauty and splendor of the exhibition. The force of the whirlwind was so great, that young trees of six or eight inches in diameter, which had been cut and were lying on the ground, were taken up by it, and carried to the height of forty or fifty feet.

The scene was to me perfectly novel; and though it occurred nearly fifty years ago, is still clear and distinct in my recollection, and it was one of the most magnificent spectacles that I have ever witnessed."

"*New York, November 28th*, 1831."

Mr. Dwight related, also, that the men who lighted up the field, became so alarmed by this whirlwind of fire, as to rush for safety to the neighboring river.

During a visit to Amherst, in Massachusetts, in the month of August, 1832, I obtained from Dr. Cowles, of that place, the following account of a similar case, which occurred in that vicinity, under that gentleman's immediate observation.

Statement of Doctor Cowles.

"In the summer of 1824, I had prepared for burning the refuse timber and brushwood, on seven acres of pine woodland, which had been cut over, for some months previous. A still day, which proved very warm, was selected, in order to avoid the danger of extending the fire to the neighboring woodlands by means of the wind; and as the materials were in fine combustible order, I invited several friends to witness the burning. The combustibles were collected in piles and ridges, and fire was set to the outward portions of the field, on all sides, as fast as was conveniently practicable. The smoke and flames were now concentrated in a large whirling column, over the center of the field, rising in the form of a cone, and ascending to a great height. It was attended with a heavy roar, which was heard at a great distance. Although on a perfectly calm day, the action of this whirlwind was so violent as to remove from the ground large pieces of brushwood, even from places not touched by the fire, carrying them high in the air, from whence they afterwards fell without the limits of the burning field."

I learned also from Dr. Cutler, of Amherst, that his attention had likewise been drawn to this phenomenon, which he beheld from near his own house, at a distance of a mile and a half from the fire. He informed me, that it exhibited to his view, an elevated pillar of black smoke, attended by a "roaring noise, like that occasioned by the violent burning of a chimney."

These statements were received from the above gentlemen, and separately and carefully noted down on the spot.

An intelligent farmer, a resident of Delaware county, N. Y., whom I met on the 9th of May, 1832, informed me that he had on several occasions seen whirlwinds formed in burning over newly cleared lands; and had known them so violent as to take up heavy limbs or branches into the air. He had recently seen one in that county, which moved up the side of a hill, on a still day, and prostrated trees in its course.

In the burning of a wooden building, I have myself seen a momentary effect which seemed analogous to the foregoing; and a temporary impulse of this sort, I believe, is not uncommon in large fires.* I have, however, seen no distinct account of phe-

* In the month of August last, (1838,) a similar phenomenon was observed in the burning of one of the large wood yards and wood houses, belonging to Yale College. The yard was a rectangular area, with the wood arranged chiefly on the outer boundaries, and the same ascending column of flame and smoke was distinctly observed by many, but more particularly by Mr. B. L. Hamlen, the printer of this Journal.—*Eds.*

nomena like the foregoing, in those great fires which attend the burning of cities or forests, even if during a gale; if I except the account contained in the following extract, which appears to indicate something of this kind on an extended scale.

"*A Great Fire.*—Mirimichi is mentioned* as connected with one of those tremendous fires which sometimes arise in the American forests, and spread havoc by circles of longitude and latitude. In the autumn of 1825, such a calamity occurred on the river Mirimichi, which extended 140 miles in length, and in some places 70 in breadth. It is of little consequence that no wind was stirring at the time; for, as Mr. McGregor observes, the mere rarefaction of the air creates a wind, "which increases till it blows a hurricane." In the present case, the woods had been on fire for some days without creating any great alarm. But "on the 7th of October, it came on to blow furiously from the westward; and the inhabitants along the banks of the river were suddenly surprised by an extraordinary roaring in the woods, resembling the crashing and detonation of loud and incessant thunder, while at the same instant the atmosphere became thickly darkened with smoke. They had scarcely time to ascertain the cause of this awful phenomenon, before all the surrounding woods appeared in one vast blaze, the flames ascending from one to two hundred feet above the top of the loftiest trees; and the fire, rolling forward with inconceivable celerity, presented the terribly sublime appearance of an impetuous flaming ocean. Two towns, those of Douglass and New Castle, were in a blaze within the hour; and many of the inhabitants were unable to escape.

Multitudes of men on lumbering parties perished in the forest; cattle were destroyed by wholesale; even birds, unless those of very strong wing, seldom escaped, so rapid was the progress of the flames. Nay, the very rivers were so much affected by the burning masses projected into their waters, that in many cases large quantities of salmon and other fish were scattered upon their shores. Perhaps the plague of fire has never been exhibited, or will be, till the final destruction of this planet, on so magnificent a scale."

I am unable to give the authorship of this paragraph, which came to my hand through the columns of a newspaper; but it

* Mirimichi is in the British province of New Brunswick, near the southwestern borders of the Gulf of St. Lawrence.

appears to have formed part of a more extended notice of that region of country; and the occurrence of this calamitous fire, is a fact well remembered.

Remarks on the foregoing Cases.

Among the many considerations suggested by these interesting phenomena, I shall notice in a cursory manner, the following:

1. *The rarefaction which is ordinarily produced by fires, even if they are of an extensive and violent character, is not attended with these effects.* Common observation and experience are sufficient to determine this point; and to show that rarefaction *alone*, is entirely inadequate to the production of such results. The strongest degree of heat which has ever been created in the atmosphere by fires, has never produced an ascending current of sufficient power to prostrate or carry forward any contiguous body possessed of tolerable stability or weight, much less to carry any such body into the air.

2. *The foregoing results can be accounted for, only by a violent vortical action, steadily maintained.* This appears too plain to need illustration.

3. The origin of the rotative action and its continuance for a considerable period, in the circuit of conflagration, *appear to be chiefly owing to the circular outline of the several fires, and to the absence of a disturbing horizontal current.* When, however, the principal seat of the vortical action is found in the body of an elevated current of atmosphere, we then find that the progressive action of the foot of the whirling column upon the earth's surface, and the resistance which is also offered to its progress by an inferior cross current, are not sufficient to break up, or sensibly impede, the regular action and progress of a powerful vortex. This was strikingly manifested in the tornado which passed through the city of New Brunswick, in New Jersey, in June, 1835.

4. *The ascending power of the vortical column or whirlwind is, in these cases, strongly exhibited.* We observe, that the heated air from large fires, or even from the most powerful furnaces, ejected in a column at the heat of melted iron, will ascend only to a comparatively short distance from the earth; the ascending force being lost in counter movements and convolutions with the adjacent colder air, and the combined product soon spreads off in a

horizontal direction. But the spire of a columnar vortex, exhibits a penetrating and ascending power which far exceeds, both in its intensity and the extent of its action, any other ascending movement that we witness in the atmosphere. This effect appears to be owing to the spiral motion of the column, which presses onward in the direction of its axis, until it reaches a limit of elevation which is yet unknown. Even the *ring vortex*, which is sometimes seen to form at the muzzles of cannon or the ejection pipes of high pressure steam engines, on their discharge, appears to possess the qualities of a projectile, notwithstanding its unfavorable form; and is also carried forward through the air, partly on the rocket principle, by means of the rotary action by which the circular axis of the ring is involved; the line of progress in this case being in the direction which is perpendicular to the plane of the ring.* On the proximate causes and *modus operandi* of this ascending action in the columnar vortex, we cannot now dwell.

5. *The analogy of the foregoing cases to those violent columnar whirlwinds which are so often formed over the craters of active volcanoes, and the apparent identity of the causes which produce them*, well deserve our notice. We may hence comprehend the manner in which volcanic ashes, having no projectile qualities, are carried to a vast height in the atmosphere, and become wafted to a great distance by the different currents of the atmosphere into which they successively subside. The loud roaring noise and thundering detonations, which usually attend these volcanic exhibitions, are also illustrated to some small extent, by the cases before us.

6. *It appears that these cases were attended by electric explosions or detonations*, and that, apparently, there was only wanting the contact of more extensive masses of the higher and lower atmosphere, and the presence of a larger body of aqueous condensation, as in the case of the so called *thunder cloud* which so commonly attends the naturally formed vortex, in order to have produced the phenomena of genuine thunder and lightning, on a most mag-

* The vortex here described is also produced in a beautiful manner, by the burning of bubbles of phosphuretted hydrogen gas, as they escape from water. In this case the peculiar movements of the ring vortex, as well as the sustaining and expanding power which appears to belong to aerial vortices, may be advantageously observed.

nificent scale. This effect, it appears, is most fully produced in the volcanic exhibitions above mentioned.

7. These cases may serve to illustrate, in some degree, the favoring influences which are presented in the *calm latitudes*, near the equator, and on the exterior limits of the trade winds in mid-ocean, for the production of vorticular action, either in the form of squalls, thunder gusts, or water spouts. The main horizontal movements of circulation which are common to our atmosphere, being here comparatively sluggish or inert, opportunity is thus afforded for the minor influences of rarefaction to come into play; by which means, frequent squalls, water spouts, and other local movements in the lower atmosphere, are excited in these regions.

8. The velocity and strength of the wind in the rotative action of a vortex, the axis of which is in a vertical position, as in the above cases, greatly exceeds that which is exhibited in other circumstances.

9. We may perceive, also, in these cases, how effectually the heated stratum of air nearest the earth's surface, may be caused to penetrate a homogeneous and colder overlying stratum of current, by means of the vorticular action; a movement which is otherwise physically impossible, except in a partial degree, by means of other concurrent movements or favoring circumstances.

10. These considerations, and others which suggest themselves, will enable us to account for the sudden and rapid formation of hail, in summer hail storms and tornadoes; and in the structure of the hail stones, in successive layers, and their occasionally fractured condition, we may perceive both the evidence and the effects of the violent vortical action, and the successive changes of temperature and hygrometric condition in which they have been successively placed, before leaving the vortex, and while falling to the earth.

11. These cases, viewed in connection with the natural phenomena which have been exhibited in a multitude of instances, appear fully to confirm the opinion of Franklin, in favor of the general identity of the columnar whirlwinds with the so called *water spouts*.

12. By the clue which is here afforded us, in the peculiar noise and rumbling detonations of these violent whirlwinds, we may become apprised of the existence of a violent vortical action in the atmosphere, or within the envelopement of a visible thunder

cloud, even in those numerous cases in which the vortex or whirlwind does not reach the earth's surface.

13. Perhaps we have also, in these noises, a clue to the sounds which are ascribed to certain moving sands, in the heat of summer, as in the case of *Jebel Narkous*, or the sounding mountain, near Tor, on the Red Sea,* and also in the *Reg-ruwan*, on a hillside, near Cabul, which is described by the Emperor Baber and by Capt. Burnes. From the descriptions given of the localities and the other circumstances which attend these sounds, which, however, cannot be here recited, I have been led to infer that they proceed from the action of a whirlwind formed on the leeward side of the hill, and revolving upon a horizontal axis; analogous in a degree, as I suppose, to the celebrated Helm Wind of the Cross Fell mountain in Cumberland, (England.)

The inquiry opened to us by the consideration of these phenomena is extensive and interesting, in all its bearings, and I cannot but regret my inability to pursue it with the attention which it so well merits.

New York, December 31, 1838.

Art. III.—*Additional facts relating to the Raleigh's Tyfoon of August 5th and 6th,* 1835, *in the China Sea;* by W. C. Redfield.

To the Editor of the Nautical Magazine.

Sir—In my account of the tyfoon of August 5–6, 1835, in the China sea, is a paragraph derived from the Canton Register, in which it is stated, that "the American ship Levant, Capt. Dumaresq, which arrived on the 7th, the day after the gale, came in with royals set, from Gaspar Island in fourteen days, having had light winds all the way up the China sea, and did not feel the tyfoon."† The prolonged absence of Capt. Dumaresq from this country, alone prevented me from verifying this statement. He has now returned and has kindly placed his private journal in my hands, from which I extract the following; which shows, that in running into the path of the tyfoon from its southern side, the

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* Wellsted's Travels in Arabia, Lond. 1838. Vol. ii, pp. 23—27.

† Am. Journ. of Science, Vol. xxxv, p. 212.

Levant came so far under the heel of the storm as to make it necessary to take in the light sails and double reef the topsails.

Courses.	Winds.	
N. N. E. Distance by log, 171 miles.	S. W. Breeze $6\frac{1}{2}$ to 8 knots.	August 4th, 1835. [Nautical time.] Throughout these 24 hours fine breezes and clear pleasant weather. All possible sail set. Current N. E. by N. 50 miles. Lat. by obs. 12° 55′ N. Lon. by chr. 112° 13′ E.
N. b E. $\frac{1}{2}$ E. N. b E. Distance by log, 190 miles.	S. W. Breeze 7 to $8\frac{1}{2}$ knots.	Aug. 5th. Commences with fine breezes, and pleasant. All sail set and trimmed to the best possible advantage. Middle and latter part the same. Lat. by indifferent obs. 15° 55′ N. Lon. " " 113° 24′ E.
N. $\frac{1}{4}$ W. Distance by log, 225 miles.	S. S. W. Breeze $8\frac{1}{2}$ to 10 knots.	Aug. 6th. Begins with fresh breezes, and cloudy. All sail set. At 4 P. M. passed a barque standing eastward. Through the night strong breezes and squally, with rain and heavy sea. Latter part the same. Took in the royal studding-sails. [The ship was now running into the path of the gale which had just passed.] At 11 A. M. [6th.] heavy squalls, with rain in torrents. Took in all studding-sails, royals, and top-gallant-sails, and double reefed the top-sails. No observation: sun obscured. Lat. by account, 19° 54′ N. Lon. " 113° 38′ W.
N. $\frac{1}{2}$ W. North. N. $\frac{1}{4}$ W. North. N. by E. to N. W. and to N. E.	South to S. S. E. S. by W. to S. E.	August 7th. From noon to 8 P. M., strong breezes and squally. Shook out reefs and set all light sails. Middle part, fine breezes and pleasant weather. At daylight made the Ass's Ears bearing E. by N., distant five miles. At 7 passed the Great Ladrone. After part, wind S. E. and pleasant.

It appears from the foregoing, that on the southern side of the storm, the S. W. monsoon was prevailing at this time, with even more than its usual force. It happens, unfortunately, that no entry of the state of the barometer was made in this part of the journal.

It also appears, that the position which I have assigned to the Levant, in my geographical sketch, at noon on the 6th, is within a few miles of her actual position at that time;* and the main conclusions which I adopted are confirmed by these extracts.

* See this Journal, Vol. xxxv, p. 214. January, 1839.

Owing to some oversight in my last communication, the name of the *Paracels* was printed in the observations on the methods for avoiding the heart of this storm, instead of the rocks or shoals called the *Pratas*, which were intended.

New York, February 19th, 1839.

Art. IV.—*Cherty Lime-rock, or Corniferous Lime-rock, proposed as the line of reference, for State Geologists of New York and Pennsylvania;* by Amos Eaton, Senior Professor of Rensselaer Institute, and Professor of Civil Engineering.

Troy, N. Y., February 9th, 1839.

TO PROFESSOR SILLIMAN.

I was one of your earliest correspondents on Geology; consequently it is to be presumed, that I have introduced more errors to the public, through your Journal, than any other individual. In truth I consider your 35 volumes as a fair exhibition of the *birth*, *boyhood*, and *green manhood* of geological science in America.

This article is intended chiefly for an auxiliary in aid of those who wish to discuss the adverse views of my friends, Conrad and Rogers, which were referred to in your last number, while pursuing their investigations into the true order of superposition, among the rocks of New York and Pennsylvania. As my age and infirmities may soon drive me into the state of "untried being," I will give a concise account of some facts familiar to me, which might cost those gentlemen and other geologists much labour and travel.

They being state officers of high responsibility, I shall not ask them to receive my suggestions as of any other authority, than as they may guide their footsteps to localities, which may be useful in their inquiries.

The lime-rock which I have called *corniferous*, extends from Lake Erie easterly and southerly, throughout most of the district in question. Its characters are so unequivocal, that it is recognized at sight, throughout its whole line, of about five hundred miles. It is a gray rock, often inclining to dark brown. Its color gave the name to the village of Black Rock, at the outlet of Lake

Erie. It abounds in hornstone and stone horns, (as the petrifaction, Cyathophyllum, is called.) Seven distinct species are found in this rock, at Bethlehem Caverns, in Albany county; but the *Cyathophyllum ceratites* is most abundant. As hornstone is found in no other rock in the district, but the calciferous sand-rock, (a good example of which is Flint Hill on Erie Canal,) its presence (hornstone) is a good test of the identity of the stratum. This rock being less subject to disintegration than the overlying gray slate, it may be traced by its naked out-cropping edge, and more or less of its flat surface, as follows. It forms the bottom of the whole eastern part of Lake Erie; Fort Erie is on it, and its wall is of blocks of this rock. Its north edge may be traced in an easterly direction, by way of Auburn, (the state prison there is built of it,) to Otsego county. Here it changes its course; taking a southeasterly direction to the south part of Albany county. Here it exhibits its cavernous character, in the two caverns of Bethlehem; and numerous other caverns are found in that vicinage. From Bethlehem caverns it extends along the west side of Hudson River, through Esopus, (Kingston,) Esopus strand, and up the Rondout. Then it gradually disappears under the very gray slate, (third graywacke,) which embraces Carbondale coal beds, &c. This statement I make from my own personal examinations; generally accompanied by my students in geology, from time to time, through twelve successive years.

Throughout the whole extent of this vast rock, as you follow it from Lake Erie to Esopus strand, it is seen to pass laterally to the right, under higher rocks. It manifestly forms the basis rock of the Catskill and the Alleghany mountains; and it is said to crop out on the west of Alleghany. It was for these reasons that in all my geological surveys, I used this rock as the line of reference for other strata; as strangers in New York City use Broadway as a place of reference for other streets. I now advise the two gentlemen referred to, (Messrs. Conrad and Rogers,) and other state geologists, to take six points on this rock, and to proceed from them in a transverse direction, over all the rocks above and below it. The points I would assume, are—1, Lake Erie; 2, Auburn; 3, at Otsego; 4, at Bethlehem caverns; 5, at Catskill; 6, the Rondout creek, on the Hudson and Delaware canal.

As most of the geological surveys of the states, where such surveys are undertaken, seem to agree in applying the nomenclature which I adopted temporarily, until, *by a general community, they establish a better*, I shall adopt it in this article, so far as relates to the general rock strata. These rocks I suppose distributed into four classes—*primitive*, *transition*, *lower secondary*, and *upper secondary*, and that each class is divided into three general formations—*carboniferous*, *quartzose*, and *calcareous*. The Green Mountain range is primitive. The *carboniferous* formation includes granite, hornblende rock, mica slate, and talcose slate, alternating perpetually, and containing carburet of iron. The *quartzose* is the range of granular quartz. The *calcareous* is the vast range of granular lime-rock or marble.

The argillite, under which the primitive passes near the west bounds of Massachusetts, is the *carboniferous* of the *transition*. It contains anasphaltic coal in small quantities every where; also a fucoid at the roof slate quarries of Hoosick. (This is Mr. Conrad's opinion; but it resembles the spike of a Lycopodium.) The vast ridge of first graywacke, called rubble or conglomerate, and silicious graywacke, running through Rensselaer county, is *the quartzose formation*. Shawangunk in Ulster county, is a continuation of the same ridge. It is called millstone grit there, and is the rock from which Esopus millstones are obtained. The lime-rock range (compact, shelly, sparry, and silicious,) which extends from Albany county to Sackett's Harbor, form the *calcareous*. Its distinguishing petrifaction is the *genus Fungia*.

The second graywacke, under which the transition lime-rocks pass, which extends from near Bethlehem caverns in Albany county, by way of Utica, to Big Salmon River on Lake Ontario, is the carboniferous or lower secondary. It contains anasphaltic coal in small quantities every where. The conglomerate or millstone grit, very well characterized, is found in large patches, in Oriskany, Westmoreland, &c., between Utica and Otsego. This is the *quartzose formation*. The corniferous lime-rock, before described, is the *calcareous* of the *lower* secondary. Its distinguishinging petrifaction is Cyathophyllum. The third graywacke slate, which rests upon the corniferous lime-rock, is the *carboniferous* of the UPPER SECONDARY. It contains all the great coal measures of Pennsylvania. The conglomerate overlying the graywacke slate, and capping most of the high ridges of Catskill and Alleghany mountains, is the *quartzose*. The coral rag on the Helderberg, and in patches on said mountain, form the *calcareous* of the UPPER SECONDARY.

This generalization of our rocks requires extensive subdivisions in some localities. But numerous reviews, since I proposed this nomenclature in your Journal of January, 1830, have confirmed me in its correctness. And I now ask state geologists to examine these rocks, from the six proposed starting points, on the *corniferous* or *cherty lime-rock.* I have considered that as the upper rock in the lower secondary class. If I am right in regard to it, as an equivalent of the cherty lime-rock of English authors, its vast extent and the important disposition it holds among North American rocks, will make it very useful to geological surveyors. If I am not right, it will be equally useful, for examining the relative position of other rocks; as they can take their true equivalent places in European systems, after its character is demonstrated. For example, all our salt springs are in a red (or variegated) sand-rock. This rock is below the *corniferous lime-rock*, together with its peculiar associate; as *ferriferous rocks* embracing the iron stratum, liasoid, (water cement,) geodiferous or fetid lime-rock, all our gypsum beds, &c. But there is on Catskill Mountain a red sand-rock and conglomerate, resembling the red sand-rock and trap tuff under the basaltic rocks on Connecticut River, and also on Hudson River. As these red rocks all contain a fucoid, resembling that of Mr. Conrad, found in our saliferous rock, I will refer the geologist to these definite localities. On Catskill Mountain, twelve miles west of the village of Catskill, about one mile south of the Little Lake and mountain house, there is a round hill, about two hundred feet higher than Little Lake. On ascending this hill, alternations of red sand-rock and marble are found. This red sand-rock contains a species of branching *fucoid*, resembling in general appearance the fucoid of Oak-orchard Creek, on the Erie canal, between Genesee River and Lockport. I have found it on said creek, so uniformly articulated, that I called it an *encrinus*, until Mr. Conrad corrected me. But they differ from those on Catskill Mountain, in that the latter have no articulations, so far as I have examined. I am at present a proselyte to the paleontous method of reading out rocks. But, as the sand-rocks on the loftiest peaks of Catskill and Alleghany mountains, are thousands of feet above the corniferous lime-rock, and the saliferous rock always below it; my learned friend, Conrad, ought to examine the locality just mentioned; also a similar one at the southeast foot of Mineral Hill in Blenheim, Schoharie county, and numerous others.

I will here commence my directions for *tracing rocks, which extend along, laterally, above and below the* CORNIFEROUS LIME-ROCK. *First, those above it.*

1st Point.—At Lake Erie, a gray slate rock is seen lying immediately on the corniferous lime-rock, along the south shore for many miles. About two or three miles west of Eighteen Mile creek, the rock becomes highly bituminous, and some specimens will burn freely. This is the genuine *Pierre Asphaltique* of *Henri Fournel*, Canton of Neufchatel, Switzerland. I have a specimen before me, which I received from M. Ernest Calus, Pearl st., N. Y., together with Fournel's treatise. On comparison, it appears to be the same mineral which M. Ernest used in a state of fusion in constructing the specimen side walk, last summer, above the Astor House. This rock promises to be of vast use as a substitute for slate and tin on flat roofs, &c. This rock, though it has the same geological position four or five hundred miles, varies greatly in character. On its upper side lies a thin siliceous pyritiferous lime-rock, containing numerous terebratulae, (now made a new genus,) which consist wholly of iron pyrites. In this I found branching corals, scarcely changed in appearance from specimens recently from the ocean. The same rocks rest on the corniferous, near the water's edge, in lakes Seneca and Cayuga. The most unequivocal are seen near the head of both lakes, on the east side of each; here they contain thin layers of coal and much pyrites.

2d Point.—At Auburn, on the bank of the Owasco creek, there is a slate rock lying on the corniferous, of a darker gray, containing bituminous pyrites, and minute layers of coal.

3d Point.—At Otsego there are some almost insulated prominences of similar slate, lying on the corniferous lime-rock, containing coal.

4th Point.—At Bethlehem Caverns, the same gray slate rocks are seen reposing on the corniferous lime-rock, and it may be traced many miles backward and forward, in a precipitous ledge. But it becomes of a coarser texture, rarely containing coal, scarcely bituminous, but contains a vast bed of iron pyrites, at the distance of a few miles north of the caverns. Over this slate lies the true coral rag of England, as appears to me from comparing specimens. The best locality is Coral Cave, two miles north of Knox Village. Livingston Cave is in a very coarse third graywacke, geologically between the corniferous rock of Bethlehem Caverns, and the coral rag rock of Coral Cave. Petrifactions are so numerous in the upper lime-rock (coral rag) of the *upper formation* that Mr. Conrad (our exceedingly careful palæontologist) may here settle the true equivalent value of them, compared with European specimens.

5th Point.—Catskill presents a field for much investigation. Take the corniferous rock at Madison Village, or in the long swamp, two miles westerly from the village, on the turnpike towards the mountain. Both of these positions require a circuitous route for tracing the rock to its dip under the Catskill mountain. The best course is to go southerly and meet the mountain south of Cauter's Kill Clove. Following the Clove turnpike road, we enter two miles into the mountain before we make more than a moderate ascent. The ledges on each side present a profile of more than a thousand feet of perpendicular rock. Here are alternating layers of red sandstone, and slaty graywacke. The red sandstone layers may be traced northerly until they pass gradually into gray slate. The series of layers become alternately conglomerate and unchanging red sandstone, towards and at the top of the mountain. Organized remains are found there thinly scattered through all the layers. I have generally found bivalves in the gray, and fucoides in the red; perhaps this is not found to be uniformly true.

6th Point.—The relative position of the corniferous lime-rock along the Rondout, seems to me to offer some most important subjects of reflection to the Pennsylvanian geologist. Here the Shawangunk mountain is distinctly seen to dip beneath it, but not to come in contact with it; the upper transition lime-rock comes in between them. The same gray slate layer of Lake Erie, Seneca, and Cayuga, here rest upon it, as appears by actually pursuing that rock to this place. But the rock, like all others approaching the Alleghany mountains, has here become more coarse and more quartzose. I have long since remarked in this Journal, that rocks of the Catskill and Alleghany ridge wore a more primitive (or coarse and harsh) aspect than equivalent European rocks. My friend, Dr. Morton, recognized this fact, and Brongniart's decisions in regard to the vegetable fossils of Pennsylvania, confirm the suggestion. But the all-conquering fact, that no rock is interposed between the corniferous lime-rock seen on the Rondout, and the Carbondale coal beds, settles the point. The Pennsylvanian geologists have a very great advantage in being able to say to all travelling geologists, "take passage up the Hudson and Delaware canal, and the Carbondale rail-road, and you see, at every step, the naked gray slate rock, without an interposed layer, and you will see vegetable fossils in the ledges all the way, bearing more or less resemblance to those adjoining the Carbondale beds of anasphaltic coal."

When I commenced my geological surveys, the application of organized remains for demonstrating strata, was not studied in America. I had become acquainted with no method for determining the character of such strata, but that of tracing them separately through a vast extent of country, and then comparing their general characters. For this purpose I travelled some thousand miles at my own expense and with the liberal aid of students of Williams College, with Professor Dewey at their head, where I was employed more than a score of years since, by the authorities of the College, to introduce the natural sciences. Afterwards I travelled more than seventeen thousand miles on geologizing tours, at the expense of the Hon. Stephen Van Rensselaer. And I was always aided by several assistants and competent students. Had the application of palaeontology been then as well understood as it now is, I could have settled the characters of most rocks as well in my closet, by the aid of specimens. But it is a true remark in your last Journal, that strata must have been first settled according to the method to which I was compelled by ignorance to submit, before the service of organized remains could be successfully employed. In this country, no material progress had then been made in the study of organized relics; and even now, we have very few good palaeontologists.

Directions for tracing rocks below the corniferous lime-rock, beginning at the Bethlehem Caverns in Albany county.

4th Point.—It appears to me, that European geologists are misled in regard to their cherty lime-rock, mountain lime-rock, carboniferous lime-rock, &c. By request, I gave a hasty extemporaneous lecture on this subject before the New York Lyceum of Natural History in May, 1831, to a very full house. I will here take an opposite method for illustrating my views. I will simply state facts, and beg my geological friends to follow my walks. Most particularly do I beg this favor of the State geologists, Con rad, Rogers, Vanuxem, Emmons, and Hall. I believe that Emmons and Hall informed themselves practically on this subject while they were my pupils. But the influence of a teacher on the minds of affectionate pupils, is scarcely to be trusted. As the expenses of all State geologists are (or ought to be) defrayed by the State, I hope they will test my accuracy by personal examination. If Europeans are in an error, our geologists will do a favor to science by correcting such errors, in a country where (according to De Luc) "nature operates on a vast scale."

By travelling about a mile from Bethlehem Caverns on the Albany road, we descend a steep ledge of graywacke slate, of about sixty or seventy feet in thickness. This is a continuation of the second graywacke of Big Salmon River, on Lake Ontario, Utica, &c. At the bottom of this slate ledge, we come to the upper transition lime-rock. To demonstrate this assertion, we follow that diverging lime-rock, by way of Amsterdam, around the primitive spurs of Root's Nose and Little Falls, and thence to Sackett's Harbor, on Lake Ontario. Its branches penetrate northerly, far into the primitive district, between the high ridges. If we proceed southerly from Bethlehem Caverns, we soon perceive that it converges towards the corniferous lime-rock, and actually comes in contact with it in the White Rock of Coeymans. The two rocks then proceed southerly in contact, or nearly so, to Esopus strand, and up the Rondout. But each retains its own distinctive characteristics; the lower containing no hornstone and no Cyathophyllum, but containing the fungia and transverse encrinites, &c. In England, these rocks probably run parallel, and in contact, in most or all localities. Hence the confusion among English geologists in the case of Conybeare's carboniferous lime-rock, in which they blend the uppermost rock of the transition and secondary classes. These two rocks by their diverging direction on their northerly course, open so as to leave a wide district between them. This district is occupied by the second graywacke slate and rubble millstone grit of Utica, Big Salmon River, Westmoreland, &c.

Subordinate rocks; or Red sandstone group of De La Beche.—In the years 1822 and 1823, when taking a geological survey for Mr. Van Rensselaer, of a belt of 50 miles in breadth, from the Atlantic to Lake Erie, I was much annoyed by our non-conformable salt-bearing rocks and their associates. Finding no equivalents in European rocks, I called them *subordinate rocks*, and thus published them in my report of 1824. Before I published the result of later surveys, and my geological map of the state of New York, and of parts of the adjoining states, in 1830 and 1832, I read De La Beche on red sandstone groups. I adopted his name; but there remains an incongruity, to be adjusted by state geologists, respecting the equivalency of the two localities, in reference to their order of superposition in geological series.

On going westerly from Big Salmon Creek, along the south side of Lake Ontario, the gray slate and conglomerate rock (both I called second graywacke) are distinctly seen passing under the red sand-rock, in which the salt springs of Salina, &c., are found.

No geological fact is more evident to the senses, in my opinion, than that this red sand-rock, with its overlying associates, which I have called the *ferriferous* strata, (embracing a stratum of red *argillaceous iron ore*,) the *liasoid*, (embracing gypsum,) and *geodiferous* lime-rock, pass under the great corniferous lime-rock range, at their southern edges. It is equally evident, that they terminate at no great distance south of Erie Canal, in their edges, by the approximation of the corniferous lime-rock above, and the second graywacke below. The state geologists are particularly referred to Niagara Falls. Here, and all the way to Queenston, they will see all these strata in the ledgy shores; and a short distance above the Falls they will see the corniferous lime-rock, lying upon the geodiferous, or fetid limestone, which is the uppermost of the red sandstone group.

5th Point.–Here geologists should commence their examinations at Madison village in Catskill. The transition lime-rock of Sackett's Harbor, Trenton Falls, Fort Clair, Amsterdam, Glenn's Falls, below the ledge of Bethlehem Caverns, at Coeymans, White Rock, &c., is here seen in the bank of Catskill Creek, in its near approach to, and sometimes in contact with, the under side of the corniferous lime-rock. From Madison to Catskill village (about 4 miles) may be seen the chief varieties of this rock. The *calciferous sand-rock*, abounding in quartz crystals, (like the same rock on West Canada Creek, near the Medical Institution at Fairfield,) is found here. The hill east of the village, which forms the west bank of the Hudson River, is geologically below it. This is the genuine *first graywacke;* which overlies the argillite along the whole course of the river, from Fort Edward to Newburgh, a distance of about 180 miles. It also spreads over a great proportion of the counties of Washington, Rensselaer, Columbia, and the northwestern part of Dutchess. But the underlying *argillite* is seen forming the bed and sometimes the banks of most of the river, throughout the whole distance; and in various parts of the four counties mentioned, the argillite is laid bare by the disintegration of the graywacke. In some places, as at the north end of Beeraft's Mountain, two miles east of Hudson, the graywacke is covered with the sparry variety of transition lime-rock. The highest ridges in Rensselaer county are terminated by the rubble or conglomerate of the first graywacke. Shawangunk Mountain, before mentioned, in Ulster and Orange counties, is a continuation of the same range. But the eastern boundary of the state is mostly uncovered argillite. There are numerous localities, on and near the banks of Hudson River, where extensive beds of siliceous rocks (sometimes called lydian stone) are seen. The rocky bluffs at Hudson city is that stone; and it contains the same fucoides which are found in the slate quarry of argillite in Hoosick, Rensselaer county. It is also the chief rock at the Troy ferry.

I will close this paper, which may be the last I shall ever send you, by saying, that the limits between classes seem not to be as well settled among geologists as they ought to be, in the present advanced state of palaeontology. Our red sandstone group has recently been placed among transition rocks by some geologists. Surely the equivalent of our vast corniferous and transition lime-rocks can be found in Europe. If we intend to correspond with Europeans, we ought to agree in the great outlines of generalization. That our red sandstone group is below our corniferous lime-rock, is surely believed by all who have been at Niagara Falls. That the uppermost transition lime-rock, and the graywacke which overlies it, are below this group, is doubted by none who have travelled from Sackett's Harbor to Rochester, along the south shore of Lake Ontario. It may be added, that several species of Cyathophyllum, are very abundant in the corniferous rock, and that two or three species of Fungia are often found in the transition lime-rock; and the red sandstone group lies geologically between the two.

I here take the liberty to disclaim all partiality for the names I have used for the last score of years in any of my geological writings in your Journal. I preferred using a kind of adjective or descriptive name, to running the hazard of misapplying the names of the great masters in the science, until I might have the means of correctly understanding their applications. I claim nothing but that of having given the true relations of our rocks, with plain, but accurate descriptions; made in all cases from my personal examinations. When the most approved names are set to the rocks which I describe, it is my hope, that future geologists will be in some measure relieved by my labors. But I acknowledge that any one could have performed what I have done, had he been sustained as I was, for nineteen years, (twelve of which I was much in the field,) by the munificence of the lamented Stephen Van Rensselaer. I did nothing but go from rock to rock, comparing their structure, mineralogical constituents, and order of superposition. This duty I performed faithfully, and with most ardent zeal, according to the directions of my patron, from the year 1820 to 1832. Since the year 1832, I have been chiefly confined at home by difficult respiration. Specimens of *organized remains*, collected by students in their travelling tours, for the last four or five years, I have carefully considered; and I hope that my knowledge of them, though imperfect, may be useful. It is Mr. Conrad's duty to give us all he knows of them, (which is as much as any man can give us,) in his final report.

P. S. Allow me a little space for acknowledging my obligations to Dr. Theodric Romeyn Beck, of Albany, for first proposing to Gen. Van Rensselaer, that he should employ me as his geological surveyor.

Art. V.—*Account of the Hurricane or Whirlwind of the 8th of April*, 1838. By Mr. J. Floyd; communicated by J. H. Patton, Esq., Magistrate of the 24 Pergunnahs.

Abridged from the India Review and Journal of Foreign Science and Arts, for July, 1838.

This remarkable whirlwind swept through the villages, near the city of Calcutta, on a course nearly southeast; its path being from a quarter to half a mile in width.* The destructive effects

* The track of this whirlwind passed within three miles of Calcutta, on its eastern side, between the city and the great salt-water lake. Its average course on

as exhibited on sixteen miles of its track, near Calcutta, were examined by Mr. Floyd, in company with the magistrate, soon after its occurrence. The examination commenced at the village of Codeleah, near the termination of its ravages, and was continued from thence towards the northwest, on the line of the storm.

"At Codeleah many houses were destroyed, large trees were torn up by the roots, and many were broken off at the stumps, while the small and elastic ones escaped with only the loss of leaves and branches. A peepul tree which had been standing time out of mind, and to the knowledge of the oldest inhabitants had never lost a bough, was the first tree that here encountered the storm, and the first that fell. The circle from whence the roots sprung, was 35 feet in diameter, and these being of extraordinary length, caused the earth to come away with the tree, and to leave a chasm of about 38 feet in width and 14 in depth; most of its stouter branches were wrenched off, and thrown into an adjoining tank, at such a distance as to prove the extraordinary violence with which the tree was assailed. The paths were obstructed by fallen trees, &c. and the tanks choked with branches. Fifty persons have sustained bodily injury, but reports vary as to deaths. Seventeen have their limbs severely injured, and I fear cannot survive. The severest cases we advised to be removed to the hospital at Allipore, but without effect; the "Gunga," they said, was close at hand, whither their friends would take them, were they to die.

At Bykunthpore, for about a quarter of a mile, not a house, hut, nor tree had escaped the violence of the storm; in fact every thing that opposed its progress, was levelled to the ground. Persons visiting the place, ignorant of the occurrence of the storm, would suppose the mischief had been caused by fire. I had almost come to the above conclusion myself on observing the stumps of trees, withered leaves, and here and there posts of houses, &c. Such was the violence of the wind, that cocoa-nut and date trees were twisted out of the ground, and hurled to a distance of two or three hundred feet; granaries have been swept away, and life both of man and beast destroyed. We traversed the whole extent of the village, and witnessed many shocking sights.

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this part of the route, as given on the sketch, appears to have been South 37° East. It appears to have been remarkable for its slow rate of progress, and it is to this, perhaps, that its unusual destructiveness is in part to be ascribed.

I also visited Majaree Gaon, Pergunnah Anarpeer, Dum Dum, Anundpore, Baleaghatta, the salt water lake, and adjacent villages. Baleaghatta suffered less than other places, but Mr. G. Princeps' salt works, on the opposite side of the canal, have suffered materially.*

On the canal, it would appear by information collected from the boatmen and others, that fifteen lives were lost, and about twelve boats. That there may have been more I do not deny; I saw only five wrecks, one of them in the new dock, said to have been conveyed thither by the violence of the wind, the anchor of which must have weighed at least twelve maunds! But in "Bairnala," almost every boat was swamped. The villages of Sambandal and Chowbagan have been laid desolate; men, women, and children, as well as animals have died without number. I say, without number, because there was an established hut in Sambandal, and on that day, I understand, it was crowded to excess by people from the neighboring villages, as well as by residents. In other villages the visitation has been awful indeed, but in these places it surpasses all description. As far as the eye could reach, not a house is to be seen. The grass (I am at a loss to account for it) has been consumed, and the choppers [frames?] of houses have vanished as if they were mere vapor. *Dongahs* and saultees† have been carried up, and in their descent shattered to atoms. The bark of the palm trees has been peeled off as with a knife, and their leaves broken into shreds. I am of opinion, that the effect of the whirlwind was more severely felt at Chowbagan and Sambandal, than at any other part; also that it was owing to the vast expanse of water over which it took its

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* Some particulars of the damage sustained by these works, are worthy of record. An iron salt boiler, weighing more than a maund, was lifted into the air and conveyed a few yards distance. The tiles of the terraces, laid in the best cement, were ripped up as it were by suction. A boat lying on the ground for repair, disappeared, and only a few fragments were found. It appears, from an observation made by Prof. O'Shaughnessy in this month's Asiatic Society's proceedings, that some of the salt fell in lumps at a great distance. Large beams were lodged on the salt works *from the opposite* side of the canal. But the most extraordinary proof of the force exerted in a lateral direction, was evinced in the projection of a slight bamboo horizontally through one of the raised tiled walks, which pierced through the whole breadth, breaking the tiles on both sides. It has been cut off and preserved in situ, as the monument of the storm. A six pounder could hardly have forced so light an arrow through a mass of earth five feet thick.—*Editor of the India Review*

† Canoes and hollowed logs of wood used as fishing boats.—*Id.*

course ere it met with any impediment, and having encountered one of the above villages almost immediately after crossing the water, every thing before it was swept away. It pursued its course in a southerly direction, levelling trees and houses in its course, exhausting itself at Codeleah.

These villages were inhabited chiefly by fishermen who were, at the time, on the lake, and never felt the effects of the storm, till on their return they found their villages demolished, and only a few surviving to account for the occurrence.

Bakharies or split bamboos forming the choppers of houses, did great execution. The gomastah of the above villages gave me the following romantic account of the storm.

"On Sunday, at about half past two P. M., the hurricane came on: at first it appeared in a westerly [N. W.] direction, and to the best of their judgment two dark columns that were visible whirling round and round, descending to the earth, had the appearance of two huge daityas (or demons) preparing for combat;—that a second before they were fairly alighted they engaged in mortal strife, and agitating the waters of the lake began their work of destruction on land;—that such as were in their houses, hastened out to witness this wonderful phenomenon, and ere they could return to their homes, the sudden darkness that overspread the place, the howling of the wind, and clouds of dust attending it, rendered it impossible for them to bear testimony as to which of the two gained the victory. That from the occurrence of the whirlwind to the period it lasted or left these parts, it did not occupy twenty minutes, and was almost immediately followed by sunshine. There was little or no rain, but a severe fall of hail, which probably deprived some of life.

At the village termed Mazare Ganw, the whirlwind came on at about half past one o'clock; at Soorah, Anundpore, Balleaghatta, Chowbagan and Sambandal, at two and three o'clock; and the villages farther east, Bykunthgoor and Codeleah, four o'clock, and though not lasting long in each, its effects have been truly distressing. It hailed in the above mentioned places, and in the two last named villages the hail was triangular. I give this latter information as I derived it, but at Dum Dum the hailstones were uncommonly large, one weighing, (as is said,) three and a half pounds."

Statement exhibiting the number of lives computed to have been lost, the names of the villages through which the hurricane passed, and other particulars.

NAMES OF THE VILLAGES.	Extreme extent of the storm.	Average breadth.	Direction of wind, straight or revolving.	Number of Puka houses destroyed.	Number of Kutcha houses.	Number of human lives lost.	Number of cattle do.	Number of wounded.	The period of its duration.
Anundpore, - - -	Sixteen miles.	One quarter mile and half mile.	Revolving.						Four hours.
Soorah, - - - -			do.						
Pagladanga, - - -			do.						
Mr. Princeps' Salt Works,			do.	1					
Botchtullah, - - -			do.		33				
Chowhata, - - -			do.		224	105	235	31	
Butgotchee, - - -			do.		13				
Madoordooah, - - -			do.		21				
Sambandal, - - -			do.		91	26	90	17	
Kularabad, - - -			do.		21				
Nazeerabad, - - -			do.		49	5			
Anundpore,* - - -			do.		41				
Jugdeepotha, - - -			do.		53				
Hossainpore, - - -			do.		5				
Autghurah, - - -			do.		34				
Ranabatooah, - - -			do.		13				
Dhaloo, - - - -			do.		17	3		3	
Pauchpota, - - -			do.		58	6	18	6	
Bykuntpore, - - -			do.	1	150	33	83	51	
Codeleah, - - - -			do.	3	157	13	17	55	
Sreekhundpr, - - -			do.		79	6	30	12	
Kaderout, - - - -			do.				5	5	
Sanorepore, - - -			do.	1	58	12	42	4	
Khorde Rajpore, - -			do.		45	4	8	11	
Chingreepotah, - - -			do.		46	2	5	28	
Hurreenabhee, - - -			do.		31				
				6	1239	215	533	223	

Remarks.—The extreme length of storm, properly speaking, is sixteen miles, the effects from *Kawrapakur* to Anundpore (four miles) being slightly felt.

* There appears to have been two villages of this name in different districts.

Art. VI.—*On the destructive Distillation of the Sulphate of Etherine or heavy Oil of Wine;* by Clark Hare, of Phila.

When the oil of wine is subjected in a retort, to a temperature sufficiently high, a receiver refrigerated by snow and salt being fitted to the beak, there passes over not the oil itself, but the yellow liquid which is obtained with the acid of a similar refrigeration, in the process for forming the sulphate of etherine, by the reaction of sulphuric acid and alcohol. This yellow liquid* consists of a combination of sulphurous acid and ether, called by Dr. Hare, who first described it, sulphurous ether, which boils below 30°, holding in solution a small quantity of the heavy oil of wine, which, by the formation of other more volatile compounds, has escaped decomposition.

This experiment is interesting as proving that ether may be formed from the sulphate of etherine, as well as the sulphate of etherine, from ether; and thus adding a new link to the chain which connects these two compounds. It may also perhaps serve as the ground on which to base some theoretical speculations, on the phenomena which attend the reaction of sulphuric acid and alcohol, when subjected to the process of distillation.

According to the theory of etherification, which refers the phenomena attendant on this reaction, to the formation and decomposition of sulphovinic acid, the production of ether has been ascribed to the tendency of this acid when heated, to resolve itself into its constituent parts, sulphuric acid, and ether. But there has been some difficulty in understanding how, when the process is pushed a little further, such large quantities of sulphurous acid should accompany the ether, while the sulphate of etherine, which one might, from the composition of sulphovinic acid, have anticipated as the principal product, is formed in quantities so small, as to appear rather the result of some accidental play of affinities, than of a regular decomposition.

The composition of sulphovinic acid, has been variously stated as $2\,\dot{\dot{\dot{S}}}+E+2\,\dot{H}$, and $2\,\dot{\dot{\dot{S}}}+E+\dot{H}$, while for that of the sulphate of etherine, we have had given $\dot{\dot{\dot{S}}}+E+H$, and $2\,\dot{\dot{\dot{S}}}+2\,\dot{\dot{\dot{E}}}+H$. In the following remarks founded on the writings of

* This liquid has been designated as the ethereal sulphurous sulphate of etherine, by Dr. Hare.

the European chemists, except so far as they are based on the partial conversion of the sulphate of etherine, into sulphurous ether by distillation, which I believe to be new, I shall assume as true, that one of the formulæ given above, which supposes present in each compound an atom of water for each atom of sulphuric acid. The explanation which I shall offer, will however be still more applicable on the other view of the composition of these substances.

It may easily be understood, that at the commencement of the operation, while pure ether is alone given off, the sulphovinic acid separates into one compound atom of etherine and water, one atom of hydrous sulphuric acid, and one atom of the same acid, which would be in the anhydrous state, did it not immediately unite with an atom of alcohol or water. But it might have been anticipated, that as the operation advances since the other substances present are continually diminishing, while the sulphuric acid is increasing in quantity; a period will finally arrive, when if more than one atom of that acid were to leave the etherine, it would no longer find any thing else, with which to combine; and that consequently, the sulphovinic acid, instead of separating into two atoms of sulphuric acid, and one of ether, would at this stage of the process, yield one atom of the same acid, and one of sulphate of etherine. Instead however of obtaining the heavy oil of wine in the receiver, in large quantities, replacing the ether, which ought according to the theory thus rapidly sketched, no longer to be evolved; we find there a yellow liquid, consisting of sulphurous acid and ether in a state of partial combination, holding in solution a small quantity of the sulphate of etherine.

As it now, however, appears, that this same yellow liquid is produced, when the sulphate is subjected to the process of distillation, we may believe, that the result indicated by theory, really takes place, the sulphovonic acid $2\,\dot{\dot{\dot{S}}}+2\,\dot{H}+E$ actually separating; with one atom of aqueous sulphuric acid $\dot{\dot{\dot{S}}}+\dot{H}$, and one of sulphate of etherine $\dot{\dot{\dot{S}}}+\dot{H}+E$. The latter being unsusceptible of distillation will then as I have shown, afford by its decomposition the yellow liquid which we find actually produced.

This theoretical view is very much strengthened, by the fact, that the sulphate of methylene which distils per se without alteration, is almost the sole product of the reaction of pyroxylic spirit and sulphuric acid, under circumstances precisely similar to those in which sulphate of etherine is produced in such small quantity. We may therefore conclude, from the close analogy which exists between the reactions of pyroxylic spirit and alcohol, that the sulphate of etherine is in the retort, the sole product of the decomposition of the sulphovinic acid, as the sulphate of methylene is of the sulphomethylic acid; but that being unlike the sulphate of methylene, incapable of distillation, it yields as a result of its decomposition, the substances which we actually obtain.

ART. VII.—*Abstract of a Meteorological Journal, for the year* 1838, *kept at Marietta, Ohio, Lat.* 39° 25′ *N., and Long.* 4° 28′ *W. of Washington City;* by S. P. HILDRETH.

Months.	Thermometer.				Fair days.	Cloudy days.	*Rain and melted snow.*		Prevailing winds.	Barometer.			
	Mean temperature.	Maximum.	Minimum.	Range.			Inches.	100ths.			Maximum.	Minimum.	Range.
January,	34.85	70	6	64	22	19	2	12	S., S. W. & N.		29.85	29.12	.73
February,	20.86	43	–10	53	17	11	1	79	W., N. W. & N.		29.68	28.65	1.03
March,	45.48	83	10	73	21	10	2	25	S. W. & N.		29.65	28 98	.67
April,	48.64	84	24	60	19	11	4	45	N. W., N., S. E.		29.62	29.00	.62
May,	55.51	85	32	53	14	17	5	71	N. W., N., S.		29.60	28.88	.72
June,	70.94	88	49	39	21	10	6	92	S., S. W. & S. E.		29.53	29.00	.53
July,	76.33	95	61	34	26	5	0	96	S. W., W., N. W.		29.64	29.28	.36
August,	75.42	96	56	40	29	2	3	50	N., N. W. & S. W.		29.65	29.30	.35
September,	63.91	90	38	52	27	3	1	33	N., N. E., E.		29.68	29.33	.35
October,	48.76	80	28	52	20	11	1	95	N. W., N. E., S. E.		29.85	29.00	.85
November,	38.62	63	10	53	17	13	3	42	N., N. E., S. E., S.		29.95	28.90	1.05
December,	28.15	52	–9	61	15	16	1	08	S. W., W., N. W.		30.00	28.80	1.20
Mean,	50.62						35	48					

Remarks on the year 1838.

IN reviewing the changes of the past year, we find it marked by several striking peculiarities. In it we find greater extremes of heat and cold, drought and moisture, than noticed in any other for a long period of time. The mean annual temperature is considerably below that of this climate, being only 50.62; which we should consider remarkable, when we remember the great heat and dryness of the summer months. The excess of caloric, was, however, more than balanced by the cold of the winter and spring months. The mean temperature of the four seasons is as follows. It will be proper to remark that in estimating the winter of 1838, I take in December of 1837, which properly belongs to this winter. To have the seasons correctly united, the meteorological year ought to begin with December, in the place of January, which gives a portion of two winters to the year, instead of an undivided one.

Winter months 30.42. Spring months 49.87.
Summer months 74.23. Autumn months 50.43.

Some portion of the winter, was remarkable for its severity, especially the month of February, the mean of which is lower by several degrees than that of any other for more than thirty years past. The mercury was below zero on a number of mornings, and for the whole month it rose above the freezing point in the middle of the day, only on seven days. The mean for the month is 20.86. The spring months were cold and wet; especially May, more than half the days of which were cloudy or rainy. Vegetation was very backward, and at the close of the month, the Indian corn, which was only three or four inches high, was white, and nearly as destitute of color as plants which grow in the dark. The mean heat was five degrees less than that of 1837. In June the weather became warmer, but was still very wet. Early in July the rains ceased, and it became hot and dry, so that there fell in this month less than an inch of rain. In August, the heat still continued, accompanied by severe drought, which was felt from the western side of Ohio, easterly to the foot of the Green Mountains in Vermont. The mean heat of the summer months, was five degrees greater than that of 1837. In September, the heat and drought continued until the twenty second of the month, when there fell a little more than one inch of rain. After this period, the weather was cooler. October was cold and dry, being five degrees below that of last year. November was the same, and ten degrees lower, being only 38.62 for the month. In December the cold increased in the same ratio, showing a mean for the month, of 28.15, and on the last day of the year in the morning stood at nine below zero. The dry weather still continued, and in place of the periodical, annual rains which fall at the winter solstice, with far more certainty than at the equinox, we had only a thin coating of clouds for a day or two, with the wind southerly, when it changed to W. N. W., and continued to blow from those same dry points of the compass, as it had done for the last five months. The Ohio river, which rose a few feet early in November, soon fell again to the same low stage which attended it during the summer, and was finally closed by ice as early as the sixth of December. The amount of rain for the year is 35.$\frac{48}{100}$ inches, which is about seven inches less than the mean for this region. The diminution in quantity, however, has not been so much the cause of the excessive drought which has distressed the whole western country, as its distribution. Two thirds of the whole amount fell in the first half of the year, when the weather was comparatively cool, leaving the hottest portion, and the autumnal months, with a very scanty supply.

Effects of the drought.

All the crops which depend on the summer months for their growth, suffered exceedingly. Amongst these, the potatoe, felt the ill effects most seriously, especially as great heat, as well as drought is very injurious to this valuable vegetable. In most fields there was an entire failure, and the common price of twenty or twenty five cents per bushel rose, to $1 and to $1 50. Indian corn on the hill lands was also a failure; but in the old rich bottoms, yielded a good crop. In new rich lands, there was a large growth of stems and foliage, but not a bushel of ears to the acre, the drought stopping the filling out of the grains. Beans failed in the same way. Wheat, oats, and grass, ripening earlier in the season, afforded good crops. Pastures were dried up in August, so that some farmers began feeding their cattle and horses with hay early in September. The streams, springs, and wells of water, became greatly reduced, so as to occasion, in many places, much inconvenience in procuring a supply for families and domestic animals. The water mills, which in common years furnish flour and meal to the inhabitants, were silent; and many farmers had to carry their grain fifty or more miles, to mills worked by steam power. Another serious evil has also arisen from the drought; nearly all the salines in the west are located on navigable streams, and depend on the water for the transport of the salt to market. The low stage of the rivers prevented its removal in any large quantities, until the winter closed the navigation, thus disappointing the manufacturers of its sale, and greatly enhancing the price to consumers of the small amount within their reach. Traders on the rivers cannot transport the produce of the country, nor the merchant receive his goods, either from up or down stream, causing a great scarcity and rise in the price of groceries, especially that of Orleans sugar, which has for some years past nearly supplied that old fashioned, but delicious article, maple sugar. As a consequence of the drought, there has been a rise of nearly fifty per cent. on all the articles of food, or the actual necessaries of life in Ohio. However trivial the subject of meteorology may appear to some persons, we have practical evidence of its relation to all the comforts, if not the very existence of society. A predominant direction in the course of the winds, for several months in succession, may produce and has produced very serious results to a whole region of country. In Ohio, nearly all our rains are brought by the southeasterly, southerly, or southwesterly winds; while a dry state of the atmosphere, as generally attends the westerly, northwesterly and northerly. For the last six months, the prevailing winds have been from these quarters, and we can safely infer that this has been a prominent cause in producing the late drought.

January 10, 1839.

Art. VIII.—*On Meteoric Iron from Ashville, Buncombe county, N. C.*; by Charles Upham Shepard, M. D., Prof. of Chemistry in the Medical College of the State of South Carolina.

A specimen of supposed native iron was lately presented to me by Dr. J. F. E. Hardy, for examination, accompanied with the observation that it was not completely soluble in acids. It weighed between nine and ten ounces; and had been detached from a rounded mass nearly as large as a man's head, which mass was found loose in the soil, about five miles west of Ashville village, near the southwestern base of an elevation of land, five hundred feet high. It was the opinion of Dr. Hardy that other masses existed at the same place.

The shape of the specimen in hand, evinces a distinct crystalline structure, approaching that of a flattened octahedron. Its surface presents a dissected, or pitted appearance, occasioned by the removal of portions of the external laminæ during its separation from the original mass. The cells and cavities are perfectly geometrical in shape, being either rhomboidal, tetrahedral, or in the figure of four sided pyramids. Indeed, the resemblance of the mass in this respect to that of an imperfectly formed crystal of alum, is very striking.

It requires the application of numerous and powerful blows to disengage fragments from the specimen. The hammer slightly indents the surface; and at length loosens sections of the external laminæ, which may be detached by the aid of a forceps. Their shape is commonly that of an acute rhomboid, considerably flattened in its dimensions; but they are capable of an easy division into regular octahedrons and tetrahedrons, whose exactness of form rivals the cleavage-crystals of fluor. Some of the plates will separate into leaves nearly as thin as mica, which substance they even resemble in color, (being silver-white, inclining to steel-grey,) and are slightly elastic, though when twisted up, they remain as a piece of thin iron would do under the like circumstances. The shape of the thinnest fragments is as regular in outline as the layers of the most highly crystalline fluor; and are delicately striated in every direction, in accordance with the octahedral cleavages.

Prior to the separation of any fragments, the surface of the specimen did not afford the metallic lustre; but was coated with a thin blebby pellicle, apparently of hydrous peroxide of iron. Those surfaces which have been recently developed, lose their silvery grey lustre in the course of a few weeks, but without any sensible attraction of moisture from the atmosphere.

Its specific gravity varies from 6.5 to 7.5; indeed, one fragment mounted as high as 8. This diversity of results is no doubt dependent on the compression of the fragments, produced during their separation from the specimen.

Analysis.

A. Fragments of it were treated with nitro-hydrochloric acid. The action was feeble until heat was applied, and afterwards less striking than with metallic iron, or even with the native terrestrial iron of Canaan,* (Ct.) A dark clove-brown matter remained after some hours of continued digestion, troubling the transparency of the solution, and forming also a distinct sediment at the bottom.

* See this Jour. Vol. xiv, p. 183, for Prof. Shepard's notice of this iron.—*Eds.*

Acid was accordingly added in excess and the digestion renewed, but apparently without diminishing the bulk of the insoluble matter. It was therefore permitted to subside, and the supernatant fluid becoming clear on the following day was removed.

B. The insoluble matter was washed, dried, and examined with the microscope. The greater part of it was in the condition of an impalpable powder, while the remainder was in minute, irregular shaped blackish-grey grains. The whole was ground perfectly fine in a mortar, and again treated with nitro-hydrochloric acid. After a long continued digestion, it diminished about one half in bulk, leaving the balance of a light chestnut-brown color, precisely resembling silicon. The solution obtained was found to contain only iron. The brown powder was fused along with hydrate of potassa in a silver crucible; water was affused, and the solution subsequently treated with nitric acid. A transparent solution was instantly formed, from which ammonia threw down flocculi of silicic acid, colored by peroxide of iron. A solution of potassa was now added, and the peroxide of iron separated by the filter. The clear liquid was rendered acid a second time; after which the addition of ammonia threw down white flocculi of silicic acid.

C. The clear nitro-hydrochloric solution, A, first treated with a solution of hydro-cholorate of ammonia, was cleared of its iron by ammonia, whereupon the fluid assumed a pale blue tinge. It was brought to the boiling point, and precipitated (in a close vessel) with potassa. To the remaining fluid was added, after the separation of the oxide of nickel by the filter, hydrosulphate of ammonia, which occasioned a slight precipitate. It was separated from the fluid, and examined before the blowpipe, but it simply afforded the reaction of oxide of nickel.*

D. To a portion of the solution A was added lime water, freshly saturated with chlorine. No precipitate followed, from which we infer the absence of manganese in the meteoric iron.

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* In an experiment conducted as follows, a clear indication of cobalt was obtained. The iron had been separated from a solution of the ore. The precipitate by potassa from the hydrochlorated solution, together with the concentrated fluid from which the oxide of nickel had been thrown down, was mingled with a portion of the silicon to which potassa had been added, and the whole fused together in a silver crucible. The well known color of smalt was constantly produced when the crucible was withdrawn from the fire, just at the moment when tho mass was passing from the fluid to the solid state.

E. About two hundred grains of the minutest divided iron was fused for upwards of an hour with its weight of nitrate of potassa. Water was affused, and to the clear solution, saturated with acetic acid, acetate of lead was added. A copious precipitate ensued, in which a distinct straw yellow tinge was observable, and must have been occasioned by the precipitation of a trace of chromate of lead, (along with the chloride and sulphate of the same metal.)

F. To a solution of the meteoric iron in nitric acid, nitrate of silver was added. It occasioned an immediate precipitate, proving the presence of chlorine. This element was also rendered quite apparent by testing in the other method practiced by Dr. Jackson, (to whom belongs the merit of having first detected it in meteoric iron,*) viz. by mingling a solution of nitrate of silver with water which had been boiled upon fragments of the iron.

G. The nitric solution, F, also became slightly clouded by chloride of barium, proving the presence of sulphur in the meteoric mass.

H. Through the nitro-hydrochloric solution, A, was transmitted a current of hydro-sulphuric acid gas, which simply occasioned a cream colored cloud from the precipitation of hydrated sulphur. Its yellow tinge led to the suspicion of arsenic, but chlorate of potassa did not develope a decidedly green tint in the original nitro-hydrochloric solution, A.

It is proper to add that the proportion of chlorine set down in the following analysis, was derived from heating to whiteness in a small closely covered platina crucible, two grammes of the iron in small fragments, the protochloride of iron being volatile at a white heat. The sulphur, chrome, and cobalt being present only in traces, no attempt was made to ascertain their relative proportions.

Iron, - - - - -	96.5
Nickel, - - - -	2.6
Silicon, - - - -	.5
Chlorine, - - - -	.2
Chromium, Sulphur, Cobalt, Arsenic ? } in traces.	
	99.8

Charleston, (S. C.) Dec. 26th, 1838.

* See this Journal, Vol. xxxiv, p. 332.

Art. IX.—*Analysis of Warwickite;* by Charles Upham Shepard, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

In proposing the Warwickite as a new mineral species in a late number of this Journal, (Vol. xxxiv, p. 313,) I remarked that I should avail myself of a distinct crystal of the substance, belonging to my mineralogical collection here, for obtaining a more correct knowledge of its chemical constitution. The results of the proposed inquiry are embraced in the following notice.

The crystal referred to was nearly two inches long, by one third of an inch in diameter, and imbedded in white magnesian limestone. It was presented to me by Dr. Horton, and is ticketed Amity, which town adjoins Warwick, where the mineral was first discovered.

The specimen in hand affords but indistinctly the metallic reflections, so striking in the smaller crystals from Warwick. Its diagonal cleavages also are less distinct. The color is grayish brown, approaching to black. The crop-cleavage is very obvious, and is oblique to the axis. Lustre, imperfectly metallic, in which respect it resembles columbite and some varieties of rutile. Sp. gr. = 3.0...3.14. Hardness = 6.0.

Its powder is of a chocolate-brown color, which during ignition changes to purplish black; and the mineral loses during the process 8 p. c. in weight—the particles afterwards cohering together in a a porous mass.

1. On being treated in powder with sulphuric acid in a platina crucible, it slowly swells up and emits bubbles of hydrofluoric acid gas. The application of heat causes a brisk effervescence; and on holding a plate of glass over the capsule, it is distinctly corroded by the acid vapor. A little water was added and the digestion maintained for half an hour, when the whole of the powder had suffered decomposition, having passed through various shades of purple and gray to a pale, yellowish white. On adding more water and boiling, the whole was taken into solution.

2. A portion of the clear sulphuric solution 1, was farther diluted and boiled, whereupon it threw down titanic acid in large quantity.

3. A portion of the solution 1, was treated with tartaric acid, neutralized with ammonia, and examined for lime and magnesia, without the detection of either.

4. A portion of solution 1, was precipitated by potassa, and the precipitate treated with a solution of the same agent. The clear fluid, on being separated from the insoluble matter by the filter, was boiled with hydrochlorate of ammonia, which produced only a faint troubling of the fluid, proving that a trace of alumine was present.

5. The insoluble matter, after digestion in solution of potassa 4, was agitated repeatedly with a solution of carbonate of ammonia in a close vial. The clear fluid, after many hours standing, was withdrawn by a dropping tube and boiled. It threw down a yellowish white precipitate, which was separated by the filter and ignited. No glow, like that evinced by zirconia, was observable during the process. The powder was redissolved by hydrochloric acid, without difficulty, excepting a few particles of titanic acid. Its solubility subsequent to ignition showed that it was not thorina, while its white color proved it not to be the oxide of cerium. It was therefore considered as yttria, although the tincture of nut-galls threw down from its hydrochloric solution an orange red precipitate of titanium, evincing that traces of titanic acid had also been taken up by the carbonate of ammonia.

6. A portion of the neutralized solution 3, was tested for manganese by the chloride of lime, without affording any indication of that metal. Another portion was treated with hydrosulphate of ammonia, which gave a black precipitate. It was separated from the fluid, and fused with borax before the blowpipe, whereby the reaction of iron was obtained.

7. A portion of the mineral was fused with anhydrous carbonate of soda, supersaturated with acetic acid, and tested with acetate of lead for phosphoric acid, which acid was not detected. Examination was also made for silicic acid, but with the like result.

Having thus ascertained that the ingredients of the mineral are fluorine, titanium, iron and yttrium, with a trace of aluminium, I proceeded as follows to determine their relative proportions: The yttria in the sulphuro-tartaric solution was precipitated by tartrate of potassa, although it was found impossible to obtain it in this way, entirely unmixed with titanic acid. Another method of separating it was tried, by first throwing down the titanic acid from a dilute sulphuric solution by ebullition, and then precipitating the oxide of iron and yttria by potassa, and subsequently withdrawing the yttrious earth from the iron by carbonate of ammonia; but this process equally failed—titanic acid being also mingled more or less with the potassic precipitate: and I am obliged to confess that I do not regard the proportion of yttrium in the compound as yet determined with precision, although I consider its presence as unessential to the mineral. The iron was separated by succinate of ammonia. To estimate the titanium, the increase of weight in the mineral during its oxidation by sulphuric acid was noted, and found to be 13.2 on 48 parts. The peroxide of iron and di-sulphate of yttria, (this being the supposed state of the iron and yttrium of the mineral after digestion in sulphuric acid and ignition,) were deducted from 61.2, which left 54.67 for its titanic acid. But 54.67 of titanic acid contains 32.9 of titanium. The iron which corresponds to the quantity of the peroxide obtained equals 3.5; and the yttrium answering to the di-sulphate of yttria 0.4. Upon the supposition that the titanium, the iron, and the yttrium are each combined with half an atom of fluorine, we make up the original quantity submitted to analysis, with the fractional excess only of 0.99, on 48.00 parts. We have therefore in 100 parts of the mineral,

Titanium - - -	64.71
Iron - - - -	7.14
Yttrium - - -	.80
Fluorine - - -	27.33
Aluminium, a trace.	
	99.98

If we regard yttrium as adventitious, Warwickite is a compound of twelve atoms of di-fluoride of titanium and one of di-fluoride of iron. The formula is 12 $\ddot{Ti}$ Fl + $\ddot{Fe}$ Fl.

Charleston, (S. C.) January 12, 1839.

Art. X.—*Notice of the Thermal Springs of North America, being an extract from an unpublished Memoir on the Geology of North America, read to the Ashmolean Society of Oxford University, Nov.* 26, 1838, *and now inserted in this Journal, by permission of the author*, Dr. Charles Daubeny, Professor of Chemistry and Botany in the University of Oxford.

Thermal Waters.—In the State of New York, twenty miles east of Albany, near the Shakers' village of Lebanon, occurs a spring possessing a constant temperature of 73° Fahr.

It emerges from the junction of talcose slate, with an impure schistose limestone, containing though scantily, organic remains, namely, five species of Fucoides, trilobites, &c. There is a fault in the vicinity of the spring. This thermal water has been frequently analyzed, but nothing of importance has been detected in its composition; it emits copiously bubbles of gas, which I collected on the spot, and found to contain no trace of carbonic acid, but to consist of nitrogen 89.4, oxygen 10.6. In the same chain, as we proceed into the State of Vermont, we meet with one or two other slightly thermal waters, as at Williamstown, in Massachusetts, and at Canaan at the foot of the Green Mountains. I am disposed also to consider the carbonated waters of Ballston and Saratoga, which lie about fifty miles to the northwest of Lebanon, as slightly thermal, for by reference to the table published by the Regents of New York University; it will be seen, that Schenectady, the nearest post to these springs, at which observations are recorded, and situated a little to the south of them, possesses a mean temperature of only 46.20° Fahr.

I found at Ballston one of the springs to be 50.5, and the other 49.5; and at Saratoga, the new Congress 49.5, Hamilton Spring the same; and Congress Spring 51. At both these localities, gas was given off, consisting chiefly of carbonic acid, but containing, after this had been removed in the usual way, a residuary portion of air, in which nitrogen and oxygen were both present, but with an excess of the former, as compared with the proportion existing in the atmosphere.

The next Groupe of thermal waters I shall notice is, that which occurs in Virginia, and here I am indebted to Professor William B. Rogers, for directing my attention to the geological structure of the country, immediately bordering upon these springs, which I found to be strikingly corroborative of the views I had some time ago announced, with respect to their being a general connection between the occurrence of thermal waters, and extensive disturbances or dislocations of the strata adjoining them.

In the midst of the beautiful mountain region of Virginia, west of the Blue Ridge, but in that part of the chain which attains the highest elevation, and the most picturesque character, is situated an assemblage of mineral waters, which from their reputation as medicinal agents, as well as from the purity and coolness of the air which surrounds them, attract every summer from all parts of the Union, and especially from the southern sections of it, crowds of persons in search either of health or amusement.

Several of the most noted of these seem to possess the ordinary temperature, and to owe their efficacy to the sulphuretted hydrogen with which they are impregnated; such are the white, the red, the blue, and the salt Sulphur Springs.

The three former derive their distinctive appellation from their color, which is owing, probably, to the difference in the nature of the Confervæ, that grow in them, and impart their respective hues to the water; the latter, designated as the salt, from the presence of a larger proportion of common salt than is contained in the rest.

One, "the Sweet Spring," is strongly acidulous and slightly thermal, but two others which appear to possess no remarkable mineral impregnation, are designated by the names of the Warm and Hot Spring, from the more or less considerable elevation of temperature which belongs to them.

The Warm Spring I found to possess a heat of 96° Fahr.; the Hot Spring one of 102°; whereas the mean of the climate appears to be about 56°.

Both Springs emitted bubbles of gas, in considerable abundance of which I collected samples.

That from the Warm Spring was found to contain six per cent. of carbonic acid, ninety four per cent. of nitrogen, and only six of oxygen; that from the Hot Spring varied a little, according to the source from whence it was taken; the gas obtained from the ladies bath, consisting of eleven per cent. carbonic acid, ninety eight per cent. nitrogen, two per cent. oxygen; and from the men's bath, eight per cent. carbonic acid, ninety six nitrogen, and four oxygen. These proportions are computed, on the assumption, that an expansion of two per cent. takes place in nitrogen, after phosphorus has been heated and volatilized in the vessel that contains this gas.

Now both the above springs lie at a distance of about three miles, one from the other, in a valley, the direction of which is nearly north and south, and it may be seen by reference to the section, which Professor William B. Rogers has appended to his Geological Report of the State of Virginia, that they are situated exactly at the anticlinal axis already alluded to.* And on examining the rocks on both sides of these springs, wherever the nature of the country allowed of my exploring them, I found every reason to place reliance on the correctness of his representation.

To the west of the Hot Spring, the more southern of the two thermal waters alluded to, the rocks become more and more inclined towards the west, as they approach nearer to the spring, until at length in its immediate vicinity, they assume an almost vertical position.

Immediately surrounding the spring which issues from the bottom of the valley are vertical beds of a blue fossilliferous limestone, which is called number two, by Professor Rogers, being the lowest but one of the rocks incumbent on those of the Blue Ridge, which are included in his series.

A very compact sandstone used as a freestone succeeds, then beds of clay slate again, and afterwards an highly ferruginous sandstone.

Up to this point, the rocks are inclined at so high an angle, that they may be regarded as vertical, and in consequence of being so near the axis of the movement, they are often contorted and much disturbed. Further to the west, however, they are succeeded by strata of sandstone, conglomerate, limestone and clay slate, dipping at a gradually decreasing angle of inclination, and this continues until they become nearly horizontal.

On the east of this spring, the density of the forests is such as rendered it impossible for me to obtain any knowledge of the mineral structure of the subjacent rocks, but this desideratum was supplied by following the road running to the east of the Warm Spring, which, as I have already stated, lies in the same valley.

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* In the former part of the paper which is not contained in our present number. —Eds.

Here, as we ascend the so-called Warm Spring mountain, we observe the very same rocks, successively presented to us, which we had seen to the west of the Hot Spring, equally vertical in the immediate neighborhood of the spring, dipping in the reverse direction, at a high angle, farther to the west, and at length subsiding to a moderate inclination, at a still greater distance from the axis of elevation.

Such are the particulars, which were originally communicated to me by Professor Rogers, and which I had myself the satisfaction of verifying on the spot; and I am the more pleased in communicating them, as they supply another, and that a striking example, in addition to those I have adduced from other parts of the globe, of the connection of Thermal Springs with great physical disturbances.

To these particulars I may add, that the Sweet Spring, the only other instance of a thermal water which this country exhibits, is situated, according to Professor W. B. Rogers, in a locality which evinces a considerable disturbance in the strata, as is represented in the section appended to his Report.

In Buncombe County, North Carolina, in the midst of a mountainous region, occurs a thermal water, possessing a temperature of 125° Fahr.

The rock from which it gushes, according to Professor Vanuxem, is the calciferous sand-rock, the earliest member of the Silurian system, or that resting immediately on the primary.

The layers of the rocks are very irregular, more or less vertical, and of a white color, but at a little distance to the west, they present the blue color common to the rock where the lime is in excess, and clear, well defined lines of separation dipping to the east.

The calciferous with the primary rocks to the east form a synclinal (qu. anticlinal) line, as is the case near the Hot Spring of Virginia.

To the west of the Alleghanies, in the State of Arkansas, at a distance of more than two hundred miles west of the Mississippi, not far from the river Washita, is another group of thermal waters, which I took occasion to visit in the course of the last spring.

They are very numerous, bursting out from the side of a steep acclivity which they have in process of time incrusted over with a thick coating of stalagmitic matter. It is remarkable that the travertine which the springs formerly deposited, is different in color and appearance from what they produce at present; the former being dark looking, and containing a portion of iron, as well as calcareous matter; the latter quite white, and consisting entirely of carbonate of lime.

The springs vary considerably in temperature, the hottest being 148°, the coolest 118° Fahr., according to my observations.*

They contain very little mineral matter, a pint evaporated to dryness, yielding no more than 1.8 grains; of this one half was carbonate of lime, and $\frac{1}{5}$th of a grain, silica. The rest was chiefly common salt, but there was a mere trace of sulphuric acid, when the water had been much concentrated. One of these springs deposited an ochreous precipitate, and gave indications of iron when tested. The remainder were entirely free from that ingredient.

Most of the springs emitted bubbles of gas, which according to my experiments, consisted of carbonic acid, 4 per cent., nitrogen, 92.4, oxygen, 7.6.

The rock which forms the basis of the hill, from which the thermal springs of Washita issue, is a blueish fissile clay slate, dividing into nearly vertical laminæ. Incumbent upon it, however, are beds of chert, quartzy sandstone, and flinty slate, from the junction of which, with the clay slate, the springs appear to gush out.

The prevailing rock, however, in the neighborhood of the springs, so far as my observation extends, is quartz-rock, sometimes assuming the character of whetstone slate, and in one locality (situated within a few miles of the springs) quarried for houses, but constituting a part of the same extensive formation, which I have represented myself as having followed from Little Rock in Arkansas, to St. Louis in Missouri.

The chain is regarded by Geographers, as a branch of the Ozark mountains, and is the first elevated land met with on proceeding westward from the Mississippi, though its greatest height is probably not more than 500 or 600 feet above the river. The only circumstance connected with this range of hills, which can throw any light upon the origin of the thermal waters, that issue

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* They are stated, however, in Silliman's Journal, as rising as high as 154° or 156°.

from it, is the breaking out at their foot, near New Madrid, of that tremendous earthquake, which in 1812, caused the permanent submersion of a considerable tract of land near the Mississippi, now converted into an extensive swamp. Such is the depth to which this tract has been submerged, that nothing but the summits of the trees, I am told, are seen standing above the surface of the stagnant morass.

A slightly thermal spring which goes by the name of Mud Creek, exists in the same parallel as that of New Madrid, and at a distance of not many miles from the submerged tract in question.

Such are the principal particulars I have been able to bring together, either from personal observation, or from information supplied me by others, with respect to the thermal waters existing within the limits of the United States of America. The variety of such phenomena, when the extent of country is taken into account, as well as the unfrequent occurrence of acidulous or carbonated waters, might be anticipated from the unfrequency of earthquakes, the regularity of the rock formations, and the absence of trap rocks from so large a portion of the continent.

Nevertheless, the occurrence of a few such springs in the midst of the Alleghanies, and elsewhere, seems to show, that volcanic operations are going on in a covert and languid manner, underneath certain parts of that range.

To these operations, acting formerly with greater intensity, may perhaps be attributed the uplifting of the chain itself, as well as the vertical and disturbed condition of the strata round about the anticlinal line, whereas at present the same forces only manifest their existence by imparting a higher temperature to a few of the springs, which burt out at this point, and possibly also in causing the emission of volumes of sulphuretted hydrogen, and carbonic acid, which impregnate others within a certain distance of this axis of elevation.

Art. XI.—*Experiments on two varieties of Iron, manufactured from the Magnetic Ores at the Adirondack iron works, Essex County, N. Y.;* by Walter R. Johnson, late Professor of Mechanics and Natural Philosophy in the Franklin Institute, Philadelphia.

The portion of the State of New York, bounded eastwardly by lakes George and Champlain, northwardly by the Canada line, and northwestwardly by the river St. Lawrence, embracing the counties of Warren, Essex, Hamilton, Clinton, Franklin, and St. Lawrence, appears from various representations to be peculiarly rich in the magnetic ores of iron. We may refer in particular to Mr. Redfield's account of his exploring visits to the northern sources of the Hudson,* and to Messrs. Hall and Emmons' Geological Reports relative to that part of the State of New York.

Mr. Hall observes, that "about a mile north of the inlet of Lake Sanford," (the site of the Adirondack works, at the settlement called McIntyre,) "in the bed and on both sides of the stream, is a bed of ore, which cannot be much less than five hundred feet wide, and in all probability, far exceeds that breadth. This bed, with one or two minor ones on each side of the stream, has been traced for three fourths of a mile in a northerly direction, and probably continues much farther southerly, as the great number of boulders and angular fragments of ore lying on the surface and imbedded in the soil, seem to indicate. Some of these boulders of ore cannot weigh less than three tons.†

This ore, it appears, occurs in beds and not in veins, since it lies "parallel to the direction of the mountain range, and, when in gneiss, parallel to its apparent stratification."

Mr. Emmons considers‡ that the beds at this place "are parts of a belt of an iron formation, which extends southwesterly through the wilderness to the town of Chamont, in St. Lawrence County, and that all along the line connecting those places, many beds remain to be discovered. No one of these beds of iron may be equal to those of Missouri; still, *put together*, there is a much greater quantity of it, and more advantageously distributed."

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* Am. Journal of Science, Vol. xxxiii, p. 303, Jan. 1838.

† First Geological Report of New York, Feb. 1837, p. 131.

‡ Second Geological Report of New York, Feb. 1838, p. 223.

The ore is stated to be in immediate connexion with a primitive rock, the chief ingredient of which is, Labrador feldspar.

Two varieties of ore were received accompanying the two kinds of iron here referred to.

The first variety of this ore is of a granular, but rather compact structure, color of fresh fractures deep black, and shining; that of weathered surfaces reddish brown, owing to the formation of a lttle peroxide. Its specific gravity is 4.2322.

The second variety has a compound structure, being in part amorphous, and in part crystalline. The color is a brownish black, except that of the crystalline portions, which is jet black. Its specific gravity is 4.6636. From this ore, both specimens of the iron were produced, but their difference consisted chiefly in No. 1 being wrought at a higher temperature than No. 2.

The locality of these ores, and the site of the iron works, is about forty five miles westward from Lake Champlain, between Lake Sanford and Lake Henderson, which are one mile apart, and according to Mr. Emmons' barometrical measurements, it is at an elevation of one thousand eight hundred and eighty nine feet above tide water. The north branch of the Hudson, in the distance of this one mile, has a fall of about one hundred feet.

The method of manufacture is by calcining the ore in kilns, breaking up and separating the purer parts by revolving magnets, reducing these parts to a malleable state in a forge fire, and drawing the loup out under a common tilt hammer into bars, ready for the market. This, or a similar method, is likewise pursued by the Peru Iron Company, at Clintonville, and at other works in Clinton County, in which about three or four thousand tons of malleable iron are manufactured per annum.

The appearance of the two varieties of iron, when received, was in some respects different. The structure of No. 1 was the more compact and fibrous, that of No. 2, more granular and crystalline, as indicated at the ends where the bar had been cut off with the cold chisel. No. 2 also exhibited two or three dark seams running along it longitudinally, and indicating less perfection in the welding than would be desirable.

Experiments on Specimen No. 1.

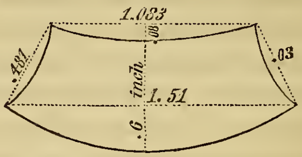
To ascertain the toughness and ductility of this iron when cold, I caused the bar to be bent at a temperature of 50°, at a part where the breadth was 1.295 inches, and the thickness .59 inch. This bend was made flatwise, and continued until the corresponding faces on the inside at about one inch from the middle of the inner curve, were .4 of an inch apart, and the widest part of the opening only .45 of an inch.

The alteration in the form of the bar appeared to be limited to this portion. On measuring along the interior and exterior edges of this curved part, the former was found to be 2.15, and the latter 3.8 inches, manifesting a difference in the length of the inner and outer fibres of 1.65 inches in about 2¼ the original length of the bent portion.

By this kind of trial, the whole form of the cross section of a bar is changed, and, instead of straight lines, exhibits only curves. In the present case, the parallelogram, Fig. 1, was converted into the form of the curved Fig. 2, the largest curve being on the inside of the bend. This change of figure and displacement of parts, was borne without exhibiting any signs of rupture, until the degree of curvature above stated had been attained, when a few cracks began to appear on the exterior part of the bend.

Fig. 1.

Fig. 2.



The next test to which this iron was subjected, was to heat a portion of the bar to redness, quench it in cold water, and then bend the same portion cold, in the manner already described. No difference of result was obtained, except a greater facility in producing it. A few slight surface cracks were seen near the close of the operation.

A third trial of a similar kind on a bar annealed and cooled in dry ashes, resulted like the preceding, but exhibited rather more cracks on the exterior surface of the bend, than either of the foregoing.

Another trial of the toughness of this iron when cold, was made by drawing out a bar .7 of an inch wide, .18 inch thick, and 5.4 inches long, and twisting it cold, in the manner of a common twisted auger, twice round, in the length just specified. The edges of the spiral were now exactly 7 inches long. Hence the elongation of the exterior fibres on the edges was $\frac{7-5.4}{5.4}=29.6$ per cent. It is proper to state, that this experiment was made after annealing the bar and cooling it off in dry ashes. In attempting to carry the torsion beyond this extent, the bar was twisted off at the jaws of the vice, in which the operation was performed.

Having thus proved that this iron is not, under any circumstances, *cold short*, I caused the bar, $1\frac{3}{8}$ inches wide and .6 inch thick, to be heated to a fair working red heat, and in that state bent flatwise over the corner of an anvil, and a right angle exterior and interior to be formed, $\frac{3}{4}$th of an inch from the end. The exterior angle remained perfectly sound. On the interior, a thin scale only of metal appeared to be corrugated and partly detached from the rest of the mass, owing probably to a defect in welding, but not the least sign of a tendency to fracture was discovered.

Another portion of the same bar was heated as before, and 3 inches of it bent over and hammered flat upon the face of the adjacent part. Complaints are made by workmen, that much of the iron which they employ will not sustain either of the two preceding operations. They were, however, borne by the iron under trial without evincing any weakness or undue distortion of parts. A slight splintering only, similar to that just mentioned, and on the same side of the bar, was seen in the last case.

A third test of the quality of the iron when hot, was afforded by heating about three inches near the end of the bar and driving a steel punch four fifths of an inch in diameter quite through it. This was done without splitting or cracking it at the edges, as is too often done in making screw nuts. Machinists are well aware of the importance of a good material for the formation of screw bolts and nuts.

The foregoing trials having, as was conceived, fully established the freedom of this iron from the defects known either as *hot shortness* or *cold shortness*, and its softness and malleability being amply tested by the cutting and hammering incident to these experiments, the next step was to determine the absolute force of cohesion, together with the extensibility, when subjected to longitudinal strain, and the interior structure of the metal under various circumstances, including that of welding in the ordinary way.

For this purpose five bars were drawn out and prepared from the specimen already described, numbered I, II, III, IV, and IX, each about nine or ten inches long, one inch wide, and a fifth of an inch thick.

No. I, after being reduced to a nearly uniform size throughout its length, was *annealed* at a red heat and allowed to cool slowly in the air.

No. II, was *hammer-hardened*, or beaten with moderate force throughout its length until it had been for several minutes black, the hammer being occasionally moistened during the process.

No III, was forged out and hammered till it was only visibly red in day light, being left at about the temperature at which workmen cease their operations on many of the articles which they produce.

No. IV, after being brought to uniform size, was upset for about three inches in the middle, and was then annealed and cooled slowly.

No. IX, was drawn out, cut in two in the middle and welded together. This sample was only six and a half inches long.

All these bars were then carefully gauged, both in breadth and thickness at every inch of their lengths, before commencing the trials of tenacity. The machine employed in testing them was the same which had been used in experiments made at the request of the Treasury Department on the strength of materials for steam boilers, and for a description of which the reader is referred to the report on that subject.*

The following table will be understood without any other remark than that the *breaking weights*, in the fifth column, are corrected for the friction of the machine. The specific gravities of several of the fragments of each bar after it had been broken up, are given under the head of observations, and may serve as well to illustrate the general character of the iron in this respect, as to indicate the effect of the several methods of preparation on the density of iron.

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* See also, Journal of the Franklin Institute, Vol. xix, p. 84.

TABLE I.

Experiments on the tenacity of Iron in specimen No. 1.

No. of the bar.	State of the bar.	No. of the experiment.	Area of section before trial in square inches.	Breaking weight in lbs. avoirdupois.	Strength in lbs. per sq. inch.	Observations.
I.	Completely annealed.	1	.1890	10175.	53820	Length before trial, 10 inches—after trial, 13.5; total elongation of all the fragments, 35 per cent. Specific gravities after trial, 7.685, 7.676, 7.668; mean = 7.676. After the 4th fracture the area of section was .1064 inch, instead of .1986 as at first—diminution = 46 pr. ct. Mean strength of this bar, 53311—greatest difference, 170 lbs. = 3.2 pr. ct. of the mean.
"		2	.1929	10288.	53336	
"		3	.1954	10345.5	52945	
"		4	.1986	10374.	52235	
"		5	.2036	10972.5	53941	
"		6	.2057	11029.5	53614	
II.	Hammer-hardened.	1	.1980	12967.5	65492	Length before trial, 9½ inches—after trial, 11 inches—total elongation, 20.5 per cent. Specific gravities after trial, 7.769, 7.756, 7.779; mean = 7.768. Mean strength, 65713—greatest difference, 2348 lbs. = 3.5 per cent. of the mean.
"		2	.2019	13053.	64650	
"		3	.2000	13399.75	66998	
III.	Hammered till nearly black.	1	.1983	11970.	60363.	Length before trial, 9½ inches—after trial, 12¼—total elongation, 28.94 per cent. Specific gravities after trial, 7.760,7.778, 7.662; mean = 7.730. After the 2d fracture the area of section at the point of fracture was .1176—diminution, 45.2 per cent. Mean strength of this bar, 58.912—greatest difference, 2444 lbs. = 4.15 per cent. of the mean.
"		2	.2151	12454.5	57919	
"		3	.2163	12768.	59029	
"		4	.2213	12910.5	58339	
IV.	Upset in the centre and annealed.	1	.2086	13110.	62847	Length before trial, 9 inches—after trial, 11.2—total elongation, 24.44 per cent. of the original length. Specific gravities after trial, 7.813, 7.731, 7.754, 7.634; mean = 7.733. Mean strength, 63142—greatest difference, 7128 lbs. = 11.2 per cent. of the mean. The last two results belong to the upset portion of the bar. The thickest part of the upsetting remained however unbroken.
"		2	.2233	13623.	61007	
"		3	.2316	13737.	59313	
"		4	.2282	15162.	66441	
"		5	.2354	15561.	66104	
IX.	Welded and hammered till dull red.	1	.1845	10773.	58395	Broke outside of the welding—the strength is about the same as in No. III.

The foregoing experiments confirm the evidence already adduced, of the great toughness and ductility of this variety of iron. Besides the facts mentioned under the head of observations in the seventh column, we may add that after the first fracture of each bar a measurement was taken between two of the inch marks still remaining on one of its parts, and the following results obtained,

Viz. No.	I,	in original length of 6 inches	had been elongated	.87 in.	= 14.5 pr. ct.
"	II,	" " 4 "	"	.2 "	= 5 "
"	III,	" " 5 "	"	.6 "	= 12 "
"	IV,	" " 4 "	"	.2 "	= 5 "

To compare this iron with others, it is proper to assume bar No. III, as the standard, that having been hammered till of a dull red heat. The report already cited furnishes us with abundant data derived from experiments made with the same machine, on other kinds of bar iron in a similar state. Thus we have,

				lbs. per sq. in.
Iron from Salisbury, Conn.,	by a mean of	40	trials possessing a strength of	58.009
" Sweden,	"	4	" "	58.184
" Centre Co. Pa.,	"	15	" "	58.400
" Lancaster Co. Pa.,	"	2	" "	58.661
" *McIntyre, Essex Co. N. Y. (as above)*		4	" "	58.912
" England, cable bolt, (E. V.)		5	" "	59.105
" Russia,	"	5	" "	76.069

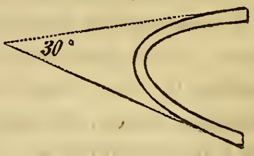
Hence it appears that the last only is *essentially* superior to the Adirondack iron. These are among the best varieties of bar iron, in point of tenacity. The second class will be mentioned below. The fracture of No. I, is of a light gray color, has a silky lustre and generally displays a compact structure. It is worthy of remark that most of the fractures took place in directions oblique to the line of tension, and making with it, either in the breadth or thickness, one or more angles of about sixty degrees each.

The fibrous structure of the metal was very marked in cutting with the cold chisel, and was further developed by acids on a part of the bar No. III, on the surface of which delicate lines were shown traversing a distance of several inches. The specific gravity in the annealed state appears to have been increased 1.2 per cent. by hammer-hardening.

Experiments on specimen No. 2.

This was a bar one inch square and about two feet long. It was first bent cold, till incipient fracture appeared on the outer edges of the curved portion, which took place when the two limbs had approached so as to make an angle of 30° with each other. The exterior fibres in the part to which the change of form had been confined, were then found to have

Fig. 3.



a length of 7.43 inches, while those on the inside had but 4.8 inches. The difference 2.63 inches is to be attributed to the combined influence of compression and elongation of the interior and exterior fibres. By measuring and marking bars before and after bending them, such differences may under certain restrictions be employed as means of determining the positions of neutral axes. Changes analogous to those already observed in the form of the cross section, were also remarked in the present instance.

The next trial was by turning a right angle when hot on a short portion of the bar, and subsequently folding another part over flat upon one of its faces. All the phenomena of developing curves out of the square cross section were beautifully exemplified, and the soundness of the iron when thus tested at a red heat, incontestably proved. A short portion of this inch-square bar was next heated to a fair working temperature and perforated with a punch five eighths of an inch in diameter. No signs of cracking on the sides or splitting longitudinally were observed.

Four bars were then prepared, in all respects similar to the first four taken from specimen No. 1, and respectively treated in the same way preparatory to a trial of their tenacity.

The bar marked V, was *completely annealed.*
" " VI, " *hammer-hardened.*
" " VII, " *hammered till cooled to a dull red heat.*
" " VIII, " *upset in the middle and annealed.*

As the upsetting of No. VIII, had of necessity increased the thickness of that part to which the operation was applied, care was taken to reduce by filing, the cross section in the middle of the upset portion, to less than that of the rest of the bar, in order to insure a fracture in metal actually in that state. The trials on No. IV, had led to the supposition of an increase of strength by the process of upsetting, contrary to an opinion entertained by some practical men. Experiment No. 2, on bar No. VIII, in the following table, in which the fracture took place at the filed section, gives not only the highest result on that bar, but also higher than any other obtained from this variety of iron, except those derived from the hammer-hardened bar, No. VI, and consequently confirms our previous deduction.

TABLE II.

Experiments on the tenacity of Iron in specimen No. 2.

No. of the bar.	State of the bar.	No. of the experiment.	Area of section before trial in square inches.	Breaking weight in lbs. avoirdupois.	Strength in lbs. per sq. inch.	Observations.
V.	Completely annealed.	1	.2097	9946.5	47425	Length before trial, $10\frac{1}{4}$ inches; after trial, 14.2—total elongation 38.5 per cent. Specific gravities after trial, 7.680, 7.440, 7.670; mean = 7.596. Mean strength of this bar, 47328; greatest difference, 1080 lbs. = 2.3 per cent. of the mean.
"		2	.2121	10146.	47836	
"		3	.2131	10146.	47836	
"		4	.2132	9975.	46785	
"		5	.2237	10459.5	46756	
VI.	Hammer-hardened.	1	.2295	12169.5	53026	Length before trial, 10 inches; after trial, 12—total elongation 20 per cent. Specific gravities taken after trial, 7.608, 7.700, and 7.718; mean = 7.675. Mean strength, 55657; greatest difference, 4569 lbs. = 8.2 per cent. of the mean.
"		2	.2226	12283.5	55182	
"		3	.2202	12682.5	57595	
"		4	.2302	13081.5	56826	
VII.	Hammered to a dull red heat.	1	.2195	10659.	48560	Length before trial, 10 inches; after trial, 12.6—total elongation 26 pr. cent. Specific gravities after trial, 7.654, 7.709, 7.712; mean = 7.692. Mean strength, 49215; greatest difference, 2433 lbs. = 4.9 per cent. of the mean.
"		2	.2233	10687.5	47861	
"		3	.2154	10801.5	50146	
"		4	.2159	10858.5	50294	
VIII.	Upset in the center and annealed.	1	.2318	10972.5	47336	Length before trial, $9\frac{1}{4}$ inches; after trial, 12 3—total elongation 32.9 per cent. Specific gravities, 7.800, 7.827, 7.592; mean = 7.739. Mean strength, 49.311; greatest difference 4148 lbs. = 8.4 per cent. of the mean. The experiments 1, and 5, on parts not at all upset, conform very nearly to the mean of the annealed bar No. V.
"		2	.2242	11542.5	51484	
"		3	.2317	11913.	51415	
"		4	.2430	11941.5	49141	
"		5	.2513	11856.	47178	

The elongations observed after the first fracture on each bar, were as follows:

No. V, in an original length of 6 inches, had been elongated .9 inch. = 15 per ct.
" VI, " " 5 " " .3 " = 6 "
" VII, " " 5 " " .85 " = 17 "
" VIII, " " 5 " " .55 " = 11 "

This variety of iron is thus seen to exhibit an extensibility by this mode of trial, rather less than that of No. 1; the mean here being for the four bars $12\frac{1}{2}$ per ct., and for the four bars of No. 1, 13.6 per ct. But on comparing the total elongations of all the bars after fracture, we find,

From specimen No. 1.		From specimen No. 2.	
No. I, gave 35. per cent.	mean 27.2.	No. V, gave 38.5 per cent.	mean 29.3.
" II, " 20.5 "		" VI, " 20. "	
" III, " 28.9 "		" VII, " 26. "	
" IV, " 24.4 "		" VIII, " 32.9 "	

From these two comparisons we may infer that there is but little difference between the two kinds of iron in regard to extensibility. From both modes of comparison, however, we are led to notice the remarkable difference between the annealed and the hammer-hardened bars. Thus by observing elongations after the first trial, we have 14.5 : 5 and 15 : 6 for the ratios of extensibility in the two kinds of iron; and by taking the total elongations, we have 35 : 20.5, and 38.5 : 20 for the relations. This is in accordance with what had been observed, while making experiments on the strength of materials for steam boilers. The difference in specific gravity between the annealed and hammer-hardened bars, from specimens No. 2, is 1.01 per cent.

The iron now under consideration may be compared, in point of tenacity, with American bar iron of the second class only.

Thus from the report before cited, we find, that bar iron from Missouri, by 22 experiments, bore . 47,420 lbs. per sq. in.

That from McIntyre, by 4 expts. on bar, No. VII, (as above) . . 49,215 " "

That from Tennessee, by 21 expts., 52,909 " "

" Baltimore, by 13 " 55,213 " "

Assuming the strength of specimen, No. 1., in each state in which it was tried, as a standard, we find the following results of a comparison between the two kinds of metal above examined, viz.

Nos. I, and V, give $\frac{53,311-47,328}{53,311}=11$ per ct. inferiority in No. 2, when *annealed.*

Nos. II, and VI, give $\frac{65,713-55,657}{65,713}=15.3$ per ct. inferiority in No. 2, when *hammer-hardened.*

No. III, and VII, give $\frac{58,912-49,215}{58,912}=16.4$ per ct. inferiority in No. 2, when *hammered to dull red heat.*

No. IV, and VIII, give $\frac{63,142-49,311}{63,142}=21.9$ per ct. inferiority in No. 2, when *upset and annealed.*

And the mean difference is 16.15 per cent. in favor of No. 1, or about one sixth of its total tenacity.

The fracture of No. 2, presents less of the clear fibrous texture, silky lustre, and uniform compactness, than ought to characterize iron of the first quality.

A few general remarks seem worthy of attention in connection with the subject of tenacity as presented by the above experiments.

The *first* is, that *in the annealed state, different kinds of iron more nearly resemble each other, in respect to strength, than in any other condition.* This is verified by the last comparison in which the difference between the two kinds, when *annealed* is seen to be only eleven per cent; while in the other three conditions, it varies from 15.3 to 21.9 per cent.

The second remark is, that *in the annealed state, the same bar has greater uniformity of strength within itself than in any other case.* This is proved by comparing the *greatest differences* as stated in tables I, and II, in the column of observations.

The two *annealed* bars are there seen to give for these differences between their highest and lowest results, 3.2 and 2.3 per cent; mean=2.75.

The two bars *hammer-hardened,* gave results, 3.5 and 8.2 per cent; mean=5.85.

The two bars *hammered to dull red heat,* gave results, 4.15 and 4.9 per cent; mean=4.425.

The two bars upset and annealed, gave results 11.2 and 8.4 per cent; mean=9.8.

The experiments on the annealed bars were, in both cases, fully as numerous, as those on the same kind of iron in any other state; and hence, other things being equal, ought to have presented, at least, equal discrepancies; while in fact, these are scarcely more than one half as great as the *least* of the others, and are less than one third as great in either kind of iron, as those found in the *upset and annealed* bars.

The third observation I would make, is that in upsetting part of a bar, and subsequently annealing the whole of it, the differences in tenacity, between different kinds of iron, and between the several parts of the same bar, are both at a maximum.

Thus the two varieties of iron, gave a difference of nearly twenty-two per cent. from each other, and their mean diversity for the same bar is 9.8 per cent. of its mean strength. This may be satisfactorily explained only on the supposition, that upsetting iron *increases* its direct cohesion, since we know that annealing alone diminishes it, while the structure is thereby rendered more uniform.

Our next remark is, that between the ordinary and the hammer hardened state of No. 1, there is a difference in tenacity of 11.7 per cent. of the strength in the former condition; and that for No. 2, this difference amounts to 13 per cent. The English cable bolt iron, above mentioned, manifested a difference of 20 per cent., under similar diversity of treatment. The difference between the tenacity of No. 1, when annealed, and that when hammer hardened, is 23.3 per cent. of the strength when annealed, and for No. 2, this difference is 17.6 per cent.

Now as we have already proved, that hammer hardening diminishes the extensibility of a bar, it must follow, that *stiffness as well as strength, is essentially augmented by this treatment.*

It may be further remarked, that by thirteen trials, the stronger variety of McIntyre iron, had a specific gravity of 7.728, and by twelve trials, that of the weaker kind was found to be 7.676, the difference .6 of one per cent.—and that the mean specific gravity of other kinds of bar iron formerly tried, was found by seventeen trials to be 7.725. The Russian iron above mentioned, had by the mean of ten trials on separate portions of the same bar, a specific gravity of 7.801, the highest being 7.8702, and the lowest 7.7586. These facts in connexion with the increase, both of strength and specific gravity by hammer hardening, appear to favor, though perhaps they do not *establish* the supposition, that *whether from chemical constitution, or from mechanical treatment, a deficiency in specific gravity, is an indication of inferiority in the strength of iron.* I am aware of some apparent exceptions to this rule.

In conclusion it may be observed, that the great amount of much worse iron which finds its way into the American market, will render even the McIntyre iron, No. 2, an object worthy of the attention of the consumers of this article. But as a large and increasing demand for good iron prevails in the United States, in proportion to the increase of finished and accurate machinery, requiring superior materials as well as workmanship, there can be no doubt, that any quantity which could probably be produced, if possessing the properties of No. 1, would command a ready market, and the best of prices.

Art. XII.—*Description of a New Fossil, (Calymene Bucklandii;)* by John G. Anthony.*

Cincinnati, February 5th, 1839.

TO PROF. SILLIMAN.

Dear Sir.—Having within the past month discovered near this place, another undescribed fossil, I herewith forward a description to you, with a request that it may appear in the columns of your Journal.

Calymene Bucklandii. Anthony.
Cabinet of John G. Anthony.

Clypeo antice rotundato, sub-convexo, granulato et punctato; oculis minimis, remotis in lateribus capitis; tuberculis sex, distinctis, in lateribus frontis.

The buckler of this species is semilunate; the front sub-triangular, and covered with granulations; the margin of the front is thickened and rounded, that of the cheeks flattened out; its posterior raised rim running nearly parallel with the articulations of the abdomen. The front has three nearly equal tubercules on each side, placed in a deep furrow which separates it from the cheeks; the eyes are very remote from each other, being situated near the lateral angles of the cheeks. The cheeks form spherical triangles covered with minute granulations, having small depressed points among them. A narrow raised line passes from the angle formed by the lip and margin, and is attached to the oculiferous prominences, and a depressed line has an attachment near it at the under part of each eye and passes over the anterior margin.

The tail and part of the abdomen are wanting in this, the only specimen yet discovered; eight articulations only remain. These articulations possess a peculiar character, one which I have never observed in any other species of Calymene; the costal arches of the middle lobe although in reality separated from those of the lateral lobes by a deep furrow, have the appearance of passing beyond this furrow, and becoming interwoven with them. The lateral arches are nodulous.

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* Read before the Western Academy of Natural Sciences, January 12th, 1839.

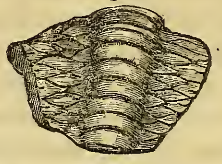
This specimen is fossilized in grey limestone, the body contracted so that the buckler is nearly parallel with the back; this has rendered two drawings necessary in order to give a representation of both the head and abdomen, each of which is characterized by some peculiarities not common in this genus.

It is named after one, whose works on geology and fossil organic remains, have given him an enviable station in the scientific world.

Fig. 1.

Buckler of Calymene Bucklandii, drawn by J. G. Anthony.

Fig. 2.



Back of Calymene Bucklandii, drawn by J. G. Anthony.

ART. XIII.—*Notices of the Native Copper, Ores of Copper, and other Minerals found in the vicinity of New Brunswick, New Jersey;* by Prof. LEWIS C. BECK.

ALTHOUGH many of the ores of copper are found quite abundantly in various parts of the State of New Jersey, and extensive mining operations evince the high expectations which have been entertained of their value, I am not aware that any detailed description of them has been published. A brief and general account of them is given in Gordon's Gazetteer of New Jersey, and in Prof. H. D. Rogers's report of the geological survey of that State, made in 1836; and some of them are also noticed in the general mineralogical works. Having been engaged at intervals, for some time past, in studying the minerals found in the vicinity of New Brunswick, and the copper ores of the State generally, I propose to give the results of my observations and analyses. I offer them, however, as mere notices, and not as a complete account of these minerals.

NATIVE COPPER.—Small pieces of this metal have been found on the surface of the ground in various parts of New Jersey. In the vicinity of Somerville, specimens weighing from five to ten pounds, have been obtained. The largest mass which has, to my knowledge, been found in New Jersey, is now in the possession of James C. Van Dyke, Esq., of New Brunswick. Its weight is seventy eight pounds; but a large piece has been detached, and it is said to have weighed, when first obtained, one hundred and twenty eight pounds. It was ploughed up by a farmer near Somerville. On examining this specimen, pure metallic copper is visible in various parts, but with it is intermixed the lead grey oxide, and it is generally incrusted with the green carbonate of copper. There is also associated with these ores an earthy red oxide in the form of a thin crust, and the cavities, which have been formed by the partial decomposition which has taken place on the surface, sometimes contain small quartz crystals. The specific gravity of one of the purest masses of native copper, taken with considerable care, was 7.842; but in consequence of the variable proportions of the oxide of copper which they contain, scarcely any two specimens give the same results. In three specimens the specific gravity ranged from 7.553 to 7.842.

A small mass of the purest native copper that I could obtain, was treated with nitric acid. It weighed 14.30 grains, and was entirely dissolved by that agent, with the exception of a few minute particles, probably silica. The solution was treated with caustic potash, and boiled. The black oxide of copper thus obtained, when carefully washed to separate the potash and ignited, weighed 17.95 grains, so that there can be no doubt of the mass having been pure copper. Similar solutions of this mineral were tested for the purpose of ascertaining whether any other metals were combined with the copper; but none were detected.

The occurrence of the detached masses of native copper above noticed, is not, however, so interesting as the vein or sheet of this metal which is found in the city of New Brunswick. About fifty rods nearly east of Rutgers College, a thin vein of this kind crosses the red shale, which is here the prevailing rock. It sometimes adheres so closely to the rock as to be with difficulty separated from it. The thickness of the vein is from $\frac{1}{16}$th to $\frac{1}{8}$th of an inch; in regard to its extent, no certain information can be obtained. It has, however, been traced for several rods; and I have been informed, that previous to the American revolution, mining operations were carried on here, and that a shaft was sunk which extended for a considerable distance under the bed of the river.

The specimens from this locality which I have seen, resemble the copper of cementation. They are all malleable; but some are much more so than others. Sometimes a thin plate of the metal passes through the center, which is incrusted on both sides with the oxide and carbonate, and a little adhering silica; while at others, the metallic plate is on the outside. An average specimen was subjected to analysis, and gave the following results:

Copper, - - - -	86.30
Silica, - - - -	2.55
Carbonic acid and oxygen, - -	11.15
	100.00

Or metallic copper about 70, and oxide and carbonate 27.50, in 100 parts.

Red Oxide of Copper.—I have specimens of this mineral from the Schuyler mine, the Bridgewater mine, near Somerville, and from the immediate vicinity of New Brunswick. Some of them have a lead grey color, and a high metallic luster, with an imperfect crystallization. Others, and especially those from the Bridgewater mine, vary in color from purple to brick red, have a compact structure, and are nearly destitute of lustre. The powder of all of them is reddish.

At New Brunswick, this oxide of copper occurs in thin veins in the red shale, and is sometimes accompanied by native copper and by the green and blue carbonates of copper. The color is usually grey, the powder red, and, unlike the native copper, it is brittle, and easily powdered in a mortar. The rock which is immediately in contact with this mineral, is of a drab color, and appears as if it had been altered by heat.

The specific gravity of one of the best specimens that I have obtained from this locality, is 4.758. On being freed as much as possible from the adhering rock, it was found to be composed of

Red oxide of copper, - - -	91.55
Silica, &c. - - - -	8.45
	100.00

A specimen from the Schuyler mine, which was compact, and had a brownish red color, had the following composition, viz.

Red oxide of copper, - - -	82.52
Silica, - - - -	17.41
Oxide of iron, - - -	trace.
	99.93

But it is seldom that specimens of even this degree of purity can be obtained, and they are found only in small quantities.

Compound of Carbon and Oxide of Copper.—Associated with the red oxide of copper, there is often found at New Brunswick a dark earthy substance, which is quite friable, and is easily crushed into grains between the fingers. But it sometimes also occurs in separate veins of from half an inch to two inches in width. On examining the mass with a magnifier, small black shining particles are seen diffused through it. At first I thought, from the association, that they might be black oxide of copper; but upon trial, I found the black particles to be carbon, probably anthracite. When a portion of this aggregate is heated in the flame of an alcohol lamp, it soon begins to glow, and it continues red hot until a part of the carbon is consumed. This, I suppose, is owing to the oxygen of the oxide of copper. During the combustion, no odor was observed. Thrown into red hot nitrate of potash, this compound burns, and loses about half its weight. Heated to 300° or 400° F., it loses seventeen per cent. of its weight, which is probably caused by the driving out of the water which it contains.

A portion of this substance, after being ignited, was treated with nitric acid. The residuum, amounting to twenty five per cent., was found to be silica. The solution was subjected to the action of sulphuretted hydrogen, and to the clear liquor after filtration; ammonia was added to precipitate the oxide of iron. The composition is as follows:

Oxide of copper, - - -	17.50
Oxide of iron, - - -	5.00
Carbon, - - - -	35.50
Silica, - - - -	25.00
Water, - - - -	17.00
	100.00

The carbon and silica being mechanically mixed with the oxide of copper, the above proportions are very variable. It is a fact of some interest, that so large a proportion of carbon should be associated in this manner with the ore in question ; nor can I conjecture by what decomposition it has been produced, unless by that of the carbonate of copper, which may have originally existed in the rock in which this substance is found.

Carbonates of Copper.—It has already been stated that some of the specimens of native copper are incrusted with the green and blue carbonates of copper. The most interesting locality of these carbonates, however, is on the banks of the Delaware and Raritan Canal, about a mile N. W. of New Brunswick. At this point the strata of shale are nearly horizontal, and alternate with a gray slate containing particles of mica.

In the cleavages and fissures of this slate, the blue carbonate is found in the form of a crystalline incrustation. These crystals effervesce, and are entirely dissolved in nitric acid. The green carbonate is sometimes associated with the blue.

This locality is near the bed of a ravine; and when it is remembered that the oxide of copper is very common in the rocks of this vicinity, it will not be difficult to account for the formation of these carbonates, which I believe to be constantly going on. Water, charged with carbonic acid, dissolves a portion of this oxide, and whenever circumstances favor the escape of the excess of carbonic acid, these salts are deposited. These minerals are manifestly the result of precipitation from an aqueous solution ; and in applying the above explanation, it is only necessary to admit that the carbonates of copper, by an excess of carbonic acid, are rendered soluble in water.

Bisilicate of Copper.—This mineral, which was formerly often labelled phosphate of copper, was first correctly described by the late Prof. George T. Bowen. It invests the impure ores of copper found at the Schuyler, the Franklin, and the Bridgewater mines ; but it sometimes also occurs in small veins or masses in the rock, which forms the gangue of these ores.

The color of this mineral varies from mountain green to a deep bluish green. It is easily broken, and may be scratched by the knife. Fracture, uneven, or somewhat conchoidal. Usually opaque and dull, but sometimes translucent, and with a vitreous lustre. When reduced to powder, and slightly heated in a platina crucible, it assumes a reddish color ; but when the heat is raised, it becomes brown or black. Before the blowpipe on charcoal it first becomes black, and on increasing the heat, the color changes to red.

The analysis was performed by subjecting a portion of the powder to a low red heat to expel the water. It was then mixed with about thrice its weight of carbonate of soda, and the whole heated to redness in a platina crucible for upwards of half an hour. The mass was dissolved in dilute muriatic acid, the solution evaporated, and the residuum again dissolved in water, slightly acidulated with the same acid, and this solution then filtered. The oxide of copper was thrown down by sulphuretted hydrogen, and afterwards, the oxide of iron by ammonia.

The following is the composition of a specimen of this mineral from the Schuyler mine:

Oxide of copper, - - -	42.60
Silica, - - - -	40.00
Oxide of iron, - - -	1.40
Water and loss, - - -	16.00
	100.00

A specimen from the Bridgewater mine contained thirty seven per cent. of silica. The proportions therefore are subject to variation; and this will account for the discrepancy in the analyses of Bowen, Berthier, and Kobell, noticed by Dr. Thomson in his Mineralogy.

Gray Sulphuret of Copper.—This ore occurs at the Flemington and Nashanic mines. It is massive, sectile, has a dark lead grey color, and is sometimes in the form of roundish grains in the slate rock. All the specimens that I have seen are exceedingly impure. The best one gave me the following results:

Quartz and silica, - - -	53.25
Copper, - - - -	38.75
Sulphur, - - - -	8.00
Iron, - - - - -	trace.
	100.00

Copper Pyrites, or Yellow Copper Ore.—This mineral occurs massive at the Flemington mine, but I have found it only in very small quantities. It has a brass yellow color, greenish powder, and is a compound of the sulphurets of copper and iron.

Such are the ores of copper, hitherto found in this part of New Jersey. Although widely distributed, they do not occur in sufficient quantity at any one locality, to render mining operations profitable. Thousands of dollars have been expended in fruitless researches, and other thousands will probably still be wasted in the same manner, for in this business, the lessons of experience seems to be of little avail.

I shall notice a few other minerals found in this vicinity.

Sulphate of Barytes.—In the slate on the banks of Lawrence's brook, about two miles southeast from New Brunswick, narrow veins of a kind of ochreous clay, are sometimes observed. In one of these veins, which was three or four inches wide, fragments of crystals of sulphate of barytes have been found. They are translucent, have a bluish color, and vitreous lustre. Specific gravity from 4.422 to 4.447. By cleavage the primary form of the crystal may be obtained.

About a mile west of New Brunswick, on the farm of I. C. Van Dyke, Esq., there is another locality of the same mineral. Some of the specimens are opaque, and have a yellowish color, with a foliated structure. Others exhibit crystals of the primary form, the right rhombic prism, which are translucent, and have a bluish tint. But more frequently, they present foliæ, with two sides of the primary, diverging from a centre, and gradually increasing in width.

Fibrous Carbonate of Lime.—This mineral occurs in the strata of red shale, about half a mile above the rail road bridge at New Brunswick. The seams are from a quarter to half an inch in thickness. They are in some cases at right angles to the strata, and at others paralled with them. The perpendicular veins are either fibrous, or semi crystalline, like a plate of zinc. The horizontal layers consist of delicate and almost silken fibres, translucent, and of a bluish white color. Specific gravity 2.719. Soluble in nitric or muriatic acid with effervencence.

As this mineral was supposed to contain carbonate of strontia, I dissolved a portion of it in nitric acid, and evaporated the solution to drive off the excess of acid. To a clear solution of this salt in water, I added a saturated solution of sulphate of lime, but no precepitate, nor even cloudiness resulted. The sulphate of lime employed in this way is, I believe, the most certain test of the presence of strontia.

Mountain Leather.—A variety of this mineral, which from its resemblance to horn, might be properly enough called *mountain horn,* occurs in thin plates, associated with the native copper and the oxide of copper at New Brunswick. It has a gray or bluish white color, is composed of fibres, brittle, imbibes water, and then becomes apparently more tender.

Small fragments alone, before the blowpipe curl up, and if the heat is continued, melt into a white enamel or opaque glass. These characters sufficiently distinguish this mineral from Abestus, and from the Nemalite of Nuttall, to which it bears some resemblance.

I have also found in this vicinity, masses of the same mineral of a more spongy texture, scarcely fibrous, and of a lighter color. They resemble decayed wood. Their behavior before the blowpipe, is similar to that of the preceding variety.

Bitumen.—About two miles northeast of Somerville, there is found in cavities in the slate rock, a variety of bitumen, which deserves to be noticed. It has the consistence of wax, and is of a black or dark brown color. When heated to redness on a piece of platina foil, it burns with a yellow flame, emits a dense smoke, and leaves a slight coaky residuum. It approaches more nearly to the variety, called elastic bitumen, than any other, but it is softer and is not elastic. My specimens have undergone no change in the three or four years in which they have been in my possession. I make this remark because it has been stated, that the soft elastic bitumen, by long keeping, becomes hard and brittle. The minerals of organic origin, allied to the one just noticed, have recently been examined by Professor J. F. W. Johnston, and by his able investigations, our knowledge of them has been greatly extended. I regret, that the small quantity of this substance in my possession prevented me from determining its other chemical characters.

Art. XIV.—*Note on the New Brunswick Tornado, or Water Spout of* 1835; by Prof. Lewis C. Beck.

TO PROF. SILLIMAN.

As some difference of opinion appears still to prevail concerning the characters of the so called tornado, which passed through the city of New Brunswick in 1835, perhaps you will do me the favor to publish the following remarks. Having had, as I thought, a good opportunity of observing it in its commencement and progress, I prepared a short account of it which was published in several of the newspapers of the day. I subsequently collected additional facts, and intended to have embodied them for publication in a more permanent form. But finding that I had adopted views in regard to its character, entirely opposed to those of gentlemen who had devoted themselves to these inquiries, I hesitated and delayed, until I supposed little interest would be taken in the subject. The discussions at the last meeting of the British Association, and Mr. Redfield's paper in the last number of your valuable Journal, have led me however, to suppose, that the testimony of an *eye witness* of this tornado may still be of some importance.

On the 19th of June, 1835, at about half past five o'clock in the afternoon, while on board the steam boat Napoleon, then about six miles from New Brunswick, (by the river, but in a direct line not more than three or four miles,) one of my friends directed my attention to a singular appearance in a northwesterly direction. A very dense and low cloud stretched itself along for some distance like a dark curtain, which near the centre was dipping towards the earth in the form of a funnel or inverted cone, and was gradually uniting with another cone whose basis apparently rested on the surface. At one extremity of this dark cloud was a smaller one, having a flocculent appearance, which soon also became conical in its form, but did not descend to the earth. These cones seemed to have been formed by whirling movements produced by currents of wind passing in opposite directions, viz. from the northwest and south. In a few minutes the well defined character of these united cones was changed, and there arose a column, spreading at the top, and resembling a volcanic eruption. A vast body of smoke, as it seemed, rose up and again descended, producing a sort of rolling upward and downward movement.

Presently the dense column was dissipated, and we could then distinctly observe the whirling motion of the wind by the dust, fragments of timber, &c., which were carried upward in its course. Onward it swept with incalculable velocity, until another dark and well defined cone was again formed, which remained stationary for an instant, and then again gave place to the eruptive appearance and whirling movement before mentioned. Thus it passed, distinctly visible, along the northern bank of the Raritan, approaching in its course to within a mile of the boat. At this point the whirling character* was very apparent, and may be represented thus,

The alternations already described, continued, although much less distinctly characterized, until the whole faded from our view.

On approaching New Brunswick, we witnessed the devastation which the tornado had occasioned; but it was in this city alone that its mighty power was fully exhibited.

From inquiries since made there can be no doubt, that the cone above described was formed about six or seven miles west of New Brunswick, and that it remained stationary for some minutes. But when the second movement took place a dense cloud overshadowed the city. Several intelligent persons have informed me that slight, though distinct, explosions were heard. The heat of the air became oppressive, and volumes of smoke and even flame, were thought to be issuing forth and rolling over in various directions. Indeed, so general was this impression, that the alarm bells were rung and the firemen hastened to their engines; but while all eyes were directed to the black and terrible column which was approaching apparently towards the head of Albany street, no one could fix upon the exact spot to which effort should be directed. This state of uncertainty, however, did not long continue, for soon a tremendous wind rushed through the city, and in an instant after, the dense column, which had been an object of so much wonder and dread, stood on the opposite bank of the river, as it were, rallying for another desolating march.

* The direction of these whirls was the same as the hands of a watch; or from the west round by the north, east, south and west.

The course of the tornado from its supposed place of beginning to New Brunswick, was a little north of east, in which direction it continued to the village of Piscataway, about three miles distant, and which was almost totally destroyed; then inclining somewhat to the south, it held an easterly course, passing through Perth Amboy and thence to the ocean. It terminated, as I have seen it stated, by a fall of ice or hail and by a great commotion of the water. The fall of ice is said also to have characterized its commencement; but on this point I have never been able to obtain authentic information.

I shall add only a few remarks concerning the cause of this, at least in our latitude, very remarkable occurrence. The formation of the inverted cone or funnel, so often mentioned, was undoubtedly produced by currents of air from opposite directions. But whether these currents were caused by a vacuum arising from the electrical discharges from the cloud, or whether the supposed vacuum was the *result* of these currents, it is difficult to determine. But if this funnel may be compared to the tube which forms the water spout, we may suppose that there was a current established from the earth to the cloud. That there was an upward current of this kind, is at least rendered probable, by many of the facts which have been ascertained. Among these may be mentioned the unroofing of those houses into which the air rushed through the doors and windows, and the lodgment of these roofs nearly in front of the houses to which they belonged. This upward movement was distintly visible at a distance, and it was this which caused the eruptive appearance already described. At the same time there was also undoubtedly a *whirling* motion, to which the destruction produced by the tornado is to be chiefly ascribed. This motion, as I have already said, appeared to us from on board the Napoleon, to succeed the upward movement and characterized the progress of the tornado until it passed from our view. That the tornado possessed this whirling character, was also abundantly demonstrated by the appearances presented in New Brunswick and its vicinity. According to my measurement, its track through the city was about three hundred yards; but the circle seems to have been much larger where the cone was first formed, and on the opposite side of the river the track seemed also to have been wider. Near the circumference of the supposed whirls or circles, was the line of the most destructive force of the wind. Several buildings in their centres entirely escaped injury.

I carefully examined the track of this tornado for nearly five miles; that is, from Middlebush to New Brunswick, and thence onward on the opposite side of the river, and I must confess, that I was greatly surprised when I saw it subsequently stated that there was here no evidence of a whirling motion, but that the "violence of the wind was produced by two currents making towards each other, and having at the same time an onward motion." I am constrained to believe that had the facts been carefully examined without reference to a previously adopted theory, such an inference would never have been drawn from them.

Art. XV.—*Account of the Bituminization of Wood in the human era, in a letter to Prof. Silliman, from Prof.* Wm. Carpenter.

Jackson College, Louisiana, Dec. 18, 1838.

Dear Sir,—In my last letter to you,* I mentioned a deposit of bituminized wood at Port Hudson in this parish. At that time I had examined the locality only, for a few minutes, and was misled by appearances, as regards the extent of the deposit, and its position relative to the bluff formation. I did not think at that time, that the beds of bituminized wood extended under the beds of the bluff formation, as I have ascertained is the case; nor did I think they were the ruins of extensive forests, as they undoubtedly are.

Figure 1.

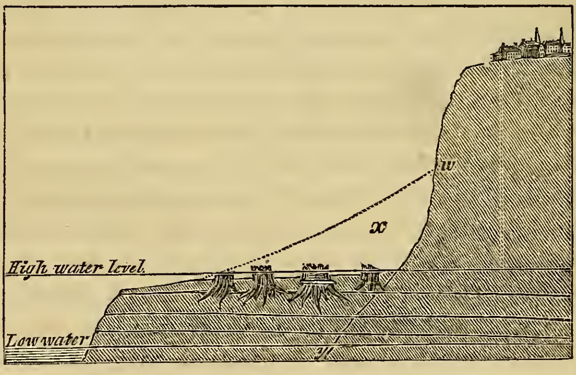


Figure 1, is intended to represent the bluff on which the village of Port Hudson is situated. At the bottom of the bluff, and near

* Vol. 35, p. 344.

the level of high water of the Mississippi, may be seen a shelf extending some distance into the river. The level surface of this projecting shelf was covered by earth which had fallen from the bluff, forming a kind of talus x. This superincumbent mass of earth was removed in forming a new steam boat landing, and a surface was exposed, covered with logs partly changed into a glossy black coal, and with many stumps standing erect where they had evidently grown. The logs and branches found on this surface were very much flattened, some portions of them being very soft, while the remainder was in various degrees bituminized. Many bore the marks of the axe so distinct as to be recognized without hesitation by all who examined them. This circumstance misled me, and induced me to consider the deposit as much more recent than, as will be hereafter seen, it really is. The axe marks must of course be, comparatively recent, though they were evidently made before the change in the wood commenced. From the data obtained during my first hasty and superficial examination, I concluded, that the deposit was a small one, formed by the Mississippi, and resting against the clay of the bluff, which I supposed to present a face somewhat similar to the line, $w\ y$.

I was led to give the locacity a more careful examination, from being told by those who had been long acquainted with the place, that the bluff had within their recollection, retreated very considerably, and in fact, a field which is said to have extended more than four hundred yards back from the edge of the bluff, has almost disappeared, by falling into the river beneath, which is evidently encroaching rapidly at this time in consequence of a strong current setting against the bank at this point, situated as it is in the lower part of a considerable bend, which the river makes here.

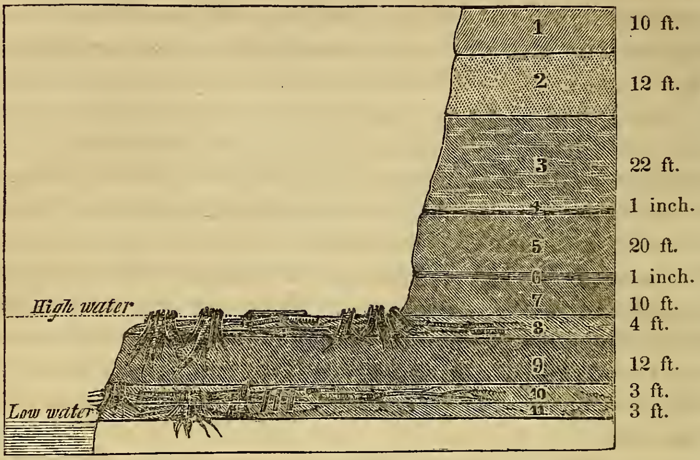
I will now proceed to give, in a manner as condensed as possible, a statement of the result of a more thorough examination.

Figure 2, represents a section of the bluff.

No. 1. A layer of reddish sandy clay which forms the sub-soil in this region.

No 2. A bed of sand of variable thickness, in which water is obtained, by sinking wells to it in various parts of the adjoining county. It often contains, and sometimes lies between beds of quartz pebbles, which bear the marks of shells, encrinites, favosites, asterias, &c.; and there are often associated with it, lumps or sometimes large masses of soft and bright red clay, without grit, of the kind usually found accompanying veins of lead ore, in the western country; thickness 10 feet.

Figure 2.



No. 3. A bed of bluish clay intermixed with a little sand, 22 ft.

No. 4. A very thin layer of vegetable matter, consisting of small sticks, some of which are flattened and bitumanized. This bed sometimes vanishes and re-appears at short intervals. Its thickness though varying, may be set down at one inch.

No. 5. A bed of fine-grained aluminous clay, of a deep blue color, which seems to have a tendency to break into blocks of irregular cubic or prismatic forms, on account of thin septæ or laminæ of a ferruginous brown color, which traverse it in various directions. Reniform concretions are also formed in this clay, which, when they first fall out, have the color of the clay, and seem to differ from it only by being a little harder. After being exposed for some time, they present the appearance of being worn by running water; their surface becomes of a deep brown color, but if broken, they will be found as light colored within, as the clay in which they originated; if exposed long enough, the brown color pervades every portion of them. These changes no doubt depends on the decomposition of some compound of iron, which perhaps gives the blue color to the clay; thickness 20 feet.

No. 6. A thin, but continuous layer of indurated ferruginous clay of a nature similar to the nodules, presenting, when perfectly indurated, and particularly when weathered, a texture exactly similar to the red shales of the Alleganies, but without any sign of cleavage; thickness from one to two inches.

No. 7. A bed of clay, similar to No. 5, but of a somewhat deeper color, and having a similar tendency to produce the uniform concretions spoken of above; thickness ten feet.

No. 8. A bed of vegetable matter, containing logs, branches, &c., lying horizontally, and often so much flattened as to have a diameter six or eight times as great in one direction as in another. They are in various degrees bituminized, and softened; some being transformed into beautiful coal at one extremity, all appearance of woody fibre being obliterated, and consisting of wood at the other so soft that it is easy to crush a stick as large as the arm between the fingers. The logs thus softened, are often covered with thin bark, and look as fresh as if just fallen. The largest logs, when reduced to this state, can be cut through with the spade without difficulty; and wherever they projected a very short distance from the bank they break off square, presenting the same appearance as if they had been sawed off. In no case did I perceive the least sign of transformation into coal, when this softening had not taken place. On the surface of this bed, which was exposed by the removal of the earth which had fallen on it from the bluff, I discovered, as has already been said, pieces of wood, which were changed into perfect coal, bearing the marks of the axe. These have no doubt been brought there recently, deposited on the denuded surface of the bed, covered by earth from the bluff, and rapidly bituminized. They cannot of course establish the age of the formation, and can only show how short a period these changes sometimes require. Many stumps are seen in this bed, standing erect, and sending their roots to considerable depth, in the beds below. The outer layers of these stumps scale off when exposed to the atmosphere, the squamæ being bituminized, the internal parts retaining to some extent the properties of wood. I could not satisfy myself as to the species of tree to which these stumps belonged, but as no cypress stumps are to be seen, it is very reasonable to conclude, that the growth was not that of our low swamps. The only logs satisfactorily recognized by me in this bed, were those of the water oak (Quercus aquatica) and of a pine, together with a great deal of pine bark, and the strobiles of the Pinus tæda; thickness four feet.

No. 9. A bed of fine aluminous clay, similar to No. 5 and 7, but of a color deeper than either, and having a greater tendency to form the same kind of nodular concretions, which tend in this bed to arrange themselves in a horizontal and linear manner; thickness twelve feet.

No. 10. A bed of vegetable matter consisting of sticks, leaves, fruit, &c., arranged in thin horizontal laminæ, with very thin layers of clay interposed between them. There are a great many logs lying horizontally. The fruit of this swamp hickory (Juglans aquatica) is very abundant; the nuts are found compressed, but rarely changed into coal. The burr-like pericarp of the sweet gum, (Liquidambar styraciflua,) are also found, and occasionally walnuts, (the fruit of the Juglans nigra,) are met with. The logs found in this bed, are those of the cypress, (Cupressus thyoides,) swamp hickory, a cotton-wood, (either the Populus angulata or heterophylla,) and other trees peculiar to the low swamps of Louisiana. A great number of stumps are seen standing erect, and sending their roots deep into the clay beneath. These are principally cypress of the large size, common in our swamps, the wood of the internal parts retaining much of its hardness and strength, the outside only being softened or changed into coal. These stumps are surrounded by the peculiar knobs or stump-like excrescences, called cypress knees, found on the roots of the cypress when growing in a submerged soil; and which standing up from the soil, from one to three feet, or sometimes in deep water, six or eight feet, give the area surrounding one of these trees, the same appearance as would be presented if a great many small trees had been cut, and their stumps left standing. They differ however, from stumps, by having rounded tops, covered by a smooth bark. The forest of which this bed contains the remains, was evidently composed of the same trees, which are now the common growth on the new made lands of the delta of the Mississippi. The cypress is peculiar to swamps which are subject to overflow, and the cotton-wood and swamp-hickory are among the first tenants of the land, after it has risen, by successive annual deposition, from the overflowing waters of the Mississippi, a little above the level of low water; thickness three feet.

No. 11. A bed of aluminous clay of a lighter color than those above. As the low water level is only about two or three feet below the upper surface of this bed, nothing is known respecting its thickness, or of the nature of the beds beneath. The strata associated in this formation seem to have an order of conformable superposition with respect to each other, and to dip southward, as the second bed of vegetable matter disappears below the low water level, about two miles down the river, but I have never heard of their cropping-out in any place north of this. What may be the extent of country underlain by these subterranean forests, I have no data to judge from ; as no excavations have ever been made in the neighboring country, deeper than the wells, which go only as deep as the bed of sand, marked No. 2, which rests on the blue clay, No. 3 ; and the only chance of obtaining sections of any depth, is where the river is encroaching on the bluff. This is not a very common case in this immediate portion of country, as the line of bluffs is not generally very near the river banks, but separated from them by an intermediate strip of level, swampy land, sometimes several miles broad, the surface of which is about as high as the high water level. A bed of vegetable matter, very similar to the thin bed, marked, No. 4, is to be seen projecting from high banks in the vicinity of Jackson, (fourteen miles from Pt. Hudson,) and as its situation is the same as that, relatively to the blue clay, it is probably continuous.

No remains of animals have yet been found in any of the beds of this formation, although it is but reasonable to expect that they will be found ; and I look forward in hopes that a deep cut, which is to be made through the bluff for the passage of the railroad which ends there, may afford better opportunities of becoming acquainted with the contents of the deposits.

A circumstance perhaps worthy of some farther notice is the peculiar soft condition of the wood, previous to flattening and transformation into coal, as it may be the means of saving some geologists the trouble of accounting for the enormous pressure they have thought necessary to the production of this effect. The fact that this state seems always to precede the transformation into coal, would appear to favor the opinion, which is perhaps the prevalent one, that it is only during incipient decomposition, and perhaps during this peculiar soft state, that the woody fibre is ever replaced by any other kind of matter. If we adopt

Dutrochet's views with regard to absorption, &c., and make the application of them to account for phenomena of this nature, such a state would be, if not necessary, at least most favorable to such processes.

I have given this long description of a formation which appears to me somewhat curious, in hopes that you may find something in it to interest you. I will not apologize to you for describing a kind of formation which is so far from being rare; for I am well aware that in addressing you upon this subject, my motives will be a sufficient apology.

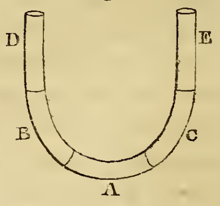
Remark.—We should like to compare this bituminized wood with well characterized lignite.—*Eds.*

Art. XVI.—*The Construction of Galvanic Magnets;* by John B. Zabriskie, M. D., of Flatbush, N. Y.

Many experiments are still wanting to establish the best proportions of galvanic magnets, and the most advantageous mode of using them; such as the best shape of the iron, the maximum size of the bar, the relative weight and best form of the winding, the most advantageous mode of communicating the galvanic current to rotating magnets, &c.

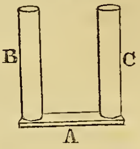
That the shape of the iron used in constructing galvanic magnets will tend to vary the result of their action, must be evident upon reflection. If we take as an example a common horseshoe galvanic magnet, the most active parts are the two extremities; and although every portion of the iron contributes its effect from induction, still this effect is continually decreased until it reaches the center, when it is reduced to nothing. If then we divide the iron in a magnet of this description (Fig. 1,) into five equal parts, the iron in A may be considered as nearly inert, and that in B and C as more powerful, but still far inferior in power to D and E. The part A, may then be considered as nearly useless as far as its own original effect is concerned, and useful only by acting as a bond of union between the two extremities of the magnet by conduction. Any form of

Fig. 1.



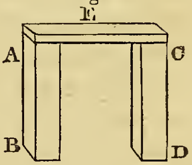
the magnet, then, which will diminish the weight of A, to that quantity which shall be sufficient for the conduction of the magnetic power between the poles and enable them to react upon each other, will prove of great advantage in the construction of these magnets by diminishing the weight of iron while this power remains the same. This has been partially attempted by Mr. Davenport, who made the iron in his magnets rather thinner near the center, and heavier at the poles. But the same effect may be much more advantageously produced by giving the iron the form seen in Fig. 2. Two straight pieces of iron, B and C, are welded to a smaller flat bar A, which is large enough to conduct the inductive effects of the two extremities upon each other, and by being much lighter than B and C, lessens the weight of the whole magnet. There are several advantages resulting from this form. The sides, B and C, being straight, are capable of being wound more evenly and more compactly; for in curved magnets, the winding upon the outer or convex side, must necessarily be more loose than that upon the inner side of the iron, and upon this account a greater quantity of wire can be put upon the same weight of iron when straight.

Fig. 2.



That the attractive force of a magnet is increased by the reaction of the two extremities upon each other, may be easily proved by the following experiment. Let AB, CD, Fig. 3, be two magnets, having the poles A and C of different names. The attractive force of the lower extremities will be increased if A and C be joined by a bar of soft iron E. But this increase will by no means equal the sum of the separate action of the four poles, A, B, C, D, or in other words, A will not impart to D a force equal to that which it exerts upon the bar E, nor in like manner will C impart an equal force to B. So that the greater the active surface, the greater must be the power of the magnet.

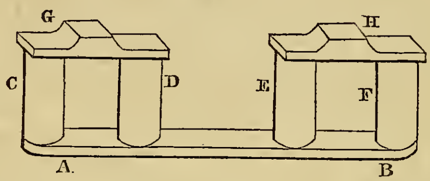
Fig. 3.



Again, although the magnetic power of the parts B and C in the galvanic magnet Fig 1, is conveyed by conduction through the parts D and E, yet as the conducting power of the softest iron is very imperfect, the force exerted by the parts B and C through D and E, is very far short of that which they would be able to exert themselves at their own extremities. That this is the case may be easily proved by experiment. Take any magnet, and apply to one of its poles a piece of soft iron. This iron will have considerable magnetic power while in contact with the magnet. But the power of this iron is much less than that of the magnets, and the longer the iron, the less is its power.

If then we can bring into direct action the extremities of all four of the parts of the magnet, Fig. 1, we shall increase the power of the whole magnet while its weight remains the same. This may be accomplished by means of compound galvanic magnets constructed in the following manner. To the transverse bar of iron, A B, Fig. 4, fasten, by welding, riveting, or screwing, the

Fig. 4.



four upright pieces of larger iron, C, D, E, F, and wind the whole, either with wire or metallic ribbon, in such a manner that the poles, C and D, shall be of the same name, but of a different denomination from E and F, which are also alike. Upon connecting C, D, and E, F, with the plates of soft iron G, H, which act as the armatures of compound steel magnets, we shall have the whole converted into a compound galvanic magnet, which may be supposed to represent the magnet Fig. 1, having the extremities of the four parts B, C, D, E, brought into direct action, and the part A, forged out into a bar of half the thickness, and twice the length, which acts as the connecting point between the compound poles. Experiment proves the truth of the above reasoning. A bar of iron one foot in length, and weighing one pound, was wound with a piece of metallic ribbon of copper foil, covered with silk. With a weak charge of a small galvanic arrangement, it lifted a little less than one pound at each extremity. The same ribbon was then wound around the iron of a compound galvanic magnet, constructed as in Fig. 4, and weighing four ounces; with the same charge, and the same battery, this last lifted three pounds. Now this experiment gives us the increase of power in favor of the compound magnet as 3×4 is to

2, or its effect as six times greater than that of the bar of iron. Subsequent experiments confirm the great increase of power obtained by compound galvanic magnets.

As it is difficult to magnetize a large mass of steel, and as it is preferable to magnetize small bars and unite them into a compound magnet, so it is found by experience to be very difficult to magnetize by galvanism a large mass of iron to saturation; and the failure in a number of attempts to do so, together with reasoning by analogy, led me to the construction of compound galvanic magnets. A mass of iron, two inches in diameter, was wound with a copper ribbon one half an inch wide, and one hundred and twenty feet long. Upon being connected with a small galvanic circle, containing half a square foot of zinc, it lifted nearly fifty pounds. The same ribbon was then applied to a horseshoe of soft iron, two feet long and one inch in diameter. With the same battery and the same acid, the latter lifted one hundred and fifty pounds. Both these magnets were of the horseshoe form, and nearly of equal weights. This experiment shows the difficulty of saturating with magnetism large masses of iron; but if we divide perpendicularly each extremity of the large magnet into four equal parts, and wind each part separately, there will be no difficulty in completely saturating the whole.

Magnets made with hollow iron have been constructed and are highly spoken of by some experimenters. With the same weight of iron they may be made more powerful to a certain extent, because more of the iron is brought near the winding and thus a greater surface is brought near the action of the electrical current but it soon reaches a maximum point. When the cavity is enlarged, the circumference also must become larger, and a greater length of wire or ribbon is required to go around it. On this account, with the same weight of wire, there must be a less number of layers of wire coiled around it, and the magnet will possess less power. When the bore of a hollow magnet does not exceed a certain size, its power must be greater than a solid magnet with the same weight of iron, but this hollow magnet must be of less power than when its cavity is filled up with soft iron.

As the power of an electrical current resides principally in the *surface* of the conductor, it would seem reasonable that if the surface of the wire which is wound around galvanic magnets be increased, its magnetic effects will be increased. This is true to a certain extent, but not in proportion to the extension of the surface. If we suppose a wire to be rolled out into a flat ribbon, and covered with silk, we might suppose that the effect of the wire would be increased directly in proportion as its surface becomes greater. If a wire $\frac{1}{10}$ of an inch in diameter, be rolled out to the width of half an inch, their surfaces will be as 3 to 12 nearly, and it might seem rational to suppose that the power of the ribbon will be four times that of the wire, but this is not found by experience, to be the case. The tenuity of the metal opposes the free passage of the electric fluid, and the silk covering being thicker than the metallic ribbon, occupies too much room, so that as many layers of the winding cannot be made in the same space as of wire. Therefore, although the magnetic energy of the ribbon is greater than of the wire, it does not increase in the same ratio as the increase of the surface of the winding.

I have made many experiments with ribbons of fourteen ounces copper, or of copper weighing fourteen ounces to the square foot, of four ounces, and of two ounces copper, in all of which I found that with the same weight of metal, the thinner the foil, the greater the power of the magnet, but that with the same surface, the ribbon from fourteen ounces copper, possessed much more power than those from the lighter foils.

I have repeatedly verefied a remark made by Dr. Page, in the last number of this Journal, that those magnets which lift the greatest weights, do not always answer best for rotating magnets. The galvanic magnets constructed with metallic ribbon, although they will lift more, with the same weight of copper than wire wound magnets, yet they will not rotate with as much rapidity. This I always supposed to be owing to the resistance of the air as their bulk is greater, but from the experiments of Dr. Page, it would appear that the whole effect is not to be attributed to this cause, as the same discrepancy is observed among wire wound magnets. It would hence appear evident, that galvanic magnets constructed by winding soft iron with metallic ribbon, and especially compound magnets are best for stationary magnets, as they lift the greatest weight, and consequently must have the greatest attractive power; but wire wound magnets are best for rotating. Many experimenters also prove that the thinner the foil, the shorter must be its length. A ribbon of fourteen or sixteen ounce copper and two inches wide, may be nearly two hundred feet long, before we reach its maximum length. If this ribbon be half an inch wide, the magnet which it is employed in constructing, will lift more if we have two lengths of sixty feet each, than if we employ one hundred and twenty feet in one ribbon. With four ounce copper, one inch wide, fifty feet was the greatest length employed, and when the copper foil weighed two ounces to the square foot, about twenty-five feet was found to be the maximum length.

Art. XVII.—*Electro-Magnetic Rotations;* by John B. Zabriskie, M. D., of Flatbush, N. Y.

Electro-Magnetic rotations may be considered as of two kinds. 1st. Those where the motion is produced by changing the poles of one magnet or system of magnets, when they come opposite to the poles of another magnet or system of magnets. 2d. Where a magnet or conductor is moved by the tangential force of an electric current.

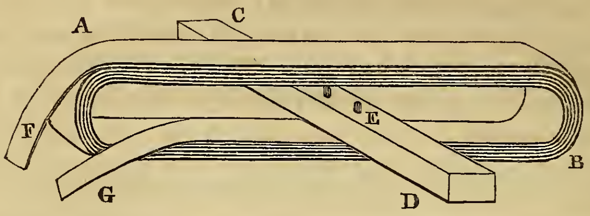
The power of the first class is greater than that of the other with the same weight of metal, and the same battery power, for although the effect of the electrical current, especially when passing through a helix or flat spiral resembles, that of a magnet, still it is not equal to the attraction and repulsion of the contiguous poles of powerful magnets.

The following experiments contain an application of the tangential force operating in a manner never yet described.

In the winter of 1836, I made the following experiment. A metallic ribbon, 180 feet long and two inches wide, was formed into an oblong coil, so as to encircle a large compound magnet two feet long which was suspended freely upon an axis within the coil of ribbon. Upon connecting the extremities of the ribbon with the poles of a galvanic battery, the magnet was immediately thrown at right angles to the coil, when a lever moved by the revolving magnets turned an apparatus which changed the direction of the galvanic current in the metallic ribbon. The rotation was thus continued until the magnet reached the revolution of half a circle, when the direction of the current was again changed.

This apparatus is represented in Fig. 1. Let A B represent a coil of metallic ribbon, C D a magnet revolving upon an axis in its centre. Upon connecting the extremities, F and G with a

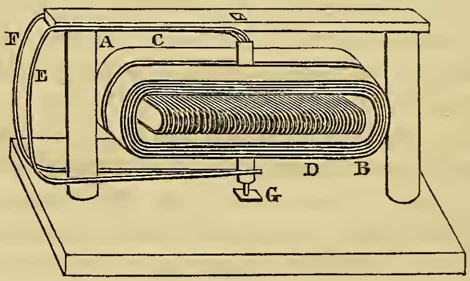
Figure 1.



galvanic battery, the magnet will be thrown at right angles to the coil by tangential action of the current; when it reaches this point, the pin E upon the magnet C D moves a lever which turns an apparatus for reversing the current in the coil. The motion in the magnet is then continued until it reaches a half revolution, when the pin E moves the lever in the opposite direction, and changing the direction of the current again, the magnet is impelled as at first. The motions of this magnet were rapid, being about one hundred and twenty revolutions in a minute, although weighing six pounds, and would continue half an hour without much diminution with the same charge of the battery.

Fig. 2, represents an apparatus by means of which the ribbon may be made to revolve around the magnet. Let A B represent

Figure 2.

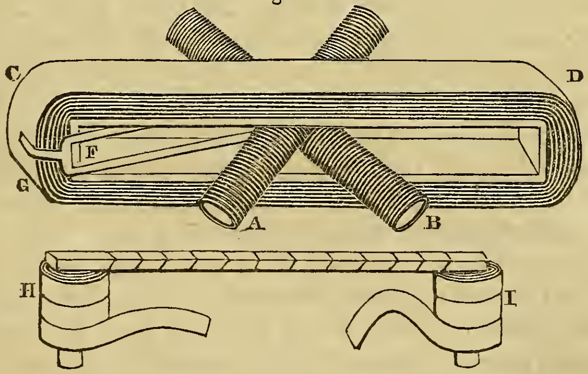


a galvanic magnet suspended upon an axis G. The wires E F, are the extremities of the wire which is wound around the magnet, and which pass through a copper tube which serves as an axis for the revolving part of the apparatus. These wires are first well covered with silk so as completely to insulate them from each other, and from the tube. A stout iron wire firmly riveted to the magnet passes through the tube and being fastened to the frame by a screw serves to suspend the magnet. The ribbon C D is wound over a thin frame of wood and each extremity soldered to a semicircular strip of copper, forming when applied to the lower axis, a pole changer similar to those of Dr. Page, this pole changer is placed so as to change the direction of the current in the revolving ribbon when it is at right angles to the magnet. The extremities of the wires E F press upon the semicircular strips of copper, and thus when a communication is made between each of these wires, and the poles of a battery they transmit a currunt both to the ribbon and to the magnet. The ribbon will be found to move immediately to a position at right angles to the magnet, and when it arrives at that point, the direction of the current is changed by the pole changer, the motion is continued, and thus a constant rotation is obtained.

The same experiment is reversed by making a galvanic magnet rotate within a coil of metallic ribbon changing the poles of the magnet when at right angles to the coil by means of the pole changer.

The following (Fig. 3,) is a powerful machine acting upon this principle. A and B are two galvanic magnets each one foot in length, fixed upon the axis E, and turning freely within a wooden

Figure 3.



frame, around which is coiled the ribbon C D. The strip of copper F conveys the electrical current to the wires upon the galvanic magnets A and B, through two pole changers, one for each magnet, and which are fixed to the axis, one above and the other below the magnets. These pole changers are fixed so that each magnet changes its pole when at right angles to the coil of ribbon. A strip of copper G is soldered to the copper F, and the outer extremity of the ribbon C D, while the inner extremity of the ribbon is connected with another strip similar to F upon the other side of the apparatus. Upon connecting these two strips of copper with the two poles of a battery, the magnets will revolve with rapidity. This motion is much increased if a galvanic magnet H I be laid across the coil and at right angles to it, so that its poles are near the poles of the revolving magnets when their poles are changed. The same change of poles answers for both, and we have in this way the combined effect of a rotation produced both by a double magnetic force, and the tangential action of a current.

All persons who have made experiments in electro-magnetism must have observed, that large magnets cannot be made to revolve with as great rapidity as small ones. The small magnet will not only make the greatest number of revolutions, but its extremities will move with much greater rapidity than the extremities of the large magnet, notwithstanding the latter a much greater circle. This is owing to several causes, one of which may be a deficiency in the quantity of the galvanic fluid, there not being a sufficient quantity generated in a small battery to saturate a large magnet, at least for more than a few moments after the commencement of its action. But when there is battery power sufficient, there is often deficiency in the means of communication of the electrical current to the rotating magnet. The communication being by means of two wires or small strips of metal, and no greater with a large magnet or circle of magnets, than with one small magnet, and as the most finished polishing of the wires, and tinning of the semicircles of the pole changer, can bring little more than one point of each into contact, the whole supply must pass through these two points. The current on this account does not pass as freely as it ought, and the magnets do not possess the power they would if the communication was less impeded. That this is the case, may be proved by pressing the communicating wires of a revolving magnet together, and the power of the magnet will, to a certain extent, increase nearly with the pressure. But in a revolving circle, if we increase the pressure beyond a certain degree, the increase of friction impedes the motion of the apparatus, although the lifting power of the magnets will increase with the pressure. This shows that with the ordinary apparatus, the means of communication is imperfect, and much power is lost. I have attempted to remedy this by making two or more wires upon each side press upon the same pole changer, but this increases the friction. Increasing the thickness of the wire will allow more free circulation of the fluid, until it reaches the points of contact; but as this does not increase the surface in contact, it will not remove the whole difficulty; still it is always of great importance to have large communicating wires.

Art. XVIII.—*Steam Ships, and Steam Navigation;* by Junius Smith.

London, 21st January, 1839.

TO PROFESSOR SILLIMAN.

Dear Sir—I was gratified to learn through my friends, Messrs. Wadsworth and Smith of New York, that you discovered indubitable marks of mental aberration* in my last letter upon steam ships of war.

I was gratified because the conclusion to which you came shows that there is something in that letter which took you by surprise, something startling in the application of steam power to the fortune of empires, something new in a statement which shows the differential degrees of maritime greatness at a glance, something that does not rest upon mathematical calculations, or philosophical experiments, or physical power, or moral influence; but something so different from all this that its very elementary principle is weakness, although its force is mechanical.

The questions you ask are just such, as in my present state of mind, I should expect would be asked, namely, what will become of a steam ship upon the wide ocean without masts, in case a boiler bursts, the fuel is exhausted, or the machinery breaks down and the ship is disabled? My answer is, that she would then be precisely in the situation of an ordinary sailing ship dismasted, and would of course resort to the same remedy of rigging jury masts. There is no difficulty whatever in having the foot

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* *Enthusiasm*, not mental *aberration*.—B. S.

of the masts, from the keelson to the main deck, permanently fixed, and the top-masts made to slide down by their side so as to be easily hoisted in case of necessity. But I apprehend that even this precaution, proper enough to be taken, would be entirely useless excepting in the case of the breaking down of the main shaft.

The bursting of a boiler at sea, which by the way I do not see how it is possible to effect where Hall's condenser is used, unless by design, is a matter of no consequence as regards the working of the ship, because she would never have less than four boilers, and two would work the engines. The ship has two engines, and a defect in one would weaken but not destroy the power, and therefore would not disable the ship.

Steam naval ships will be supplied with fuel upon just the same scale as they are supplied with pork. If the commander is weak enough to put to sea with a short supply for the intended voyage, the ship must be put upon a short allowance until she can make a port and lay in a fresh stock.

I am obliged to you for your questions, and if you can think of any more which seem coupled with objection to steam ships of war, pray let me have them, for the subject is of vast magnitude; one which involves the security of states, the freedom of the seas, and the whole system of future maritime warfare, and which will bear the sternest examination. Although an island, as noticed in my last letter assailable at all points, is peculiarly exposed to the assaults of armed steamers, I am not unmindful that a continent may be equally defenceless. The United States of America, stretching round half a continent, with a sea-coast scooped into numberless bays, harbors, and inlets, with a government bearing rule over a people almost too independent to submit to any, urged on by ambition, vain of their acquirements, and proud of their country, is, nevertheless, slumbering in dangerous security. To such a people, the power of steam as a means of national defence is of incalculable value. But do they perceive it? or will they continue to slumber on until their cities, towns, and villages, are battered about their ears? Do they think that the golden images of successful avarice set up in every part of the country, are no temptations to the daring bucaneer? and do they not perceive, that unless the means of protection correspond with the growth of the thing to be protected, the probability is that all will be lost? If we cast our eyes upon the European continent, we find the reigning dynasties lost in every great enterprize. They may indeed catch a glimpse of the far-off coast, looming in the horizon, and speckled with objects indistinctly visible; but they must wait for a nearer approach, a clearer atmosphere, before they can realize the grandeur and beauty of the prospect.

"The emperor of Russia embarked with his family on the 3d of October, at Stetin, in the steam boat Hercules, and found at the entrance of the Gulf of Finland, the Russian fleet ranged in order of battle. The fleet manœuvered before the emperor," &c. &c. &c.

If we did not know that hereditary talents are not necessarily connected with hereditary rights, we should imagine the head of a vast empire and the descendants of Peter the Great, seated upon the deck of the Hercules, would catch an idea of the importance of steam power from his very position, from the manner in which he was conveyed into the presence of his fleet; from the contrast which the exhibition before him presented, and from the facility and celerity with which he approached his fleet and withdrew from it. But we are told that the emperor discourages steam navigation. Let him. We cannot conceal the fact, that improvements upon a grand scale are scarcely compatible with the notions of aristocratical and feudal governments. They tremble under the secret apprehension, that they read their own doom in the melioration of society, and therefore grasp the "rod of empire" with a firmer hold, and close the inlets of every stream whose flowings would fertilize the public mind. But perhaps even this exclusive state of things is not without its alleviation. States of less physical force, unfettered by hereditary bonds, free to move, free to act, seize upon the advantages thus cast upon them, and occupy a position for which they are indebted to the repulsive character of others, rather than to any superior sagacity of their own.

This is the reason why nations just peering into notice, gain so rapidly upon ancient dynasties. They have no antiquated thraldoms to overcome, no prejudices to surmount, no prescribed limits to check their career, no masters to consult, but with all the freedom and buoyancy of youth, bound away in pursuit of every gainful enterprize, heedless of toil, regardless of restraint, intent only upon securing the result. The single fact, that there are at this moment, more steam vessels navigating the waters of the Mississippi river, than all the steam vessels of Great Britain and her colonies combined, and more than three times the number of all owned upon the whole continent of Europe, is an irresistible evidence of the truth of these remarks.

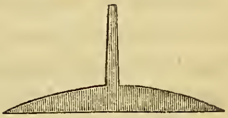
It is a question of the greatest magnitude, but one which cannot at present be answered practically, how many sailing ships of war in naval combat would be equal to one steam ship of equal force? We may suppose one seventy-four gun steam ship, placed to the windward of four seventy-four gun sailing ships. It is quite obvious, that the sailing ships cannot approach the steamer in a direct line. If they attempt to tack in different directions to gain an advantage in position, the very act of separation would be instant destruction. If they form in line, perhaps the only chance of security, the steamer may bear down upon a flank ship, and what is to prevent her destruction? Fifteen minutes would complete the work, and I fearlessly ask any nautical gentlemen, who has the slightest acquaintance with steam ships, what power a sailing ship has to defend herself, and what can prevent the steamer from annihilating the four?

If this supposition carries any truth with it, these thirty steam ships of the line are equivalent in battle to one hundred and twenty sailing ships of the line, which I suppose would be sufficient to show, that the latter in any naval engagement would be utterly useless.

No doubt an actual engagement of two hostile steam fleets, which, like armies of soldiers, can move in any direction, and at any time must be terrific, and the destruction awful. But when we recollect, that the violence of a storm, indicates its brevity, we may gather some consolation from the hope, that the calamities of war which have too often extended over many years, may by a new system of naval warfare, be compressed within the limits of a few months.

Art. XIX.—*Galvanic Batteries.—On the Benefit of Fresh Immersion;* by Charles G. Page, M. D., Washington, D. C.

The fact is familiar, that the first few moments of immersion of a galvanic pair, are attended with an intense action, which, subsiding, leaves the battery in a state of low and rapidly diminishing action. But the solution of this fact, the cause of this vivid primal action, yet remains in entire obscurity, although many attempts have been made for its development. The effervescence of the battery, or the copious development of gas, is doubtless a sufficient obstruction to the passage of the galvanic current, to account for that subsidence which is found always to occur when the evolution of the gas becomes audible, or is visible at the surface of the liquid. The following experiments will show that the primal action of a battery, (or in broader terms,) the *galvanic current* must be traced to some other source than chemical action, or at least those obvious modes of chemical action, recognized during the immersion of a battery. These experiments were performed more than a year since, and as they led to conclusions mostly of a negative character, I have been intending to pursue the subject farther; but being unable to gratify my wishes in this particular, I am induced to publish the unfinished investigation, trusting that the data thus afforded will draw attention to a subject so important and interesting. The battery used, was an amalgamated zinc battery, similar to that recommended in Sturgeon's Annals of Electricity. Two copper plates were prepared for the experiments, and in lieu of being perforated with numerous holes, were rendered slightly concavo-convex, with a funnel-like tube at its centre.



The figure represents a vertical, middle section of the plate and its funnel. The chief advantage of this form of plate over the collander plate, is, that the sprinkling of acid occasioned by the bursting of the gas bubbles, is entirely prevented. The flat perforated plate acts better as a conductor; but the difference is so trifling, that I prefer the latter for the sake of cleanliness. One of the copper plates was immersed, and the action of the battery immediately observed by the common test of the spark, produced by rupturing the circuit, completed by a coil surrounding a bar of iron, or rather a bundle of iron wires. As soon as the primal action had subsided, the plate was removed and immediately reimmersed. The primal action was by no means as intense, nor of as long duration as when the plate was first immersed. It occurred to me that there was something due in this case to the dryness of the plate. To ascertain this point, the immersed plate was withdrawn, and the second plate, which was entirely *dry*, was immediately substituted; the primal action was as intense, and of as long continuance as with the first plate when first immersed. That any new state of the liquid, induced by repose, is not essential to the full action of a reimmersed plate, is proved by this last experiment, viz. the introduction of a *dry* plate immediately after the withdrawal of an immersed plate. The plate was then removed from the liquid and left standing over the battery, while the other was dried by the fire. When this last was entirely dried, the two plates were immersed in succession, with the same difference in the results as before; the *dry* plate affording a more intense and *lasting* primal action than the wet plate, which had remained out of the battery about the same length of time. The experiment was then varied in every possible way, but always with the same difference in favor of the dry plate.

The following experiment is still more striking, more especially as the galvanic and chemical actions are not recognized in the amalgamated zinc battery, until the plates are joined by a good conductor. The two plates were thoroughly dried by a fire, and one of them then immersed and suffered so to remain about the same length of time as the primal action had usually continued. The action of the battery was then examined, and was found to be much below that of its primal impulse, and after the first junction of the poles, immediately subsided to the low standard. Evincing no more activity than such accumulation as would be due to the disjunction of the poles when the battery had been in use for a considerable length of time. The other dry plate was then immersed, and the primal impulse, on immediate examination, was found to be intense and lasting as in prior experiments.

From frequent observations, I am inclined to think, that chemical action upon the zinc of the amalgam is somewhat promoted by the presence of the copper plate, although the two plates are not in metallic contact. The above experiments, repeated many times, prove, beyond a question, a fact which rather contravenes our experience in galvanic philosophy. *A priori*, we should have decided in favor of the wet plate, as the conducting liquid would be brought more immediately into contact with it, by means of the thin stratum of liquid already adhering to the plate. Whether dryness *alone* be the condition required for this superior action, or some other condition necessarily involved in the absence of moisture, I am unprepared to say; the course of my investigation having been discontinued at this point. The subject is worthy of a thorough examination, and seems to promise some new and important developments in respect to the construction of the galvanic battery. The introduction of metallic salts as galvanic motors, and of membranous partitions to prevent the degeneration of action, have much improved the battery as an instrument for research. But it must be confessed that the batteries with the membranous linings, are very inconvenient, and require too much attention from the vitiation and decay of the membrane. The gain, too, is so trivial over the unprotected batteries where sulphate of copper is used, that I have always preferred, for ordinary use, the revolving zinc plate battery, described in a previous number of this Journal,* or else the cylindrical, or square plate battery, where the zinc plate is movable and supported entirely independent of the copper. The revolving zinc plate battery gains the benefit of fresh immersion by the withdrawal, cleaning, and *drying* of the zinc plate without a cessation of action. But the gain by fresh immersion is by no means so great here as in the presentation of a dry copper plate in the amalgam battery. It frequently happens that a battery does not act until some minutes after its immersion. In the acid battery the failure is owing to the foulness of the zinc plate, which must be removed or penetrated by the acid before it can act upon the zinc. In the sulphate of copper batteries, the failure of action may arise from the foulness of either plate. Hence it is important to observe, that both plates should be thoroughly cleaned when they are to be used with the sulphate of copper. If the zinc plate be perfectly cleaned, there will be scarcely any *galvanic* action if the copper plate is immersed, as it not unfrequently is, covered with a film of insoluble carbonate. In the revolving plate battery no

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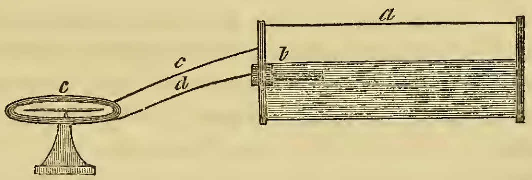
* See Vol. XXXII, p. 359.

benefit is derived from the drying of the zinc plate unless it be previously cleaned. From long and frequent use, I find that lead is superior to copper for the negative plate. Immediately before use, the surface of the lead which is to be opposed to the zinc plate, should be well rubbed with coarse sand paper. It becomes thus cleaned, and the numerous scratches made upon its surface, serve as lodgments for the particles of copper deposited from the solution of the sulphate. When the lead plate has been used a short time, after such preparation, it receives a thick and ragged coating of copper, affording an excellent conducting surface.

The superior energy gained by drying the negative plate in the amalgam battery, induced me to hope that a battery might be constructed wherein the greatest amount of galvanic power might be obtained with the least possible consumption of the zinc. The experiment proves that *galvanic*, is far from being commensurate with *chemical* action, and presents this singular anomaly, *that the galvanic power is greatest when the chemical action is the least.* Considering the obvious mode of chemical action in the battery, viz. the formation of the sulphate of zinc, we have first in the series of actions the decomposition of the water, the union of its oxygen with the zinc, and the simultaneous evolution of hydrogen as an indicator of the extent of this action. But the escape of hydrogen, which mechanically impedes the primal action of the battery, is protracted for a considerable length of time when the plate is dried prior to its immersion; and during nearly the whole of this time, the electrical action is at its maximum. Suppose now a number of copper plates attached to the circumference of a wheel, and by the revolution of the wheel these plates are presented to the zinc of the amalgam in frequent succession. The last plate out of the liquid would be the last to enter; and if each plate could be thoroughly dried in the course of its revolution, according to the foregoing statements, the *electrical* action would be constantly at its maximum, and the *chemical* action at its minimum. Indeed, I see no reason why a continuous copper plate, revolving slowly upon the circumference of the wheel, would not give the same result, attended with the advantage of unceasing action, provided one part of this plate could be *dried* before its immersion.

Art. XX.—*Application of the Galvanoscope to detect the Failure of Water in Steam Boilers;* by Charles G. Page, M. D., Washington, D. C.

The prevention of accidents by the explosion of steam boilers, has become to us a subject of vast moment; and since its legislation has been attempted, a multitude of plans have been devised, which should give warning of the approach of danger by audible or visible indications of a deficit of water in the boiler. No one of the plans so far proposed can be regarded as infallible, and should even an unexceptionable monitor of danger be obtained, it would utterly fail of its purpose, if we could not rely upon the prompt and faithful co-operation of skillful engineers. Nothing can be imagined more simple than the plan adopted by the French and English,* to show the level of the water in their boilers. A stout, curved glass tube is connected with the interior of the boiler above and below the water, and shows plainly at all times the level of the water in the boiler. It is not difficult to understand why this simple invention has not received merited attention in this country, in some portions of which especially, the invariable rule has been to keep danger out of sight. The plan I am about to propose, should it prove feasible, will present a feature possessed by no other. As it will indicate the state of things in the boilers with as much certainty to the passengers in the cabin as to the engineer in his room. The proposal is to make the galvanic action of the water upon a pair of plates or single plate, operate upon the needle of a galvanoscope, and the cessation of this operation an index of the failure of its cause.



In the above figure, *a* represents a vertical middle section of a steam boiler; *b*, a thick plate of zinc perforated with numerous holes just under the surface of the water. This plate must be

* E. g. in the Royal William, Atlantic Steamer, and in some steam boats on the Delaware.

insulated from the boiler by glass or some other non-conducting substance ; *e* represents a galvanoscope, consisting of a coil of insulated copper wire surrounding a magnetic needle ; *c d* are the terminations of the coil, connecting respectively with the metal of the boiler and the zinc plate *b*. When the water in the boiler is above the plate *b*, the magnetic needle will take a position at right angles to the coil of wire, when the water is below the plate *b*, the needle will assume its direction north and south. When the action of the coil and that of the earth are in conjunction, that is when the needle under the influence of the coil, is at the same time in the magnetic meridian, it will fail to indicate any want of action upon the plate *b*. To provide for this case, place another coil at right angles to and at a little distance from the coil *e*, and connect it with the metal of the boiler and the plate *b* in the same manner as the coil *e* ; thus the failure of action would be indicated by the departure of either needle from its right angle position. The galvanic series in the above plan is represented by the metal of the boiler and the plate *b* ; if the boiler is of iron, the plate may be of copper or zinc ; if the boiler is of copper, the plate may be of iron or zinc. It perhaps would be as well, on account of the remoteness of the two plates in the foregoing plan, to introduce a pair of plates in lieu of the single plate, connecting the one with the boiler, and insulating the other from it. Where salt water is used in the boilers, there would be no want of action, and it is probable that fresh water heated to such a high degree, would always afford action enough. It is a question, whether high pressure steam would form a conducting medium between the plates. In the case of a single galvanic pair, (however large,) I presume it would not. The humid atmosphere of a compound battery it is said, will keep up an action for a considerable time after its emersion. Even this point I consider as questionable, and have always attributed the continuance of action after the emersion of large batteries, to the acid and water adhering to the pieces of wood, or whatever substance is used, to separate the zinc and copper plates. No experiments have been tried to test the value of the plan here proposed, but as no suggestion should be lost on a subject of so much importance, I have deemed it worthy of communication, hoping that the hint may ultimately lead to something useful.

PROF. B. SILLIMAN,—*Dear Sir*—In a recent communication in your Journal, on the application of Electro-Magnetism as a mechanical agent, I alluded to the invention of Mr. Sturgeon of England, as being the first to establish this interesting branch of science. I owe an apology to our distinguished countryman, Prof. Henry, for the injustice done him in that communication, and it gives me great pleasure in correcting my mistake, to concede to that gentleman, the honor which he justly merits, of having produced the first invention which led to the investigation of this interesting subject, and laid the foundation of a new branch of science. Yours truly, C. G. PAGE.

ART. XXI.—*Dr.* JACKSON'S *Reports on the Geology of the State of Maine, and on the public lands belonging to Maine and Massachusetts.*

THE history of geological investigations having for their object the advancement of the arts and the improvement of agriculture, carried on by liberal appropriations of the State Legislatures, as well as by the General Government, furnishes an unequivocal proof of the healthy and progressive state of the public mind. And it should not be forgotten, that geology, aside from its economical and practical bearings, viewed solely as an intellectual and ennobling branch of physical inquiry, is now receiving a larger share of attention than at any former period. This has resulted mainly from our system of popular lectures, lyceums, &c., by which facilities have been given to the dissemination of knowledge, rarely, if ever equalled by any other people.

The credit of proposing and carrying into practical execution, the first geological State survey, belongs, we believe, to the legislature of North Carolina.* Though but a few years have since elapsed, the example has been followed to some extent by nearly every State in the Union; and researches have also been made into the distant territories of Missouri and Arkansas. From the various reports of the geologists employed, much information has been obtained towards the preparation of an accurate geological

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* The survey of North Carolina did not, we believe, embrace the whole State. In Vol. XXII, p. 1, note, we stated our belief, that Massachusetts was "the first example in this country of the geological survey of an entire State."—EDS.

map of the United States, for which the friends of science have been anxiously waiting. The reports of Dr. Jackson, four of which have appeared, the first in December, 1836, and the last in November, 1838, comprise a recognizance of the public lands belonging to Maine and Massachusetts, authorized by the legislature of the latter State, and also a survey of the entire State of Maine, by its legislature. The appropriation by the two States was liberal, securing the labors of two assistant geologists and a draftsman, and leaving the period for the completion of the work undetermined. It reflects great honor upon the chief magistrates of those States,* by whom the surveys were warmly recommended, that their influence has been thus opportunely exerted, as these able reports sufficiently show, in a way calculated to advance the best and most immediate interests of their constituents. The first report is accompanied by an atlas of picturesque views, and colored representations of interesting localities and sections presented along the coast, as well as of the more remarkable inland prominences. We offer an extract from this report, showing the plan marked out by Dr. Jackson, as best calculated to give him the geological limits and superposition of the different rock formations of the State. In determining these, the sea coast afforded him remarkable facilities, by its bold and deep indentations, exposing its whole structure to view, with all its mineral contents. He observes:

"The State of Maine is one of the most interesting sections of our country, and presents a great diversity of geological facts, which are important in the advancement of the arts and sciences. No other State in the Union has such an extensive and varied rocky coast, indented by thousands of arms of the sea, and estuaries of great rivers."

"Knowing from former observations, that the general direction of strata in Maine is N. E. and S. W. I found that the coast section would give me the extent of most of the strata in a longitudinal direction, while the indentations, bays and mouths of rivers gave those of a transverse order. I was anxious to divide the State as far as practicable, into squares, so as to intersect every rock on which it is based, and explore the different beds and veins of metallic ores as they presented themselves to view. This plan has been followed and advantage was taken of the river courses to obtain the most perfect views of the strata."

* Governors Lincoln and Everett of Massachusetts, and Kent and Fairfield of Maine. Under the former gentleman, a suitable appropriation had previously been made for the survey of his own state; a work which, as our readers well know, has been most ably conducted by Prof. Hitchcock.

"The seaboard from Lubec to Thomaston was carefully examined, so as to determine the nature and position of the different rocks. Then the St. Croix was explored, and the line followed onward to Houlton. From that place we proceeded to the St. John River, and pursuing its western bank, we obtained a section of the strata, which cross the public lands, and crop out along the course of that river. At the Grand Falls we took canoes and examined the rocks and soils to the Madawaska River. By following this plan, it will be seen on inspecting the map, that we have made a reconnoissance of two sides of a very large square, forming the eastern, and northern boundaries of the State."

Dr. Jackson makes a division of his subject into topographical, argicultural and economical geology; the latter treating of those substances which are of pecuniary value. The rocks enumerated under the first head, are mostly members of the primary class, forming the principal mountain elevations of the state, and affording many valuable quarries of granite, and mica slate, besides beds of white granular marble, and repositories of metallic ores, which have already been made available to a considerable extent. To these he has added feldspar, suitable for porcelain ware, granular quartz for the manufacture of flint glass, foliated argillite or roofing slate, soapstone, serpentine, verd-antique and pyritiferous slate, the latter employed in the making of copperas and alum. The rocks of this class, as well as those of later epochs, are frequently pierced through by powerful dykes and veins of trap rock, which have left abundant proof, both chemical and mechanical, of their firey origin, often changing the rock into complete scoriæ, and forming, by their sudden intrusions and interfusions, singular metamorphic combinations out of the previously existing strata. The phenomena presented by the beds of magnetic iron at Mount Desert and other places, and also of the limestone at numerous quarries mentioned in the reports, are of the most interesting character with regard to this point. We doubt whether there are any where to be found recorded, facts more strongly attesting the igneous theory than are presented in the reports, and as the author had become conversant with analogous appearances while visiting many of the most noted localities in Europe, his inferences will be received with great confidence by the public. By a careful examination of the trap dykes, he has shown that they were ejected by at least four distinct paroxysms of elevation, the last dyke cutting through and intermingling with the others, in such a manner as to leave no doubt of its comparative newness.* Many striking facts of this kind are presented, and the subject is well illustated by diagrams. Masses of granite and slate are often included in the dykes, forming an interfused kind of breccia, while the slate is not unfrequently converted into jasper, hornstone and chert, besides being abundantly charged with pyrites; the trap itself assuming a spongy or vesicular appearance, showing evident marks of fusion. After mentioning several localities in reference to this point, Dr. Jackson says, "it will be observed, that the slate rocks where they are in immediate contact with the trap dykes, are hardened into a kind of green flinty slate, while more remote from them, the slate is less hard, and is converted into novaculite or hone stone, valuable for fine hones or oil stones, and presenting various stripes of blue, brown and green colors which run in the direction of the strata." Those who are accustomed to geological observations will readily understand with what satisfaction the following facts were recorded.

"Our excursion to Bald Head was exceedingly instructive, since we there discovered the relative ages of most of the trap-dykes, the directions of which we had before been accurately recording, knowing that if we put down exactly what we found in nature, some useful instruction would certainly result. Here, then, to our surprise and gratification, we met with absolute proof of their different ages, a result which I had only hoped to have obtained after a long research. This locality solved at once, by absolute demonstration, this important problem; for here we saw the various dykes cutting across each other, in such a manner, as to prove their several different eruptions; and we may confidently affirm, that four or five distinct eruptions of molten trap rocks have burst through the strata of Maine."

The chemical changes effected upon the limestone at some of the quarries where the dykes are now left standing like immense walls, are thus mentioned. "The limestone at its junction with the trap is closely cemented to it, and is converted into a perfectly white crystalline variety, which loses this character in proportion to its distance from the dyke. The effect was the same in the

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* One of these dykes is 500 feet wide, and extends completely through a mountain of graywacke and clay slate 1900 feet high, rising higher above the sea than he had ever seen that rock (trap) attain.

beds of blue magnesian limestone, the compact rock, being always transformed into granular and semi-crystallized dolomite; the extent of the change being exactly proportionate to the size of the dykes." "It is interesting to observe," says Dr. Jackson, "that the most valuable quarries of limestone opened, are those distinguished by the dykes; and even the lime burners, who are certainly not aware what opinions are entertained by geologists, and cannot be accused of theoretical bias, attribute a good influence to the presence of this rock." The opinion of Von Buch, that dolomite, or magnesian limestone, owes its magnesia in some way to the igneous influence of the trap dykes which are now found intersecting it, is not confirmed by any facts at the localities here referred to, nor indeed by any, so far as we know, which have been brought to light in this country; and Dr. Jackson hesitates not to say, "that after carefully examining the places referred to in Europe by Von Buch, he is convinced, that the igneous rocks acted there also, only by fusing a limestone which contained magnesia in the original state."

Rich veins of magnetic iron ore, apparently contemporaneous with the dykes of trap, were discovered in the granite and mica slate of Mount Desert and Marshall's Island. They are the most compact variety, (the *oxide ferroso ferricum* of Berzelius,) and possess polarity to a most astonishing degree; for Dr. Jackson observes, that a "compass needle will not traverse within thirty or forty yards of a vein; and when a crowbar, or drill of steel, is struck upon its surface, it instantly becomes a strong magnet, and when suspended by a cord, will oscillate, and swing to the north like a compass needle."

The connection which exists between these dykes and the various metallic ores mentioned in the reports, is not a little remarkable, and throws much light on the origin of both. It is thus spoken of in the first report.

"It will be remarked by those who examine the facts stated in this Report, that all the metallic ores which have been described, are found in those places where trap dykes have been thrown up; and no one can doubt that their origin was in some way connected. This fact is not only interesting in a theoretical point of view, but also offers a valuable guide to those who are seeking to discover metalliferous veins. It is also an indication that the various ores mentioned, were injected or sublimed from below, and that the veins may probably widen, and improve as they descend. This appears to be the case with the Lubec Lead Mines, so far as they have been examined."

"In Nova Scotia likewise, the most valuable beds of iron ore are found in the immediate vicinity of similar rocks, while at Cape D'Or, in the same province, we find an abundance of rounded (evidently once molten) masses of copper, in the mixture of trap rocks with the new red sand stone."

The hypothesis of segregation, which has recently been offered in explanation of the origin of metallic veins in rocks, finds no support from discoveries thus far made known in Maine; and we must think that, should it continue to be received at all, its application must be limited to veins contained in those rocks, through which there are also abundantly disseminated concretionary masses of the same substance, at a distance from the veins. The theory of igneous injection, certainly offers a more unexceptionable explanation of all those veins of a contrary character, or whose substance is entirely foreign to the nature of the rock in which they are contained; and to oppose it on the ground that the "extinct volcanoes of France afford no other metallic mineral than 'a little oligiste iron,'" (implying that if veins were formed by igneous injection, these volcanic rocks would present them to a great extent,) seems to us hardly sufficient; for we are not to infer that the metals were always in a situation to be thrown up, and therefore the rocks of some epochs, whose volcanic origin is undoubted, may be comparatively, or even positively, nonmetalliferous, while others of the same character may abound in metals; at least, the objection referred to, is removed by the well known fact, that various metals, such as tellurium, gold, copper, iron, and antimony, are the frequent products of volcanoes not yet wholly extinct. However, we are rather inclined to agree with Mr. Bakewell, that these phenomena, whether caused by electro-chemical agency, by sublimation, or by igneous injection, are involved in much obscurity, and that the state of chemical science, with the facts at present known, do not throw any certain light upon it.

The other metallic minerals enumerated, beside iron, are lead, zinc, molybdena, titanium, manganese, copper, bismuth, and tungsten. The latter mineral, occurring in the usual form of wolfram, which accompanies all the tin mines of Europe, has led Dr. Jackson to anticipate the discovery of tin in Maine; a discovery which has as yet been made only in one place in the United States,* and is there confined to a few single crystals. The discovery of gold was announced some time since, and specimens were sent to Prof. Cleaveland for examination, said to have been found at Albion. It proved to be an alloy of gold and silver; but it is the opinion of Dr. Jackson, confirmed by persons residing near the locality, that the specimens were of foreign origin, and that some deception had been practised.

Towards the eastern part of the State, the transition and secondary rocks are predominant, forming a large extent of the sea-coast, and extending northerly to the boundary line of Canada, and into the disputed territory, being rarely broken in their continuity by the old rocks, excepting one or two isolated mountains. Among these are limestone, containing marine fossil shells, sandstone, calciferous slate, graywacke, breccias, and all the varieties of trap rock. This section of country is represented as being more valuable in an agricultural point of view than any other in the State, and also as possessing local advantages over any other in reference to its commercial and manufacturing interests. It was here that the discovery of coal became a subject of great importance. Dr. Jackson states, that "all the characteristics of the regular anthracite coal formation exhibit themselves over a great belt of country, from the Suboois to the Aroostook and St. John's, and extend to the Temiscuata Lake, near the frontiers of Canada." The new red sandstone on the St. Croix River, was found to be connected with that of New Brunswick, which contains the coal measures of Grand Lake, and is identical with that in which the gypsum and bituminous coal of Nova Scotia are found; but no beds of either varieties of coal or of gypsum† were discovered, and Dr. Jackson thinks it probable that some of the members of the bituminous coal series are wanting, while the anthracite region, owing to the thick alluvial deposits that overlay the strata, and the unbroken forests, has not received the careful examination which he would have been glad to have given it. He does not propose boring, as the readiest means of discovery, the dip of the rocks being generally

* Goshen, Massachusetts, discovered by Professor Hitchcock.

† In New Brunswick, just beyond the eastern line of the disputed lands, extensive deposits of red and white gypsum were visited by Dr. Jackson. He observes, that as it is subject to no duty, it is almost as valuable to Maine as if it occurred within the State.

so very bold that their outcropping edges, on the removing of the soil, would expose the coal beds without it. The report speaks of the many wild speculations that had been entered into in searching for coal, where it was geologically impossible that any could exist. We ourselves happen to know of one instance, in which some persons in Maine, believing that they had discovered indications of a coal mine on the Kennebec River, actually sent a quantity of black tourmaline to Boston, which was exhibited by one of the principal coal dealers there as anthracite coal, and in a few days all the necessary implements for boring into a solid ledge of *granite* were prepared and sent to the spot. The exploration was not abandoned until the sum of two thousand dollars had been expended; and we believe the history of mining in this country, does not afford an instance of more blind and determined disregard of the principles of science, than this. Not many months afterwards, a person, probably on his own responsibility, visited Boston to obtain subscribers to stock in a new mining company, and brought with him specimens of gneiss and mica slate, in which he declared he had found a bed of bituminous coal near the mouth of the Kennebec River. One or two persons, known to the writer, became subscribers to the stock; and it was not until after one of them took occasion to visit the spot, that the gross fraud was detected. Pieces of coal were found there, but they came from Newcastle.

The most valuable and extensive iron mine discovered in Maine, is on the Aroostook River. It is a compact red Hematite. Its situation, in the midst of water power, and an abundance of wood for charcoal, and its being also on the frontier of the State, and near the United States Military Post, renders it, in the opinion of Dr. Jackson, a favorable site for the erection of a national foundry.

"The bed is included in red and green argillaceous slate rocks, and runs in a N. W. and S. E. direction to an unknown extent. It is thirty-six feet wide, and was traced by us to the length of 1000 feet, while there is not a doubt that it runs across the country to an immense extent, and probably belonging to the same range as the great bed of iron ore that I discovered last year in Woodstock. Its direction would cause its line to strike in the township belonging to Williams College and Groton Academy, situate near Houlton, and it will probably be found to cut through this town. It is of great extent and evidently inexhaustible. Situated upon a great and navigable river, where a large flat boat may run to the St. John, there being but one obstruction at the falls, near its mouth, where there is a carrying place for half a mile, it is evident that this iron may be advantageously wrought, not only for the supply of our territory, but also for the inhabitants upon the St. John, for at Woodstock no less than $120 is paid for a ton of bar iron, and we can afford to supply them for a less price, with better iron than England can produce. This ore yields fifty-three per cent. of pure metal, and will give sixty per cent. of pig iron. It is the very best kind of ore to smelt, being easily mined, and just heavy enough to make a good charge for the blast furnace. Wrought by means of charcoal, it will yield iron equal in quality to the best from Sweden, and capable of being wrought into the finest kind of cast steel."

The following is Dr. Jackson's analysis of this ore.

" Water, ...	6.00
Insoluble residue, consisting of silex, .	8.80
Per oxide of iron, ...	76.80
Ox. manganese, ...	8.20
	99.80
Loss, ...	20
	100.00"

Much statistical information in relation to the limestone, granite, and other quarries, and the agricultural capabilities of some parts of the State, as yet but little known, are set forth in the economical and agricultural departments of the survey : the principles on which are founded the application of science to farming, are also stated with great clearness, and several analyses of soils from different parts of the State given ; but we have room, under this head, for one extract only, which points out, we think, the best plan yet offered for rendering agricultural and analytical chemistry a thing practically attainable by our farmers.

" Attempts have been made to render the art of chemical analysis easy, so that farmers might be able to do them for themselves, but such attempts have been entirely abortive, for it would presuppose a knowledge of chemical science and manipulation rarely if ever in possession of any but professed chemists, and it would be idle to put instruments and reagents into the hands of those who do not know how to use them. It would certainly be very useful to the community, if our agricultural brethren would establish a college or institute, devoted exclusively to those arts appertaining to agriculture, and such institutions will ere long be founded in each of the States, for we begin to see and feel the importance of a good scientific education among the farmers throughout our country, and our young men ought to possess advantages so desirable and important for their welfare and prosperity. It is evident that small schools will do no good, since they would not be sufficiently well endowed to command the services of scientific teachers, and hence if the attempt is made, let there be one large and well endowed agricultural college in each State, connected, if found practicable, with the usual classical institutions, and forming a branch of each university. Many who do not desire to spend years in the study of Latin and Greek authors, are still anxious to learn the elements of those sciences which appertain to their professions, and I have not the least doubt, that a well ordered and scientific agricultural institute would prove one of the most popular and useful schools in the country. In such a college, mathematics, drawing, surveying, mechanics, architecture, chemistry, mineralogy, geology, zoology and the practical arts, each in their several departments, might be taught by study and lecture, while every practical operation should be learned by actual practice."

The subject of diluvial phenomena is frequently alluded to in the pages of these reports, and the facts stated are of the most positive and convincing nature, tending to confirm the opinion long entertained, and of which the evidences in other parts of our country are numerous, that a mighty and devastating current of water has swept over the surface of this continent from the north-west, carrying with it large masses of rock, scooping out vallies, and leaving parallel furrows upon the sides of mountains.* For a statement of these facts, of which we have space to give only a part, we would refer our readers to Dr. Jackson's second report, page 148. He observes,

"In various sections of this report may be seen recorded the proofs of diluvial transportation of rocks, far from their parent beds, and we have every reason to believe, that this removal was effected by a tremendous current of water, that swept over the State from the north 15° west, to the south 15° east, and we have adduced in testimony, that such was the direction of that current, numerous grooves, furrows or scratches upon the surface of the solid rocks, in place, and have shown conclusively, that the rocks which we find thus transported, proved to be portions of ledges

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* The opinion that boulders generally have been transported by ordinary or tidal currents whilst attached to masses of ice, and not by one general catastrophe, seems now no longer tenable; De la Beche, more satisfactorily, we think, than any other writer, has solved the problem of their occurrence, and established the truth of Prof. Buckland's hypothesis. See his Geological Manual; also Hitchcock's Report on the Geology of Massachusetts, and the Reports on the Geological survey of New York.

situated to the North of the localities where their scattered fragments are found.

"It is a matter of surprise, that such enormous masses of rock should have been moved so far by an aqueous current; but when it is remembered, that a rock weighs but half so much when immersed in water, as it does when weighed in air, owing to the support given it by the water around; and when we reflect on the fact, that a rock is still more powerfully supported under the pressure of deep water, it may be conceived, that if a flood of water did once rush over the land, it might have removed large and weighty masses of rock, such as we find to have been the case.

"From the observations made upon Mount Ktaadn, it is proved, that the current did rush over the summit of that lofty mountain, and consequently the diluvial waters rose to the height of more than 5,000 feet. Hence we are enabled to prove, that the ancient ocean, which rushed over the surface of the State, was at least a mile in depth, and its transporting power must have been greatly increased by its enormous pressure.

"It will be readily conceived, that if solid rocks were moved from their native beds, and carried forward several miles, that the finer particles of soil should have been transported to a still greater distance, so we find that the whole mass of loose materials on the surface has been removed southwardly, and the soil resting upon the surface of rocks, in place, is rarely if ever, such as results from the decomposition of those rocks, but was evidently derived from those ledges which occur to the northward.

"If an attentive observer examines the soil in the city of Portland, he will discover, at once, that it is made up from the detritus of granite and gneiss rocks, while the ledges in that city are wholly composed of the argillaceous, talcose, and mica slate rocks, and granite and gneiss occur in great abundance to the northward.

"All the markings on the surface of the rocks, and the scattered boulders of granite and gneiss, which abound in that soil, indicate its origin to have been in the north 15 or 20° west. I merely quote the above locality, on account of its being a spot where most persons will have occasion to examine the facts stated. The various sections of the State present ample illustration of the same fact, and every one who will take the trouble, may convince himself of its reality."

We can only add his remarks in relation to the grooves:

"Diluvial grooves in the rocks are exceedingly common in Maine, but I know of few localities where they are so distinct as at Hope and Appleton. Here they may be observed running in a N. W. and S. E. direction, while they are very deep and perfectly defined. Their direction, it will be remembered, does not coincide with that of the stratification of the rock, and could not have resulted from disintegration of the different strata. Three quarters of a mile S. E. from a hill in Appleton, they may be seen forming deep channels in the rocks, to the depth of a foot, and six inches in width. Since the direction and appearance of these grooves, correspond with those observed in other parts of our country, I feel no hesitation in attributing them to a similar origin. They are certainly the result of an aqueous current, which once prevailed over New England, and probably over the whole world. The current from similar grooves seen in other places, appears to have proceeded from N. to S., or from N. W. to S. E."

Dr. Jackson has stated an important fact, proving that the rocks along the coast, particularly at Lubec Bay, have changed their level within the recent zoölogical period, having discovered attached to the sides of the trap, at the distance of twenty-five feet above high water level, numerous remains of shell fish, precisely like those now living on the neighboring coast. He says,

"It is evident from the position in which these shells are found, and the attachment of barnacles to the rocks in place, that the sea once stood over the very spot, where these marine relics are deposited. Has the level of the sea become depressed, or have the rocks been elevated? To answer these questions I would observe, that it would be difficult, if not impossible, to account for a subsidence of the waters here, without a general change of level in the ocean; and this is not proved to have taken place. We cannot suppose a partial subsidence of the waters; for the bay communicates freely with the ocean, and the level would be invariably maintained. The concurrent testimony of all geological observers is in favor of a change of level in the land, by elevation; and such a change appears to have taken place here, within the recent zoölogical period."

The proof of such local elevations of rocks have been greatly multiplied by the observations of geologists, during the last few years; and though it appears in some few places, that the sea has subsided from its former level, and in others has risen; the general inference from all facts bearing upon this point, is, that the land only has been raised or depressed, and that the cause of these changes, whether local or general, in the relative level of the land and sea, must be sought for in the agency of earthquakes and volcanoes. These have happened not only within the present zoölogical period, but within the last century, and even so late as 1822, the land on the coast of Chili, for the distance of more than one hundred miles, was suddenly raised three or four feet, the paroxysm extending to the mountains of the interior, and producing dislocations and chasms in the solid substratum of granite.* As a still later example, might be mentioned, the volcanic island which suddenly appeared in the Mediterranean, and almost as suddenly disappeared.

The topographical features of the State of Maine, are more striking than has generally been supposed. Dr. Jackson has determined the height of some of the most elevated points of land, by barometrical observations, confirmed by triangulations by the aid of Sir Howard Douglas's reflecting semi-circle, and a pocket sextant. Mount Ktaadn is the highest, "being 5,300 feet above the level of the sea, or a little more than one mile perpendicular elevation, and forming the most abrupt granite mountains in New England." The accounts which are given of the ascent of some of these most remarkable eminences, as well as of the picturesque features of the country generally, are written in that graphic, enthusiastic style which it might be expected the subject would naturally inspire; and some of the incidents related, show that perils were encountered of no common magnitude. Much novelty was added to the expedition, by the necessity of engaging Indian guides into some parts of the State, unoccupied by, and almost unknown to the whites. The last report is in the form of a daily journal or record, which though it does not admit of the same generalization, has the advantage over every other, in insuring greater accuracy and minuteness of local detail; a desideratum in the case of lands not yet disposed of, and of which the rightful possession by Maine has been denied by a neighboring Province.

In thus giving the readers of this Journal but an imperfect sketch of these able and interesting reports, we hope we have prepared them for a rich treat in the entire perusal of them, and led them to look anxiously forward to the completion of the survey, and the publication of the remaining reports, and the final one, which will be accompanied by a geological map, colored sectional views, &c. &c. The State of Maine, we trust, having secured the services of one so thoroughly qualified by study and observation, will not permit a work so creditable to their liberal-

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* Mrs. Maria Graham, as quoted in the Geological Manual, by De La Beche, p. 131.

ity, and condusive to their best interests, to terminate short of accomplishing all that was originally intended.

We had intended to have said, something of the mineralogy of the survey, and also of the fossil remains, but as these are to be made the subject of more special consideration by Dr. Jackson, hereafter, we shall omit, or at least defer, any notice of them at this time.

Art. XXII.—*Obituary notice of the Hon.* Stephen Van Rensselaer.

During the twenty-one years of our editorial course, we have often been called, as our volumes evince, to lament the removal of distinguished coadjutors, patrons and friends—friends of our labors, friends of science and of mankind.

In all these relations, we knew the excellent man whose name stands at the head of this notice.

He did not indeed, lay claim to great attainments in science, but he evinced the highest opinion of its value; he cheered its laborers onward, by his kind encouraging voice; he sanctioned their efforts by his influence, and sustained them, by bounties, free and frequent, as the rains of heaven.

In this number of our work, a living witness, the pioneer* of American geological surveys, records the early largesses of Gen. Van Rensselaer, for the examination of the opulent and interesting region on the Erie Canal; to that paper, we refer our readers, and to the results of the survey, as given by Mr. Eaton in our fourteenth volume. It is in the character of a most munificent and untiring patron of useful knowledge, that we commemorate the name of our departed friend; but as he was not less distinguished for his moral excellence, in every department of a long, active and useful life, we hesitate not to cite his virtues as well as his

* Professor Amos Eaton, was employed by Gen. Van Rensselaer, at his own exclusive expense, to make a detailed examination of a very important and extensive region, that on the Erie Canal, in the State of New York. Mr. Maclure, had drawn his great geological sketch of the North American continent, a few years before, but Professor Eaton's was the first instance of an elaborate examination of a region several hundred miles in length.

bounties; moral excellence is the golden framework of the pictures of science.

The late Gen. Stephen Van Rensselaer* was born in the city of New York, in November, 1764. He was the lineal descendant of one of the oldest families, which at the first settlement of the country, obtained from the Dutch Government, the grant of the manor of Rensselaerwyck, which after the country passed under the dominion of the English, was confirmed by James II., in 1685, and again in 1704, by Queen Anne.

His father died when he. was a boy. His mother afterwards married Rev. Dr. Westerlo. She was remarkable for her piety and charity, and her influence as well as that of her husband, was seen in the character of her son.

"The memory of that mother he cherished to the last, with a strong and affectionate attachment. To her lessons of piety, most carefully inscribed upon his youthful mind, he often adverted with feeling interest, as a great and permanent blessing. He had early been taught by her to employ a "Manual of Devotion," with which he commonly engaged in that solemn duty; and a worn-out copy, used to his dying day, remains a memorial, as much of his filial affection as of his habits of devotion. Her mourning ring, which he always wore, he desired should be buried with him†.

"He received the rudiments of his education first at a day school in this city, and then at Elizabethtown, N. J. He was afterwards at the Kingston Academy, where commenced his acquaintance with the lamented Abraham Van Vechten; which ripened into a warm, confiding intimacy, and survived in all its strength until the recent death of his friend. From the Academy, he was placed by his mother, ever anxious for his religious welfare, under the charge of Rev. Dr. Witherspoon, whom he accompanied on horseback from this place to Princeton; part of the distance with an escort provided by General Washington, by whom they had been hospitably entertained at West Point. After a year or two of preparatory study, he entered Nassau Hall: but subsequently removed to Cambridge, where he graduated in 1782. Although too young to take an active part in our revolutionary struggle, he was early imbued with the sentiments and feelings which animated the men of that period, and retained them through his life. He uniformly adhered to the political creed of the

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* Dr. Vermilye's funeral discourse.

† "She was a daughter of Philip Livingston, one of the signers of the Declaration of Independence, and sister to the wife of Dr. Livingston, late of New Brunswick. She died, April 17, 1810, aged 64, leaving three sons and two daughters."

"Father of his Country." His public career commenced in 1789, when he was chosen to the Assembly of this State. He was next in the Senate: and in 1795, at the age of thirty-one, became its presiding officer, in the capacity of Lieutenant Governor; which station he held for six years. From 1800 to 1820, he was frequently in the Assembly; was a member of two different state conventions, called to explain and revise the Constitution; and for several years occupied a seat in the Congress of the United States. He was among the earliest and most ardent friends of internal improvements throughout the State. In 1810 he was appointed one of the State Commissioners, and for the last fourteen years of his life was President of the Canal Board. He was at the same time the Chancellor of the University of New York, President of the Albany Institute, &c.

"His military course began in 1787; but he was never employed in active service, except during the last war with Great Britain, when he commanded on the Niagara frontier, with reputation and honor.

"He was twice married, and leaves his widow and a numerous family to deplore his loss."*

He was united to the first Dutch Church in Albany, in his twenty-third year, and continued a zealous member until his death.

In Gen. Van Rensselaer, we have a remarkable case of a man of great weight of character, continually acting a conspicuous part, where conflicting interests were often at his disposal, but who never had an enemy; and whose name the tongue of slander never assailed. Still he was always decided in his politics, from the revolution to his death. Washington, Hamilton, Jay, C. C. Pinkney, &c., were among his personal friends; and although he outlived them, he never could outlive their principles. His munificent deeds of benevolence are found on the printed pages of almost every leading religious and scientific journal in our country. Every important public improvement, exhibits evidences of his generous zeal. But the strongest marks of his own peculiar characteristic views, are found among his efforts to benefit the common laboring classes. Through *his* munificence, those

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* "His first wife was the daughter of Gen. Philip Schuyler of revolutionary memory. Of this marriage, one son (the present Gen. Stephen Van Rensselaer) remains. His second wife is the daughter of the Hon. Wm. Patterson, late Governor of New Jersey, and at the time of his decease, one of the Judges of the Supreme Court of the United States. Her nine children (six sons and three daughters) survive their father."

useful sciences, which had been locked up among the learned few, are now the property of the farmer, and the mechanic, and of the heads and members of families in domestic life. Facts and principles drawn from chemistry, geology, botany, &c., are now familiar to persons of every class, and fill up the laborer's hours of leisure, as an exhilirating mental repast.

It appears from Gen. Van Rensselaer's letter to the Rev. Dr. Blatchford, dated Nov. 5, 1824, that he established the school, afterwards called the Rensselaer Institute, in the city of Troy—"for the purpose of instructing persons who may choose to employ themselves in the *application of science to the common purposes of life.* He states his principal objects to be to qualify teachers, for instructing the sons and daughters of farmers and mechanics, by lectures or otherwise, in the application of experimental chemistry, philosophy, and natural history, to agriculture, domestic economy, the arts, and manufactures. He remarks, that every school district may have the benefit of such a course of instruction, about once in two or three years, as soon as we can furnish a sufficient number of teachers. I prefer this plan, he observes, to the endowment of a single public institution, for the resort of those only, whose parents are able and willing to send their sons from home, or to enter them for several years upon the Fellenberg plan. It seems to comport better with the habits of our citizens, and the genius of our government, to place the advantages of useful improvement, equally within the reach of all. Whether my expectations will ever be realized or not, I am willing to hazard the necessary expense of making the trial. You will excuse me if I attach too much importance to the undertaking."

This school was incorporated by the Legislature of New York, March 21, 1826, and has been in active and useful operation ever since, under the zealous and efficient direction, and instruction of Prof. Amos Eaton, who was appointed senior professor, and Dr. Lewis C. Beck, was named junior professor. It was a peculiar feature of this school, that the pupils were required by the founder, to exhibit their proficiency, not in the ordinary method of examination, but by themselves giving lectures and performing experiments.

Able instructors have been trained here, and among them are several gentlemen now attached to the geological surveys of several States.

For a notice of the great geological survey on the Erie Canal, we have already referred our readers to Mr. Eaton's own paper in the present number of the Journal, and we are pleased to observe, that his authority is respected by the present State geologists. It is indicative of the public spirit of Gen. Van Rensselaer, that when an anonymous writer in the North American Review, questioned the accuracy of the survey, he stated that he was willing, if the work had not been done correctly, to take a re-survey of the geology of our State as before, at his own expense.* The State Legislature might well have authorized him to fill up the chasms in his surveys, which farther discoveries among organized remains required. It is stated to us, that all the State surveyors have found Mr. Eaton's geological map of 1830 and 1832, to be correct and full, so far as respects order of superposition of strata. Geological nomenclature was not then settled, (and is not yet,) but it is averred, that there has not yet been any mistake discovered in regard to the order of superposition.

The following statements will illustrate the character of Gen. Van Rensselaer, and will evince that economy is not parsimony, and is at least in his case, found united with great liberality.

He was projecting a journey with several of his children to Lake Ontario, first by land to Lewiston, and then by water to Ogdensburgh. From motives of economy as well as of convenience, he declined using his own equipage, and employed a livery man to transport his party to Lewiston, and then to meet them again at Ogdensburgh with his carriage.

Obviously it was not the love of money which caused him to consider a moderate sum ($16 in four weeks) as worth saving; but it was his habit to practice economy and to make prudent and wise arrangements in order that he might set a good example to his children and dependants; that he might benefit those whom he employed, and perhaps more than all, that he might have the means of more enlarged liberality. It was a remarkable coincidence, that, at the very moment while he was negociating the arrangements with the livery man, two young gentlemen called on him with good letters of introduction, being recommended as men of piety designed for the christian ministry, and needing pecuniary aid. He instantly filled a check for each of them for the

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* See Journal Vol. XX, pp. 419, 420.

sum of $100—$200 for both—and then finished the arrangements for his journey. In this little history we see him combining economy and presenting the example of it to his children, with employment for a worthy man in his honest calling, and crowning the whole with an act of prompt and liberal benevolence. This, remarks Mr. Eaton, was a fair trait of his character and a true specimen of the economy which he always urged upon thousands of tenants: he adds, "who ever heard of this fact, but those to whom I may have told it? He never told any one of his charities. I scarcely dare relate those benevolent acts of this extraordinary man where I was the only witness. Long will the widow speak of his charities, the orphan lisp his bounties, and the poor tenant melt in tears to bless him."

"Having been in his service," continues Mr. Eaton, "as a confidential servant of science, for eighteen years, I have witnessed acts in the line of scientific patronage which no one else has known. He authorized me (and paid me richly) to educate one student in practical science, from every county in our state, gratuitously, at his expense. Some, not understanding his limit came from other states. A Professor of Transylvania University, a man of talents, is a case in point. I assume to say, that our calls were prudent; but we, his agents, never made a call for funds without receiving his check by the first mail."

He aided in sustaining various periodical as well as standard works. In this Journal there exists monuments of his munificence, especially in the expensive plates on the geology of New York in the fourteenth volume, which were furnished gratis by him. He not only observed a sound economy, but also great moderation in the use of the bounties of providence. He gave "without stint," and he gave in a manner so kind and winning, so free from ostentation, as greatly to enhance the value of the gift. Born to princely affluence, he sustained the dignity of his station by a noble hospitality; but his own wants were few and simple, and he was moderate and self denying in personal indulgence, while his boundless liberality "may be read throughout the land in many churches of different denominations, in institutions of learning of various kinds, in works of public utility, and on the lists of our benevolent and religious societies, which he has aided, and for which he was foremost to suggest the plans and to devise the means."

Nor did his benevolence stop here, but diffused itself abroad, descending by a thousand silent streams to the firesides of the poor and destitute. Within two days of his decease, and while confined to his sick chamber, he sent for his agent and said to him, "It is very cold! how the poor must suffer! Go round and see if there are any that want and give them what they need."

"The blessing of him that was ready to perish came upon him"—he was constantly devising liberal things, and felt that he was merely a steward of God's bounty. He was great in goodness, and his goodness was the fruit of his piety.

The Rev. T. E. Vermilye remarks in the discourse already cited, that in Gen. Van Renssalaer there was a rare and delightful combination of substantial qualities—a sound judgment and strong good sense to perceive the right, with courage and decision to maintain it; his quiet firmness was without obstinacy, but he adhered to opinions which he deemed correct, and no one ever questioned the purity and elevation of his motives.

His real humility was in strict keeping with the simplicity of his manners; they were elegant and refined, and stamped with the dignity of the olden time, but without any assumption, or the slightest indication of a sense of superiority. There were in him no arts to attract admiration.

"It was certainly remarkable, that possessing boundless wealth, standing in the highest rank of society, having enjoyed dignities and station, and commanding universal respect and admiration, his mind should have remained so completely untainted, his manners so untouched by any of these things. He was unassuming and simple as a child.

His affections were warm and kind in an uncommon degree: they shed a delightful influence over his domestic scenes, and made him the centre of a wide circle of friendship and affection, embracing all classes of society.

The bible was his favorite volume—perused often and attentively every day; and in private devotion he sought the intelligence and direction which he needed. He was assiduous in the moral and religious instruction of his children and household, and observed with exactness his public as well as private religious duties. His death was in exact correspondence with his life. His mental faculties remained unimpaired to the last. He died at four P. M., on Saturday, Jan. 26, 1839, being in his 75th year. "He was sitting with his family without any indication of immediate danger. Having been seized with coughing he rose to obtain some relief; and the difficulty seeming to increase, he said to his son who was with him, "can this be dying." "He regained his chair, and while his family collected round and were hanging over him, his spirit was released so quietly that the moment was unperceived by them."*

It would be a delightful employment to follow this truly wise and good man through the various walks of his long and active life; but it would be out of place in this Journal, and is the appropriate duty of the biographer.

It is not however beyond our province to exhibit Gen. Van Rensselaer as the munificent patron of science, in support of which he poured forth his thousands with the copiousness of his own noble river.†

It is impossible however to do him justice in this particular, without taking into view his general benevolence, which reached every human interest and evinced that enlargement of mind, which enabled him to perceive and justly to appreciate all that appertains to the happiness and prosperity of mankind. In this view of him, especially, he appears truly great; and his well balanced, enlightened, and principled philanthropy, places him in the same group of great and good men, with Washington, Jay, Howard, and Wilberforce. We cannot take leave of our admired and venerated friend, without holding him up as a model to two classes of persons who are numerous in our country.

To the opulent we may say—what is the use of boundless accumulation! Why not, while in full life, enjoy the luxury of doing good, and of seeing it done; why not make your money work for you to produce you an immediate return of gratitude, and a certain, an inappreciable reward, in the consciousness of spreading blessings all around you. The grave makes you poor indeed if you have no reversion of grateful remembrance, or anticipations of good deposited in heaven—and who will thank you for dying rich! Thousands might thank you for sowing blessings with a liberal hand while you live!

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* Rev. Dr. Vermilye's Funeral Discourse.

† The Hudson, which runs through his vast estates, and near whose bank stands the venerable family mansion, the ancient residence of the patroons of Albany, of whom he was the lineal descendant and representative.

To the ambitious youths of our country, who are striving for wealth as if it were the summum bonum, we drop the cautionary remark, that if they have no better views, disappointment will surely crown their efforts; for, without higher and nobler aims, it is not in wealth to afford happiness; while efforts, prompted and directed by a liberal and enlightened benevolence, produce an immediate and sure return—payment, day by day—with a rich reversion to come.

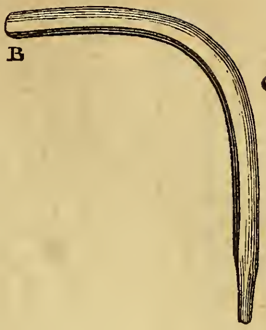
The wealth of this country is sufficient for all purposes of benevolence, literature, science, and arts, and we trust that it will be directed more and more to such objects.

The example of Stephen Van Rensselaer stands as a bright signal light, to direct and cheer the wise and good in their career through this short and transient life—long enough, however, for great results of both evil and good, which end not with our brief personal action here, but like mechanical impulses, are propagated in successive and boundless vibrations.

Art. XXIII.—*Some notice of the Kilee or Boomerang, a weapon used by the natives of Australia;* by Charles Fox.

The first notice which I remember to have seen of the weapon, was in a slight volume of travels in Van Diemen's Land, published about four years since in London, but with which I have not been able to meet again. It is there described as made of heavy wood; and, as being in the hands of a native, a very dangerous and powerful instrument of offense. About three years since, some specimens were imported into Dublin, and there soon became such a demand for them, that they have since been manufactured there. They are used by the students at Oxford and Cambridge, to throw for recreation. The specimen now in my hands was imported from Australia; but is evidently intended for England, and is made of light materials which could do little harm should it chance to strike any one.

It is of some native wood, and has been either cut out of a branch, having the appropriate bend by nature; or it must have been twisted by means of steam, the vein of the wood following the curve to prevent its splitting.



From A, the handle, to B, it measures, including the curve, two feet nine inches. It is two inches in breadth, and about the eighth of an inch in thickness. The upper side is slightly rounded, the lower one is flat. By holding the missile by one end, A, the plane side undermost, and throwing it towards C, as if to hit the ground at thirty yards distance, and giving it, on leaving the hand, a rapid rotary as well as progressive motion, instead of striking the ground, it rises in the air horizontally, sixty or eighty feet, flies round *behind* the projector, and finally falls near his feet; or if thrown with skill, it may be made to form two circles before coming to the ground.* The natives of Australia have attained to such skill in the use of it, that they can hit objects at a great distance, and procure their food by means of it; but to a foreigner, such a degree of accuracy appears to be next to impossible.

The rotary motion may be tried on a small scale by cutting a piece of card the same shape as the annexed wood cut, and throwing it with a jerk of the finger, from the back of a book.

Art. XXIV.—*Meteorological Table and Register.*

The following elaborate meteorological table of Prof. Loomis we have inserted, as an example of the most improved mode of keeping these registers. We regret that we cannot devote the space requisite to continue them *in extenso;* and also to insert the numerous tables that are sent to us by other valued correspondents. Summaries are admissible in a condensed form, and particular registers, when remarkable from the place or phenomena.

We are happy to observe that a new periodical work has appeared, devoted to meteorology. Such a record is much needed, and we decidedly recommend it to the patronage of the public. It is entitled, *Meteorological Register and Scientific Journal; edited by James H. Coffin.* Monthly, 16 pp. 4to, Oswego, N. Y. Price $2 per annum.

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* An explanation of the singular motions of this missile, is given in Lond. and Ed. Phil. Mag., April, 1838, p. 329.—*Eds.*

Meteorological Journal kept at Western Reserve College, Latitude 41° 14′, Longitude 5h. 26m. West; by Professor Loomis.

1838. SEPTEMBER.	Barom.	Att. ther.	Ex-tern. ther.	Hygrom. Wet.	Hygrom. Dn'l.	Wind. Direction.	Wind. Force	Clouds. Character.	Clouds. From	Clouds. Am't.	Rain.	Remarks.
S. 1, 9 A. M.	28.779	65.0	64.4	59.8	60.0	80—134	2	cumulus.	N. W.	10		
3 P. M.	.800	64.6	65.0	55.8	54 3	111—171	4	cumulus.	W.	5		Dreary.
S. 2, 9 A. M.	29.078	60.2	52.5	49.2	44.5	152—200	2	cumulus.	N. N. W.	8		Dreary.
3 P. M.	.081	59.7	59.2	50.3	48.1	104—165	2	cumulus.	N.	2		[of the season; vines, buckwheat, etc. killed.
M. 3, 9 A. M.	.173	56.6	52.5	49.9	43.6	279—344	1			0		Fine—th. 36°.3 at 5½h. A. M. Very heavy frost, first
3 P. M.	.096	56.7	67.8	57.6	45.0	69—120	1			0		Fine. [ing, but less than yesterday.
T. 4, 9 A. M.	.207	58.7	58 2	56.0	46.3	55—90	1			0		Fine—th. 43.0 at 5½h. A. M. Frost again this morn-
3 P. M.	.146	59.0	76.0	63.0	54.3	190—254	1			0		Fine. Atmosphere a little smoky.
W. 5, 9 A. M.	.232	61.6	62.7	59.5	54.3	135—176	1			0		Fine. Atmosphere quite smoky.
3 P. M.	.178	63.5	78.0	62.8	58.9	100—182	1			0		Fine. Quite smoky.
T. 6, 9 A. M.	.239	62.2	65.5	61.8	59.8	16	0			0		Fine. Do.
3 P. M.	.173	66.7	81.4	65.0	64.7	144—235	1			0		Fine. Do.
F. 7, 9 A. M.	.217	63.2	67.3	62.0	62.5	180—214	1			0		Fine. Exceedingly smoky.
3 P. M	.171	69.2	79.5	63.2	63.2	137—173	1			0		Fine. Do. Do.
S. 8, 9 A. M.	.154	63.4	66.4	61.4	58.4	178—207	2			0		Fine. Do. Do.
3 P. M.	.108	69.0	78.8	67.9	66.5	125—170	2			0		Fine. Do. Do.
S. 9, 9 A. M.	.115	65.0	64.3	63.8	62.3	195—233	1	stratus.	N. E.	10		Dense fog came on in the night and lasted till noon.
3 P. M.	.050	67.8	79.2	69.5	65.5	243—270	1	light cum.	N. W.	1		Sultry. Very smoky.
M. 10, 9 A. M.	.017	63.0	66.0	63 6	60.5	46	0	cirrus.	W.	1		Smoky. Fog this morning—mostly gone by 8 A. M.
3 P. M.	28.925	67.5	81.6	66.1	68.2	47—62	1			0		Smoky.
T. 11, 9 A. M.	.919	65.4	67.4	59.5	61.9	218—285	2	cirrus.	W. N. W.	6		
3 P. M.	.883	67.5	72.4	63.0	63.3	155—256	3	cirro-strat.	S. W.	4		
W. 12, 9 A. M.	.833	61.2	62.2	59.3	56.5	206—241	2	cumulus.	N. N. E.	2		Pleasant.
3 P. M.	.823	64 3	65.3	58.6	58.3	177—215	3	cum. strat.	N. W.	10		
T. 13, 9 A. M.	.960	59.4	61.0	55.7	51.5	144—212	2	cumulus.	N.	1		Fine. [evening—quite bright.
3 P. M.	.992	61.7	69.8	60.4	53.3	117—165	1			0		Fine. Auroral bank of light in north most of the
F. 14, 9 A. M.	29.102	58.3	61.5	58.2	57.1	45—96	1			0		Fine. [with some crimson light.
3 P. M.	.070	61.5	75.7	63.4	61.3	270—296	1			0		Fine. Aurora brilliant—sudden flashes and beams
S. 15, 9 A. M.	.184	61.5	65.4	60.4	58.9	195—242	1			0		Fine.
3 P. M.	.124	66.0	75.5	63.2	61 8	159—233	3			0		Fine. Faint aurora to night.

1838. SEPTEMBER.	Barom.	Att. ther.	Extern. ther.	Hygrom. Wet	Hygrom. Dn'l.	Wind. Direction.	Wind. Force	Clouds. Character.	Clouds. From	Clouds. Am't.	Rain.	Remarks.
S. 16, 9 A. M.	29.115	60.5	61.8	57.7	52.6	263—333	1			0		Fine. [merry dancers.
3 P. M.	.009	63.8	76.3	63.1	63 1	268—300	1	cirrus.	N.	1		Fine. Aurora to night from 9—10 with beams and
M. 17, 9 A. M.	28.936	61.4	62 2	57.7	56 2	286—326	1			0		Fine.
3 P. M.	.817	64.0	77.4	64.7	52.4	133—158	1			0		Fine.
T. 18, 9 A. M.	.751	62.2	64.2	59.8	58.5	47—166	1	cirrus.	N. W.	1		Pleasant. Quite smoky.
3 P. M.	.727	75.5	78.7	64.8	58.3	93—133	3			0		Pleasant. Quite smoky.
W. 19, 9 A. M.	.894	65.2	62.2	56.4	52 9	120—174	1	cumulus.	N.	3		Pleasant.
3 P. M.	.888	64.6	65.0	56 8	57.6	98—174	2			0		Fine. [morning.
T. 20, 9 A. M.	.931	56.8	54.2	53.6	52 0	253—326	1			0		Fine—th. 45°.2 at 6h. A. M. Moderate frost this
3 P. M.	.832	60.2	70.7	57.2	51.9	235—320	1	cirrus.	S. W.	1		Fine.
F. 21, 9 A. M.	.789	61.6	66.0	53.0	59.7	289—334	1	cirro-strat.	S. E.	1		Fine.
3 P. M.	.711	67.0	76.8	69.0	65 1	276—11	1	cumulus.	S. S. W.	9		
S. 22, 9 A. M.	.669	69.5	72.3	68.2	64.9	333—111	3	cum. strat.	S. W.	9		Rain from 11 A. M. to 6 P. M.
3 P. M.	.634	70.8	71.7	67.6	66 2	352—81	3	cum. strat.	S. W.	10	.105	
S. 23, 9 A. M.	.925	61.3	46.8	43.4	47 5	62—126	3	stratus.	N. W.	10		Dreary.
3 P. M.	.931	59.4	51.4	46.1	43.6	55—141	4	cumulus.	W.	8		
M. 24, 9 A. M.	29.063	53.7	49.3	47.3	41.4	55—148	2			0		Fine—th. 38°.4 at 6 A. M. Frost this morning.
3 P. M.	.000	54.0	65.0	55.4	48 3	66—115	2			0		Fine.
T. 25, 9 A. M.	.127	54.5	56.3	53.5	47.7	37—42	1			0		Fine—th. 46°.2 at 6h. Slight frost.
3 P. M.	.073	58.5	70.7	58.4	57.3	272—332	1			0		Fine.
W. 26, 9 A. M.	.170	59 0	60.1	56.1	51.7	277—343	2			0		Fine.
3 P. M.	.086	60.5	72.7	63.4	57.7	248—276	2	cumulus.	S. E.	2		Fine.
T. 27, 9 A. M.	.120	59.8	60.3	58.4	56 9	269—328	1	cirro-strat.	S. W.	8		Pleasant. Slight fog this morning.
3 P. M.	.057	61.8	71.8	63 6	59.0	257—344	1	cirro-strat.	S. W.	8		Pleasant.
F. 28, 9 A. M.	.020	62.5	63.3	61.4	60.0	288—325	1	stratus.	S. W.	10		
3 P. M.	28.936	64.3	76.2	67.7	60.9	321—336	1	stratus.	S. E.	10		
S. 29, 9 A. M.	.875	64.6	64.8	62 7	61.5	160—182	1	cirrus.	W. S. W.	2		Pleasant.
3 P. M.	.888	66.2	66.5	61 8	61.0	190—225	1	cirro-strat.	N.	8		
S. 30, 9 A. M.	29.023	56.8	57.6	56.0	53 6	231—302	1	light cum.	E.	2		
3 P. M.	28.969	60.0	68.0	59 1	58.7	250—271	2			0		Fine.
Mean 9 A. M.	29.021	61.1	63.3	57.8	57.0	N. 9° 21′ W.	1.33		N. 50° 38′ W.	2 80	Sum	Mean of barom corrected for capillarity and reduced to 32° F. 9 A. M. 28.942
Mean 3 P. M.	28.973	63.8	74.5	61 6	60.2	N. 14° 34′ W.	1.73		S 81° 43′ W.	2.62	.105	3 P. M. 28.888

Mean variableness of wind, 9 A. M 52°.3; 3 P. M. 56°.1

Mean force in mean direction, 9 A. M. .30; 3 P. M. .66

1838. OCTOBER.	Barom.	Att. ther.	Extern. ther.	Hygrom. Wet	Hygrom. Dn't.	Wind. Direction.	Wind. Force	Clouds. Character.	Clouds. From.	Clouds. Am't.	Rain.	Remarks.
M. 1, 9 A. M.	29.033	58.8	60 .	57.8	51.7	255—284	1	cirro-strat.	S. S. W.	6		
3 P. M	28.959	60.7	71.6	60.8	50 9	255—330	1	cirro-strat.	W.	7		Pleasant.
T. 2, 9 A. M.	.947	60 2	60.5	58.3	55.9	83—133	2	cirro-strat.	S. W.	5		Quite smoky.
3 P. M.	.885	62.4	74.5	62.3	54.5	166—197	1	stratus.	W.	10		
W. 3, 9 A. M.	.980	61.0	58.2	53.2	51.0	154—199	2	cumulus.	N.	5		
3 P. M	.991	60.5	62.1	52 8	49.6	132—178	3			0		Pleasant.
T. 4, 9 A. M.	29.074	54 7	54.0	52 0	47.7	73—78	1			0		Fine.
3 P. M	28.981	58.0	69.8	59.8	45.7	53—88	2			0		Fine.
F. 5, 9 A. M.	.972	57.5	56.3	52.9	46.8	50	0			0		Fine. Hazy and smoky.
3 P. M.	.863	60.0	72.4	61.1	47.4	65—76	1			0		Pleasant. Very smoky.
S. 6, 9 A. M.	.655	59 6	60 2	55.2	47.6	45—71	2	cirrus.	S. W.	2		[thunder about 6 h., ceased raining 8½ P. M.
3 P. M.	.527	63.2	72.4	64.3	60.5	32—122	4	cum. strat.	W. S. W.	10	.406	Commenced raining 5 P. M.; bar. 28.500; heavy
S. 7, 9 A. M.	.989	59 0	48.3	45 6	48.8	185—235	3	cumulus.	N.	6		Ice this morning.
3 P. M.	.967	56.6	54.9	46 4	43.3	160—179	1	cumulus.	N.	2		[morning.
M. 8, 9 A. M.	.803	50.8	46.5	45.7	41.2	24—48	2	cumulus.	S. W.	1		Pleasant. Th. 36°.0 at 6 h.; *very* heavy frost this
3 P. M.	.650	51.1	58.8	51.2	41.8	350—61	3	cirrus.	S. W.	1		Pleasant.
T. 9, 9 A. M.	.575	52.2	49.9	46.8	45.4	99—147	3	cum strat.	W.	9		
3 P. M.	.627	52 6	53 8	49.7	46.6	5—88	3	cumulus.	N. W.	9	.026	Rain from 3h.—4h., P. M.
W. 10, 9 A. M.	.710	50.3	45.3	43.2	42.2	195—232	2	cirro-cum.	S.	4		Th. 39°.0 at 6h. A. M.
3 P. M.	.665	49.8	49.2	43 4	39.7	144—187	4	cum. strat.	N.	10		Dreary. Chilly air.
T. 11, 9 A. M.	.646	47.8	43.8	41.0	43.5	58—110	3	cum. strat.	N. W.	10		Dreary.
3 P. M.	.504	48 6	52.3	46.2	38.5	32—74	1	stratus.	W.	10		
F. 12, 9 A. M.	.658	50.5	42.3	39 4	38.1	40—109	2	stratus.	W.	10		A few drops of rain, commenced at 8 A. M.
3 P. M.	.823	49.5	39.8	38.0	40.0	80—136	4	stratus.	W.	10	.223	Raining still—ceased at 4 P. M. [tenth inch thick.
S. 13, 9 A. M	.916	44.6	40.4	37.3	37.3	36—41	1	stratus.	N. W.	10		Th. 30°.0 at 6h. A. M. Ice formed on still water one
3 P. M.	.721	44.7	48.3	41 3	39.0	323—10	2	stratus.	W. N. W.	10		Dreary.
S. 14, 9 A. M.	.611	48.2	50.5	49 8	49 2	49—62	1	stratus.	S. W.	10	.309	Rain last night.
3 P. M.	.608	49 6	53.0	52.0	51.0	62—77	1	stratus.	S. W.	10	.366	Rain from noon to 3 P. M.
M. 15, 9 A. M.	.628	51.6	42.6	40.5	39.7	75—91	2	cirro-cum.	S. W.	3		Slight flurry of suow at 8 A. M.
3 P. M.	.679	50 5	48.6	39.3	37.7	75—114	3	cumulus.	W.	5		
T. 16, 9 A. M.	29.021	46 3	35.9	31.8	34.3	48—75	1	cum. strat.	S. W.	4		Th. 28°.3 at 6h. A. M.
3 P. M.	.090	44.5	44.4	37.9	36 0	88—114	2	cum. strat.	W.	10		Dreary.
W. 17, 9 A. M.	.339	44 0	42 8	39.9	37.0	163—234	2	cumulus.	N. E.	1		Pleasant. Th. 32°.4 at 6h.
3 P. M.	.293	44.1	55.4	44.7	34.5	244—260	2	cum. strat.	S. E.	9		

1838. OCTOBER.	Barom.	Att. ther.	Ex-tern. ther.	Hygrom. Wet.	Hygrom. Dn'l.	Wind. Direction.	Wind. Force.	Clouds. Character.	Clouds. From.	Clouds. Am't	Rain.	Remarks.
T. 18, 9 A. M.	29.159	47.0	43 4	39.5	39.0	274—303	2	stratus.	S. W.	10	—	Commenced sprinkling at 8 A. M.
3 P. M.	28 992	47 3	51.4	45.2	42.7	272—285	2	stratus.	S. W.	10		Occasional drops of rain.
F. 19, 9 A. M.	.589	51.6	55.8	55.2	54.1	42—52	1	stratus.	S. W.	10	.868	Raining moderately—rained hard during the night.
3 P. M.	.692	53 3	47.0	41.8	39.3	45—103	3	stratus.	W. S. W.	10	.003	About 10 A. M. wind veered to west somewhat suddenly, blowing very fresh—ceased raining and barometer began to rise.
S. 20, 9 A. M.	.827	49.3	41.7	36 5	39.0	51—109	4	stratus.	W. N. W.	10		Dreary.
3 P. M.	.780	48.0	46 0	39.4	36.2	49—101	3	stratus.	W.	10		
S. 21, 9 A. M	.839	46.3	40 6	36.2	35.2	67—107	2	stratus.	N. W.	10		Dreary.
3 P. M.	.839	46.0	44.3	37.7	36.3	108—132	3	stratus.	W.	10		
M. 22, 9 A. M.	.972	44.3	38.3	36.4	37.2	73—111	2	cum. strat.	N. W.	3		Th. 30°.4. at 6h.
3 P. M.	.989	43 8	47.6	39.8	33.1	104—165	3	cumulus.	W. N. W.	8		
T. 23, 9 A. M.	29 008	44.8	43.5	40.0	36 0	10—17	1	stratus.	S. W.	10		
3 P. M.	28.922	45.7	53.4	44.7	39.5	167—182	1	stratus.	S. W.	10		
W. 24, 9 A. M.	.613	47.7	44.4	41.5	43.4	38	0	cum. strat.	W.	4		Commenced sprinkling at noon; not sensible in [gauge.
3 P. M.	.518	48.2	46.6	42.2	43.7	28—150	4	stratus.	W. S. W.	10		Dreary.
T. 25, 9 A. M.	.400	47.8	43.0	39.0	39.6	45—116	4	stratus.	W. S. W.	10	.069	Dreary. Rain during night.
3 P. M.	.492	47.4	47.1	40.0	34.7	35—98	3	stratus.	W. S. W.	10		Occasional squalls of snow and rain.
F. 26, 9 A. M	.826	45.8	39.7	36.0	33.7	65—95	2	stratus.	W.	6		Th. 30°.4 at 6h.
3 P. M	.745	45.4	51 3	43 4	38.6	25—27	1	light cum.	S. W.	2		Pleasant: commenced raining 7 P. M., ceased in the [night
S. 27, 9 A. M.	.844	46 4	42.2	39.2	38.2	79—126	3	cum. strat.	W.	9	.043	
3 P. M.	.855	47.6	44.4	37.8	39.0	78—110	2	cum. strat.	W. S. W.	10		
S. 28, 9 A. M.	.728	44.7	36.0	34.1	35.5	75—91	1	stratus.	S. W.	10		About a half inch of snow this morning, the first of [the season, except occasional flaws.
3 P. M.	.691	43.8	38.5	35.2	36.6	111—135	2	cumulus.	N. W.	9	.040	Light snow fell all the forenoon, until 2 P. M., but melted as soon as it reached the ground.
M. 29, 9 A. M.	.852	41.3	35.2	froze	30.7	58—90	2	cum. strat.	N. W.	10		Th. 28°.6 at 6h, two inches of snow on the ground; fell last night and this morning.
3 P. M	.808	40.5	35.8	froze	27.0	80—97	3	stratus.	W.	10		Snow not entirely melted.
T. 30, 9 A. M.	.790	39 0	34.0	froze	30.4	293—8	2	stratus.	S.	10		Light snow again this morning.
3 P. M.	.642	38.8	35.3	33.0	34 5	52—120	2	stratus.	S. W.	10	.071	Just ceased snowing; about two inches on the ground.
W. 31, 9 A. M.	29.156	37 4	32 2	froze	22.0	120—156	3	stratus.	N. W.	10		Th. 26°.4 at 7 A. M.; two inches snow on the ground.
3 P. M.	.210	36.8	35.4	froze	25.5	121—161	3	stratus.	N. W.	10		Th. 23°.6 at 9 P. M.
Mean 9 A. M	28.844	49.4	45.4	43.7	41.0	N. 88° 11′ W.	1.90		S. 80° 19′ W.	6.71	Sum	Mean of barom. corrected for capillarity and reduced to 32° F. 9 A. M. 28.796
Mean 3 P. M.	.807	49.8	51.8	45.9	40 8	N. 83° 53′ W.	2.36		S. 84° 39′ W.	7.81	2.424	3 P. M. 28.758

Mean variableness of wind. 9 A. M. 34.°1; 3 P. M. 43.°2

Mean force in mean direction. 9 A. M. 1.07; 3 P. M. 1.50

1838. NOVEMBER.	Barom.	Att. ther.	Ex-tern. ther.	Hygrom. Wet	Hygrom. Dn'l.	Wind. Direction.	Wind. Force.	Clouds. Character.	Clouds. From	Clouds. Am't.	Rain.	Remarks.
T. 1, 9 A. M.	28.986	35 6	33.3	froze	24 2	333—23	2			0		Fine—th. 21°.6 at 6 A. M.
3 P. M.	.683	35 6	47.6	froze	32.5	8—60	1	stratus.	W. S. W.	10		Snow nearly melted.
F. 2, 9 A. M	.950	41 8	39.4	37 2	34.9	59—73	1			0		Fine. Snow disappeared.
3 P. M.	.890	43.0	54 8	43 4	40 2	47—118	2	cirro-strat.	S. W.	1		Pleasant.
S. 3, 9 A. M.	.805	46.0	46 3	45.3	45 3	337—27	2	stratus.		10	.034	Rain 7—11h. A. M.
3 P. M.	.702	47 6	54.7	52.2	49.7	32—57	1	stratus.	S. W.	10		
S. 4, 9 A. M.	.669	53 5	53 2	52.6	52.5	45	1	stratus.	S. W.	10	.093	Rain during evening and night.
3 P. M.	.684	55.5	50.2	47.7	49.2	133—162	2	stratus.	N. W.	10		
M. 5, 9 A. M.	525	52 0	41 8	41.0	41.0	265—313	2	stratus.		10		[and then snowed about 4 inches next morning.
3 P M.	.327	50.5	44 8	43.0	44.0	47—111	2	stratus.	S. W.	10	.272	Rain commenced about noon, ceased in the evening,
T. 6, 9 A. M.	.921	43 7	32 4	froze	30.7	83—95	1	cum. strat.	W.	4		Th. 27° 8 at 6 A. M.
3 P. M.	.935	42.7	41.8	32.4	26.7	250	1	cum. strat.	W.	8		Snow gone in spots.
W. 7, 9 A. M.	617	41.4	36.6	35 4	37.2	283—346	3	stratus.	S.	10	.661	Raining—began with snow last evening—changed to sleet, and this morning to rain—cleared at 11 A. M.
3 P. M.	.455	42 0	50.8	47.7	44.9	300—338	2	stratus.	S. W.	10		Sprinkling moderately, snow almost entirely melted.
T. 8, 9 A. M.	.668	48.0	34 7	33.0	34.0	70—107	3	cum. strat.	W.	10	.209	Dreary. Wind changed a little before midnight to N. W., bar. 28 350, rained furiously, ended with sleet.
3 P. M.	.700	46.3	31 5	froze	30.1	76—135	3	stratus.	N. W.	10	.016	Dreary. Occasional rain and sleet during the day.
F. 9, 9 A. M.	.968	36.0	17.7	froze	17.3	54—103	4	cumulus.	S. W.	2		Th 14° 5 at 6h. A. M. [Ground bare of snow.
3 P. M	951	32 6	24 8	froze	18 4	53—119	3	cum. strat.	W. S. W.	9		Ice found in my room—first this season.
S. 10, 9 A. M.	29 439	28.5	19.4	froze	12 6	64—93	1			0		Pleasant, th. 13°.5 at sunrise, ice quite hard in my room,
3 P. M.	.430	27.4	30 7	froze	13 7	276—317	1	cirro-strat.	W.	2		Halo about the sun at 3 P. M. [bar. 29.460 at 11 A. M.
S. 11, 9 A M.	.392	29.7	31 8	froze	20.7	302—342	3	cirro-strat.	W. S. W.	9		
3 P. M.	.276	31 7	44 2	35.0	29.2	304—337	2	light cum.	W. S. W.	8		
M. 12, 9 A. M.	.105	38 2	43.6	38.0	29.9	355—46	2	light cum.	S. W.	6		
3 P. M.	28.940	40 4	53.0	47 5	43 6	341—46	1	stratus.	S. W.	10		Slight rain from 4—6 P. M.
T. 13, 9 A. M.	.684	50.3	52 5	51.0	51 3	351—90	3	cum. strat	S. W.	10		Cloudy all night—no clear sky.
3 P. M.	.682	52.0	62 8	52.5	47.6	44—136	4	light cum.	S. W.	3		Pleasant.
W. 14, 9 A. M.	29.099	48.2	33.4	froze	28.0	34	1			0		Pleasant.
3 P. M.	.016	46.0	43 7	37.3	33.2	286—287	1	stratus.	S. W.	10		
T. 15, 9 A. M.	28 739	45 6	43 8	43.7	44.0	315—335	1	stratus.	S. E.	10		Raining—commenced last night.
3 P. M.	.678	46 8	55 4	55.0	52.3	40—52	1	stratus.	S. W.	10	.360	Nearly ceased raining.
F. 16, 9 A. M.	.992	48.4	28.0	froze	25 0	103—122	2	stratus.	S. W.	10	.256	Rain in night.
3 P. M.	29.029	45.3	31.0	froze	27.4	50—126	2	cumulus.	W.	9		

1838. NOVEMBER.	Barom	Att. ther.	Ex-tern. ther.	Hygrom. Wet.	Hygrom. Dn'l.	Wind. Direction.	Wind. Force.	Clouds. Character.	Clouds. From	Clouds. Am't.	Rain.	Remarks.
S. 17, 9 A. M.	29.179	36 4	23 4	froze	16.7	88—111	1	cumulus.	S. W.	1		
3 P. M.	.123	34.5	28.6	froze	21.1	115—130	1	cum. strat.	N. W.	8		
S. 18, 9 A. M.	28.884	31.5	24.7	froze	23.5	87—152	1	stratus.		10		Just commenced snowing moderately.
3 P. M.	.793	31.5	27.2	froze	25.1	72—116	2	stratus.		10		Snowed very slowly but uninterruptedly since 9 A. M.
M. 19, 9 A. M.	.940	28.7	16 0	froze	12.7	43—50	1			0		Th. 8°.7 at sunrise—about one inch snow on the [ground.
3 P. M.	.860	27.8	30 7	froze	22.5	5—47	2	cirro-strat.	S. W.	10		
T. 20, 9 A. M.	.839	29.6	28.4	froze	24.1	52—120	3	stratus.	W.	10		Dreary.
3 P. M	.871	30 0	29.6	froze	24.0	45—117	2	stratus.	W.	10		Dreary.
W. 21, 9 A. M.	29.016	33.8	34.8	froze	27.3	0—90	2	cumulus.	S. W.	8		
3 P. M.	28 845	35.4	44.0	38.5	33.5	32—120	3	cirro-strat.	N. W.	2		
T. 22, 9 A. M.	.846	40 4	40.4	36 5	33.6	66—90	1	stratus.	N. W.	10		
3 P. M.	.825	41.0	47.7	40.4	35.7	59—76	1	cirro-strat.	W. N. W.	8		
F. 23, 9 A. M.	.867	43.4	39.4	36.8	38.3	234—243	1	stratus.	N. E.	10		
3 P. M.	.847	44.0	37 0	34 7	36.0	187—196	1	stratus.		10	.018	Commenced raining at noon—ceased 6 P. M.
S. 24, 9 A. M.	.989	40.0	30 0	froze	28.0	104—115	1	cum. strat.	N. W.	10		
3 P. M.	29.010	38.0	28.8	froze	27.3	164—195	3	cum. strat.	N.	10		Dreary.
S. 25, 9 A. M.	.175	30.6	16.3	froze	15 6	192—233	2	stratus.	N. E.	10		Snowing moderately—amount scarcely half an inch.
3 P. M.	.220	27.2	16.3	froze	12 7	164—205	3	stratus.	N.	10		
M. 26, 9 A. M.	.239	26 3	21.4	froze	15.9	64—115	2	stratus.	N. W.	10		
3 P. M.	.090	27.0	27 4	froze	18 6	343—30	2	cirro-strat.	W.	10		Halo about moon this evening.
T. 27, 9 A. M.	28.773	29.7	26.8	froze	25.7	34—105	2	stratus.	W.	10		
3 P. M	.692	30.4	30.8	froze	24.6	45—53	1	stratus.		10		
W. 28, 9 A. M	.974	33 0	25.2	froze	24.1	104—154	2	stratus.	N. E.	10	.014	Slight snow this morning—an inch or two.
3 P. M.	29.101	31 4	24.8	froze	13.5	122—167	3	cum. strat.	N. W.	9		
T. 29, 9 A. M.	.285	27.0	18.7	froze	11.5	62—107	2	cum. strat.	N. W.	6		Th. 12°.2 at 7h. A. M.
3 P. M.	.178	27 4	32 6	froze	18 7	49—121	2			0		
F. 30, 9 A. M.	.053	28.4	25.2	froze	18 7	46—52	1	cirro-strat.	W.	6		
3 P. M.	28.903	29.1	37 7	froze	21 2	15—50	1			0		
Mean 9 A. M.	28.954	38.2	32.0		28 1	s. 56° 38′ w.	1.80		s. 83° 42′ w.	7.07	Sum	Mean of barom. corrected for capillarity and reduced to 32° F. 9 A. M. 28 935
Mean 3 P. M.	28.891	38.0	38.8		30.6	s. 86° 13′ w.	1.87		s. 85° 5′ w.	7.90	1.933	3 P. M. 28.873

Mean variableness of wind, 9 A. M. 38°.1; 3 P. M. 43°.3

Mean force in mean direction, 9 A. M. .97; 3 P. M. .94

The barometer employed in the preceding observations, was made by John Newman of London, and is similar to that of the Royal Society of London. The inner diameter of the tube is .55 inch, and the tube plunges into a cylindrical glass vessel about three inches in diameter nearly filled with quicksilver. The scale is movable, and terminates at its lower extremity in an ivory point, which by a screw may be brought to exact contact with the surface of the mercury in the cistern. The scale is graduated to half hundredths of an inch, and read by a vernier to the two thousandth part of an inch. After the instrument was completed, I directed it to be taken to the apartments of the Royal Society, and placed by the side of the Society's barometer, where it was left for a day, in order that both might acquire the same temperature. The two instruments were then read off alternately by myself and Mr. Roberton, the assistant secretary of the Society. The mean of observations at four different times, made my barometer .012 inch lower than the flint glass barometer of the Royal Society. The instrument is rendered portable by inverting, and turning a screw in the bottom of the cistern. It was admirably packed on springs, and I have reason to believe suffered not the slightest injury from transportation. The height of the baromeeter cistern above tide water at Albany, is believed to be 1131 feet. The correction for capillarity is assumed to be .006 inch, and that for temperature is made by Schumacher's Tables, Copenhagen, 1826.

The thermometers are all graduated by Fahrenheit's scale. The external thermometer is divided to fifths of a degree. It is exposed on the north side of the building where there is a perfectly free circulation of air. It is on a level with the barometer cistern, and 21 feet from the ground. The wet bulb hygrometer is a common thermometer whose bulb is enveloped in a white cotton rag, and kept wet by means of another rag hanging from a vessel of water by its side. When the water freezes the instrument is not observed. Daniell's hygrometer is of the usual construction, and was made by Newman. At each observation, the point at which the dew disappears, as well as that at which it forms, is invariably noted and the mean taken.

The vane is attached firmly to an upright revolving shaft, to whose lower extremity is secured a graduated circle. The zero of this circle indicates the South point of the compass; 90° is

West, 180° is North, and 270°, East. The vane is moved by a very faint breeze, and hence is seldom at rest. At each observation, its extreme excursions during an interval of about five minutes are noted, so that the observations in column seventh indicate the variableness as well as mean direction of the wind. This arc of vibration is commonly from thirty to forty degrees, and sometimes even ninety and upwards. The mean of these daily arcs I call the mean variableness, which will be observed to be uniformly greater in the afternoon than forenoon. The force of the wind is estimated by a scale in which 0 indicates a calm; 1 a breeze just perceptible; 2 gently pleasant; 3 brisk; 4 very brisk; 5 high wind. The mean direction of the wind for the month is obtained, not by taking the mean of the numbers denoting the daily directions, which would be a very erroneous method, but in the usual mode of resolving a traverse; the wind's direction being considered the course, and its velocity the distance. We wish to learn whether the atmosphere merely *oscillates* to and fro, or has a *progressive* movement. The observations indicate the latter to be the case. The northerly and southerly motions are nearly equal; but the westerly far exceeds the easterly; so that the absolute progress of the wind is nearly from west to east, and at the mean rate of three or four miles per hour.

In column eleventh, 0 indicates a sky perfectly clear; 10 entirely overcast. The clouds are always noted when they cover one tenth of the visible heavens, and their direction when it can be ascertained. Sometimes a stratum of clouds is so uniform and unbroken, as renders it impossible to detect any movement. In all cases it is the highest observed stratum which is recorded. The mean direction of the clouds is deduced in the same way as that of the wind, with the exception that all the clouds are necessarily regarded as moving with the same velocity.

The rain gauge is a copper cylinder of ten inches diameter, elevated 49 feet from the ground. The water is measured in a glass tube of one inch diameter graduated to tenths of an inch.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Echoes.*

I. *Musical echo in Virginia.*

Description of a remarkable echo in Fairfax Co., Virginia, by *Charles G. Page*, M. D., Washington, D. C. Dr. Birch describes an echo in Roseneath, Argylshire, which it is said does not now exist. When eight or ten notes were played upon a trumpet, they were returned upon a key a third lower than the original notes, and shortly after upon a key still lower. A similar curious property I accidentally discovered in an echo on the grounds belonging to my father in Fairfax County, Virginia. The echo had long been observed as an interesting and striking phenomenon, and gives three distinct reflections. The second echo or return is much the most distinct. It gives thirteen syllables with great distinctness, and a very amusing effect is produced by uttering a question and answer in the same breath, and at the same in a different tone. For instance, how do you do? pretty well I thank you, how are you? Twenty notes played upon a flute are returned with perfect clearness. But the most singular property of the echo is, that some notes in the scale are not returned in their places, but are supplied by notes which are either thirds, fifths, or octaves. When the second F in the scale is sounded by itself upon a flute, the first reflection gives the same note, the second likewise, and sometimes, though rarely, the last reflection gives C the fifth above. But when the low F is sounded, the first return is always the same note, the second return generally the octave above, and the *last invariably* the fifth C in the octave above the note played. A slight change in the wind or density of the atmosphere will frequently vary the result. The first natural F upon the flute is the *only* note which gives a distinct fifth; and it is not a little singular, that the same note sounded by the voice or upon a bugle is not thus modified, but is returned in the identical tone of utterance. The first A upon the flute, gives by the first and second reflections, the same note, by the third reflection an octave above. The same is true of B flat, but of no other notes in the scale. The peculiar configuration causing the three distinct echoes is perfectly visible, but the causes of the remarkable modifications of certain sounds are difficult to explain. It is evident that is not a case of simple refraction, for all refractions whether of light, heat, or sound are governed by the refracting media. The constantly varying atmosphere which is the medium in this case, would not of course furnish constant results. The effect of refracting media upon vibrations producing musical tones, is to *distort* and render them disagreeable. It appears to me, that as the modified echoes are always some *harmonic* tones of the original note, there is a strong analogy to the polarization of light and heat. The actual condition of the vibrations is evidently as follows. A portion of them must be transmitted or conducted by the reflecting surfaces, and the reflected portion possesses new and definite properties. I leave the fact in the hands of theoretical philosophers.

II. *Echo, many times repeating.*

The communciation of Dr. Page, reminded us of a surprising echo between two barns on the estate of Philip Church, Esq., at Belvidere, Alleghany County, New York.

With this echo we are personally familiar, and its delightful and astonishing reiterations have often held the hearers in admiration, of what we believe is no where surpassed in the number and distinctness of the repetitions. Their delicacy and distinctness, but not their number, are finely exhibited among the mountains of Lake George, while the wide sweeping echo, circling miles around, when a powerful horn is blown, or a cannon is discharged among the White Mountains of New Hampshire, has something of the terrible and sublime, as in both these cases we have had occasion to observe.

For the following notice, we are indebted to *John B. Church*, Esq. —Eds.

The echo repeats eleven times, a word of either one, two or three syllables; the sound at each successive repetition, gradually dies away, but the echo retains its distinct articulation to the last; in a very favorable state of the atmosphere, it has been heard to repeat thirteen times.

The barns stand nearly in a direct line, east and west, with their gable ends towards each other. The echo sounds in the direction of the barn opposite to the one at which you stand, and it sounds equally well from either barn.

By placing yourself in the centre between the two barns, there will be a double echo, one in the direction of each barn, and a monosyllable will thus be repeated twenty-two times, but in such rapid succession as to render it difficult to count the repetitions.

At the same time with the repetitions in the direct line of the barns, there is a lateral echo, which gives but one reverberation, indistinct, but loud and apparently rolling along the amphitheatre of hills.

East and west from the barns are ranges of hills that skirt the opposite banks of the Genesee river, distant from each other about one and half mile, the barns are about half way between them, the range of hills on the last, sweep in a bow around towards the N. W., till nearly opposite the barns, whence they bear off north, approaching at the nearest point in their course, to within fifty yards of the barns.

The hills, east and west from the barns, rise up rather abruptly from the plain, but with a smooth and unbroken ascent; and although the echo sounds as if reverberated from objects more and more distant, and with distances very equally graduated, yet the eye can fix upon nothing but the barns, and the range of hills opposite.

The echo reflects back every tone, and undulation of the voice, with the utmost accuracy.

An echo is heard out of the line of the barns.

2. *Analysis of Marl from Farmington, Conn.;* by Prof. E. Hitchcock.—I have made an analysis of the Farmington marl, which you sent me, and the result is as follows, in 100 grains heated to 300°;

Sulphate of lime, - - - -	2.1
Carbonate " - - - -	66.3
Phosphate " - - - -	0.4
Soluble geine, - - - -	3.1
Insoluble " - - - -	9.7
Silica, alumina, iron, &c., - - -	18.4

This is certainly a rich marl, and I have been surprised to learn that the farmers in Farmington have nearly given up its use. Either a great deal of experience in Europe, and some in this country, must go for nothing, or this marl can be made of great value.—*Letter to Prof. S.*

3. *Tabular View of the price of labor and subsistence in certain parts of Continental Europe.*

To Prof. Silliman.—*Dear Sir*—While travelling on the Continent of Europe, about five years since, I endeavored to ascertain, in the countries through which I was passing, how comfortable a person could make himself by his own unassisted labor. I supposed that the wages paid to a stout healthy laborer on a farm, might be taken as a fair sample of the price of labor, and my inquiries were made chiefly of such persons as they presented themselves in the fields by the way-side, although sometimes I extended them also to tradesmen. At the same time, I endeavored to learn the prices of provisions, &c. The investigation was made in a desultory manner; I have since regretted that it was not prosecuted more industriously and with more system; but the results, such as they are, may be interesting to the public.

My course during these inquiries was from Trieste to Vienna, thence by Saltzburg, and through the Tyrol, to Constance, by Zurich and Basle to Strasburg and Carlsruhe, and so along the banks of the Rhine to Holland. The money, weights, &c., of the different countries, are here reduced to the American Standard. The time when the inquiries were made was in August, September and October.

Places observed.	Wages of an able bodied laborer on a farm.			Wages of good journeymen tradesmen.		Beef per pound.	Pork per pound.	Mutton per pound.	Veal per pound.	Flour.	Eggs per dozen.	Lard per pound.	Butter per pound.	Cattle, &c.
	per year.	per day if found.	pr. day if not found.	per week.	per day.									
	Dollars.	cents.	cents.		cents.	cts.	cts.	cts.	cts.		cents	cts.	cents	
Stiria.	6.72	5	15			4 3-4			4 2-3		5 3-4	8	10	
Near Saltzburg.		10	17 to 20								10		9 1-2	Good Cow, $14.40. Ox 3 years old, $17.20. Horse 2 yrs. old, $44.00. Sheep, do. do. $1.40.
30 miles w. of Inspruck.	8 to 12	12												
Near Feldkirk.		16			Shoemaker 13 1-2, Tailor 10, Carpenter 16.				6				13	
Bordering on Lake Constance.		8 to 12.		Shoemaker 80 cents and found.	Mason 15, and pays 7 for board	5	6	4 3-4	5				13	Good Cow, $22. Working Ox, $28.
Neighborhood of Zurich						6	7 1-2	5 1-2	7 1-2	Wheat 90 cts. per bushel.				
Neighborhood of Basle.				Tailor, 80 cts. and found. Shoemaker, $1 45, and not found.		5	6 2-3	4 2-3	4 2-3		10 2-3		10 2-3	
20 miles N. of Basle.	12 to 16	8 cents in summer, 6 2-3 cts. in winter; they have meat but twice a week.				4 2-3	6						10 2-3	Good work-horse 6 yrs. old, $52.
Neighborhood of Rastadt.	16	13		Tailor, 40 cts., Shoemaker, 40 to 80 cts.		4 2-3	6	5 1-3	4 1-3					Sheep, $3.20. Potatoes, 6 2-3 cts. per bushel.
Carlsruhe.											10 2-3		11 1-3	Goose, 43 cts. Ducks, 43 cts. per pair. Fowls, 16 cts each.
Neighborhood of Weisbeden.	16	8		Shoemaker, 32 to 40 cts.						Wheat, 80 cents per bushel. Indian corn, 10 2-3 cts. per gallon.				Potatoes 20 c. pr. bush'l Beech wood, $5.60 for 216 cubic feet.
Neighborhood of Ruhr.		12 in harvest time, 9 1-2 other seasons; woman 5 cts.				6 1-2	7 1-4	5 1-2	4		9 1-2		9 1-2	
Neighborhood of Meer.	14.35, best hands 16.40	8 1-2	19 to 24											Good Cow 2 1-2 years old, $24.60.

It will be seen from this table, that the condition of the poor, is not only a wretched one, but also a hopeless one. As the father has been, so the son must be, and so also to other generations. The food of these laboring classes consists of potatoes and milk, with coarse brown bread, and meat in small quantities, two or three times a week. To this diet, however, they are accustomed from childhood, and it is not much complained of; but that brightness of hope which cheers him on, who by daily savings is laying up comforts for the future, is unknown to them. Their poverty is utterly desperate, and must ever be so.

Yours respectfully, G. J.

Near Portsmouth, Va., March 6, 1839.

4. *Rain from a clear sky.*—The annexed account of a shower of rain at Geneva, from a serene sky, having excited much interest, some additional facts of a similar nature are added, for the use of future meteorologists. Although occurrences of this sort are doubtless uncommon, yet a diligent search will probably show, that they are less rare than has been supposed. It will be noticed, that two of the cases occurred very near the time of an unusual display of shooting stars, but there seems to be no reason whatever for suspecting them to be connected therewith. E. C. H.

1. At Geneva, Switzerland, on the 9th of August, 1837, at 9 P. M. around the horizon were large black clouds in much agitation. The zenith was clear, and the stars shone with their usual lustre, when a shower of large drops of tepid water fell in different parts of the city. Many persons who were abroad at a quarter past nine, were obliged to seek a hasty shelter from so unexpected a rain. The shower ceased in a minute or two, but it was repeated several times in the course of an hour.—*Letter of Wartmann to Arago; Comptes Rendus de l'Acad. des Sci. Oct.* 16, 1837; p. 549.

2. At Harvard, Worcester County, Mass., on the 13th of November, 1833, about 8 A. M. there was a slight shower of rain, when not a cloud was to be seen, the weather being what is called perfectly fair.—*This Journal,* Vol. xxv. p. 398.

3. On Wednesday, the 23d of April, 1800, between 9 and 10, P. M., Philadelphia, Pa., was visited by a very curious phenomenon. A shower of rain of at least twenty minutes' continuance, and sufficiently plentiful to wet the clothes of those exposed to it, fell when the heavens immediately over head were in a state of the most perfect serenity. Throughout the whole of it, the stars shone with undiminished lustre. Not a cloud appeared, except one to the east and another to the west of the city, each about fifteen degrees distant from the zenith. In order to be satisfied that he was not under an ocular deception, the writer of this paragraph called on two or three persons to witness the phenomenon. They all concurred in the reality of the fact above related.—*True American, quoted in N. Y. Spectator of May* 3, 1800.

4. *Descartes* states (*Meteora*, cap. vi. sect. xvi. Amst. 1656) that he had in several instances, during a hot suffocating time in the summer, observed showers of rain in large drops, before any clouds had appeared.

5. *Antonius le Grand*, in his *Historia Naturæ*, (Lond. 1680, 4to,) remarks, that sometimes it begins to rain before the clouds are seen; and that he once observed an occurrence of this nature, while walking in the fields in a calm, hot, suffocating day. p. 273.

5. *European observations on the Meteoric Shower of November*, 1838.—In our last number, Professor Olmsted gave an account of the observations made in this country at the time of the expected return of the meteoric shower of November, which indicated that in 1838, this phenomenon was visible chiefly on the morning of the 14th of that month. The inference which this fact naturally suggested, that the exhibition was more splendid in places to the east of us, is now amply confirmed by the following important information from Austria, which we take from *L'Institut* of Dec. 27th, 1838.

"M. Littrow, Director of the Observatory of Vienna, has published a notice in the Gazette of that city, which proves that an extraordinary display of shooting stars was visible there in November last. On the 10th of November, 1838, from 8 P. M. to the next morning, *nine* meteors per hour were counted, which is, according to M. Quetelet, about the average hourly number visible to a single observer during the year. On the 11th, the sky was clear from 6 to 11 P. M., and *twenty* meteors per hour were counted. The night of the 12th was so cloudy that no observation could be made. On the 13th, the sky cleared up about midnight and remained so during the rest of the night. During these six hours, *one thousand and two* shooting stars were observed, which gives a mean of one hundred and sixty-seven per hour. But the phenomenon was far from being of uniform intensity during this period. It increased in frequency from the first until 4 A. M., and after that hour, decreased. In the first hour, thirty-two meteors were seen; in the second, fifty-two; third, seventy; fourth, one hundred and fifty-seven; fifth, three hundred and eighty-one; sixth, three hundred and ten. During the night following, (14th,) the sky was too cloudy to permit observation."

The number of observers should have been stated: we presume there were enough to note all, or nearly all, the meteors visible above the horizon of Vienna. . . . .

6. *Meteorological Register for* 1838,

Kept at Montreal, Lower Canada, in Lat. 45° 50′ N. Long. 73° 22′ W.; by J. S. M'Cord, Corresponding Secretary of the Natural History Society, and Member of the Literary and Historical Society, Quebec, and Albany Institute, State of New York.

MONTHS.	Barometer.	Thermometer.	WIND. Number of days blowing. N.	N. E.	E.	S. E	S.	S.W.	W.	N W.	WEATHER. Number of days each. Cr.	Cy.	Rn.	Shrs.	Fog	Snw.	Rain Gage, in	Snow Gage, in.
January,	29.999	21.1	15.5	0.0	0.0	0 0	5.0	3.0	4.0	2.5	8.50	15.75	2 75	* 25	0.0	2.75	0.0	14.35
February,	29.776	9.0	4.0	0.0	0.0	0.0	1.0	4.0	12.0	1.0	7.00	12.25	0.0	†.25	0.0	2.50	0.0	6.20
March,	29.954	31.6	7.5	.50	1.0	0.0	1 0	0.0	2.0	1.0	5.50	6.50	0.0	0.0	0.0	1.0	0.0	9.70
April,	29.861	34.5	5.25	0.0	.25	2.0	3.75	5.5	10.75	2.50	16.50	6.75	4.75	0.0	0.0	2.0	1.95	3.85
May,	29.799	52.8	6.50	3.5	1.5	3.0	2.5	5.5	5.0	1.5	12.25	9.25	4.5	3.0	0.0	0.0	2.1	. .
June,	29.820	69.9	5.5	1.0	2.0	0.0	4.5	4.0	6.0	1.0	10.5	7.75	3.5	2.25	0.0	0.0	3.25	. .
July,	29.873	68 9	3.0	1.0	0.0	1.0	2 0	6.5	9.5	4.0	18.75	3.5	1.25	3.5	0.0	0.0	3.5	. .
August,	29.913	65.5	4.5	0.5	1.0	0.0	11.0	3.5	7.5	3.0	19.25	7.0	2.75	2.0	0.0	0.0	1.85	. .
September,	30.034	57.9	5.0	4.0	0.0	0.0	1.5	5.0	8.5	2.0	16.0	6.5	2.0	1.5	0.0	0.0	1.25	. .
October,	29.823	46.6	1.5	1.5	1.0	4.0	3.0	5.5	10.5	2.0	9.5	13 0	5.5	1.0	0.0	0.0	3.2	0.20
November,	29.944	28.8	2.5	1.0	0 5	2.0	5.5	4.0	9.5	5.0	10.25	11.5	5.0	0.0	0.0	3.25	1.5	9.75
December,	29.822	12.4	6.0	0.0	0.0	0.0	8.5	2.5	9.5	4.5	12.75	12.75	0.5	0.0	0.0	5.0	0.0	21.80
	29.884	41.58.															18 60	65.85

Mean Pressure of the Year, corrected and reduced to 32° Fahrenheit, ... 29.884
Mean Temperature of the Year, mean of Maxima and Minima by Register Thermometers, ... 41.58
Maximum height of the Barometer during the year, ... 30.780 . (mean of yearly Maximum, 30.383)
Minimum, ... 29.300 . " " Minimum, 29.392)

Range of Barometer, ... 1.498

* Hail. † Drift.

Warmest day,	+90°	
Coldest day,	−13	
Range of Thermometer,	103	
Number of days Clear,		146.75
" " " Cloudy,		112.50
" " " Rain,		32.50
" " " Showers,		13.25
" " " Hail and Drift,		0.50
" " " Snow,		16.50
Number of days observed,		322.00
Number of days Westerly winds,		163.00
" " " Easterly "		32.25
" " " North "		66.75
" " " South "		49.25
Number of days observed,		311.25
Mean Temperature, 1836,		40.43
" " 1837,		41.22
" " 1838,		41.58
Mean of three years,		41.07

MONTHLY RANGE OF BAROMETER AND THERMOMETER.

	BAROMETER.					THERMOMETER.				
Months.	Max.	Date.	Min.	Date.	Range.	Max.	Date.	Min.	Date.	Range.
Jan.	30.460	27	29.312	28	1.148	+47	5	—12	31	59
Feb.	30.300	1	29.330	16	.970	26	8.13	—14	17	40
March,	30.424	4	29.464	19	.960	45	14	+9	4	36
April,	30.250	16	29.450	3	.800	55	28	12	16	43
May,	30.150	1	29.460	26	.690	76	15	36	8	40
June,	30.044	20	29.450	7	.594	88	21	52	8	36
July,	30.271	14	29 500	30	.771	90	7	52	22	38
Aug.	30.276	20	29.300	17	.970	88	7	41	26	47
Sept.	30.490	26	29.560	1	.930	73	5	39	3	34
Oct.	30.384	17	29.300	6	1.084	72	1	31	29	41
Nov.	30.772	11	29.300	6	1.472	51	5	—3	24	54
Dec.	30.780	31	29.282	23	1.498	36	5	—13	30	49
Mean.	30.383		29.392							

SUDDEN FLUCTUATIONS IN BAROMETER.

Date.	Inches and parts.	Rise or fall.	In what time	Wind.	Weather.
Jan. 7 to 28,	.978	fall.	24 hours.	S.	Storm.
27 to 28,	1.148	fall.	24 hours.	N.	Storm.
Nov. 1,	.534	fall.	12 hours.	N. W.	Snow storm.
6,	.836	rise.	12 hours.	N. E. S. W.	Storm.
7,	1.000	rise.	24 hours.	S. W.	Storm.
8,	.800	fall.	24 hours.	S.	Blowing.
21,	.420	fall.	12 hours.	W. S.	Cloudy.
Dec. 3,	.750	rise.	24 hours.	W.	Clear.
5,	.658	fall.	24 hours.	N.	Rain.
9,	.644	rise.	24 hours.	W.	Clear.
12,	.988	rise.	12 hours.	N. W.	Gale.
12, 13,	1.050	rise.	24 hours.	N. W. W.	Gale.
15, 16,	.722	rise.	24 hours.	N. W.	Gale.
23,	.702	rise.	6 hours.	W.	Gale.
28,	.864	fall.	24 hours.	S. W.	Snow storm.

SOLAR RADIATION.

Day and Hour.		2	3	4	Weather.
	A. M.				
July 19,	10.30	19.50	68	114	Clear.
	11.00	17.62	69	122	A few light clouds.
	11.30	19.50	69.5	118	Clear.
	Noon.	20.00	71	120	Fleecy Clouds.
	12.30	20.00	73	116	Perfectly Clear.
	1.30	20.00	73	. .	Clear.
26,	Noon.	14.67	71	94	Clear, blowing fresh.
27,	4 P. M.	17.07	77	. .	Clear.
28,	Noon.	19.05	77	98	Clear.
	3 P. M.	19.50	78	101	Clear.
29,	Noon.	19.80	83	105	Clear, fresh breeze.
Aug. 2,	Noon.	17.30	73	100	Clear.

Remarks.—These observations were made during the warmest and brightest days of July, on the Montreal mountain, place of observation 307 feet above St. Lawrence. The *first* column gives the day and hour; the *second*, the indication of Sir John Herschel's Actinometer, (by Robinson, London,) mean of three observations:—the *third*, the temperature of air in the shade, Thermometer 5 feet above the earth; the *fourth*, the indication of the Thermometer placed in the sun on garden mould, (not blackened,) after an exposure of ten minutes. N. B. This Actinometer was, in Sept. 1837, compared on the same spot, with one in the possession of Dr. Daubeny of Oxford, England, and gave similar indications.

TERRESTRIAL RADIATION.

Day.		2	3	4	Wind.	Weather.
July,	18 to 19	69	60	50	N. W.	Clear.
	19 to 20	73	54	50	do.	do.
	22 to 23	71	55	50	N.	do.
	26 to 27	73	61	49	S. E.	do.
	27 to 28	78	69	62	S. W.	do.
	28 to 29	80	70	65	S. W.	Showery.
Aug.	6 to 7	76	69	63	S. W.	Clear.

Remarks.—The *first* column indicates the 24 hours during which the observation was made, reckoning from 9 A. M. of one day to 9 A. M. of the next; the *second* gives the *max.* of the Thermometer in the shade, for the same period; the *third*, the *min.*; the *fourth*, the indications of a register spirit Thermometer, placed on a grassplot and exposed freely to the Heavens during the night. All these instruments are made by first artists (British) and carefully compared with standards.

Storms, &c., during the year.

January 8—Wind shifted suddenly from N. W. to S. at 2 P. M.; at 4, blew a gale —lasted most of the night—dust flying—no snow.

" 27 to 28—Heavy snow storm from N. with heavy fall of snow—lasted 48 hours.

April 8—Storm with rain—wind, moving at N.—at 2 P. M. shifted suddenly to to S. through E.—blew a gale with heavy rain.

July 29—3.30 P. M.—Thunder storm from the N. W. with heavy rain. The storm passed up the St. Lawrence, along the Montreal or north shore of the river, returned in about 30 minutes down the south shore along Laprairie, as far as Boucherville, and again returned up the river with increased violence—thunder, lightning, and the heaviest rain, falling in one continued tropical shower from 3.30 to 9 P. M. At 10 P. M., bright moon, starlight, and perfectly calm. The electric fluid fell and consumed a barn on the bank of St. Lawrence, about 2 miles above the city. Thermometer in shade, previous to storm, indicated 85°,—fell to 77° during storm. Thermometer in the sun on garden mould indicated 112°, after exposure to storm, same place, gave 77°.

September 22—Equinoctial gale commenced about 11 P. M. of 22d—continued blowing, with heavy showers and without intermission, till sunset of the 24th—wind varying from W. to S. W. and W.

November 5—Began to blow from the N. at 7 P. M.—blew hard all night, with rain, till 9 A. M. of the 6th, when wind shifted suddenly to S. W. and blew a gale, with snow and sleet, till 9 A. M. of 7th, when wind again suddenly changed to the N., and continued blowing hard all day.

December 23—Barometer rapidly falling all day, till 6 P. M. when lowest; (29.282)—then a heavy storm commenced from the N. W. and lasted 16 hours, with great violence—wind did not abate till noon of the 24th—during the storm the Barometer rose .702, and the Thermometer fell 39°.

7. *Chromate of Potassa—a reagent for distinguishing between the Salts of Baryta and Strontia;* by J. Lawrence Smith.*—Having had occasion some months since, to examine a specimen of fibrous celestine, from Niagara, I was led to suspect from its specific gravity, that baryta was present.

With this supposition, I examined for baryta in the usual way, with fluo-silicic acid; in fact, the only certain method that I was aware of. The indication that this test gave of its presence, was so unsatisfactory, that it led me at once to search for a more decisive, and more delicate distinguishing test; and the following was the result of my labor.

It will be needless to detail the various reagents that I had recourse to, in my experiments, but suffice it to say, chromate of potassa satisfied my most sanguine wishes; for no reagent with which I am acquainted, acts so promptly upon any body, as does this upon the salts of baryta; and moreover, so delicate in this test, that in one of my experiments in which a grain of chloride of barium was dissolved in one gallon of water, it gave immediate indication of the presence of baryta, although sulphuric acid failed to do so; in fact, it will affect perceptibly a solution that contains less than $\frac{1}{100000}$ part of baryta.

When a strong solution of chromate of potassa is poured upon a strong solution of a salt of strontia, a precipitate (similar to that which is produced when a salt of baryta is used) will take place. Solutions of these two salts of ordinary strength, will not affect each other.

Lest this fact should, under any circumstance, cause erroneous conclusions, I sought for some acid which would dissolve the one precipitate and

* See Lond. and Ed. Phil. Mag. Jan. 1839, p. 78

not the other. Acetic acid is the only acid among the many that I tried, which answered this end. If a small quantity of dilute acetic acid (common acetic acid, diluted with five times its weight of water, was used) be poured upon the precipitate produced in the case of strontia, it will be completely dissolved; whereas no impression is made on that from the salts of baryta.

Acetic acid, so concentrated as to crystallize when its temperature was below 50°, was poured on the precipitated chromate of baryta, and a portion of it was taken up, but in no instance did any quantity of the acid dissolve the entire precipitate.

With the above means, there need not now remain the least doubt in ascertaining promptly, the presence of baryta in a salt of strontia supposed to contain it; for all that is necessary to be done, is to add to a solution of the salt, a solution of chromate of potassa, which, if baryta be present, will produce a light yellow precipitate insoluble in acetic acid.

This reagent will also serve to distinguish baryta from lime.

8. *Frozen Wells.*

To Professor Silliman,—*Dear Sir,*—There is a well near this village, which has drawn the attention of the scientific and curious for many years, but the phenomena which happen in it, have never yet been explained. I have taken some pains to ascertain the facts, and now communicate them to you, in hopes of hearing a scientific exposition of this apparent contradiction of nature's laws.

The well is excavated on a table of land, elevated about thirty feet above the bed of the Susquehanna River, and distant from it three-fourths of a mile. The depth of the well, from the surface to the bottom, is said to be seventy-seven feet; but for four or five months in the year, the surface of the water is frozen so solid as to be entirely useless to the inhabitants. On the twenty-third of the present month, in company with a friend, I measured the depth and found it to be sixty-one feet from the surface of the earth, to the ice which covers the water in the well, and this ice we found it impossible to break with a heavy iron weight attached to a rope. The sides of the well are nearly covered with masses of ice, which increasing in the descent, leave but about a foot space (in diameter) at the bottom. A thermometer let down to the bottom, sunk 38° in fifteen minutes, being 68° in the sun, and 30° at the bottom of the well. The well has been dug twenty-one years, and I am informed by a very credible person, who assisted in the excavation, that a man could not endure to work in it more than two hours at a time, even with extra clothing, although in the month of June, and the weather excessively hot. The ice remains until very late in the season, and is often drawn up in the months of June and July. Samuel Mathews drew from the well a large piece of ice on the 25th day of July, 1837, and it is common to find it there on the 4th of July.

The well is situated in the highway, about one mile northwest of the village of Owego, in the town and county of Tioga. There is no other well on that table of land, nor within sixty or eighty rods, and none that presents the same phenomenon. In the excavation, no rock or slate was thrown up, and the water is never affected by freshets, and is what is usually denominated "hard," or limestone water. A lighted candle being let down, the flame became agitated and thrown in one direction at the depth of thirty feet, but was quite still, and soon extinguished at the bottom. Feathers, down, or any light substance, when thrown in, sink with a rapid and accelerated motion.

The above facts may be relied upon as entirely correct, and a solution of the mystery is respectfully requested, by

Your obedient servant,

D. O. Macomber.

Owego, Feb. 26th, 1839, N. Lat. 42° 10′.

Remarks.—We wish it were in our power to solve this interesting and difficult problem.

At the depth of more than sixty feet, the water ought not to freeze at all, as it should have nearly the same temperature of that film of the earth's crust, which is at this place, affected by atmospheric variations, and solar influence, being of course not far from the medium temperature of the climate. Could we suppose that compressed gases, or a greatly compressed atmosphere were escaping from the water, or near it, this would indicate a source of cold; but as there is no such indication in the water, we cannot avail ourselves of this explanation, unless we were to suppose that the escape of compressed gas takes place deep in the earth, in the vicinity of the well and in proximity to the water that supplies it. Perhaps this view is countenanced by the blowing of the candle at the depth of thirty feet, blowing it to one side, thus indicating a jet of gas which might rise from the water as low as at its source, and even if it were carbonic acid, it might not extinguish the candle, while descending, as the gas would be much diluted by common air; and still in the progress of time, an accumulation of carbonic acid gas might take place at the surface of the water sufficient to extinguish a candle.

We would recommend that a bottle of water be let down, and by means of a string so affixed as to empty the water, and of course to collect the air both at the jet and at the surface of the water. It should then be examined by lime-water and by other well known methods. As the water is impregnated with carbonate of lime, this appears to indicate a source from which the carbonic acid gas (if such it be) is derived, and it may be forced into cavities as it is extricated until it is condensed to such a degree as to escape from its prison, and in expanding it may possibly produce the requisite cold.

9. *Ice formed at the bottom of a river.*—At the town of Scottsville, on the James river in Virginia, many cakes of solid ice have been seen adhering to the rocks at the bottom of the river, when the ice above had broken away, and often when none had been formed on the surface of the water. These collections of ice are usually formed in shallow places, where the water runs pretty rapidly, but have been observed two feet below the surface where the water moved along very gently. Ice has been taken out of this river, at the mouth of a small stream, to the bottom of which fragments of brickbats and particles of the soil, and grass of the bottom were attached, and this too, when the water there was two feet deep, the ice five or six inches thick, and formed apparently on the top of the stream. How to account for this undubitable fact, and for these partial crystallizations at the bottom, I am somewhat at a loss. By dropping one line of explanation, you will much oblige your sincere friend, Hugh W. Sheffey.

To Prof. Silliman.

Remarks.—Facts similar to those described by our correspondent, are not uncommon in cold countries, and have been often described in Germany, Great Britain and North America. In the Elbe, the fishermen are often annoyed by the ground ice on the bottom, which prevents them from fixing their anchors, and it is often brought up on the hooks instead of fish. The ground ice is found in the northern seas, at the depth of more than one hundred feet, and in the Baltic, at still greater depths. Flood gates are sometimes stopped by the ground ice and mills are thus locked in winter.

The ice sometimes rises to the surface, bringing up with it, mud, gravel, sticks, and even in some cases, anchors and large stones, thus proving that it is buoyant like common ice.

We have just now conversed with a gentleman, whose saw-mills in Allegany county, New York, on the Genessee river, are frequently stopped by the ground ice, which he remarks sometimes forms a foot in thickness.

In his opinion it forms on the surface, as it is seen, every where in the Genessee mixed with the water; but it is not easy to understand why it should sink, except it were carried down by eddies and currents. It is stated by Dr. Jas. Mease, (Edinb. Enc., article, Ice,) that the ground ice uniformly freezes at the bottom, before there is any ice on the top.

10. *Fossil fishes of the red sandstone.*—In our number for October last, we noticed the discovery of a single species of fossil fish, by Prof. Gale, in the red sandstone of New Jersey, and its apparent identity with an undescribed species of *Palæoniscus* found in the red sandstone formation of Connecticut, at Middletown. The locality has been further explored, and two fine specimens are now in the posses-

sion of Mr. Edward Renwick, Columbia College, one of which proves to be the *Catopterus gracilis* of Redfield,* and the other a strongly marked species of *Palæoniscus*, also found at Middletown. It appears, therefore, that most of the fossil fishes found in the Connecticut sandstone, prove to be identical with those which have been found in New Jersey. This discovery promises to be of some importance in settling the geological relations of these sandstone formations. R.

11. *Volborthite, a new Mineral.*—At the session on the 16th of March, 1838, of the St. Petersburgh Imperial Academy of Sciences, a notice by Dr. A. Volborth was presented on a new mineral containing vanadium.

The vanadic acid has hitherto been found only in Mexico, Scotland, and the eastern part of Russia, and in combination with lead in the form of vanadiate of lead. This new mineral, called Volborthite, was communicated to the author by Dr. Rauch, who had purchased it with other minerals, of M. de Solomirsky, from which he presumed that it came from the mines of Solomirsky, (Syssersk ?). It is a vanadiate of copper, and consists of a mass of minute conglobated crystals, of an olive color, and which are so small that their crystallographic characters cannot be well determined. Its fragments are translucid—transparent, with a crystalline lustre by reflected light. It scratches calcareous spar; *streak,* pale yellowish-green and nearly yellow: *gravity,* =3.55. It undoubtedly occurs in great abundance in the copper mines, between Miask and Katharinenburgh. Its gangue is Beresite.—*L'Institut,* (*Paris,*) *Dec.* 27, 1838.

12. *Reclamation of M. A. Warder, in a letter to Prof. Silliman, dated Springfield,* (*Ohio,*) *March* 8, 1839.—Much as I regret to occupy your valuable time, with any subject not strictly scientific, still, since the insertion in the last number of your valuable and highly interesting Journal, of J. G. Anthony's letter, with its implied censure, calculated to convey a false impression, I feel it due to my brother, Dr. J. A. Warder, to state, that the fossil trilobite described by him, had been in my possession many months, before I had an opportunity of presenting it to him to be described and named. I am aware that the priority of discovery, is of little consequence to the cause of science, and was submitted by Dr. Warder, to the decision of those, who were disinterested, in the very letter, of the July number, 1838, of which J. G. Anthony so unjustly complains; and I should not now trouble you, if I did not fear that the censure will be read without a reference to the letter from Dr. Warder.

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* Annals of the New York Lyceum of Natural History, vol. iv.

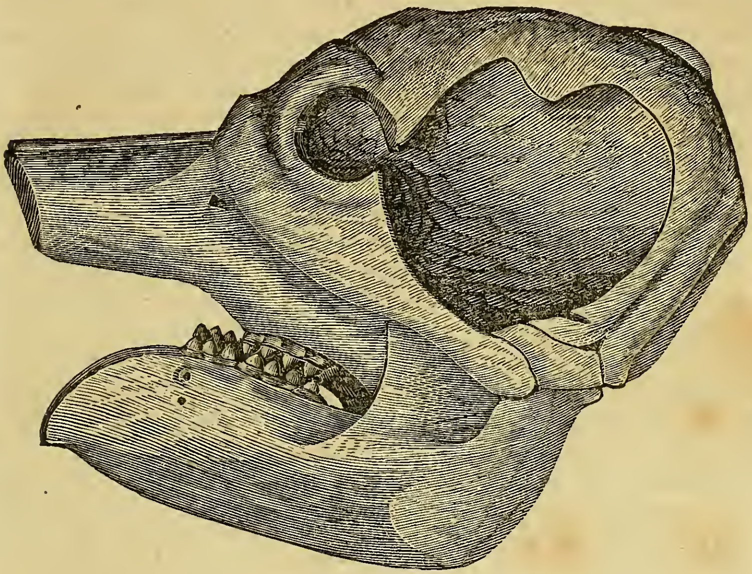
13. *Quantity of Salt in Sea Water ; by Dr. Daubeny.*

Locality.	Latitude.	Longitude.	Sp. gravity of the water.	Proportion of solid matter in 500 grs obtained by evaporation in a water bath.	Authority.
Atlantic Ocean,	Equator	23.° 0′ West,	1027.85	19. 6	Dr. Marcet.
South Atlantic,	21°.0′	0. 0	1028.19	20. 6	——
North Atlantic,	25.30	32. 30	1028.86	21. 3	——
Indian Ocean,	Equator	84. 0 East,	1026.00	19.00	Dr. Daubeny.
Do.	Do.	8. 16	1025.90	19.23	——
Do.	Do.	do. depth of 625 ft.	1027.47	20.88	——
Atlantic Ocean,	Do.	19. 30 West,	1026.70	19.10	——
Bay of Naples,	40.50	14. 15	1030.00	22.30	——
Marseilles.	43.17	5. 22	1031.00	23.10	——
Off Southampton	50.54	1. 24	1027.00	19.40	——
Water taken up during a voyage between Portsmouth and New York, in 1837.	49.38	2. 0 about	10267.26	20. 4	——
	49.10	4. 0	10269.08	. .	——
	49 28	6. 36	10269.99		——
	50. 5	9. 19	10269.99	20.95	——
	50. 0	12. 0	10269.99		——
	49.34	12. 7	10270.90	. .	——
	47.27	13. 35	10271.81		——
	48.50	15. 30	10271.81	20. 9	——
	48.40	17. 40	10271.81		——
	46.45	17. 34	10272.72		——
	44.40	20. 15	10272.72	20.85	——
	43.41	21. 42	10272.72		——
	43.43	24. 18	10275.45	21.00	——
	43.18	28. 38	10275.45		——
	43.30	32. 9	10274.54	. .	——
	44.45	33. 22	10272.72	. .	——
	45 12	34. 52	10273.63	. .	——
	45.36	37. 3	10271.81	. .	——
	45.40	40. 14	10269.08	. .	——
	42.49	45. 45	10272.72	. .	——
	41.10	48. 23	10254.52	. .	——
	41.30	50. 48	10249.06	18. 9	——
	42.30	52. 10	10249.06		——
	44. 0	53. 51	10249 97	. .	——
	42 52	57. 18	10248.15	. .	——
	42.52	57. 58	10249.06	. .	——
	42.35	62. 00	10254.28	18. 7	——
	41. 0	65. 43	10254 28		——
	40.40	67. 24	10256.34	. .	——
	39.50	69. 27	10249.06	. .	——
	39.27	71. 13	10265.44	19. 2	——
Off Sandy Hook,	. .	. .	10229.04		——
Drawn from a depth of 80 fathoms,	41.10	48. 23	10265.44	. .	——
do. of 100 fathoms	39.54	67. 34	10273.63	21. 0	——
Surface-water nearest to the above,	. .	. .	10254.28	18. 7	——
				2. 3 grs. difference.	——
Between Charleston and Havanna,	28.16	80. 0	10258.16	. .	——
	27.30	——	10277,27	. .	——
	24.40	——	10273.63	20.90	——
	23 28	——	10273.63		——
	23.15	——	10276.36	. .	——
Gulf of Mexico, between Havanna and N.Orleans	24.23	84. 30	10276.36	. .	——
	26.33	86. 47	10275 45	. .	——
	28.20	89. 00	10278.18	21. 1	——

14. *Head of the Mastodon Giganteum.*

To Prof. Silliman.—*Dear Sir*—Enclosed I send you a profile view of the head of the *Mastodon Giganteum.* The specimen from which the drawing is taken, was brought to light during the year 1838, in excavating a mill-race on the land of Mr. Hahn, near Bucyrus, Crawford County, Ohio, and is believed to be the most perfect one which has yet been discovered. We are thus enabled to complete the skeleton of this gigantic quadruped, the remains of which are so abundant throughout the western country.

Fig. 1.



Other portions of the skeleton were also exhumed. They were, according to Mr. Briggs,* as follows:

Head.—The entire head, with the exception of the tusks.

"*Vertebræ.*—6 Cervical; 6 Dorsal; 1 Lumbar; 5 Caudal.

Ribs.—28; 12 entire.

Pelvis.—The sacrum and the whole of the left side, and the ossa pubis, and part of the ossa ischium of the right side.

Extremities.—1 Os-femoris; 1 Tibia; 1 Fibula; 1 Radius; 1 Ulna; 2 Patellæ; 11 Bones of the feet."

I am also indebted to the same source for the measurements of the head and under jaw.

* Annual Report on the Geology of Ohio, pp. 127, 8 and 9.

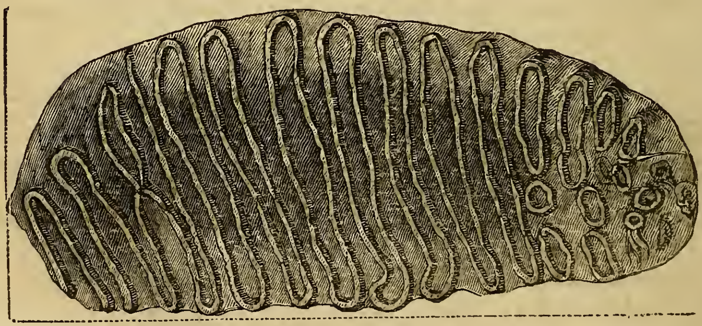
The greatest breadth of the head, formed by the occipital bone, is 24½ inches, and this bone extends nearly to the superior part of the head, a slight curve only being formed above it. This bone, which is 17½ inches in height, is very rough and uneven, presenting a proper surface for the insertion of large and powerful muscles necessary to support the enormous head of the animal. The distance from the base of the occipital bone, over the superior part of the head to the termination of the intermaxillary bones, is 57½ inches. The distance across the superior part of the head, between the temporal fossæ, is 15⅜ inches; while the greatest breadth of the head, formed by the zygomatic arches, is 27¼ inches. Thus large spaces are left within the temporal fossæ to be occupied by powerful muscles. The distance between the orbitary processes, over the anterior part of the head, is 22 inches. The interior diameter of the tusk sockets is 5½ inches.

The under jaw weighed, when taken from the earth, 69 pounds. Its length is 2 feet, 6¼ inches; and the distance from the top of the condyloid process to the angle of the jaw, is 12⅛ inches; while the articulating surface of this process is 5½ inches.

These bones were found in a bed of fresh-water marl, formed in a depression of a deposit of yellowish clay, which is a continuous deposit, occupying the western portion of the state. Beneath it, in geological position, occurs a deposit of dark blue clay, resting unconformably on the mountain limestone. These deposits are composed of finely divided particles, disposed in nearly horizontal layers, through which are interspersed pebbles of primary and secondary rocks. These superficial materials often attain a thickness of 150 or 200 feet.

The boulders, which are found so abundantly throughout the western part of Ohio, repose upon these materials, and are, therefore, a more recent formation.

Fig. 2.



I also send you a drawing of the crown of a molar tooth, (Fig. 2,) belonging to the fossil elephant, exhumed about two years since, in

Jackson County, by Mr. Briggs and myself. A more particular description of these bones is contained in this Journal, Vol. xxxiv, pp. 358–9. They were found in the blue clay before spoken of, which is lower in the geological series than the fresh-water marl.

The bones of the *Mastodon* and elephant have been found in juxtaposition, at Nashport, in Muskingum County, which establishes the fact, that they existed contemporaneously; but whether they disappeared from the face of the earth at the same epoch, is a matter of doubt. Yours, truly,

J. W. Foster.

Zanesville, Ohio, 14th Feb. 1839.

15. *Notice of the use of the fumes of Nitric Acid in Pulmonary diseases.*

[Extract of a letter to the senior Editor.]

Dear Sir—I cheerfully comply with your request, to make a statement of the facts in my possession, with regard to the use of *nitric acid* for pulmonary diseases. In the spring of 1833, Mr. Edwin E. Wells, now Rev. Mr. Wells of Huntington, U. C., had a severe cold upon his lungs, accompanied with a violent cough. The various prescriptions he employed, failed to afford relief, until at the earnest solicitation of a friend, he was induced to use the *nitric acid.* This removed the disease, and in a few days his health was perfectly restored.

The same spring, I was attacked in a manner similar to Mr. Wells, and being afraid of the *acid,* it was not until the usual remedies had failed, and my friends had become alarmed at my condition, that I consented to use it. When I did so, I found immediate relief.

In 1827, Mr. James H. Trowbridge of Plattsburgh, under similar circumstances experienced like happy results from the use of the acid.

The most remarkable case is, that of Mr. Gray of Utica; who first recommended the use of the acid to Mr. Wells. The account he gave of it was as follows. He had a cough with frequent and copious discharges of mucus and blood; he became much reduced, and it was thought that he was in the last stages of the consumption. At this time he commenced the use of the nitric acid, and immediately his health began to mend. When he related to me this fact, he was in perfect health.

The following is the mode of using the acid: Pour a small quantity upon a hot iron and inhale the fumes as they rise. Repeat this several times a day, until the disease is subdued. Mr. Gray said, that he, in addition to this, used to fill his bedroom with the fumes before going to bed. The immediate effect is to produce a spasmodic action of the throat and glottis, so that I suppose but a small part of the fumes enter the lungs.

After the first application, I experienced relief; the cough began to subside, and expectoration became free and easy. I believe I applied it but three or four times. In every case of using the acid in this application, with which I am acquainted, the effects have been happy.

Yours respectfully, David Judson.

New Haven, Feb. 14th, 1839.

Remark.—The late Mr. Elihu White of New York, related to us similar results obtained under his direction, but the event was not always favorable.—Sen. Ed.

16. *Greece.—Revival of Letters.*—We have received through our friends, the Rev. Mr. Robertson, episcopal missionary, and G. A. Perdicaris, Esq., an account of the formation of two societies in Athens.

One for the cultivation of Natural History.

Another for inquiries in archæology.

Both societies have entered upon their duties, and we have received pamphlets containing the constitution and doings of the Archæological Society, and the address made before that body. The speakers could not fail to catch the spirit of the occasion, for the meetings were held on the Acropolis, and among the columns of the Parthenon.

Well may they be indulged in the enthusiasm which they manifest on the recovery of their national liberty, and in contemplating the colossal and beautiful ruins around them, over which twenty-five centuries have winged their way, and left them still the admiration of mankind, despite of the tooth of time, and the more barbarous hand of war as well as the wanton aggressions of antiquaries.

The following extract of a letter from Mr. Perdicaris, dated, Athens, Sept. 1838, is addressed to Professor Silliman, and will, we doubt not, be perused with satisfaction by all admirers of Greece and of her antiquities. It is hardly necessary to add, that Mr. Perdicaris (a native of Greece, of the city of Berea, whose ancient inhabitants St. Paul styles noble) was many years a resident in this country, travelled and gave finished lectures in many of our cities, north and south, east and west, and was universally respected as a scholar, a patriot, and a man of talents and moral excellence.

Antiquities of Greece, &c.—"The antiquities of Greece have exerted no ordinary influence upon her destinies. Her rulers actuated by their reverence for her ruins, and envious to flatter the whims of the learned, decided upon bringing the *capital* of modern Greece to Athens, and by this simple act, have prejudiced the best interests of the dead and the living. The removal of the *capital* to Athens, has brought modern improvements into close contact with the matchless ruins of the ancients, and has deprived them not only of that solitude which is one of the chief charms of ruined temples, but has profaned the holy places of the dead with the abominations of the living. It has turned the sites of temples into *stables*, and in endeavoring to raise Athens from her ruins, it threatens to put her out of the record, by destroying that which constituted her chief characteristic—*her deserted and solitary ruins.* This plan has not only failed to attain its chief end, but it has produced consequences of a very mischievous nature to the interest of the Greeks. It brought the metropolis of the nation at a distance of *seven miles from the sea*, and has thus taken from the Greeks—what they might have had—a commercial metropolis. While the people of other countries are struggling for sites favorable to communication, and while the Greeks have such central positions and such ports as those of Corinth and the Piraeus, their rulers have brought them among ruins, and have thereby shown their love for deserted sites, to the neglect of commercial and political interests. This state of things is much to be regretted by those who delight in the present progress of the world; and while I wonder at the ill policy of the Greek government, I cannot deny the fact that untimely efforts have produced some good results. Mr. Petakes, the chief antiquary of the king, has been very active, and has succeeded in rescuing many fine works from the rubbish of time and barbarity. By the enthusiastic efforts of this individual, the ruins of the Acropolis, have assumed a new aspect, and the eye of the visitor now rests upon objects which a few years ago were buried beneath the ground. Nearly two-thirds of the Propylaia have been saved, and the entrance which of late had become a mere name, now presents a truly magnificent ruin. Besides, the beautiful little temple of Victory, without wings, which was to the right of the Propylaia, and which was entirely under ground, has been discovered, and restored to its just proportions. Many baso-relievos have been found around the different temples, and the museum is already enriched with many exquisite fragments of the plastic arts.

The efforts of the king's antiquarian, have been seconded by those of the Archæological Society of Athens, and they are both actuated by honorable emulation. The A. S. A. has proved itself very useful and is at present employed in the excavation of the theatre of Bacchus, which as you well know, is situated to the southeast of the Acropolis, and in its best days could accomodate thirty thousand spectators. The seats of this magnificent theatre being cut in the living rock, could not be affected by time, and there is reason to believe that the greater part, if not the whole of them will be laid open to the eyes. It is difficult to predict whether they will find the well known spring of water, but even if they were to fail in this, the clearing of the seats and its vast area will be a sufficient recompense. The cave at the termination of the seats, and half way up the Acropolis is still to be seen, and is singular for the changes it has witnessed, and interesting for the associations that cluster around it. It seems to be a joint work of nature and art, and it is difficult to say which of the two has had the greater agency in giving it its present shape.

The rock in this cave is hard limestone, but half way up the interior, there is a stratum which resembles the congealed rock of Malta, and which has the lines of the agate. In the upper part of the cave there are two marble pillars, which formerly supported tripods, but which at present stands like two sentinels over a spot sacred to genius and the tragic muse.

Lest you should think that excavations are the only thing we attend to here, I would beg leave to inform you, that we are equally busy in other matters. The cause of education, of justice and of civil government, is making some progress; and Greece, though struggling with many an impediment, is still indulging in the hope of success, and we may yet live to see the day which will reward her by the attainment of the object of all her efforts, the happiness of her people.

17. *Tongueless Dog retaining the power of barking.*—I have a favorite spaniel dog of the "king Charles breed," thirteen years old, and as he cannot relate a "tale of wo" of himself, I propose to do so for him, in as few words as possible.

In June last, in a small steel trap, set in the cellar, for the purpose of taking rats, he was accidentally caught at about midway of the tongue, and in this situation he remained about three-fourths of an hour. On examination after he was extricated, the tongue was found started out of its natural position in the mouth, some four inches. Every thing was done to relieve his sufferings, and in the hopes that the tongue would again adhere to its former position in the mouth, but the tongue being much mutilated, was found after a lapse of forty-eight hours, the weather being warm, to have become perfectly black; at this time the "poor old dog" exhibited a desire to leave his kennel, which he was permitted to do, and he went direct for the ocean, where he "cooled the fever of his blood" by a swim; he thence went away and was absent alone about half an hour, when he returned to his kennel perfectly tongueless, having as was supposed, torn out his own tongue, by putting his paws upon it, as he had before been seen to do. He was fed during the time upon boiled rice and soup, and ate the usual quantity, on his head being held up so that the food would run down his throat. Necessity is said to be the mother of invention, which seems to have been verified in this case, as the "old favorite" now feeds himself as well as he ever did, upon every variety of food; drinks as well as ever, although after the manner of a pig, by running his nose more than usual into the water, and what seems still more remarkable, he barks with the same distinctness as usual, on the least intrusion upon his premises in the night time, as he did before the loss of his tongue, and is in all respects seems as well as he was previous to the accident.

Boston, Aug., 1838.—*Extract of a letter to the Editors.*

18. *Officers of the New York Lyceum of Natural History, elected February 25th*, 1839.

Joseph Delafield, *President.*
John Torrey, 1st *Vice President.*
John Augustine Smith, 2d *Vice President.*
John C. Jay, *Treasurer.*
John H. Redfield, *Corresponding Secretary.*
Robert H. Browne, *Recording Secretary.*
Issacher Cozzens, *Librarian.*

Joseph Delafield, James E. De Kay, John C. Jay, Robert H. Browne, H. C. De Rham, *Curators.*

John Torrey, Abraham Halsey, Joseph Delafield, James E. De Kay John C. Jay, *Committee of Publication.*

John Augustine Smith, Joseph Delafield, William C. Redfield, John C. Jay, Abraham Halsey, *Committee of Nomination.*

H. W. Field, A. R. Thomson, Samuel T. Carey, *Committee of Finance.*

James E. De Kay, William C. Redfield, Robert H. Browne, *Library Committee.*

19. *Royal Society of London—honor to an eminent scientific artist.*—The chronometers of London, as well the excellent artists who make them, are famous the world over; among them, Messrs. Parkinson and Frodsham, are conspicuous, and their chronometers have been proved extremely accurate in voyages to the arctic regions, as well as to other parts of the world. Mr. W. I. Frodsham of this firm has been recently elected (as we observe by a London newspaper) a Fellow of the Royal Society, an honor which appears peculiarly appropriate in the case of artists, who by the construction of fine instruments, contribute the most important aid to scientific discovery, and not a few of these artists deserve the name of philosophers.

20. *Progress of the U. S. Exploring Expedition.*—The Exploring Squadron, of which we gave an account in our last volume, arrived at Madeira, on the 18th of Sept. 1838, having left Norfolk on the 18th of August. These ships sailed from Madeira, Sept. 24th, and Oct. 6th, entered Porto Praya, St. Jago, one of the Cape de Verd Islands. On the 7th of October, they sailed for Rio Janeiro, S. A., at which place they arrived on the 22d of November. From this port they sailed for the south on the 8th of January, 1839, and were spoken on the 18th of January in latitude 36° 40′ S., ten days from Rio Janeiro.

21. *Prof. J. W. Webster's Manual of Chemistry, new edition.*—Marsh, Capen & Lyon have in the press, " A Manual of Practical Chemistry, on

the basis of Brande and Turner; containing the principal facts of the science, arranged in the order in which they are discussed and illustrated in the lectures at Harvard University, and various Colleges and Medical Schools in the United States: by J. W. Webster, M. D., Erving Professor of Chemistry in Harvard College. The *third edition,* with numerous additions and alterations, adapted to the present state of the science."

The reputation of this work is well known, the two former editions having been adopted as the text book in many Colleges and Institutions throughout this country. The present edition has been carefully revised, and rendered of a still more practical character than the preceding ones, and many new engravings and other improvements introduced. The publishers would refer those who are not already acquainted with the work, to the 11th Vol. of the American Journal of Science, for a notice of it, and to the Preface to Prof. Silliman's Chemistry, in which he remarks, "few books on Chemistry, contain so much important information."

Orders for parts as published, or for the entire work, may be addressed to the Publishers, *No.* 133, *Washington St., Boston.*

anuary, 1839.

22. *Notice of a new mode of preparing Fish Skins for Museums; by* by Charles Fox.—(Communicated for this Journal.)—However desirable it may be to possess good collections of the skins of fishes, as of birds and other animals, hitherto there has been some difficulty both in preserving them, and making them look natural.

The old mode of stuffing fishes, is too laborious and expensive, ever to be carried generally into effect; and the consequence is, that we find fewer specimens of fishes in collections of natural history than of any of the other branches of that science. At the late meeting of the British Association for the advancement of science in Newcastle upon Tyne, a novel mode was proposed by a physician, which combines both facility, speed in execution, and a good appearance; besides which the expense is little more than the original purchase of the specimen. As this is but slightly noticed in the published reports, I am induced to send you a further account of the process, hoping that it may prove useful.

The plan is to cut the fish longitudinally in two, parallel to and a little on one side of the dorsal fin, to take the larger part and clean the flesh entirely off it. The head is also to be cut in like manner, *nearly* to the mouth, which, however, is to be left entire. Thus, when done, there is the skin of exactly half a fish, and half the bones of the head. This having been accomplished,—and a little practice will enable any one to do it with ease, in an ordinary sized specimen, in a few minutes,—all that remains, is to pin it upon a board or piece of card; placing cotton below so as to keep the skin in its original shape, and in this way to let it dry. The writer has found the top of a common paste-board hat box, most convenient for small specimens, as having a rim which allows the pins to pass through without hitting the table. In this process the fins should be carefully extended, and nicely fastened with small pins. When quite dry, it may be removed and placed upon a thin piece of board covered with white paper, or otherwise as may suit the fancy; fastened on with a little glue; and a thin coat of varnish rubbed over it. In this state, it has the natural appearance of a fish swimming; and as no chemical substance, except a little powdered arsenic rubbed inside, or should it be preferred, a thin coat of *diluted* corrosive sublimate, is necessary to preserve it, the skin is not so subject to fading as otherwise. The eye is to be left in, which when dry gives the entire specimen as in nature.

There are several specimens thus prepared, at present placed in the museum of the Zoölogical Society in London; and both their appearance, and the facility that they offer for scientific examination, recommend them far above those stuffed in any other manner.

Should it be required to pack and carry such skins, it is better to leave the finishing and varnishing to be done when they reach their destination. They will travel with perfect safety if laid together without pressure; and a piece of thin paper be placed between each couple.

Of the fishes of this country,—many of which are both very interesting and beautiful,—we have as yet, no good public collection. May it not be hoped, that now, since they can be preserved with so much facility, it will not be long before the commoner species, at least, will be brought together in one museum, for scientific use.*

23. *An Elementary Treatise on Astronomy; by William A. Norton, late Professor of Natural Philosophy and Astronomy in the University of New York.* 1839. 8vo. pp. 373, and 112 of tables.—This work is designed by the author, chiefly for the use of students in the higher institutions of learning. It is, however, more comprehensive than books of this kind commonly are, and is furnished with a collection of tables and formulæ, that it may also be of use to the practical astronomer. The work consists of four parts; of which, the first treats of the determination of the situations and motions of the heavenly bodies; the second, of the magnitudes

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* Being recently in England, I found that the topic was creating a good deal of conversation among scientific men and collectors; and I think this mode of preserving fishes, may, from its great simplicity, do good here. The specimens I saw were really beautiful; and came as near to nature, as the subject appears to permit. Of course, as in all other things, practice is requisite to render it perfect. We understand that this method has been, for some time, put in practice in the Academy of Natural Sciences in Philadelphia, by Mr. Townsend.

and physical constitution of these bodies, and of the phenomena resulting from their motions; and the third, of the theory of gravitation. The fourth part is composed of problems in practical astronomy, to be solved by means of the tables that are given at the end of the treatise. Under the first of these four divisions, the author treats of the construction and use of the more important astronomical instruments, gives the theory of corrections, and then applies Kepler's laws to the determination of the places and motions of the bodies in the solar system; a chapter also is here added on the measurement of time. The subject of eclipses and occultations falls of course under the second division. It will perhaps be thought by some, that the department of physical astronomy, which forms the author's third division, might have occupied, with advantage, a somewhat larger portion of his work. In elementary treatises on astronomy, designed for students, this branch of the subject has, we think, not generally held that degree of prominence which it deserves, as a highly useful means of mental discipline.

So far as we have been able to examine the treatise of Prof. Norton, it has appeared to us an accurate and well digested work; and, accompanied as it is with a valuable collection of astronomical tables, we think it can hardly fail to be well received by the public.

24. *Postscript to p.* 71.—The remarks on the subject of the rocks of the western part of the state of New York, being all secondary, require some explanation. According to Buckland they are mostly transition, also most of the Cattskill and Allegany Mountains; because he does not admit a class of lower secondary rocks. See Bridgewater Treatise, Vol. I, p. 55. According to Conybeare and others, the encrinal limerock is a lower secondary rock. See pp. 352 to 356. But this appears to be an error, arising from his considering the transition *encrinal* and the *cherty*, as the same rock. That the rock at Fort Plain, on the Erie Canal, is the genuine *encrinal limerock* of Conybeare, no one will question, who follows up the Otsquago Creek one mile. I could refer geologists to numerous localities. No Europeon geologist, who admits a lower secondary class, would include in the transition class, any rock in the state of New York, west of the counties of Oswego, Oneida, Montgomery, Schenectady, Albany, Greene, and Ulster, if he was convinced, that the *encrinal limerock* is that which extends through Amsterdam, Fort Plain, Trenton Falls, &c. to Sackett's Harbor on Lake Ontario. A. E.

25. *The Mammoth,* (*Mastodon? Eds.*)—The following statement is so interesting and important that we give it a place, although it is deficient in responsibility. We resquest the unknown author to communicate with us directly; and having made a similar experiment successfully, in a very

similar case, that of an anonymous correspondent, in relation to Big Bone Lick, Kentucky, (see Vol. xx. p. 372,) we are encouraged to try a similar expedient again. We have copied the article from the Philadelphia Presbyterian of Jan. 12, 1839.

"It is with the greatest pleasure, the writer of this article can state, from personal knowledge, that one of the largest of these animals has actually been stoned and buried by Indians, as appears from implements found among the ashes, cinders, and half burned wood and bones of the animal. The circumstances are as follows:

"A farmer in Gasconade county, Missouri, lat. 38° 20′ N. lon. 92° W., wished to improve his spring, and in doing so, discovered, about five feet beneath the surface, a part of the back and hip bone. Of this I was informed by Mr. Wash, and not doubting but the whole, or nearly the whole skeleton might be discovered, I went there and found as had been stated, also a knife made of stone. I immediately commenced opening a much larger space; the first layer of earth was a vegetable mould, then a blue clay, then sand and blue clay. I found a large quantity of pieces of rocks, weighing from two to twenty-five pounds each, evidently thrown there with the intention of hitting some object. It is necessary to remark, that not the least sign of rocks or gravel is to be found nearer than from four to five hundred yards; and that these pieces were broken from larger rocks, and consequently carried here for some express purpose. After passing through these rocks, I came to a layer of vegetable mould; on the surface of this was found the first blue bone, with this a spear and axe; the spear corresponds precisely with our common Indian spear, the axe is different from any one I have seen. Also on this earth was ashes, nearly from six inches to one foot in depth, intermixed with burned wood, and burned bones, broken spears, axes, knives, &c. The fire appeared to have been the largest on the head and neck of the animal, as the ashes and coals were much deeper here than in the rest of the body; the skull was quite perfect, but so much burned, that it crumbled to dust on the least touch; two feet from this, was found two teeth broken off from the jaw, but mashed entirely to pieces. By putting them together, they showed the animal to have been much larger than any heretofore discovered. It appeared by the situation of the skeleton, that the animal had been sunk with its hind feet in the mud and water, and unable to extricate itself, had fallen on its right side, and in that situation was found and killed as above described, consequently the hind and fore foot on the right side, were sunk deeper in the mud, and thereby saved from the effects of the fire; therefore I was able to preserve the whole of the hind foot to the very last joint, and the fore foot all but some few small bones, that were too much decayed to be worth saving. Also between the rocks that had sunk through the ashes, was found large pieces of skin, that appeared like fresh tanned sole leather, strongly impregnated with the ley from the ashes, and a great many of the sinews and arteries were plain to be seen on the earth and rocks, but in such a state as not to be moved, excepting in small pieces, the size of a hand, which are now preserved in spirits.

Should any doubts arise in the mind of the reader, of the correctness of the above statement, he can be referred to more than twenty witnesses, who were present at the time of digging.—*Phil. Presbyterian.*

26. *Discovery of Mummies at Durango, Mexico.*—A million of mummies, it is stated, have lately been discovered in the environs of Durango, in Mexico. They are in a sitting posture, but have the same wrappings, bands and ornaments as the Egyptians; among them was found a poignard of flint, with a sculptured handle, chaplets, necklaces, &c., of alternately colored beads, fragments of bones polished like ivory, fine worked elastic tissues, (probably our modern India Rubber cloth,) moccasins worked like those of our Indians, bones of vipers, &c. It is unknown what kind of embalming was used, for the mummies above mentioned, or whether they were preserved by nitrous depositions in the caves where they were found. A fact of importance is stated, that necklaces are of a marine shell found at Zacatecas, on the Pacific, where the Columbus of their forefathers probably therefore landed from Hindostan or from the Malay, or Chinese coast, or from their islands in the Indian ocean.—*Ib.*

27. *Parallax of the star* 61 *Cygni.*—A letter from Prof. F. W. Bessel to Sir J. Herschel, dated Königsberg, Oct. 23, 1838, (contained in the Lond. and Ed. Phil. Mag. Jan. 1839,) gives an account of observations which he has made with the assistance of the excellent instruments of the Königsberg Observatory, which in his view, authorize the conclusion that the double star 61 Cygni has an annual parallax of 0′.3136. The summing up of this important communication, we give in the writer's own words.

"As the mean error of the annual parallax of 61 *Cygni* (=0″.3136) is only ±0″.0202, and consequently not $\frac{1}{15}$ of its value computed; and as these comparisons show that the progress of the influence of the parallax, which the observations indicate, follows the theory as nearly as can be expected considering its smallness; we can no longer doubt that this parallax is sensible. Assuming it 0″.3136, we find the distance of the star 61 *Cygni* from the sun 657700 mean distances of the earth from the sun: light employs 10.3 years to traverse this distance. As the annual proper motion of *α Cygni* amounts to 5″.123 of a great circle, the *relative* motion of this star and the sun must be considerably more than sixteen semi-diameters of the earth's orbit, and the star must have a constant aberration of more than 52." When we shall have succeeded in determining the elements of the motion of both the stars forming the double star, round their common centre of gravity, we shall be able also to determine the sum of their masses. I have attentively considered the preceding observations of the relative positions; but I consider them as yet very inadequate to afford the elements of the orbit. I consider them sufficient only to show that the annual angular motion is somewhere about $\frac{2}{3}$ of a degree; and that the distance, at the beginning of this century, had a minimum of about 15″. We are enabled hence to conclude that the time of a revolution is more than 540 years, and that the semi-major axis of the orbit is seen under an angle of more than 15″. If, however, we proceed from these numbers, which are merely *limits,* we find the sum of the masses of both stars less than half the sun's mass. But this point, which is deserving of attention, cannot be established until the observations shall be sufficient to determine the elements accurately. When long continued observations of the places which the double star occupies amongst the small stars which surround it, shall have led to the knowledge of its centre of gravity, we shall be enabled to determine the two masses separately. But we cannot anticipate the time of these further researches."

28. *Ornithology of the United States*, the descriptive part by J. K. Townsend; the drawings from nature by French artists, Philadelphia, published by J. B. Chevalier, 1839, Vol. I., part 1, large 8vo.

The prospectus states that this work will be published in monthly parts, and each part will contain four plates, or eight birds, with sixteen pages of descriptive matter. Twelve numbers will complete a volume of forty-eight plates, or ninety-six birds, with two hundred pages of letter press. Five volumes will complete the work, the price, one dollar and twenty-five cents each number, or about $60 for the work when complete.

The figures are reduced, and not drawn or colored in the highest style of lithographic plates, but sufficiently well for all purposes of the ornithologist. The text is simple and unaffected, and the descriptions accurate.

29. *Third American from the fifth English edition of Bakewell's Geology.*—In our last number, (Vol. xxxv. p. 385,) we mentioned the new American edition of Bakewell's Geology, by B. & W. Noyes, of New Haven. The entire work extends to 596 pages, 8vo., of which the appendix by Prof. Silliman, occupies 122 pages.

There are nine plates, six of which are folded, and more than thirty wood cuts.

This American edition is printed with a large clear and legible type, and upon white paper. American paper, as it appears particularly in the reprints of foreign works, is still decidedly inferior to English paper, both in the quality of the material and the firmness and beauty of the fabric. If, however, we look back a few years, we find the English paper, especially in their common and periodical works, inferior to the American paper of the present period, and we have no doubt that as soon as the American public will pay for the best paper, it will be furnished by our manufacturers as has already been done in some cases.

The entire volume of Mr. Bakewell, as published by Messrs. Noyes, is very handsome, and it is bound with an open back and strong cloth covers, not needing to be re-bound. The retail price is $3.50.

We have already spoken of the contents of the work, and it is not for us to speak of the American Appendix. That addition can be read or omitted as may be agreeable to the reader, although it is supposed, that the topics discussed in it may be acceptable to some. The editor has not disturbed the author's work. From this kind of license he has, when acting as editor, always abstained; conceiving that an author's production is sacredly his own, and that no one has any right to mutilate his pages. We believe the present edition of Bakewell's Geology, to be a valuable addition to our geological literature. In connection with Mr. Lyell's works, and those of Dr. La Beche, already republished in this country, and the Wonders of Geology, of Dr. Mantell, which will soon appear in their London garb, but under American patronage, and at a moderate price; our sources of elementary information will be as ample as can be desired, while our local surveys, and the able reports describing them, are adding daily to our knowledge, of the facts most interesting to our prosperity, and to our progress in this branch of science.

30. *Chemistry of Organic Bodies and Vegetables, by Thomas Thomson, M. D., &c. &c. &c.*—This elaborate work is a part of the system of Dr. Thomson, of which that relating to heat and electricity, 1 vol. 8vo., and the chemistry of inorganic matter, 2 vols. 8vo., appeared some years ago, followed by that on mineralogy, geology, and mineral analysis, 2 vols. 8vo.; and now we have another volume on the chemistry of vegetable substances, in 1 vol. 8vo., of more than 1000 pages. To this the indefatigable author will still add another on the chemistry of animal matter, and thus the circle of his works will be completed in seven volumes, most of them large and full.

This learned author will then have been about forty years before the public, and no one in Great Britain has contributed more than he has done to promote the progress of chemical knowledge.

Always patient, laborious, vigilant and learned, he has risen above the attacks (sometimes virulent and abusive) that have been made upon him, and stands like a rock in the ocean, unmoved amidst the winds and the waves.

The volume on vegetable analysis is a compendium of the discoveries, principally continental, and still more appropriately German, Prussian, and French, which have been made within a small number of years.

Some of them are exceedingly remarkable and interesting; but the entire series of vegetable proximate principles is appalling from their number and from the copious vocabulary of new terms which have been introduced. We hardly know whether to congratulate the young student on the vast accumulation of facts, especially in vegetable chemistry, although in a degree, the remark may be extended to all the branches of the science. Let a beginner look at it as it now stands in the great works of Thénard, Dumas, Schubart, Mitscherlich, Berzelius, and Thomson, and he will feel that a great labor is before him merely to *know* what others have done, still more to *follow them* with experimental research, and most of all, to pass beyond them and enlarge the boundaries of the science.

The period has already arrived when it is and must be taught *by selection*, and it will be a happy result should the time ever come, when it may be presented by a teacher under general principles, with no more facts than are necessary to illustrate the principles, leaving the immense encyclopedia of the literature of chemistry, like the store houses of the other sciences, to be explored as far as occasion may require, without compelling the professor to lead, and the pupil to follow, through every maze of the vast labyrinth.

If the full detail of facts is still to be given, the science must be divided under different professors and comprised in several courses constituting a system.

31. *Olmsted's Introduction to Astronomy.*—Professor Olmsted has in press, an elementary work on Astronomy, for the use of the students of Yale College, designed as a sequel to his Text Book on Natural Philosophy. Illustrated by numerous wood cuts and copper-plate engravings. 1 vol. 8vo., pp. 350.

32. *Temperature of the Earth.*—The following observations were made by Dr. Magnus with his *Geothermometer*, on the temperature of a bore sunk by M. C. V. Wulffen, at Pitzpuhl, near Burg, about nine English miles from Magdeburgh:

At a depth of	150	feet,	the temperature was	49.77 F.
"	200	"	"	50.67
"	250	"	"	51.8
"	300	"	"	53.15
"	350	"	"	54.61
"	400	"	"	55.62
"	457	"	"	56.63

The bore was provided with iron tubes to the depth of 427 feet; but when the observations were made, the portion below the tubes had already become so filled up with mud, that it was impossible to cause the thermometer to descend farther than 457 feet. The increase of temperature in this bore was pretty regularly 2°.25 F. for every 100 feet. The deepest observation was at a point more than 200 feet below the level of the sea; for the place where the bore begins, lies 111 feet above the level of the *Pegel* near Magdeburgh, which itself is about the same height at Berlin, whose elevation above the Baltic has been lately determined to be 108°.5 Rhenish feet.—(Poggendorff's Annalen, vol. xl. p. 145.)—*Edinburgh New Philosophical Journal, July*, 1838.

33. *Subterranean Temperatures.*—M. Walferdin has communicated a notice to the Academy of Sciences, on a pit sunk by M. Mulot at St. André (*départment de l'Eure,*) and on observations of temperature made in that pit, at a depth of 830 English feet. The sinking has been carried to a depth of 862 feet, without any spouting spring being met with. The following is the series of substances traversed, together with their thickness:

	Ft.	In.
Plastic clay, ...	44	5
White chalk, ...	400	6
Chalk marl, ...	95	9
Glauconite, ...	45	4
Green sand, ...	276	9
	862	10

M. Walferdin made an observation on the temperature at a depth of 830 feet in this pit on the 18th of June last. Two of his *thermomètres à déversement* were set down, each enclosed in a glass tube, sealed by the lamp at its two extremities; and after a period of ten hours, the one was found to indicate 64°.32 F., and the other 64°.27 F. The mean temperature of the plateau of St. André being unknown, M. Walferdin has taken as his point of departure, the temperature of the only pit existing in the *commune*, which he has found to be 53°.96 F. at a depth of 246 feet. By calculating, according to these data, the increase of temperature with the depth, we find it to be 1°.8 F. for every 101 feet 6.55 inches. M. Walferdin compares this result with those obtained previously from observations made in the pit sunk at Grenelle, and in that of the Military School, adopting as a point of departure, the constant temperature (53°.24) of the cellars of the observatory, at a depth of 91 feet 10 inches. Two experiments, made at different times in the pit of Grenelle, at a depth of 1312 feet 4.31 inches, give for 1°.8 F. 103 feet 3.17 inches, and 101 feet 3.39 inches. In the pit at the Military School, (also sunk in chalk,) and distant about 1968 feet from the pit of Grenelle, at a depth of 567 feet 7 inches, the temperature was found to be 61°.52 F., thus giving for 1°.8 F. 101 feet 2.6 inches. It thus results from observations made at various depths of from 567 feet to 1312 feet, that the rate according to which the temperature increases with the depth *in the chalk formation*, appears to be regular in the Paris basin It would be important to ascertain, by experiments made with care, if, in the middle and lower parts of the secondary formations, the temperature increases with the depth at the same rate; and M. Walferdin now proposes to direct his attention to this point.—*Comptes Rendus*, 16*th Avril*, 1838.—*Ib.*

34. *Extract of a Letter from M. Erman, junior, to M. Arago, upon the Temperature of the Ground in Siberia.*—I hope you will look with some interest at those parts of my historical journal which treat of the climate of Northern Asia; and in relation to this subject, I beg to direct your attention to the 242d and following pages. I have there given the result of the data obtained regarding the climate of the town of Jakouzk. The depth of a well which M. Schergin, a merchant in the town, had then excavated to the depth of 50 feet (English,) in the hope of finally reaching strata which were not frozen, and which would be capable of supplying water, was always, when I made trial, at the temperature of — 6° R. equal to 18°.5 Fahr. The temperature of the surface of the soil should not at the time have exceeded this degree of cold, since the latitude of the place was 62° 1′ 29″. This result appeared to me eminently paradoxical; but I have since confirmed it, by calculating observations made on the temperature of the air in the same town, during many consecutive years, with thermometers which I have carefully compared with my own. Some results are subjoined:

Mean month of	6 A. M.	2 P. M.	9 P. M.
January, .	—32°.8 F.	—30°.77 F.	—31°.9 F.
February, .	—44.50	—36.4	—41.8
March, .	—17.27	+ 1.63	— 7.82
April, . .	+ 8.15	+30.43	+17.15
May, . .	+35.82	+47.30	+37.62
June, . .	+54.27	+67.77	+53.60
July, . .	+64.40	+79.70	+61.70
August, .	+57.22	+72.72	+58.32
September, .	+38.75	+50.00	+40.55
October, .	+11.30	+21.20	+13.33
November, .	—13.45	— 9.17	—12.77
December, .	—42.92	—39.77	—42.02

You will conclude from these observations, as I have in the accompanying volume, that *the mean temperature at Jakouzk is perfectly in accordance with the temperature of the upper strata, which I have observed, by taking my thermometer to a depth of* 50 *feet* (*English*) *below the surface.* This being the case, it necessarily follows, that in boring deeper, unfrozen strata will not be reached till the increase of heat resulting from the approach to the centre of the globe shall amount to 6° R., equal to $45\frac{1}{2}$° Fahr. The experiments which have hitherto been made in the pits of Europe, and those which I have made in the Oural mines, carry this increase to 1° R. = 2°.25 F. for every 90 or 100 French = 96 or 106 English feet. Hence, I do not expect the unfreezing at Jakouzk at a less depth than 500 or 600 French feet = 533 or 639 English feet. The observations which M. Schergin has made since my departure from Jakouzk, and during which they have descended to a depth of 400 English feet, perfectly confirm what I have advanced concerning the mean temperature of the air and soil of this locality; for they have since found at

the depth of	77	feet, English,	a temperature of	+ 19°.63 Fahr.
"	119	"	"	+ 23.00
"	382	"	"	+ 30.88

They also indicate, for the strata occurring in this country, an increase of heat in the ratio of 1° R. = 2°.25 F. to about 60 feet, English; that is to say, a much more rapid augmentation than has been observed elsewhere. The only method, as it occurs to me, in which we can explain this phenomenon, is by attributing to the upper strata over Northern Asia a greater conducting power of heat than the other parts of the globe, which we inhabit; and this result will be the more striking, as it comes in some degree to support another result of the same kind. In fact, the excessive variations of temperature which have been observed at Jakouzk, and in other parts of Eastern Siberia, during the course of the solar year, lead us to the conclusion, that the earth's surface is there endowed with a radiating and thermal power much superior to that of Europe.—*Comptes Rendus*, 16*th Avril*, 1838.—*Ib.*

35. *Analogy between the organic structure and red color of the globules in the blood of animals, and of those red vegetable globules named Protococcus kermesinus.*—In a memoir read by M. Turpin to the Academy of Sciences, on globules in animal fluids, we find the following observations:—What has just been stated, regarding the presence of smaller red globules in globules of the blood, is perfectly explained by the very analogous structure of those small red vegeta-

bles, globulous and vesicular, so generally distributed throughout nature, and which often tinge with a blood-red color, the surface of calcareous rocks—the surface of water, both fresh and salt—snow and ice—the crystals of sea-salt—and, finally, as we proceed immediately to observe, the translucent and colorless substance of red agates; vegetables which are more particularly designated by the names of *Protococcus nivalis*, *Protococcus kermesinus*, Agardh, and *Hœmatococcus*, &c. These small vegetables, though larger by a half than the globules of the blood, still have with them a great analogy as it regards their organization, and probably also their chemical composition. A transparent and colorless vesicle, (or perhaps two, the one included in the other,) perfectly spherical, and filled with red and reproducing globules, forms the whole of the organization of these small vesicular vegetables, which, with some other analogous ones, mark the first efforts of organization, and seem to be nothing more than first attempts, or the representatives of the elementary or constituent organs of the cellular masses of more complex vegetables and animals. When the minute internal globules of these small vegetables begin to increase within the maternal vesicle, to become reproductive seminules, they cause the vesicle to assume very much the mammillated aspect of a strawberry. According to this mode of development, is it not probable that those blood-globules, of animals which, on account of their shape, are called strawberry globules, are also produced by the increase of a certain number of the red globules which they contain? All my microscopic researches compel me not only to admit this analogy, but likewise to think that the red globules of the globules of the blood are the seminules of those organized bodies which are destined to replace, and sometimes to multiply, the old globules of the blood, as they become extinct and cease to live, as individuals, in the midst of the serum which serves as their habitation, and in which they procure their nourishment.—*Ib.*

36. *Cause of the Red Color of Agates.*—The red color of agates is owing to a number, greater or smaller, of *Protococcus kermesinus* accumulated together, or more frequently reduced to their small red globules (seminules) agglomerated or coagulated, and distributed, according to certain circumstances, in the colorless structure of these siliceous compounds. Since we have now been considering, analogically, those innumerable *Proctococcus kermesinus*, and the red globules they contain, I beg leave to add, that microscopic and comparative investigations which I have recently made, and which I purpose to publish elsewere in all their details, have clearly demonstrated, that the various colors, rose, orange, blood-red, and reddish-brown, (varieties

owing to a more advanced growth,) which are inclosed in, or which surround, the translucid and colorless structure of different kinds of agates, were found to be owing to the presence either of red globules uniformly mixed, as in the carnelian agate; or agglomerated into small irregular clots, and distributed into circular waves, according to certain forms or conditions which existed at the time of the siliceous conglomeration; or finally, though more rarely, to these small red vegetables themselves, quite entire, and with perfect distinctness visible with the microscope. It is impossible to find a resemblance in color and polish more striking than that which is seen in a white glass phial filled with *Protococcus kermesinus*, when compared with a carnelian, as may be fully established by the trial.—(*M. Turpin.*)—*Ib.*

37. *Phosphorescence of the Ocean.*—The naturalists of *La Bonite* in her late voyage round the globe, have made many observations respecting marine phosphorescence, which are thus reported to the *French Academy of Sciences.*—Many observations made upon phosphorescent water, by means of reagents, of filtration, boiling, simple examination, and with the help of the microscope, have led us to the following conclusions. The phosphorescent property of sea-water is not inherent in the nature of this liquid, but is essentially owing to the presence of organized beings. The animals which produce the phosphorescence belong to different classes. In the first rank, we find the minute species of crustacea which swarm in the sea, but especially a very small species having two valves, which possess this remarkable property in the highest degree. All these species have been collected, and carefully preserved in alcohol. Many mollusca, principally small *Cephalopodes pelagiens*, *Biphores* (Salpae,) &c., and also many zoophytes, among which we remark *Diphyes*, Medusæ, &c., also possess the phosphorescent property. Finally, in certain localities, we also find on the surface of the ocean, very small yellowish bodies which are nevertheless extremely phosphorescent. We have encountered these small bodies in immense abundance when landing at the Sandwich Isles, and in crossing from this archipelago to the Marianne Islands. We encountered them in such vast quantities at the Straits of Malacca, and upon the coast of Pulo-Penang, that the whole surface for a great extent appeared covered by a thick yellowish dust. These small bodies have been examined with the microscope; but although they have been for a long time submitted to our notice, we have never been able to detect the slightest movement connected with them. At the same time, the experiments we have made on them through the means of various reagents, lead us to the conclusion, that they are organized and living bodies. They appeared

somewhat different, as taken at the Sandwich Islands, and in the Straits of Malacca. The former were globular and transparent, with a yellowish point in the centre, the latter were rather oval with a depression in the centre, so that they were somewhat kidney-shaped; they also were entirely yellowish.

In all the animals which possess phosphorescence, the property has appeared to us to depend upon a particular principle, probably a secretion of these animals, which, however, differs as to the manner in which it is scattered around. Some of them, as the small phosphorescent crustacea, can distinctly emit it in certain circumstances, especially when, by any cause, they are irritated; they then project true jets, regular *fusées* of phosphorescent matter, in such quantities as to form a luminous atmosphere in which they disappear. We have succeeded in collecting a certain quantity of this matter upon the sides of a vessel which contained a great number of these crustacea. Others of these animals did not appear to possess the power of emitting this matter, and in them it was developed only in certain circumstances, as for example, when they struck against any body, or when they moved, or when causes of irritation operated upon them. In others again, as in the Cephalopoda, and in some Pteropoda the phenomenon exhibited itself in a way that was nearly quite passive. The phosphorescent matter contained in their nucleus, or in other parts of their bodies, shone constantly and uniformly so long as the animal was in the enjoyment of life, and along with this disappeared the light they shed abroad. Finally, in the yellowish corpuscules above described, the phosphorescent matter also shines almost uniformly, but if brought into contact with any reagent, their lustre is first increased, and then insensibly vanishes away. The phosphorescent matter which we collected on the sides of the vase, was yellowish, slightly viscous, and very soluble in the water, which it rendered luminous at the moment it was projected by the animal.—*Comptes Rendus*, No. xv., 5 *Avril*, p. 458.—*Ib.*

38. *On the Composition of a new Indelible Ink; by* Dr. Traill.—In a paper lately read before the Royal Society of Edinburgh, Dr. Traill, after an account of many unsuccessful experiments to produce a durable ink from metallic combinations, stated that he was induced to attempt the composition of a carbonaceous liquid, which should possess the qualities of good writing-ink. The inks used by the ancients were carbonaceous, and have admirably resisted the effects of time; but the author found that the specimens of writings on the Herculaneum and Egyptian *papyri* were effaced by washing with water; and on forming inks after the descriptions of Vitruvius, Dios-

corides, and Pliny, he found that they did not flow freely from the pen, and did not resist water,—qualities essential to a good writing-ink in modern practice. The carbonaceous inks with resinous vehicles, rendered fluid by essential oils, though they resisted water and chemical agents, had the disadvantages of not flowing freely from the pen, and of spreading on the paper, so as to produce unseemly lines. Solutions of caoutchouc in coal naphtha, and in a fragrant essential oil, lately imported from South America, under the name of *aceite de sassafras*, (the natural produce of a supposed Laurus,) were subject to the same objections. The author tried various animal and vegetable fluids as vehicles of the carbon, without obtaining the desired result, until he found, in A SOLUTION OF THE GLUTEN OF WHEAT IN PYROLIGNEOUS ACID, a fluid capable of readily uniting with carbon into an ink, possessing the qualities of a good, durable, writing-ink. To prepare this ink, he directs gluten of wheat to be separated from the starch as completely as possible, by the usual process, and when recent to be dissolved in pyroligneous acid with the aid of heat. This forms a saponaceous fluid, which is to be tempered with water until the acid has the usual strength of vinegar. He grinds each ounce of this fluid with from eight to ten grains of the best lamp-black, and one and a half grain of indigo. The following are the qualities of this ink. 1. It is formed of cheap materials. 2. It is easily made, the coloring matter readily incorporating with the vehicle. 3. Its color is good. 4. It flows freely from the pen. 5. It dries quickly. 6. When dry it is not removable by friction. 7. It is not affected by soaking in water. 8. Slips of paper written on by this ink, having remained immersed in solutions of chemical agents, capable of immediately effacing or imparing common ink, for seventy-two hours, without change, unless the solutions be so concentrated as to injure the texture of the paper. The author offers this composition as a writing-ink, to be used on paper, for the drawing out of bills, deeds, wills, or wherever it is important to prevent the alteration of sums or signatures, as well as for handing down to posterity public records, in a less perishable material than common ink. He concluded his paper by stating, that should it be found to present an obstacle to the commission of crime—should it, even in a single instance, prevent the perpetration of an offence so injurious to society, as the falsification of a public or private document, the author will rejoice in the publication of his discovery, and consider that his labor has not been in vain.—*Ib.*

39. *Depth of the Frozen Ground in Siberia.*—" At page 435 of vol. 24th of Edinburgh New Philosophical Journal, we inserted Profes-

sor Baer's communication to the Geographical Society of London, "*On the Frozen Soil of Siberia.*" We have now to add, that a further communication on this subject, also by M. Baer, was read at the meeting of the British Association at Newcastle. After stating very shortly the nature of the experiments to be made at Yakutsk by order of the Petersburgh Academy of Science, he remarks: "It seems to me very important for physical geography, to ascertain the thickness of perpetually frozen ground, in countries whose mean temperature is considerably below 0° R. I will merely mention one point: if, as is the case at Yakutsk, the ground never thaws at the depth of from 300 to 400 feet, all the small streams whose superficial waters only are kept in a fluid state in the summer, must be in the winter entirely without water; and, *vice versa*, we may conclude, that all rivers which do not come far from the south, and whose course is entirely within those countries which preserve perpetual ground-ice, and yet do not cease to flow in winter, must receive their waters from greater depths than those which remain in a frozen state. It is, then, clear that these veins of water penetrate the perpetual ground-ice. This circumstance strikes me as one not devoid of interest in the theory of the formation of springs; and it would be very desirable, that some researches upon this subject should be set on foot in high northern latitudes. In the narrative of Admiral Wrangel's Travels, still in MS., there occurs a remarkable instance of very considerable rivers in very cold countries being without water in winter, like our ditches and small brooks. He was riding, to the north of Yakutsk, in about 65° lat. over the ice of a large river, when the ice suddenly gave way, and his horse went under. He was himself saved by being thrown upon the ice at the moment his horse fell. He was lamenting the loss of his horse to the Yakutskis who accompanied him, as he knew not where to get another, when they laughed, and assured him that they would soon get his horse back, and with a dry skin too! They got some poles and broke away the ice, under which the bed of the river was perfectly dry, as well as the horse and his saddle. The Yukutskis was therefore aware that there was no water in the winter-time, at the bottom of rivers of this size; and in this case the water must have disappeared before the ice had gained sufficient thickness to bear a loaded horse. Similar accidents, and similar results must doubtless have frequently occurred, during the many journies which the English have made in North America; and the agents of the Hudson's Bay Company must be well acquainted with the real state of the small rivers in winter, in these high latitudes; *i. e.* whether all of them are in a fluid state below the ice or not. I am collecting materials to ascertain the *southern* limit of perpetual ground-ice in the Old World; those I have not yet very complete; but I am already aware, that this phenomenon extends much farther in a southerly direction in Siberia, than in Europe. The farther we go east, the more southerly we find the limit of perpetual ground-ice. Humboldt found at Bogoslovsk, in lat. 59° 45′ N., at the eastern foot of the Ural Mountains, small pieces of ice at the depth of six feet in the summer. No permanent ice has been found in Tobolsk in 58° N.; but at Beresow, in 64° N., where Erman found the temperature of the ground above +1°R. at the depth of 23 feet, we learn from the observations of M. Belowski, that the lower districts are never without ice in the ground, so that it is brobable that Beresow is near the limit of perpetual ground-ice. Farther east, this frozen soil extends much more to the southward, even to the shores of the lake Baikal; indeed, the whole of the southeastern angle of Siberia has perpetual ground-ice. Captain Frehre states, that in 1836, he there found the ground frozen at some distance below the surface, and that this frozen stratum was continued uninterruptedly quite to the underlying rock, to a depth from 10 to 40 feet. But, as he always found rock there, it would be difficult to say how thick the layer of frozen mud would be in the lat. of 52°. It thawed on the surface of the banks of the river, to a depth of from 2½ feet to 6 feet, and from 6 feet to 9 feet on the naked heights; but, in the forests, where the rays of the sun were intercepted, the thaw reached only from ¾ foot to 1 foot deep. If it be true, that there are places in forests where the ground is never thawed one foot deep, it would demonstrate how little is necessary for the ground to be thawed for trees to grow on it. The development of the leaves and vegetation depends less on the temperature of the soil than on that of the air in the spring; it only requires that the ground should be so far thawed, that the tree may be able to draw from it a sufficient quantity of moisture for its growth."*—*Edinburgh New Philosophical Journal, October,* 1838.

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* Mr. De la Beche remarked, that, considered geologically, this paper of Prof. Baer, was an important one. It showed that the temperature of those regions had changed since the deposit of the detrital matter (for that was the character of the frozen ground) inasmuch as, under the condition of a perpetually frozen surface, no such deposits could take place.

40. *Notice of a Chemical Examination of a Specimen of Native Iron, from the east bank of the Great Fish River, in South Africa;* by Sir John F. W. Herschel.*

The [portion analyzed of the] specimen in question weighed originally 24·79 grains, 5·12 of which were separated, and submitted to a hasty preliminary examination for the detection of nickel, if any; but the quantity proving too small, the whole of the remainder was operated on in a subsequent trial.

The iron was highly malleable and tenacious, and apparently of excellent quality, with a somewhat whiter and more silvery lustre than belongs to the metal in its ordinary state, and apparently little liable to oxidation, qualities which are observed in iron, of what is usually considered undoubted meteoric origin.

I should not think it necessary to detail the steps of the analysis by which the presence of nickel in the proportion of 4·61 per cent. was demonstrated, but for a peculiarity in one part of the process by which an inconvenience of frequent occurrence in chemical operations, and of a very embarrassing nature, was obviated, and which may prove useful as a hint to young analysts in other cases.

18·67 grains of the iron in one piece were digested in dilute nitric acid, which dissolved the whole, with the exception of a trifling quantity of black scaly matter, apparently amounting to about a quarter of a grain.† Towards the end of the solution the iron more than once brightened on the surface, and assumed that peculiar and singular state of resistance to the action of the acid which I have described in the *Annales de Chimie* for September, 1833, and which has since been the subject of so much interesting discussion by Professor Schœnbein, Mr. Faraday, and others. In consequence, it was necessary to apply and maintain heat to complete the solution.

The nitric solution was evaporated to dryness, water added, and evaporated a second and third time. By this the whole of the iron was peroxidized, and nearly the whole separated. It was then diffused and boiled in water, to which a few drops of nitric acid were added, to take up any oxide of nickel which might have been deprived of its acid by overheating, and set aside for subsidence, filtration being out of the question.

After standing a week, however, it was still perfectly opake, and loaded with suspended peroxide of iron, and to get rid of this was the next object.

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* Read before the Literary and Scientific Institution of South Africa: now extracted from Sir James E. Alexander's "Expedition of Discovery into the interior of Africa." Lond. 1838, vol. ii. Appendix, p. 272. The specimen had been found by Sir James E. Alexander, and presented by him to the Institution.

† This black scaly matter was in all probability *graphite*—Edit. Lond. and Ed. Phil. Mag.

Lead being a metal easily eliminated, and incapable of interfering in any of the subsequent processes, its introduction seemed not likely to prove any source of further embarrassment; a few drops of dilute nitrate of lead were therefore added; and being well mixed, as much sulphuric acid as would saturate the lead, and a little more, was added, and the whole boiled. The precipitation was complete, the lead carrying down with it all the suspended ferruginous matter, and leaving a clear liquid of a greenish hue, in which the presence of lead could not be detected.

The remaining iron held in solution was removed by heating it with excess of carbonate of lime, in the manner pointed out by me in the Phil. Trans. for 1821, when after filtration, a liquid remained of that peculiar tint of pale green which characterizes the solutions of nickel, and of considerable intensity.

The presence of this metal was ascertained on concentrating the solution by the usual tests, and its quantity concluded, viz. 0·86 grains, or 4·61 per cent. on the specimen analyzed.

Thus it appears that the specimen brought home by Capt. Alexander has equal claim to a meteoric origin with any of those masses of native nickeliferous iron which have been found in different localities, and to which that origin has, without other evidence, been attributed.

All those specimens, however, have, so far as I know, been insulated single masses. But what constitutes the peculiar and important feature of this discovery of Capt. Alexander, is the fact stated by him of the occurrence of masses of this native iron in abundance, scattered over the surface of a considerable tract of country. If a meteoric origin be attributed to all these, a shower of iron must have fallen; and as we can imagine no cause for the explosion of a mass of iron, and can hardly conceive a force capable of rending into fragments a cold block of this very tenacious material, we must of necessity conclude it to have arrived in a state of fusion, and been scattered around by the assistance of the air or otherwise, in a melted, or at least softened state.—*Lond. and Ed. Phil. Magazine, Jan.* 1839.

41. *Dr. Bowditch.*—His Royal Highness the Duke of Sussex, late president of the Royal Society, in his anniversary address delivered from the chair, Nov. 30th, 1838, thus commemorates the character and death of our distinguished countrymen.

"Dr. Nathaniel Bowditch of Boston, in the State of Massachusetts in America, was born at Salem, in the same State, in 1773: he was removed from school at the age of ten years to assist his father in his trade as a cooper, and was indebted for all his subsequent acquisitions, including the Latin and some modern languages, and a profound knowledge of mathematics and astronomy, entirely to his own exertions, unaided by any instruction whatever. He became afterwards a clerk to a ship-chandler, where his taste for astronomy first showed itself, and was sufficiently advanced to enable him to master the rules for the calculation of a lunar eclipse; and his subsequent occupation as supercargo in a merchant vessel sailing from Salem to the East Indies, led naturally to the further development of his early tastes, by the active and assiduous study of those departments of that great and comprehensive science which are most immediately subservient to the purposes of navigation. It was owing to the reputation which he had thus acquired for his great knowledge of nautical astronomy, that he was employed by the booksellers to revise several successive editions of Hamilton Moore's Practical Navigator, which he afterwards replaced by an original work on the same subject, remarkable for the clearness and conciseness of its rules, for its numerous and comprehensive tables, the greatest part of which he had himself recalculated and reframed, and for its perfectly practical character as a manual of navigation: this work, which has been republished in this country, has been for many years almost exclusively used in the United States of America.

"Dr. Bowditch having been early elected a Fellow of the American Academy of Arts and Sciences at Boston, commenced the publication of a series of communications in the Memoirs of that Society, which speedily established his reputation as one of the first astronomers and mathematicians of America, and attracted likewise the favorable notice of men of science in Europe.

"During the last twenty years of his life, Dr. Bowditch was employed as the acting president of an Insurance Company at Salem, and latterly also as actuary of the Massachusetts Hospital Life Insurance Company at Boston: the income of which he derived from these employments, and from the savings of former years, enabled him to abandon all other and more absorbing engagements, and to devote his leisure hours entirely to scientific pursuits. In 1815 he began his great work, the translation of the *Méchanique Céleste* of Laplace, the fourth and last volume of which was not quite completed at the time of his death. The American Academy over which he presided for many years, at a very early period of the progress of this very extensive and costly undertaking, very liberally offered to defray the expense of printing it; but he preferred to publish it from his own very limited means, and to dedicate it as a splendid and durable monument of his own labors and of the state of science in his country. He died in March last, in the sixty-fifth year of his age, after a life of singular usefulness and most laborious exertion, in the full enjoyment of every honor which his grateful countrymen in every part of America could pay to so distinguished a fellow citizen.

"Dr. Bowditch's translation of the great work of Laplace is a production of much labor and of no ordinary merit: every person who is acquainted with the original must be aware of the great number of steps in the demonstrations which are left unsupplied, in many cases comprehending the entire processes which connect the enunciation of the propositions with the conclusions, and the constant reference which is made, both tacit and expressed, to results and principles, both analytical and mechanical, which are co-extensive with the entire range of known mathematical science; but in Dr. Bowditch's very elaborate commentary every deficient step is supplied, every suppressed demonstration is introduced, every reference explained and illustrated, and a work which the labors of an ordinary life could hardly master, is rendered accessible to every reader who is acquainted with the principles of the differential and integral calculus, and in possession of even an elementary knowledge of statical and dynamical principles.

"When we consider the circumstances of Dr. Bowditch's early life, the obstacles which opposed his progress, the steady perseverance with which he overcame them, and the courage with which he ventured to expose the mysterious treasures of that sealed book, which had hitherto been approached by those only whose way had been cleared for them by a systematic and regular mathematical education, we shall be fully justified in pronouncing him to have been a most remarkable example of the pursuit of knowledge under difficulties, and well worthy of the enthusiastic respect and admiration of his countrymen, whose triumphs in the fields of practical science have fully equalled, if not surpassed, the noblest works of the ancient world."—*Ib.*

TO OUR SUBSCRIBERS AND READERS.

That we may in future finish a volume in the last quarter of the year, and begin a new volume in the succeeding January, we shall publish two numbers of this Journal in July. No. 2 of Vol. xxxvi, and No. 1 of Vol. xxxvii, will appear in that month; No. 2 of Vol. xxxvii, in October, and No. 1 of Vol. xxxviii, in January. This effort will be made in order to avoid the confusion arising from linking together two years by the same volume.

The consequent anticipation of one quarter of a year in the payments, will, we trust, be readily acquiesced in by our subscribers and agents, as this anticipation will occur but once, and a full equivalent will be rendered.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Some notice of British Naturalists;* by Charles Fox.

Natural History, like other branches of science, has had its infancy, its childhood, and its maturity. At first and in early times, it observed isolated facts and grouped them promiscuously, without skillful arrangement and classification founded on natural analogies and differences. It has advanced slowly, until in our times it has fallen into the train of the inductive sciences, and now marches onward with confidence and success.

Solomon is the earliest naturalist; then follows Aristotle, Pliny, and Elian. Of the works of Solomon on natural history, we know little, although he described "Trees from the cedar-tree that is in Lebanon, even unto the hyssop that springeth out of the wall; and spake also of beasts, and fowls, and of creeping things, and of fishes." It is believed that Aristotle not only had access to his writings, but made great use of them in the compilation of his own works. Natural History was to him a collection of miscellaneous facts; mingled with much that was doubtful, and still more that was apocryphal: his works evince vast industry in collecting, and a mind well adapted to research. In the words of Mr. Swainson:*

"In his famous book, *Περι Ζωῶν Ἱστοριας*, he first sought to define by the precision of language, those more prominent and comprehensive groups of the animal kingdom, which, being founded on

* Cabinet Cyclopædia.

nature, are exempt from the influence of time and the immutability of learning. Had this extraordinary man left us no other memorial of his talents than his researches in zoology, he would still be looked upon as one of the greatest philosophers of ancient Greece, even in its highest and brightest age.

"With peculiar tact he brought the rules of philosophic reasoning to bear upon a subject to that time neglected; upon the extent and depth of his personal researches; upon the clearness with which he arranged his results; and above all, upon those obscure perceptions which he acquired while so employed, of hidden truths which were to be developed only in subsequent ages.

"He discarded from his work all those popular tales, and fancies, and beliefs, which were received by the mass of his countrymen as religious truths sanctioned by antiquity, interwoven in their history and consecrated in their poetry. The death of this great father of the science, was the death of natural history in the Grecian era. The splendor of his discoveries passed like a comet. He left no luminary behind to follow his wake, still less, to throw additional light upon realms which he had but glanced upon."

After nearly four hundred years, Pliny appeared and strove to emulate Aristotle, but without his erudition or genius; his voluminous works are chiefly compilations; they abound in fables and prodigies evincing credulity rather than a disposition to investigate truth; and this is the more surprising, as Rome possessed the most wonderful menagerie that has ever been collected, containing not only lions and other ferocious beasts destined for the circus; but probably all that was rare and curious in more peaceable tribes, since these were often exhibited in triumphal processions. Pliny informs us that Sylla exhibited the terrific spectacle of a combat of one hundred male lions. Cæsar had four hundred, and Pompey had six hundred lions at one time. Natural history now declined in Rome, and with the fables and absurdities of Ælian and one or two others, all records of science expired for nearly fourteen hundred years. Nor was there, A. D. 1500, much more sound knowledge, as regarded the works of the Creator, and the wonders of the earth and of the heavens, than there had been in past ages.*

* As an instance of the ridiculous extravagancies into which some, calling themselves Philosophers, rushed, even as late as the seventeenth century, we copy the following *actual* Patents, of the period of 1634, as recorded in Ry-

In the sixteenth century appeared—with the revival of learning in England, Lister, Willoughby, and Ray; Belon in Mans; Rondelet in France; Saleciani in Rome; Gesner in Germany, Aldrovandus in Bologna, and others, producing among them important works on the leading branches of natural history.

The end of the sixteenth, and the beginning of the seventeenth centuries, were signalized by rapid advances in knowledge. The art of printing, now come into general use, and the reformation, now fully established,—the former by extending and making more common all kinds of knowledge, the latter by freeing the minds of men from that thralldom in which they had so long been held,—prepared, if they did not force the way, for a vigorous and successful emancipation of the human mind. Men, remarkable for the freshness and grasp of their intellect, arose, both on the continent, and in England; and not afraid of the name of reform, they carefully scrutinized all the information and theories which they had received from their fathers, and boldly cast aside all which they did not find to be true.

Our present improvement and progress in science we owe primarily to England. It was there, about 1600, that Lord Bacon the father of natural science, arose. To that country, and to that master-mind, we are indebted for the logical precision which alone could direct our steps in the search after truth: and it is this period which we must mark as the *new era* in natural science. As the rising sun dispels the mists and fogs of the morning, so did the brightness of his exalted mind illuminate the darkness around.

The object of this paper is to give a sketch of the progress of natural history—limiting it, for the present, chiefly to the higher orders of Zoology in Great Britain. We shall, therefore, now

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mer's *Fœdera:* "The *Fish-call*, or a looking-glass for fishes in the sea, very useful for fishermen to call all kinds of fish to their nets, seins, or hooks." "An instrument which may be called the *Windmate*, very profitable, when common winds fail, for a more speedy passage of calmed ships and vessels on seas and rivers." "A moveable *Hydraulic*, or chamber weathercall, like a cabinet, which being placed in a room, or by a bed side, causeth sweet sleep to those who, either by hot fevers, or otherwise, cannot take rest; and it withal alters the dry, hot air, into a more moistening and cooling temper, either by musical sounds, or otherwise." These patents were for fourteen years, and paid £1 6*s.* 8*d.*, yearly to the Exchequer.—*See Life and Adminis. of Edward, first Earl of Clarendon, by H. T. Lister, Vol. I, p.* 23, *note.*

confine ourselves to that portion of the world; with an occasional glance, but only incidental, at other countries, as our plan is restricted within narrow limits. We shall at the same time, give short sketches of the lives of such as have been peculiarly devoted to this science, *for its own sake.* In this view, science is in our utilitarian age more neglected in the present, than in some former periods of its history. Men are too much taken up in attempting to promote the *minor* arts. The *philosophical* spirit is too much banished; that spirit, which Bacon has characterized as the germ of life in the sciences. Hoping to be ourselves guided by this spirit, we shall not however abstain from introducing apposite proofs of the usefulness of the knowledge and study of natural history.

The state of science towards the close of the sixteenth century, presented a field of observation singularly calculated to attract the curiosity and awaken the genius of Bacon.

"One of the considerations which appears most forcibly to have impressed itself upon his mind, was the vagueness and uncertainty of all the physical speculations then existing, and the entire want of connection between the sciences and the arts. Those things are in their nature so closely united, that the same truth which is a principle in science, becomes a rule in art; yet, there was at that time hardly any practical improvement which had arisen from a theoretical discovery. The natural alliance between the knowledge and the power of man, seemed entirely interrupted; nothing was to be seen of the mutual support which they ought to afford the one to the other. The improvement of art was left to the slow and precarious operation of chance, and that of science, to the collision of opposite opinions."*

To use Bacon's own words in his *Advancement of Learning:* "As things now are, if an untruth in nature be once on foot, what by reason of the neglect of examination, and countenance of antiquity, and what by reason of the use of opinion in similitudes and ornaments of speech, it is never called down."

But there was still another circumstance which, in a peculiar manner, attracted his attention—the neglect then prevalent of ordinary, and the thirsty zeal for extraordinary objects. What is immediately before us, and of every day occurrence, however

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* Professor Playfair.

important and interesting it may be in its peculiar features, we are apt to neglect and overlook. That which is rare, and is seldom observed, excites an active investigation. And thus it was that the philosophers of old, in their pursuit of natural science, applied their chief attention to phenomena, and left the more general laws of physics uninvestigated. Nobody sought to know why a stone falls to the ground; why smoke ascends; or why the stars revolve around the earth; while the discovery of a double-headed snake, or a deformed bird, excited the warmest interest, and the approach of an African seal to the shores of Europe, revived the fable of a mermaid. But the natural consequence of this neglect of common, and of minute attention to the extraordinary occurrences, was to render it impossible to establish any general or useful principles, and still further, to deduce any general laws. It is a beneficial rule of the Creator, that that which is in nature most *truly* valuable, should be the easiest of access; and it is in the properties of such things as exist familiarly around us, that we must look for the explanation of what seldom occurs.

To quote again from Bacon, in a passage which contains the germ of much of his *Novum Organum:* "So it cometh often to pass, that mean and small things discover great, better than great can discover the small: and therefore Aristotle noteth well, 'that the nature of every thing is best seen in its smallest portions,' and for that cause he inquireth the nature of a commonwealth, first in a family, and the simple conjugations of man and wife, parent and child, master and servant, which are in every cottage. Even so likewise, the nature of this great city of the world, and the policy thereof, must be first sought in mean concordances and small portions. So we see how that secret of nature, of the turning of iron touched with the loadstone towards the north, was found out in needles of iron, and not in bars of iron."

Notwithstanding, however, this well merited compliment to the Aristotelian philosophy, as regards *Natural Science*, this course is imperfect and deceptive. It has culled a few from a great many things; it has taken its principles from common experience, and without due attention to the evidence or precise nature of the facts; the philosopher is left to work out the rest from his own invention.

Like Luther before him, his great predecessor in the work of reform, although in another sphere, Bacon bore a strong enmity to what *then* went under the title of Aristotelian philosophy. It was indeed little better than an eclectic system, passing under that great name, mingled with the dogmas of Popery, and was in a great measure devoted to the propagation and support of trivial arguments or positive error. Bacon was not unacquainted with the writings of Aristotle; for in those days, to be well educated, was to be an adept in his system; but his acute discrimination soon perceived, that however well adapted, this system was to act as a guide in some branches of knowledge; it was wholly unfit for the investigation of *natural* science; and in this respect, was but the blind leading the blind.

Bacon cannot indeed be said, *in toto*, to have originated the inductive philosophy, for Aristotle himself does both use it and recommend its adoption in certain cases. It is, in truth, founded in the very nature of man's intellectual powers, in the very fitness of things. But he culled it forth from the mass of facts and speculations where, hitherto, it had lain concealed and neglected; he applied it where it had never been applied before, and, in this respect, too great a degree of praise cannot be awarded to him. If not an inventor, he stands at least next to that place of honor; and we know not but that the new and just application of old and venerable principles to new positions, demands a genius more energetic and more subtle than his who first struck upon the vein of thought. Few have power; fewer still have courage to interfere with opinions rendered venerable by antiquity, or supported by high and noble names. It is by this *application* of mind to matter, that mind becomes truly predominant, and claims to itself its high and commanding rank among created things, and its mastery over matter.

Although Bacon pointed out to all succeeding naturalists the course which they ought to pursue in their researches, he was himself no naturalist. He was the commander of the host, but he did not himself march at their head: he was by far too much occupied with his investigations of the laws of mind and matter to be able to pay any minute attention to the particulars; and what he has left behind under the name of "*Natural History*," is rather intended as an example to his successors, than as a work of absolute profit. The great principle for which we are indebted to him, was from the observation of a large body of physical facts to deduce general laws, not by theorizing, but by steady and stern induction.

"As things are at present conducted," says he, "a sudden transition is made from sensible objects and particular facts, to general propositions, which are accounted principles; and around which, as around so many fixed poles, disputation and argument continually revolve. From the propositions thus hastily assumed, all things are derived, by a process compendious and precipitate, ill suited to discovery, but wonderfully accommodated to debate. *The way that promises success is the reverse of this.* It requires that we should generalize slowly, going from particular things to those which are but one step more general, from those to others of still greater extent; and so on to such as are universal. By such means we may hope to arrive at principles, not vague and obscure, but luminous and well defined, such as nature herself will not refuse to acknowledge." The end of all knowledge is utility, the improvement of the condition of mankind; and vain must that species of it ever be which revolves within itself, and has in view no ultimate effects.

It was not long before his works began to take effect among thinking men. Truth advances slowly; especially when long established errors oppose its progress; but still, there are always in society a certain number of persons, who, standing on a higher eminence, like the Hebrew sentinels of old, receive the first gleams of light, and inform those below of the fact. Bacon awakened a spirit of inquiry; and the minds of men began to be opened to the absurd fables of ancient authors, and to cast aside the interminable synonyms which obscured, while they were meant to elucidate natural history.

The first whom we may rank in the new school of British naturalists was John Ray, or Wray, for he wrote his name in both ways. He was born in 1628, at Black Notley, near Braintree, in Essex; a small and picturesque country hamlet, but remarkable for nothing else, we believe, except as being the birth place a few years before of the celebrated William Bedell, bishop of Kilmore, in Ireland; a man equally remarkable for his piety and moderation; and respected and well treated by even his opponents and enemies.

Ray was the son of a blacksmith, who, from the little we can learn of him, appears to have been in his station, a person of sober habits and respectability, and to have amassed sufficient property to give his son a good education. Of the early years of the naturalist we know nothing. Interesting as an account of this period in general is, as giving some evidence of future activity and eminence, it is too often lost for want of a record; and this especially in the station in which young Ray's early life was past. He was when a boy sent to a classical school at Braintree, and at the age of sixteen he entered, as a commoner, at Katherine Hall, Cambridge. Not being, however, satisfied with this college, he was soon transferred to Trinity, where, in the usual course, he took his degree. His abilities were certainly good; and he was remarkable at this early period for his proficiency in the knowledge of the learned languages. He was likewise very industrious; and being aware of the value of time, he carefully gathered up the fragments of it; and was able to accomplish not a little, besides the usual routine of study. And here he soon manifested his taste for natural history. Botany first attracted his attention. Like Lord Bacon, he was extremely fond of flowers; and he collected and examined what he met with during his walks for recreation. As this was his first love among the works of God, so was it always his strongest passion, and predominant over that for all other departments of nature. His abilities soon attracted attention in the university. In succession he became a Fellow of Trinity College; Greek and Mathematical Lecturer, and Reader in Humanity, besides holding several other offices. Not only was he an eminent tutor, but likewise a distinguished preacher. Theology was a favorite study of his; and he brought the books of revelation and of nature respectively to bear the one upon the other. He was not however ordained at this time; for, during the disorders of the Commonwealth, the ministerial office was as generally held by persons not in orders as the contrary. While thus diligently pursuing his graver duties, he found time, in 1660, to publish his first work on natural history—*a Catalogue of Cambridge Plants*, in the arrangement of which he was much assisted by a friend of the name of Rid. It is neither the power of intellect, nor the brilliancy of genius, which is the peculiar honor of man; but the soundness of his judgment, the strength of his moral feelings, and the warmth of his affections. Without these latter the former are, as they concern himself, mere baubles; trusts committed to him, it is true, but which he wants the power properly to use. And we may here remark upon what appears to have been a distinguishing part of Ray's character, his admiration for friendship, and his cherishing of his friends. We never find him alone. Is he writing a book? Some friend assists him in collecting the details. Is he making a tour to increase his stock of knowledge? Some brother in feeling is his constant companion. Is he engaged in editing the works of another? He is performing the last melancholy duty for one who never forsook him, either in prosperity or adversity.

This work may be said to be the beginning (of any importance) of the publication of *local floras;* a branch of literature which has been of late so successfully cultivated; and which has had more effect in ascertaining and fixing this part of the natural history of Great Britain, than even the writings of more scientific and learned authors. And it is greatly to be desired that it were more thoroughly prosecuted than it has hitherto been, in this our own land. Not only do we want such accounts of plants, but likewise of all the different departments of nature. From such sources the great and commanding writers draw their information; and if these minor springs run dry, we cannot possibly expect any truly important results. It was in this way that the great Cuvier himself began, when engaged in his investigations of the inferior animals, while a tutor in Normandy; and he owed not a little to it in after life. Each district has its own peculiarities which are easily observed by those who live there; and thus to collect information will ever be found a labor which is fully repaid by the pleasure which accrues from it. To make it public may cost more pains; but magazines and journals are always ready to notice any important fact or observation. Previous to this time botany had been much neglected over the whole of England; but this publication of Ray gave it a new spring, and set up a model of what might be effected by others. In Ray's own words, "many were prompted to those studies, and to mind the plants they met with in their walks in the fields." He had now hit upon a path along which his genius pointed, and for the following of which his peculiar talents fitted him. Having once begun, he eagerly pursued his researches; and not content with what he met with in the neighborhood of Cambridge, he extended his investigations throughout the greatest part of England and Wales, and the south of Scotland. In these tours, for he was only absent at intervals, he was generally accompanied by Willoughby, whose various works on the subject are well known, and whose fondness for nature was equal to his own.

Of these short journies he kept journals, which were afterwards published under the title of *Itineraries.* They contain little that is of general interest; and are curious chiefly from the account which they give of the state of the roads and towns at that period.

The restoration of king Charles II, bringing with it a return to old manners and customs, and more peaceful times, Mr. Ray determined to enter into holy orders. For this, as we have seen, his previous education had been such as fully to prepare him; and in December, 1660, he was ordained both deacon and priest, by Dr. Sanderson, bishop of Lincoln. He however still remained at the university, engaged in his previous duties, without any fixed cure of souls. In 1662, came the celebrated Bartholomew act; and as, from conscientious motives, he refused to sign the declaration, he lost his fellowship and other offices. From what sources he now derived his income does not appear. Whether his father had been enabled to leave him any property, or whether his previous college appointments had been so lucrative as to enrich him sufficiently, none of his biographers mention. He however immediately set off, with a party of three, for a scientific tour upon the continent, whence he did not return till March, 1665; and till, in conjunction with Mr. Willoughby, he had collected a large number of miscellaneous specimens of natural history. Then began his great labors; and those in which the order and strength of his mind are peculiarly perceptible.

Bishop Wilkins had for some time previously occupied his leisure in the study of botany; and for the next two years, Ray was engaged with him in classifying the plants of England; and in throwing them into a natural arrangement. With his first plan, as he informs us in his preface to the *Synopsis methodica Stirpium Britannicarum*, he was not altogether satisfied; and, as was very natural on a subject so truly new, he perceived many errors. In this trait, however, it is not difficult to trace the germ of his future eminence.

Far as he had proceeded beyond all previous writers, he could not be contented till he had attained the utmost excellency which his imagination held out before him; and instead of sitting down quietly to rest, one labor was but the precursor of another still greater. These errors he by degrees corrected, and laid the foundation of that natural system which was so long afterwards adopted. In 1667, at the age of thirty-nine, he was admitted a member of the Royal Society of London, at that time no small honor, and no little profit to the mind, as the greatest philosophers of the day were its active members; in 1670, he published the first edition of his *History of British Plants.*

From this period his life passed quietly away. The man of science lives much by himself. He converses with nature: free from the turmoil and anxieties of the world, his days are rather marked by the progress of his discoveries in knowledge, than by any thing which can interest the general reader. He gradually became more celebrated as a naturalist; and being still a person of most industrious habits, his writings accumulated. Among other subjects which engaged his attention at this time, we find that he was actively employed in investigating the phenomenon of the circulation of the sap in trees, the discovery of which was reserved for later times, and a deeper knowledge of the principles of mechanical science. His writings are contained in about twenty volumes. They have never been collected, and many of them are now very scarce and difficult of attainment. Besides his volumes on botany, which form nine independent works, he edited the writings of his friend, Mr. Willoughby; published his own travels both in England and on the continent,—the most remarkable topic in the latter of which is his description of *lock-gates* for canals, which appear to have been then quite novel,—a collection of unusual or local English words; the same of proverbs; a dictionary of three languages; a persuasion to a holy life; the wisdom of God manifested in the works of creation; Physico Theological discourses, with practical inferences; two volumes on insects, and some minor volumes and papers.

With a glance at his private life we shall conclude this sketch.

After his return to England he appears never to have officiated as a clergyman; but to have resided where his fancy led him, or the society of his friends induced him. In 1672, he met with a heavy affliction in the death of his old and constant friend, Mr. Willoughby. This gentleman left him by his will, property to the amount of £60 per year, and bequeathed to his care the education of his two sons. The younger one afterwards became the first Lord Middleton. Thus occupied he removed to Middleton

Hall, where he staid, in all, about four years; and he appears to have acted, not only the part of a valuable tutor, but of an indulgent guardian and kind parent to his charge.

"In 1673," says his biographer, "having lost some of his best friends, and being in a manner left destitute, he began to have thoughts of marriage; having met with a young gentlewoman, (then in the family he was in,) of about twenty years of age, whose piety, discretion, and virtues, as well as her person, recommended her to him." Her name was Margaret Oakeley, of an Oxfordshire family. They were married in the May following, and he never appears to have had occasion to repent of his choice.

In 1679, having parted with his pupils, with an affection for the place of his birth, he removed back again, as his years were increasing, to Black Notley. Here for ten years he resided, being actively engaged in writing, till in 1687, his health failed; he became infirm, and he died, worn out, in 1704, in the seventy-sixth year of his age. He was buried in the Parish church, and a monument was erected to his memory by his friends.

A good fame is the peculiar possession of the dead; and with all his faults, few appear, in those busy times, to have left behind them a more unsullied name. If we may judge from the high station which he held in Cambridge, and from the internal evidence of his works, he was a fine scholar, and possessed of both descrimination and taste. Contemplation rather than action was the peculiar form of his mind; but he wanted not activity, and certainly was of a restless and most inquiring turn. While anything was to be learned, which he thought it worth while to employ himself upon, he allowed no difficulties to dishearten him and no self-denial to prevent his pursuit. And we may here make a general observation, that however much it may please some to disparage the study of natural history, or to declare it to be only fit for trifling and inferior minds, we not only see in this case, but in all others, that eminence in this science is of peculiar difficulty of attainment. The highest powers of judgment, of research, and of perseverance are necessary; and it has seldom been reached, where general learning and a well regulated education have not previously prepared the mind. Considering the numbers who have attempted it, there are fewer who have made any real progress in this, than in any other of the pursuits of mankind.

Of his goodness of heart we have already had occasion to speak. A child-like simplicity seems to have been a prominent point in his character; and he enjoyed the society of those whose minds were of a humble and inquisitive nature. His friendships were unalterable; and his course in life was marked by an absence of quarrels, and the love of those connected with him. In 1682, he was led into dispute with Tournefort and Rivinus. Literary controversy is but too often the offspring of arrogance and folly on one side or the other, and seldom leads to any other result than to leave each champion the more strangely convinced of the truth of his own opinion. Ray was soon sorry for it and gave it over. "The contentious way of writing was by no means agreeable to his sweet and peaceful nature, who, as he loved all men, so desired to be at perfect peace and unity with all." It is perhaps to be lamented, that having voluntarily entered into holy orders, he should so entirely have forgotten the vows which were upon him, as not afterwards to have officiated; and we can only account for it from the fact of his being in a measure prevented by the Bartholomew act, and by the bent of his mind leading him, weakly leading him perhaps, to other pursuits. Had he made natural history a *part* of his studies while prosecuting his still more important profession, all honor would have been due to him; but as it is, we can only be sorry that his course in this respect was not different. In the words of one who knew him well, we conclude: "In his dealings no man was more strictly just; in his conversation no man more humble, courteous, and affable. Towards God no man more devout. Towards the poor and distressed no man more compassionate, and charitable according to his abilities."

He was but a man, and as such but weak and fallible. In his works his piety is predominant. He never forgot that he was occupied in searching the wonders of his God; or that his labors were to tend to his honor and glory: and thus it is that where science becomes the handmaid to religion, she is in her appropriate sphere and is all glorious; but that when she descends from this her proper place, then her form is polluted, and her influence worse than evil.

Did we not confine ourselves especially to the writers upon *British* natural history, the name of Willoughby, the friend of Ray, would be deserving of high and honorable mention. He was then in a great measure to zoölogy, what Ray was to botany; but he included in his writings, species from all countries. His chief works on birds and on fishes—which are still valuable from the correctness of the plates—he did not live to finish, and they were edited and published by Ray. Of his character, a biographer thus speaks:

"And now, having mentioned the diligence of this great man, let me add that it was such, and his labors so incessant in studies, that he allowed himself little or no time for those recreations and diversions which men of his estate and degree are apt to spend too much of their time in; but he prosecuted his design with as great application as if he had been to get his bread thereby. All which I mention not only out of the great respect I bear to Mr. Willoughby's memory, but for an example, as has been before recommended to persons of great estate and quality: that they may be excited to answer the ends for which God gives them estates, leisure, parts, and gifts, or a good genius, which was not to exercise themselves in vain and sinful follies; but to be employed for the glory and in the service of the infinite Creator, and in doing good offices in the world, especially such as tend to the credit and profit of their own families."

(To be continued.)

Art. II.—*On the Natural History of Volcanos and Earthquakes,** by Dr. Gustav Bischof, Professor of Chemistry in the University of Bonn. Communicated by the Author.

I. *Are volcanic phenomena capable of a satisfactory explanation from the increase of temperature towards the centre of the earth, or can chemical processes be admitted with greater probability to be the cause of volcanic action?*

On inquiring into the cause of volcanic phenomena we must not forget, says Von Humboldt,† that the arrangement of volcanos sometimes in circular groups and sometimes in double lines, is the most decided proof that their action is not dependent on

* From the Edinburgh New Philosophical Jour., Vol. xxvi, No. 51, Jan. 1839.

† On the structure and action of volcanos in various parts of the earth, in the Abhandlungen der Königl. Acad. d. Wissensch. zu Berlin, 1822 and 1823, p. 137, and in Jameson's Phil. Jour. vol. v. p. 223.

any trifling causes, lying near the surface, but that they are vast and deeply-seated phenomena. Thus, for example, the whole of the high country of *Quito* is one volcanic hearth, of which the mountains of *Pichincha*, *Cotopaxi*, and *Tunguragua*, form the summits. The subterranean fire breaks out sometimes from one, sometimes from another of these vents, which are usually considered as distinct volcanos. The earthquakes, with which *America* is so dreadfully visited, are also remarkable proofs of the existence of subterranean communications, not only between countries free from volcanos, as has been long known, but also between volcanic hearths situated at a great distance from each other. All these circumstances prove that the forces do not act at the surface of the crust of the earth, but that, proceeding from the interior of our planet, they communicate contemporaneously by fissures with the most distant points on the surface.*

Two hypotheses may be proposed respecting the causes of volcanic phenomena. The one supposes them to be occasioned by intense chemical action taking place between bodies having a very great affinity to each other, and by which so great a heat is produced, that lavas melt and are forced to the surface of the earth by the pressure of elastic fluids. According to the other, the earth at a certain depth is at a white heat, and this heat is the chief cause of volcanic phenomena.

1. *The hypothesis, which ascribes volcanic phenomena to intense chemical action, shewn to be untenable.*

We will not detain our readers, with an account of the earlier hypotheses, which derive volcanic phenomena from the action of iron upon sulphur, or from the combustion of pyrites or coal, as their insufficiency is self-evident. But Davy's discovery of the metallic bases of the alkalies and earths was considered as throwing a great light on this subject.

This distinguished philosopher, who instituted some very interesting experiments at *Vesuvius* during its eruptions in 1814, 1815, 1819, and 1820, endeavored to explain the phenomena by the oxidation of the metals of the alkalies and earths.† He

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* Von Humboldt's Reisen in die Æquinoctial Gegenden des neuen Continents, t. i, p. 496, t. iii, p. 24, 26, and 40, offer many instances of this kind.

† Sur les Phenomenes des Volcans. Annales de Chim. et de Phys. vol. xxxvii, p. 133.

thinks himself justified in supposing the caverns beneath the *Solfatara* of *Puzzuoli* to have a subterranean communication with *Vesuvius*, because whenever the latter is in action, the former is in repose. A slip of paper which Davy threw into the mouth of the *Solfatara*, during an eruption of *Vesuvius*, was not rejected, from which he concluded that there must be a descending current of air. The subterranean thunder, which is heard at such great distances from beneath *Vesuvius*, seems to him to indicate the existence of great subterranean caverns, filled with gaseous substances, and that the same caverns which, during the activity of the volcano, continue for a long time to eject enormous quantities of aqueous vapor, must be filled, during its repose, with atmopheric air. In proof of the existence of extensive caverns, he mentions those in the limestone of Carniola. Now, as the metals of the earths in the supposed volcanic caverns are not only exposed to the action of the air but also to that of aqueous vapor, they will be oxidized at the expense of both, and be converted into lava. He thinks his hypothesis capable of explaining all the phenomena which he observed.

Davy also touches upon the circumstance, often mentioned by geologists, that almost all great volcanos are situated near the sea.* Supposing their first eruption to have been caused by the action of the sea-water upon the metals of the earths, and the metallic oxides, ejected from the craters in the form of lava, to have left vast caverns, the succeeding eruptions would be effected by the oxidations which would ensue in those caverns. Davy is of opinion that when volcanos lie at a distance from the sea, as those of *South America*, the water may be furnished from subterranean lakes; for Von Humboldt asserts that some of these volcanos cast up fish.

If we wish to ascribe volcanic phenomena to chemical action, says Davy, the oxidation of the metals of the earths and alkalies

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* That volcanos may act at a great distance from the sea is proved by the *Pesckan* in the centre of *Asia*, which is 260 geographical miles distant from any great sea, and from which streams of lava have issued within the period of our history. Even the opinion that the vicinity of extensive lakes operates on the volcanos of *Central Asia*, in the same manner as the ocean, is unfounded. The volcano of *Turfan* is surrounded by very inconsiderable lakes, and the Lake of *Temartu* or *Tssikul*, which is not twice as large as the *Lake of Geneva*, lies fully 25 geographical miles from *Pesckan*. See also Girardin in opposition to Davy's hypothesis in Jameson's Phil. Journ. vol. ix, p. 136.

merits our attention in preference to any other process. He himself, however, observes, that the observations in mines and in hot springs seem to indicate, with some degree of probability, that the interior of the earth possesses a very high temperature, and that, if the earth's nucleus be supposed in a state of fusion, the explanation of volcanic phenomena is simpler than according to his own theory.

Gay-Lussac very justly remarks, that it is impossible to conceive the admission of atmospheric air into the focus of volcanos, as there must be a force within them acting outwards, by which the liquid lava, a substance about three times as heavy as water, is raised to a height of above 3000 feet, as at *Vesuvius*, and more than 9000 feet in many other volcanos. A pressure of 3000 feet of lava, equal to that of a column of water of 9000 feet high, or to about 300 atmospheres, necessarily prevents the entrance of air into the interior of the volcanos; and as this pressure continues for many years, during which time the phenomena by no means abate in activity, it is impossible that air should in any way contribute to it.

The presence of water in volcanos during the various stages of their activity is, on the other hand, a circumstance repeatedly witnessed by all observers.* Even the smoking during their intervals of repose is, for the most part, nothing but a disengagement of aqueous vapor. Violent eruptions are not unfrequently followed by such enormous quantities of steam, that it condenses in the atmosphere, and falls in heavy showers, as was the case after the memorable eruption of *Vesuvius*, which destroyed *Torre del Greco* in 1794.† Among the elastic fluids evolved from volcanos, besides aqueous vapor, we frequently find sulphuretted hydrogen gas, as, for example, from those at the equator; and from others, as *Vesuvius*, muriatic acid gas. But the formation of these gases in the interior of volcanos cannot be conceived without the presence of water.

If the oxidation of the earthy and alkaline metals were to take place at the expense of water, enormous quantities of hydrogen

* See, among others, Monticelli and Covelli, der Vesuv. Deutsch bearbeitet von Nöggerath and Pauls. Elberfeld, 1824, p. 157.

† See von Buch's geognostiche Beobachtungen, tom. ii. 152. There is, however, still another cause, which occasions these heavy showers, as we shall shew afterwards.

would be necessarily evolved during volcanic eruptions. But this gas seems never to issue from volcanos. According to the observations of Breislak,* Spallanzani,† Monticelli and Covelli,‡ Hoffmann,§ and Poulett Scrope,|| flames are never seen to rise from the crater of *Vesuvius*. Neither did Gay-Lussac¶ during his stay at Naples in 1805, during which he was a frequent witness of explosions, which raised the fluid lava to a height of above 600 feet, ever observe a combustion of hydrogen gas. Each explosion was accompanied with dense black columns of smoke, which would have inflamed, had they been composed of hydrogen gas, as they were traversed by bright red-hot masses. According to Boussingault, neither hydrogen, muriatic acid gas, nor nitrogen gas, is evolved from the volcanos, under the equator, in the New World.** In opposition to this evidence, we have the assertions of Von Buch.††

Davy's hypothesis does not account for the exhalations of carbonic acid gas (Mofettes,) which not only succeed every eruption of *Vesuvius*, but also occur in the vicinity of extinct volcanos and in places affording unquestionable traces of former volcanic action (*Auvergne*, *Vivarais*, *Eifel*, *Laacher See*, *Bohemia*, and so forth‡‡,) in amazing quantities, and as far as we can learn from history, with uninterrupted uniformity. These phenomena must necessarily be closely connected with volcanic action, and cannot pass unnoticed.

But these disengagements of cabonic acid gas could not take place in the presence of atmospheric air in those vast subterranean cavities without their mixing together. Yet, according to Monticelli and Covelli,§§ the Mofettes of *Vesuvius* contain but little atmospheric air, which seems not to intermix with the carbonic acid gas until it reaches the surface. I have examined many such exhalations of carbonic acid gas, in the vicinity of extinct volcanos, (in the neighborhood of the *Laacher See* and in the

* Lehrbuch der Geologie, transl. into German by Strombeck, vol. iii, p. 117.
† Voyages dans les Deux Siciles, etc. vol. ii, p. 31.
‡ Loco cit. p. 191.
§ A personal communication.
|| Considerations on Volcanos. London. 1825.
¶ Loco cit. p. 420.
** Ann. de Chim. et de Phys. t. lii, p. 23.
†† Loco cit. t. ii, p. 141.
‡‡ Monticelli and Covelli, l. c. p. 191. Bischof and Nöggerath in Schweigger's Journ. v. xliii, p. 28. Bischof in Schweigger-Seidel's Journ. v. xxvi, p. 129. The same in his Vulcanischen Mineralquellen. Bonn. 1826. p. 251. Von Buch in Poggendorff's Ann. v. xii, p. 418.
§§ Loco cit. p. 194.

Eifel,) as well as in places where there are no immediate volcanic traces, (*Hundsrück*, the eastern declivities of the *Teutoburger Wald,*) and, in general, have found a scarcely measurable quantity of atmospheric air. According to Boussingault,* the elastic fluids, which are evolved from the volcanos at the equator in the New World, consist of a great quantity of aqueous vapor, carbonic acid gas, sulphuretted hydrogen gas, and sometimes fumes of sulphur; he considers sulphurous acid gas and nitrogen, on the other hand, as accidental. This philosopher† also found the same gases, viz., carbonic acid and sulphuretted hydrogen gas, in the springs which rise in the vicinity of these volcanos. All this is by no means favorable to the supposition of the existence of vast subterranean cavities filled with air under the craters, and an equally unfavorable circumstance is, that, according to Boussingault, no nitrogen is evolved from the volcanos under the equator, which must necessarily be the consequence of oxidation at the expense of atmospheric air.

Independently of all this, the metals of the earths have been found by more recent experiments to be by no means so easy of oxidation as Davy's hypothesis assumed. Besides, this proneness to oxidation must be supposed to be a property more especially belonging to the metals of silica and alumina, as these earths together with oxide of iron, are the principal components of volcanic products—lavas, basalts, &c., generally amounting to about 0.8, whilst lime and alkalies, although never entirely wanting, form but an inconsiderable proportion. But Berzelius‡ has shewn, that silicium, the combustible base of silica, when freed of hydrogen by being gradually heated to a white heat, is incombustible even at that heat in the air or in oxygen; and that it is equally incapable of decomposing water. In like manner Wöhler found,§ that aluminum, the metallic base of alumina, is not oxidized under a red heat, and decomposes hot water but very slowly, while on cold water it has no influence whatever.

Therefore Davy's hypothesis would be applicable only to the metallic bases of alkaline earths and alkalies. But, as these occur only in small proportions in the volcanic rocks, it is scarcely conceivable that so much heat should be evolved by their com-

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* Loco cit. v. lii, p. 5. † Ibid. p. 181. ‡ Poggend. Ann. v. i, p. 221.

§ Poggend. t. xi, p. 146.

bustion at the ordinary temperature as would be sufficient to melt the pure earths, or to inflame their metals, supposing them to exist at the seat of the volcanic action.

The slight specific gravity of the metals of the alkalies, also proves fatal to Davy's hypothesis; for, if the mean density of the earth surpass that of all kinds of rocks, those metals cannot exist, at least not in great quantities, in the interior of the earth.* Davy's hypothesis, therefore, according to the present state of science, will not account for volcanic phenomena.†

Gay-Lussac,‡ assuming that water supplied the oxygen in volcanos, endeavored to account for the absence of uncombined hydrogen among the exhalations of volcanos, by supposing it to form such combinations with other bodies as would not inflame by coming into contact with the air. This is the case when it combines with chlorine to form muriatic acid gas. He here refers to the observations of Breislak,§ and of Monticelli and Covelli,‖ which shew that this acid is among the exhalations of volcanos. He himself, however, observes, that an enormous quantity of muriatic acid must be evolved from the craters, if the hydrogen, which would result from an oxidation by means of water, were to enter into combination with chlorine. But it would be strange that such an exhalation should not have been remarked sooner. In order to account for the formation of muriatic acid, he mentions the experiments made by him and Thénard, in which they evolved that acid, by introducing aqueous vapor into a mixture of sand and common salt heated to a red heat. In support of his position, he mentions the occurrence of common salt in the lavas, from one of which, (that of *Vesuvius* in 1822,) Monticelli and Covelli extracted more than 0.09, and in the slags which cover the white hot lava, and which sometimes contain very beautiful

* Also the latest experiments, made with admirable exactness by Prof. Reich in *Freiberg*, with the assistance of the torsion-balance, have given 5.44 for the density of the earth, as a mean of 14 experiments which afforded very nearly the same results. Versuche über die mittlere Dichtigkeit der Erde mittelst der Drehwage von F. Reich. Freiberg, 1838. This result accords very nearly with that, which was found by Cavendish and Hutton.

† Davy, however, afterwards abandoned his hypothesis. See Consolation in Travel, or the Last Days of a Philosopher.

‡ Loco cit. § Loco cit. iii, p. 57 and 94.

‖ L. c. p. 172. See also Daubeny's Description of Active and Extinct Volcanos. Lond. 1826. p. 372, and v. Humboldt's Reise, etc. t. i, p. 195.

crystals of salt. He father notices the spongy lavas which contain so much iron-glance, and is of opinion that this may also be a consequence of the sublimation of chloride of iron, and its subsequent decomposition, by coming in contact with aqueous vapor and atmospheric air, while at a red heat.* And, lastly, he mentions that chloride of iron, in contact with water, becomes so exceedingly hot, that it is capable, in large quantities, of raising itself to a white heat, and that the chlorides of silicium and aluminium must be able to produce a much more extraordinary degree of heat.

It cannot be denied that there is some justness in these conclusions. But it must be remembered, on the other hand, that the premises are only taken from appearances at *Vesuvius*,† and that the occurrence of common salt and muriatic acid in the products and exhalations of volcanos, seems by no means to be general. We have already quoted Boussingault's observation, that muriatic acid is not evolved from the volcanos under the equator in the New World. The hot springs in those regions contain but little

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* We may here notice the formation of artificial crystals of oxide of iron in a potter's furnace. Poggendorff's Ann. v. xv, p. 630. Mitscherlich, who gives an account of this, finds an analogy between this formation and similar ones in volcanos. He explains it by supposing that common salt and steam both act together upon silica or siliceous combinations, and form muriatic acid, and that this comes either alone or with a small quantity of water into contact with oxide of iron, or ferriferous combinations. Thus chloride of iron is formed, which is again decomposed by the aqueous vapors, and, if the decomposition proceed slowly, the oxide of iron remains behind in large crystals.

In some volcanic eruptions, the conditions necessary for the formation of iron glance seem, indeed, to have been very frequent, whilst in others they have been entirely wanting. It is not only the lavas of *Vesuvius* and *Aci-reale* in *Sicily*, and the rents in the lava of *Stromboli*, which contain distinct crystals of iron-mica; but it is also found in the greatest abundance in *Auvergne*, (*Volvic*, *Mont d'Or*, *Puy de Dome*, etc. . . . .) On the other hand, it has never been found by Nöggerath in the volcanic masses of the *Siebengebirge*, the *Laacher See*, and the *Eifel*; it has only lately been found that some of the slags of the *Roderberg*, an extinct volcano, about two leagues distant from *Bonn*, are scantily covered with iron-glance. See Thomæ der vulkanische Roderberg, &c. Bonn. 1835. p. 22. It is worthy of notice, and speaks in favor of the probability of the above-mentioned production of iron-glance, that in the places last mentioned, the appearance of combinations of chlorine is very limited.

† The observations of Von Humboldt, Gay-Lussac, Von Buch, and Monticelli, made at different times, shew also that the exhalations of muriatic acid are very variable. They are sometimes so frequent as to surpass the exhalations of sulphurous acid, sometimes only a few traces of it are found.

common salt.* In my frequent excursions in the vicinity of the *Laacher See* and in the *Eifel*, I have never found any efflorescence of salt either on the undisturbed or fresh broken lavas, and other products of the extinct craters in those districts. On the uncovered walls of trass, in the *Brohl* valley, efflorescences are, indeed, to be found, but they contain chlorides only as very subordinate ingredients.† The lixiviation of trass, basalt, and other volcanic rocks, also gives but a trace of common salt.‡ That muriatic acid must have played a very insignificant part in the eruptions of these ancient volcanos, seems to be proved by the mineral springs which rise in their vicinity; for common salt is one of their least considerable components, indeed they frequently contain mere traces of it. This is the result of more than forty analyses of mineral springs in those regions, which I have undertaken during these last few years. But these waters would extract the chlorides from the volcanic masses through which they flow, if they existed in any considerable quantities in them, and would return impregnated with them to the surface.

From all this we do not seem to be justified in considering the chlorides as the chief agents in volcanic phenomena, although it cannot be denied that they may, in some instances, co-operate in their production.§ It has even been supposed that the beds of

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* Loco cit. p. 181.

† Die vulkanischen Mineralquellen, &c. p. 243.

‡ Idem, p. 246 and 247.

§ Many volcanos have produced considerable quantities of common salt, as, for instance, *Vesuvius*, *Hecla*, &c. Also sal-ammoniac is found among the volcanic sublimations of *Vesuvius* and *Etna*, and almost exclusively in some volcanos of the interior of *Asia*. Vauquelin found in a porous rock, constituting a considerable part of the *Puy de Sarcouy*, in the chain of the *Puy de Dôme*, 0.055 of muriatic acid, which is worthy of remark in connection with the frequent occurrence of iron-glance in that neighborhood. (Ann. des Mines. vi, p 98.) There are felspar crystals in the trachyte, colored sulphur-yellow by muriatic acid vapors of a former time. Common salt also forms the chief ingredient in the thermal springs of *St. Nectaire*, in the department *Puy de Dôme*. In the mineral springs of *Mont d'Or*, *Vichy*, *Chaudes-Aigues*, *Vals*, &c., on the contrary, it is in very small quantities. In the lavas of *Etna* 0.01 of muriatic acid has been found. In basalt, Kennedy found 0.01; Klaproth 0.0001; and I, 0.00085 of muriatic acid. I also found that acid in a steatitic substance in the trachyte conglomerate of the *Siebengebirge*. See "Die vulcanischen Mineralquellen," p 277. But this occurrence of muriatic acid, which may, perhaps, be found in many other volcanic productions, is far too inconsiderable for us to ascribe to it any great part in the production of volcanic phenomena. Proust tells us that, according to Garicas Fernandez, the celebrated salt mines at *Poza*, near *Burgos*, in *Old Castile*, are situated in the centre of a crater, in which the latter collected various volcanic products. Journ. de Phys. vol. lv, p. 457.

rock-salt are of volcanic origin. But this proves nothing more than that rock-salt may have been raised from the interior of the earth by volcanic power, and that the beds of salt are a consequence of volcanic action, but not conversely, that chlorides and the disengagement of muriatic acid are the cause of that phenomenon.

Now, since neither any process of oxidation, nor processes in which chlorides take an active part, are capable of affording a satisfactory explanation of volcanic phenomena, we can scarcely conceive any other powerful chemical process, which could alone give rise to them. We may, therefore, look upon the hypothesis which seeks the cause of volcanic phenomena in intense chemical action as untenable.

II. *The hypothesis which supposes the temperature of the earth gradually to increase towards the centre, to a red and white heat, explains in a satisfactory manner (according to the present state of science) volcanic phenomena as well as earthquakes.*

If the heat of the earth continually increases with the depth, the rocks must at a certain depth be in a state of fusion. But since they possess such various degrees of fusibility, the more fusible rocks must be in a liquid state, at depths in which the less fusible ones are still solid. At certain depths there must, consequently, be masses of melted rocks, enclosed in the solid rock, in the same manner as iron ores are melted and reduced in the less fusible masses of which blast furnaces or crucibles are composed. These depths must, according to the above hypothesis, be looked upon as the seat of volcanic action. The crystalline rocks are the most easy of fusion on account of their containing alkalies, which indeed are not wanting in any of them. So that, in general, the more abundantly alkaline minerals, as felspar, mica, leucite, &c., are contained in volcanic masses, the more readily will they fuse.*

Sir James Hall† has endeavored to ascertain the degree of fusibility of various lavas and other volcanic rocks. Lava from *Ve-*

* According to Von Buch, (Abhandlungen d. Königl. Acad. d. Wissenschaften zu Berlin, 1818–1819, p. 62,) it may be taken as a general rule, that all real lavas, which flow in streams down the sides of volcanos, contain glassy felspar. *Vesuvius* being the only exception out of so many is not worth mentioning.

† Transact. of the Roy. Soc. of Edinburgh. Vol. v, &c.

suvius of the year 1785, melted at 18° of Wedgewood's pyrometer, lava from *Torre del Greco* not till 40°. But their fusibility varied very considerably, according as the melted lava had been cooled rapidly to a glass, or more slowly to a stony crystalline mass. Thus, for example, those two lavas, when in the form of a glass, both melted at the same degree, (18°,) whilst the lava of 1785 was less fusible than that of *Torre del Greco*, when of a stony nature.* From other appearances it may, in general, be concluded, that the fusibility of lavas is between that of silver and copper. Thus in the lava which destroyed *Torre del Greco*, some gold and a few copper coins were found unmelted; but the silver coins were melted and baked together with some copper coins.† Davy found that a copper-wire of $\frac{1}{20}$ of an inch in diameter, and a silver-wire of $\frac{1}{30}$ of an inch, thrust into the lava near its source, instantly melted.‡ A wire of copper $\frac{1}{8}$ of an inch in diameter, which I held in a stream of fused basalt, flowing out from a furnace, melted immediately. But the basalt was doubtless heated far above its fusing point. Now according to Daniel,§ silver melts at 2233° F., but copper at 2548° F.; we may therefore take a mean of 2282° F. (=1000° R.) for the melting point of lava.

Now, if we suppose the increase of temperature to continue to follow the same progression as has been discovered in accessible depths, the lava must be in a state of fusion, according to the observations near *Geneva* and in *Cornwall*, at the depth of about 113505 feet, and from those in the *Erzgebirge* at about 126829 feet below the level of the sea near *Vesuvius* or *Etna*.‖

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* Glass is well known to be acted upon in a similar manner. When converted, by being melted and slowly cooled again, into Rèaumar's porcelain, it becomes less fusible.

† Thompson: Notices of an English Traveller, &c. Breislak. (Voyage dans la Camp., vol. i, p. 279,) mentions, that when bell-metal was plunged into the lava, the zinc melted out, leaving the copper behind.

‡ Ann. de Chim. et de Phys. vol. xxxviii, p. 138.

§ Journ. of Science, xxiii.

‖ According to my observations made on a cooling basalt-ball of twenty-seven inches diameter, and which I shall communicate afterwards, the increase of temperature from the surface towards the centre of the earth, seems to take place, not in an arithmetical, but in a geometrical progression. But the exponent of this progression being very little greater than 1, this progression comes very near to an arithmetical one. The depths, above calculated, being but insignificant in proportion to the diameter of the globe, no great error has been committed in supposing

If we suppose steam to be the power by which the lavas are raised from this enormous depth, and by which the volcanic bombs, rapilli, and ashes are thrown up, and according to all observations hitherto made, water in its elastic state seems to be the only means by which the lavas* and other volcanic rocks,† are so raised; it is yet a question whether its expansive force could be sufficiently raised by heat? Parrot‡ reckons that the temperature of lava, at the moment of its ejection, is five times as great as would be necessary to raise it 48000 feet by the elastic force of steam, supposing the steam to be formed in the presence of water. But from more recent inquiries on the elastic force of aqueous vapor, this calculation must undergo considerable corrections. The formula of Mayer, as altered according to the last results of the experiments at *Vienna*§ corresponds the most nearly with the elastic force of steam as actually observed, so that it may be considered as the most correct determination of its elasticity at higher temperatures. If we wish to find the pressure of the steam in

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the increase of temperature follows an arithmetical progression as far as these depths. With this exception, we can hardly hope ever to become acquainted with the true progression of the increase of the temperature to the interior. Therefore all such calculations, as the former, can but give approximations to the truth.

* Von Humboldt's Reise, t. i, p. 186. A short time before the great eruption of *Vesuvius*, in the year 1805, he and Gay-Lussac observed that the watery vapors in the interior of the crater did not redden litmus. Many other naturalists have also found that the outlets of smoke of the *Peak of Teneriffe* emitted pure water only. Voy. de La Peyrouse, t. iii, p. 2. Hoffmann, in his letter to Von Buch on the geognostical structure of the *Lipari Islands*, in Poggendorff's Annal. vol. xxvi, p. 9 and 45, and in several places in his account of the volcanic island which rose in the *Mediterranean Sea*, vol. xxiv, p. 65. According to Monticelli and Covelli, the smoke which rises from the lava-streams consist almost exclusively of aqueous vapor. Loco cit. p. 27, 65. and 83. Numerous fumaroles (exhalations of aqueous vapor) rise on the island of *Ischia* out of the cracks in the lava. Forbes, in Edinb. Journ. of Science, N. S. iv, p. 326. Reinwardt, Verhandlingen van het Bataviaasch genootsthap van Kunsten en Wetenschapen, negende deel, Batavia, 1823, p. 1. Ordinaire mentions, in his "Histoire Naturelle des Volcans," a mass of melting iron having been cast to a height of 150 feet, out of a blast furnace, by some water having accidentally got into it. See D'Aubuisson, Traité de Geognosie, v. i, p. 215.

† The water contained in basalt speaks in favor of this opinion. See Klaproth's Beiträge, &c., vol. iii, p. 249, and Kennedy in Appendix to the same, p. 255. On melting basalt, and introducing a gun-barrel into the crucible, I observed a considerable evolution of aqueous vapor.

‡ Grundriss der Physik der Erde und Geologie. Riga u. Leipzig, 1815, p. 264.

§ Arzberger in the Jahrbüchern des Polytechnischen Instituts, vol. i, p. 144.

Paris inches of a column of mercury from this formula, we shall have

$$\log. e = 2.8316686 + \log. (213 + t) - \frac{847.3}{140 + t}$$

in which t is the temperature in degrees of Reaumur $= \frac{4°}{9}$ F.*

It is clear that the elastic force of steam cannot surpass a certain maximum, which it reaches when its density is equal to that of water. This is the case when the elasticity of the vapor $e = 232952$ Paris inches of mercury, or nearly 8320 atmospheres, which supposes a temperature of 2786° F.†

Thus, if aqueous vapor were to reach its greatest possible elasticity, its temperature must exceed that above assumed for the melting point of lava by 504° F. The highest column of lava, which steam at its maximum elasticity is capable of supporting, is, therefore, if we suppose the specific gravity of liquid lava three times as great as that of water, 88747 feet. But a temperature of 2786° F. will, according to the observations at *Geneva* and in *Cornwall*, be met with at a depth of 139265 feet, and according to those in the *Erzgebirge*, at a depth of 155613 feet (about thirty English miles) below the level of the sea near *Vesuvius* or *Etna*.‡

Supposing, then, the values found for the maximum elasticity of steam for the corresponding temperature, and for the depth at which that temperature must exist, to be correct, it would not be possible, that a column of lava, of the whole height, from the seat of the volcanos to the surface of the earth, should be raised up. On the other hand, in the same manner as a bubble of air let into a barometer, drives the mercury into the Torricellian vacuum far above the barometric height, aqueous vapor may raise a column of lava of a height equal to its expansive force into the channels opening into the craters. Thus, then, it may happen that aqueous vapor, though far from its maximum elasticity, may yet be able to raise a column of lava equal in height to its elasticity from still greater depths to the surface of the earth. A continual alternation of columns of lava and steam in the channels may be very well conceived, the consequence of which would be an alternate

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* On steam and steam engines in the Abhandlungen der Königl. technischen Deputation für Gewerbe, part i, p. 344.

† Ibid.

‡ Supposing the mean temperature of this localtiy = 61° F.

ejection of lavas, red hot masses, and clouds of steam, just as Spallanzani,* Scrope,† and Hoffmann,‡ observed on *Stromboli.*

We have now to examine the circumstances under which water might find its way to the origin of volcanic action. The difficulties which present themselves when we suppose a direct communication between the sea and the seat of the volcanos, have already been discussed by Gay-Lussac. We shall make an attempt to solve these difficulties.

If we imagine the sea to have free access by means of fissures to the seat of the volcanos, the depth of which, according to the above calculation, may be taken at from 113505 to 126829 feet, the elastic force of steam at that depth, where $t=2282°$ F., will be $=5310$ atmospheres. But the hydrostatic pressure of these columns of water is only from 3547 to 3963 atmospheres. The expansive force of steam at that depth in which the temperature is 2282° F. is, therefore, greater than the hydrostatic pressure opposed to it, so that the latter cannot resist it. But since, as the temperature decreases, this expansive power diminishes more rapidly than the hydrostatic pressure, there must be a certain depth and a corresponding temperature in which they will be in equilibrium. For a constant increase of temperature of 1° F. in 51 feet, this point will be at the depth of 88044 feet below the surface of the sea, where the temperature is 1754°.5 F.;§ for, according to the above formula, if t be taken equal to 1754°.5,

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* Voyag. t. ii, p. 21.

† Considerations on Volcanos, &c., p. 54. A phenomenon observed by Scrope during the night in the crater of *Stromboli* distinctly shows, that, by the force of aqueous vapor alone, the column of lava is raised. The lava once suddenly disappeared in the depth of the crater; on the contrary, innumerable little columns of steam appeared at the edges of the mouth of the crater, which arose with a hissing noise. This lasted for some minutes, when the melted mass rose again from beneath, and the phenomena pursued again its ordinary course. Spallanzani remarks very justly with a view to this, that the compressed vapors prevented from being discharged by the sinking lava which had become tenacious on the surface, will now escape laterally through the fissures in the walls of the edge of the crater, and in this case the lava cannot be elevated by them. It is not until the lava has been sufficiently heated and become again liquid, that the vapor can rise again with the lava, and that the phenomenon can be re-established.

‡ Loco cit. p. 9.—D. Curbeto also observed that a dense smoke always followed the streams of lava which were ejected on the 7th June, 1731, Von Buch in the Abhandl. d. Berliner Acad. of 1818–1819, p. 77.

§ To simplify the calculation, I have supposed the mean temperature of the surface = 32° F.

$e=77028$ inches of a column of mercury, or $\frac{77028}{28}=2751$ atmospheres, and $\frac{88044}{32}$ gives the same number. On the other hand, for a constant increase of temperature of 1° F. in 57.1 feet it advances to a depth of 105627 feet below the surface of the sea, where the corresponding temperature would be 1881°.5 F.;* for the same formula gives $e=92435$ inches of a column of mercury, or 3301 atmospheres, when $t=1881°.5$, and $\frac{105627}{32}$ gives the same value. Presupposing the correctness of the premises, these calculations shew the possibility of columns of lava of $\frac{88044}{3}=$ 29348 and $\frac{105627}{3}=35209$ feet being raised by the power of steam from the respective depths of 88044 and 105627 feet below the surface of the sea, whilst there is an uninterrupted communication between the sea and the volcanic focus. The difficulty mentioned by Gay-Lussac, that the water would, under its own pressure, take the gaseous form before reaching the strata, which are at white heat; without being able to raise the lavas, to cause earthquakes, and to support the volcanic phenomena; is consequently also set aside, in so far that the water cannot assume the form of gas under its own pressure before reaching those depths and their corresponding temperatures. At depths greater than 88044 or 105627 feet below the surface of the sea, if the communication with the sea remained free, a reaction would take place in the column of water. Perhaps the phenomena mentioned in Chap. xi, on Hot and Mineral Springs, vol. xxiii, of Ed. New Phil. Journal, and observed by Horner near the *Kurile Islands*, as well as the powerful stream of hot steam, observed by Hoffmann near *Vulcano*,† beneath the surface of the sea, probably at the same place where the crater of the cone formerly thrown up at this spot was situated, proceeds from a similar volcanic effervescence. In general, the rising of smoke from the sea during the eruptions of neighboring volcanos is by no means an uncommon occurrence.‡ The reflux and the internal agitation of the sea is

* To simplify the calculation, I have supposed the mean temperature of the surface = 32° F.

† Loco cit. p. 67.

‡ D. Curbetto (Von Buch loco cit. p. 78) observed a great quantity of smoke and flames (?) accompanied with tremendous detonations, rise from the sea near *Lancerote*, during the volcanic eruption on that island. Fish and pieces of pumice were seen floating about. Several examples of this sort are cited farther on.

also a forerunner of almost all eruptions, especially of those of *Vesuvius.*

But if a reaction should take place in the column of water, yet the rising vapor would soon be so far cooled down as to become liquid again, without the expansive force of the enormous quantities of vapor formed at the volcanic focus being thereby perceptibly diminished. In addition to this, the hydraulic resistance in the narrow channels, through which the water is admitted, increases very considerably as its velocity becomes greater. But the column of water, by which the aqueous vapor is cut off from communication with the surface, acquires very great velocity in those narrow channels, from the enormously increased elastic force of the steam, by which the resistance may very easily be increased to the extent of much more than 1000 atmospheres. So that, notwithstanding that the expansive force of steam whose temperature exceeds 1754° or 1881° F., is greater than the hydrostatic pressure of the column of confining water, yet this resistance may suffice, in the manner just mentioned, to raise a column of lava, of even a greater height than we have above reckoned, to the summit of the volcano. If we may be allowed to make a comparison with an analogous phenomenon, it may be remembered that the touchhole of a cannon, or of a bore-hole in a mine, does not weaken much the action of the powder, although the proportion of the diameter of the touchhole to that of the mouth of the cannon is as 1 : 30.* If Perkins's well known observation,† that water and steam cannot be forced through narrow openings in the red-hot generator of a steam engine, is applicable to the gigantic generator, which formed the volcanic focus: this might be added to the causes already mentioned, which afford resistance in the channels through which the waters are admitted.

So long as the communication with the sea remained open, the volcano could never come to a state of rest, although the forma-

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* But even when the touchhole becomes considerably widened by frequent use, the cannon is still of service, although, indeed, its power is somewhat diminished. Yet the force with which the powder projects the ball is equal to about 2200 atmospheres, in which the loss occasioned in the absolute expansive force of the powder by the touchhole, &c., is already allowed for. Muncke in Gehlers Physikal. Wörtembuch, new edition, v. i, p. 712.

† Quarterly Journ. of Sc. July to Dec. 1827, p. 471, and Annal. de Chim. et de Phys. xxxvi, p. 435. See also Muncke in Poggendorff's Ann. vol. xiii, p. 244, and Buff in the same, vol. xxv, p. 591.

tion, or much more the access of new lava from remote places, might require a long period before actual volcanic eruptions could again take place. Of *Vesuvius* we know that the periods, when it is entirely free from evolutions of aqueous vapor, are not of long duration. On *Lancerote* some of the cones, which were erupted eighty years ago, still continue to emit steam. The cones of *Jorullo* emitted boiling hot vapors, and boiling springs rose in the neighborhood at the time when Von Humboldt visited them, that is, forty-four years after the last eruption. Burkart, on visiting *Jorullo* twenty-four years afterwards, saw scarcely any evolution of watery vapor from these cones; but vapor of the temperature of between 113° and 129° F. was still rising from fissures in the neighborhood of the principal crater.* Very hot vapor continues to the present day to issue in all directions from the sides of the rocks on *Pantellaria*, and yet there seem to have been no eruptions on this island since the commencement of the historical era.†

But it is very probable that the channels by which the water enters become obstructed from time to time. This may be effected by the lava itself, which is the more likely, as the channels may perhaps be very narrow. It may, however, also be caused by the hot steam. Indeed, Monticelli and Covelli observed, during the eruption of *Vesuvius* in October of 1821, that the fragments of lava, when no longer possessed of a great internal heat, remained separate; but that when they were themselves very hot, or traversed by the hot vapors, they united so firmly together, that they could be separated only by heavy blows with a hammer on the tenacious surface.‡ If the aqueous vapors of ordinary elasticity and temperature are able to effect

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* Aufenthalt and Reisen in Mexico in den Jahren, 1825, bis 1834 Von Burkart. Stuttgart, 1836, t. i, p. 227 and 228.

† Hoffmann, loco cit. p. 69.

‡ Loco cit. p. 10. It may perhaps be allowed here to mention an observation of my own, though on a somewhat limited scale. I found that the stones by which the *Kaisersquelle* at *Aix la Chapelle* is closed, and that the canals of the *Schwerdtbad* at *Burtscheid*, which consist of black marble, were converted on the inner side into a doughy mass by the continued action of the steam. But the temperature of this steam is only 133° to 167° F. There occur innumerable instances of decompositions and alterations which rocks suffer when exposed to the continued effects of heat and acid watery vapors. See among others Krug von Nidda, p. 274. Burkart, loco cit. t. i, p. 194.

this, what effect, it may be asked, may not steam of such extraordinary elasticity, and of a temperature equal or even greater than the melting point of lava, exert upon fusible rocks, solidified masses of lava, &c., which it meets with far above the volcanic focus in colder regions? Would not such steam convert the rock into melted liquid matter? It is, indeed, difficult to conceive a state of which even Papin's digestor can give us but a slight idea.

If the channels become obstructed after a considerable quantity of water has found its way to the volcanic focus, the aqueous vapor may attain its maximum elasticity, as the focus will act like a steam-boiler closed on all sides, that is to say, it will be able, according to the above calculations, to raise a column of lava of 88747 feet.

The filtration of a large quantity of water, which, although it becomes gradually heated as it descends, is prevented by its velocity from assuming the temperature of the strata through which it passes, must tend to cool the volcanic masses. But it will be cooled to a far greater extent by the considerable formation of steam. In this manner a gradual solidification of the lava will take place not only in the crater, but also in the great volcanic focus itself,* whereby the termination of the volcanic eruptions is produced.† The contraction of the walls of the volcanic focus during the reduction of their temperature causes fissures in the rocks,‡ by which the waters are admitted in other places. But in doing so, it may frequently happen that these fissures do not communicate with the channels by which the water is admitted, and that the volcanic action is consequently for a time suspended, but that on its revival the slightest shock is sufficient to break

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* Necker, Memoires de la Société de Physique et d'Histoire Naturelle de Genève. Genève, t. ii, part i, p. 155.

† Observations made on *Vesuvius* and the *Peak of Teneriffe* shew, that the greater part of the ashes is thrown out last, so that their appearance may be considered as a sign of the approaching termination of the eruption. In proportion as the elasticity of the vapors diminishes, the substances will be thrown to a less distance, so that the black rapilli, which are the first ejected after the lava has ceased to flow, will be cast farther than the white ones. Von Humboldt's Reise, t. i, p. 245.

‡ It is well known that considerable fissures are formed in lava during its cooling, especially when it is on the surface of the earth. The streams of lava in the country surrounding the *Laacher-See*, offer many instances of this kind. Hamilton also mentions great fissures in the lava-streams of *Vesuvius*. Gilbert's Annal. t. vi, p. 23. See also Necker, loco cit.

through the walls, and thus to reopen the communication.* This may even be caused by the expansion of the cooled walls of the focus by the heat communicated to them from all sides; in the same manner as a small crack in a crucible increases when exposed to a red heat.

The more the temperature of the lava is reduced by the water and the generation of the steam, the longer will be the time required for the refusion of the solidified lava. In this manner a long period may elapse, as the lava is so very bad a conductor of heat.† The repose and activity of a volcano are, therefore, the alternate solidification and liquefaction of the lava, and the interruption and renewal of the supply of water to the volcanic focus.‡ If the store of lava in the volcanic focus should at first become exhausted by repeated discharges, the volcano is entirely reduced

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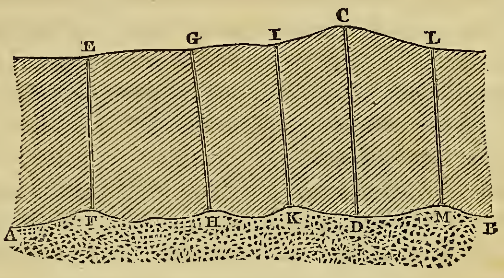
* We may here notice the well-known phenomenon, that among the ejected masses from a volcano, pieces of rock occur, which neither belong to the substances composing the edge of the volcanic cone, nor to those found in the vicinity, and therefore must be derived from masses concealed very deep under the volcano. *Vesuvius* particularly, furnishes remarkable instances of this kind. Such ejected masses, however, are now found much more rarely than formerly on this or other volcanos, from which it seems to follow, that the channels of the ejections have been by degrees widened.

† Monticelli and Covelli, loco cit. p. 15 and 39.

‡ Experiments hitherto made shew, that long spaces of time are requisite to produce the strongest effects, viz., the elevation of lava to the greatest height. Von Humboldt (Reise, &c., t. i, p. 261,) calls our attention to the circumstance, that long intervals of quiescence seem to characterize the very high volcano. The smallest of all, *Stromboli*, is nearly always in activity. The eruptions of *Vesuvius* are less frequent, although they are still more so than those of *Etna* and the *Peak of Teneriffe*. During the quiescence of the latter, from 1706 to 1798, sixteen eruptions of the former took place. From the colossal summits of the *Andes*, *Cotopaxi* and *Tungurahua*, an eruption is observed scarcely once in a century. We may venture to state, that the frequency of the eruptions of active volcanos is inversely as their height and mass. After these general remarks, we may mention the circumstance that large lava streams, namely, such as issue from *Etna* and *Vesuvius*, never flow from the crater itself, and that the quantity of the melted matters is commonly inversely as the height of the fissures from which the lava issues. But a lateral eruption of these two last-mentioned volcanos always terminates by an emission of the ashes from the crater, that is, from the summit of the mountain itself. This phenomenon has not been seen on the *Peak of Teneriffe* these last hundred years. The crater was most inactive during the eruption in the year 1798. Its basis did not sink, whilst the greater or less depth of the crater of *Vesuvius*, according to the acute remark of Von Buch, is an almost infallible sign of an impending fresh eruption. Von Humboldt, p. 268. All this shews that the conditions requisite for producing the greatest effect, viz., for producing the highest degree of the increased elasticity of the watery vapors, are not always present.

to a state of rest, or at least until it receives a fresh supply of lava from a distance. If the afflux of water be not interrupted, the exhalations of vapor may still continue, of which we have already mentioned several instances.

We may next consider how lava may be elevated from the depth of a volcanic focus. The hypothesis, which ascribes volcanic phenomena to the central heat, supposes that melted matters exist at a certain depth. In adopting this opinion, we need not assume that lava is produced by the melting of solid rocks, but on the contrary, that melted matters have existed since the creation of the world.* In the annexed diagram AB represents the



boundary between the solid crust of the earth and the melted matters in the interior of the earth ; CD represents a wide rent, exhibiting a communication from the surface to the melted matters ; EF, GH, IK, LM, &c., are narrow rents conducting water from the sea or subterranean collection of water to the heated interior ;† and F, H, K, M, may be caverns in the solid crust, formed during the consolidation of the originally fluid matters of a former period. Under these circumstances it may easily be conceived, that water penetrating into the above mentioned rents and caverns is converted into steam, which, by pressing on the melted matters, causes them to rise through the rent CD. If the lower opening in the wide rent at D be on the same level as the whole boundary between the solid rocks and the melted matters,

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* On this supposition, we assume that no basalt has been produced by the repeated melting of any known rock. Leonhard's Basalt Gebilde, &c. Stuttgart, 1832, t. i, p. 263.

† Water will naturally also penetrate into the wide rent, but, inasmuch as it is not able to fill up the rent, it cannot confine the steam generated beneath, and the latter will therefore escape.

small quantities of these only will be raised upwards, for the surface of the melted matters will soon sink below the opening of the rent at D, and steam will rise. Thus the elevation of a column of lava to a considerable height by a column of steam will take place. But if the lower opening of the rent CD descends more or less below the surface of the melted matters, considerable quantities of these will rise into it before this surface sinks below the opening. The same may take place if between the opening of the rent CD and the other rents, (those down which water flows from the surface,) ridges of solid rock reach downwards from the solid crust into the fluid mass.

Such ridges may be viewed as occasioned by gradual solidification of the fluid mass from above downwards, for it is well known that melted matters, if they crystallize by cooling, exhibit on their under surface considerable inequalities; and the consolidation of the melted matters in the interior of the earth is assuredly produced by crystallization.

There is another circumstance which may cause a continuation of the rent CD into the melted matters. After the rising of the lava and steam in this rent, the walls of it are cooled by the formation of steam, and by the atmospheric air having a ready access to the empty channel. Therefore these walls may gradually increase by the solidifying of the melted matters; nay, the rent may be entirely solidified and obstructed, so that it can only now be re-opened by the force of steam previous to a new eruption taking place. If even immense quantities of lava are ejected by the steam, yet the level of the melted matters in the interior may be but slightly changed, for in the same manner, as all seas on the surface of the earth communicate together, so the melted matter in the interior does the same. However, more or less time may elapse, before the melted matter which has sunk at one place in consequence of ejection, can regain its former level by the afflux of other melted matters from a distance. Therefore the repose and activity of a volcano, besides depending on the interruption and renewal of the supply of water to the volcanic focus, may also proceed from the alternate obstruction and re-opening of the lava channel by the melted matters. In the latter case, in the state of rest, exhalations of steam will take place, inasmuch as water penetrates continually to the volcanic focus.

But if the afflux of water be interrupted by an obstruction of the water-ducts, and if none of the above-mentioned causes be capable of restoring the communication; or if, during the repose of the volcano, the lava-ducts become so obstructed by consolidation, that the steam cannot force its way through them, a volcano may reach a state of perpetual repose. Such causes may have effected the extinction of the volcanic activity of the numerous extinct volcanos distributed throughout the globe. If this took place at a former period, when the thickness of the crust of the earth was still increasing considerably, in consequence of the gradual cooling of the earth, and as this process is still going on, there is no probability that such extinct volcanos will at any time become again active.

If volcanos, for instance *Etna*, are considerably elevated above the surface of the earth, it commonly happens that the walls of the lava-channels cannot resist the pressure of the melted matter in their interior. In this case rents are formed from which the lava issues. Such rents are always seen in the direction of the axis of the volcanic cone,* and their extent is often very considerable. A rent of this description produced by one of the most violent eruptions of *Etna*, viz. that of the 11th May, 1669, was 2½ German miles in length, and occupied almost one-third of its height. Scrope† saw distinct traces of it near *Nicolosi* so late as the year 1819. Even the rent formed during the eruption in 1794, on the declivity of *Vesuvius*, towards *Torre del Greco*, was, according to Von Buch 3000 feet in length, and according to Breislak, 237 feet in breadth at its upper edge.

Other volcanos afford instances of the formation of rents and hills. Thus, during the most violent eruption of *Scaptar Jokul* on *Iceland*, in 1783, a rent eight English miles in length was formed in a plain at the foot of the mountain. Three craters, from which immense quantities of lava flowed out, rose in the direction of the rent, and afterwards a fourth appeared below the sea in the same direction, and at a distance of thirty miles, the eruption of which formed an island, which afterwards disappeared again.‡ Similar phenomena took place in the same year in the island of *Java*. And Von Buch§ informs us, that in the island of

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* Von Buch's Beobachtungen, &c., t. ii, p. 137.

† Considerations, p. 158.

‡ Ibid, p. 154.

§ Leonhard's Taschenbuch, 1824, t. ii, p. 439.

Lancerote, during the eruption in the year 1730, a rent was formed above two German miles in length, on which about twelve conical hills rose, whose summits were from 600 to 800 feet in height.

In like manner basaltic cones, (also porphyritic and granitic hills,) are often seen, which are situated in a line, and of which two or more are connected by rents, which are filled up by basalt. Remarkable phenomena of this kind are seen near *Murol* in *Auvergne*.*

It seems surprising that the same kinds of lava are not always ejected from volcanos. Von Buch† distinguished on *Vesuvius* alone, eighteen distinct principal kinds of lava; and old and new lavas of *Etna* also differ in their characters. The lavas of neighboring volcanos are often very different from each other. In like manner, unstratified rocks of very different natures are often met with close to each other.‡ The *Siebengebirge*, near *Bonn*, offer remarkable instances of this kind. There, trachytes, trachyte tuffs, basalts, and basalt tuffs, are met with close to each other. Basalt-dykes traverse the trachyte and the trachyte tuffs, and volcanic scoriæ occur on the *Roderberg*, opposite to the *Siebengebirge*, on the left bank of the *Rhine*. However different all these rocks are, yet they seem to lead to the conclusion that their origin has been from the very same materials; for, notwithstanding this difference in their nature, it would be easy to form in the *Siebengebirge* a gradation from a white trachyte to a compact black basalt.§ On the other hand, there is every reason to suppose that the nature of melted matters in the interior is different in different places. If, therefore, after the ejection of melted matters existing in a particular spot, new eruptions will take place only when such matters flow from remote places towards this spot, we can hence easily conceive how different lavas may be ejected at different times. In the *Siebengebirge*, as well as in other places where unstratified or volcanic rocks occur, many in-

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* Leonhard's Basalt Gebilde, t. i, p. 408. † Beobachtungen, &c. t. ii, p. 174.

‡ The lavas of *Vesuvius*, of the *Solfatara*, of *Ischia*, and of *Etna*, are quite different in their nature.

§ See Leonard Horner, on the Geology of the Environs of Bonn, in the Transactions of the Geological Society, vol. iv, 2d Ser. p. 438. Von Buch states that in several places in the neighborhood of *Clermont* and *Puy de Dome*, a transition from granite into trachyte may be traced, and thus to have the gradation extended from granite to basalt.

stances are exhibited, which indicate that these rocks are of very different ages.*

If the activity of a volcano ceases, but the channels by which the waters enter remain open, the volcanic action may be replaced by hot springs.† In this case it is easy to conceive that the meteoric waters, continually sinking into the hot interior, would there assume the surrounding high temperature, and rise again to the surface with a temperature, diminished proportionally to the decrease of pressure, either through the former lava-channels, or other fissures more recently opened.‡ But if at that depth, the hydrostatic pressure be greater than the elastic force, which the water has there acquired, no steam will be generated in the whole course of the spring; but, in the contrary case, from the lowest point up to the point where the elastic force becomes greater than the hydrostatic pressure, the water will escape in the form of a vapor. However high the temperature of the water may be at the lowest point of its course, whether in the liquid or in the gaseous state, yet, when it reaches the surface, it cannot exceed the boiling point. The reason of springs but seldom attaining even this maximum, may be either the loss of heat communicated to the superior strata of the earth, or that they meet with streams of gas, (carbonic acid, or sulphuretted hydrogen,) which, even if possessed of very high temperature, will cause a depression of their temperature, as is proved by experiments cited in Chap. II, of Memoir on Springs, p. 336, vol. xx, Ed. Phil. Journ.§ The production of hot springs, according to the last species of volcanic

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* L. Horner, l. c. p. 467.

† Von Buch, loco cit. p. 65. A remark of some interest, in tracing the connection of hot springs with volcanic phenomena, is made by Burkart, loco cit. vol. i, p. 316, viz. that the boiling hot springs in the valley of *Pate* are situated on a line, running from east to west, parallel to the general line, of volcanos in *Mexico*.

‡ Von Humboldt is also of opinion, Reise, &c. t. i, p. 187 and 188, that the vapor which rises from the "*Narices del Pico*" as they are called, and from the rents in the crater of *Teneriffe*, is nothing but atmospherical water which has penetrated by infiltration.

§ According to M. Arago, the hottest spring in *Europe* unconnected with modern volcanic action is that of *Chaudesaigues* in *Auvergne*, whose temperature he quotes at 176° Fah. Annuaire du Bureau des Longitudes, 1836. The next hottest to this seems to be *Thuez*, in the *Pyrenees*, whose temperature is, according to Professor Forbes, 171°.5 Fah. Phil. Trans. t. ii, p. 603, for 1826. Forbes believes, p. 610, the baths of *Nero*, near *Naples*, the hottest spring on the continent of *Europe*, which is connected with modern volcanic action, the temperature being 182°.2 F.

action, may, however, be thus imagined; that the water which descends to the volcanic focus is there converted into steam, which, rising through fissures into higher regions, meets with atmospheric waters which it warms, and with them returns to the surface.* The course of hot springs produced in this manner can, therefore, occur only at inconsiderable depths below the surface. Lastly, it may happen that the lava last raised did not escape from the crater or its lateral openings, but became solid on its way onwards, and thus stopped up the channels. If, in this case, water should descend through rents into this still extremely hot lava, hot springs would also thus be produced, supposing a communication between these and other rents which lead to the surface at a lower level; but these springs will decrease in temperature by degrees as the lava gradually cools, till they reach that degree which naturally belongs to the place where the lava is situated. However, we have already proved by experiments formerly mentioned, and calculations founded upon them, that, if such masses of heated lava be of considerable extent, a very long period may elapse before the decrease in the temperature of the springs will be even perceptible.† On the other hand, there are examples of a very rapid decrease in the temperature of hot springs in the neighborhood of volcanos recently become extinct. Thus, the temperature of the hot springs on *Jorullo* decreased 40°.5 F. in twenty four years, between the visits of Von Humboldt and Burkart.‡ The temperature of the mixture of gases which issues from the rents in the Pass of *Quindiu*, near the *Moral*, in the *Quebrada del Azufral*, decreased from 1801 to 1827, according to the observations of Von Humboldt and Boussingault, from 118° to 66°.4.§ If, instead of this gas, a mineral spring had flowed at this place, it would, doubtless, have suffered a similar diminution of temperature. Boussingault mentions, on the other hand, that, in a period of twenty-three years, the temperature of

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* Perhaps the numerous hot mineral springs which rise at the foot of the still smoking mass of rocks on *Pantellaria*, as well as the numerous hot sulphureous springs in the vicinity of *Sciacca*, in *Sicily*, have a similar origin. Hoffmann, l. c.

† Die vulkanischen Mineralquellen, &c. p. 150.—I have calculated, that, under the circumstances there mentioned, a mass of melting basalt, equal in size to one-third of the *Donnersberg*, near *Milleschau*, in *Bohemia*, would be sufficient to have heated all the water which has issued from the whole number of springs at *Carlsbad* since the time of Adam.

‡ Burkart, loco cit. t. i, p. 226.

§ Poggendorff's Annal. t. xviii, p. 353.

the hot springs of *Mariana* and *Las Trincheras* rose several degrees. According to the observations of Hamilton, Della Torre, Abbé Soulavie, Von Humboldt, and Forbes, the hot spring named *La Pisciarella*, which rises near *Naples*, from the exterior of the cone of the Solfatara, is subject to extraordinary alternations in its temperature, from 101° F. to 199.°4 F.* But even in very short periods striking differences are sometimes found. Thus Forster† asserts, that in the neighborhood of *Tanna*, a volcano on one of the *New Hebrides*, the hot springs vary several degrees in temperature from one day to the other.

There is not, perhaps, a more striking example of intimate connection existing between volcanic phenomena and hot springs than in Iceland. As the volcanic eruptions are there confined to the district of the trachyte formation, so also are the principal mineral springs only found in this formation;‡ from which it seems natural to infer, that it is one and the same process acting in both cases, but in a different manner.§

The hot springs in this volcanic island confirm Krug Von Nidda's system of classing thermal springs—namely, 1. *such as are constantly bubbling and boiling up—permanent thermals;* 2. *those in which this ebullition only takes place at particular periods, and which are perfectly tranquil during the remaining time —intermitting thermals; and,* 3. *those whose surface is always undisturbed, and in which no bubbling or boiling ever takes place.* The springs of the first class always have a temperature at the surface equal to that of boiling water under the usual atmospheric pressure. Those of the second class only reach the boiling point during their temporary ebullition, and lose considerably in temperature during their period of rest. The springs of the third class never reach the boiling point of water.

The most famous of the intermittent springs is the *Great Geyser.* At the time when Krug Von Nidda visited it, it presented two different kinds of eruption. The smaller ones were repeated regularly every two hours; and the water was thrown only from fifteen to twenty feet high. The greater ones succeeded each

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* Forbes, loco cit. p. 611.

† Journ. de Phys. 1779, p. 434.

‡ All the hot springs of *Mexico* also rise out of trachyte and dolerite rocks. Burkart, p. 363.

§ Krug Von Nidda on the mineral springs of *Iceland*, p. 272, in Karsten's Archiv. t. ix, p. 247, and in Jameson's Phil. Jour. vol. xxii, p. 90 and 220.

other at intervals of from twenty-four to thirty hours; in these cases, the masses of steam ascended to the clouds, and the water spouted to a height of ninety feet. For two hours after, one of the smaller eruptions, during which time there were no traces of action, and only thin clouds of steam were formed at the surface, the temperature of the water was 194° F., which was reduced still lower by the evaporation. After a dull rumbling noise within, the water suddenly began to boil up again, the basin was filled till it flowed over, immense bubbles of steam burst from the funnel-shaped opening, and projected the water to a height of about twenty feet. Immediately after the eruption, when tranquillity was completely restored, the water was at the boiling point, but its temperature soon fell below that degree.

The *Strokr*, the eruptions of which almost exceed in grandeur those of the *Great Geyser*, has this peculiarity, that it is at the same time a permanent and an intermittent thermal spring. It shows itself to be permanent by its incessant ebullition, and intermittent by the tremendous eruptions which seem to be repeated at intervals of from two to three days.

No doubt can be entertained respecting the nature of the agent by which the waters of the *Geyser*, the *Strokr*, and other less considerable springs, are thrown to such an immense height. It is, as in volcanos, a gaseous body, principally aqueous vapor. We may, therefore, very fairly agree with Krug Von Nidda, and consider volcanos in the same light as intermittent springs, with this difference only, that instead of water they throw out melted matters.

He takes it for granted that these hot springs derive their temperature from aqueous vapors rising from below. When these vapors are able to rise freely in a continued column, the water at the different depths must have a constant temperature, equal to that at which water would boil under the pressure existing at the respective depths. Hence the constant ebullition of the permanent springs, and their boiling heat. If, on the other hand, the vapors be prevented, by the complicated windings of its channels, from rising to the surface; if, for example, they be arrested in caverns, the temperature in the upper layers of water must necessarily sink, because a large quantity of it is lost by evaporation at the surface, which cannot be replaced from below. And any circulation of the layers of water at different temperatures, by reason of their unequal specific gravities, seems to be very much interrupted by the narrowness and sinuosity of the passage. The intermitting springs of *Iceland* are probably caused by the existence of caverns, in which the vapor is retained by the pressure of the column of water in the channel which leads to the surface. Here this vapor collects, and presses the water in the cavern downwards until its elastic force becomes sufficiently great to effect a passage through the column of water which confines it. The violent escape of the vapor causes the thunder-like subterranean sound, and the trembling of the earth, which precede each eruption. The vapors do not appear at the surface till they have heated the water to their own temperature. When so much vapor has escaped that the expansive force of that which remains has become less than the pressure of the confining column of water, tranquillity is restored, and this lasts until such a quantity of vapor is again collected as to produce a fresh eruption. The spouting of the spring is, therefore, repeated at intervals, depending upon the capacity of the cavern, the height of the column of water, and the heat generated below.*

The two distinct classes of eruption in the *Geyser*, which we have already mentioned, seem to be attributable to two different cavities. A smaller cavity fills quicker, and, therefore, empties itself more frequently ; a larger one fills slower, empties itself seldomer, but with greater violence. But the playing of the *Geyser*, the *Strokr*, and some others, is subject to very great va-

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* The eruptions of the *Geyser* and the *Strokr*, as observed by Krug Von Nidda, agree exactly with his explanation of the action of the intermitting springs of *Iceland*. A thick column of smoke suddenly burst out of the latter, and rose to the clouds. The water was hurled with terrific violence out of the crater, and mixed like a fine mist with the rest of the column to a considerable height. From time to time, thin streams of water were seen shooting in a vertical or oblique direction through the column of smoke, sometimes rising to a height of a hundred feet and upwards. Large stones, which had been previously thrown in, were flung almost out of sight, and many so perfectly vertically that they fell down again into the crater, and were again thrown up into the air, like a juggler's ball. The whole of the water was thrown out at the beginning ; and afterwards, the column which ascended from the opening, was composed only of steam, which rushed out with a whistling and hissing noise, and rose with incredible velocity into the clouds. It continued for three quarters of an hour in this state of activity. It then again became quiescent, except that the water, deep in the tube, continued, as usual, to boil violently.

riations. Channels may become stopped by the incrusting property of the water. During the frequent shocks which accompany the greater eruptions, some cavities may fall in, and be choked up, and new ones formed. The greatest changes, however, are caused by the earthquakes, which from time to time visit the island. Thus, during the earthquake of 1789, the most important spring in the country, next to the *Geyser*, disappeared, and at present only steam is evolved from its mouth, while the *Strokr*, which before this was but an inconsiderable spring, increased to such an extent, that it is now considered to rival the *Geyser* in importance. It may be observed, that the eruptions of the *Strokr* have no connection whatever with those of the *Great Geyser*. During the long eruption of the former, the latter remained quiet, and *vice versa*. In general, each of these numerous hot springs, which are here crowded together in a very small compass, seems to be totally independent of each other. This might also be inferred from the striking difference in their levels.

It seems probable from the situation of the celebrated hot springs of *Iceland*, (of which more than fifty may be counted in a space of a few acres, at the foot of a rock about 300 feet high, which leans against a chain of higher rocks;) from the numerous fissures in these rocks, which are composed of alternate layers of tuffas, of slag-streams, and slag-conglomerates, as well as from the fact, that the springs are confined exclusively to the lower region, which extends along the foot of the hill, whilst on its sides and summit are found only gaseous exhalations (aqueous vapor and sulphureted hydrogen gas;) that these springs are supplied from the meteoric waters of the neighboring hills, and that, being originally cold, they are indebted for their high temperature solely to the hot vapors which they receive from below. The hot springs in *Iceland* seem, therefore, to be produced in the manner described at page 253.

Lastly, If the permanent obstruction of the lava and the water channels has taken place, of course no hot springs can exist, or at least they can only flow during the cooling of the lava last ejected and solidified. This seems to have been the case in the volcanic district of the *Siebengebirge*, the *Laacher See*, and the *Eifel*, as in these places no hot springs, with the exception of the baths of *Bertrich*, are to be met with; although in the two latter districts, the number of thermal springs whose temperature exceeds that of the soil at the most by a few degrees, are enormous, and considerable exhalations of carbonic gas give evidence of former galvanic action. It may, however, be conjectured, with some probability, that in the vicinity of the *Laacher See*, and in the *Eifel*, springs may have existed, whose duration depended on the cooling of the masses of lava. Similar circumstances seem to have occurred in *Auvergne* and *Vivarais*, although the hot springs, which are not uncommon in those countries, show that many of the former volcanic channels are still unobstructed.

The examination of deposits obviously formed from springs which existed at a former time, may often present an indication of their temperature. Thus, on the volcanic tongue of land, called the *Sneefield-Syssel*, in *Iceland*, we find none of the hot mineral springs which are so numerous in other parts of the island, and which are distinguished by their holding silica in solution, and exhaling sulphureted hydrogen gas. But, in former times they existed here, for in many places we find siliceous incrustations in the form of tuffas and sinters. One cold spring, which is now flowing, has certainly taken the place of a hot siliceous spring, for its present deposits are only calcareous, and quite distinct from the older incrustations.* The circumstance that arragonite is deposited from hot springs, calcareous spar, on the other hand, from cold ones, gives us also an indication of this kind. Since G. Rose† pointed out that the former is only deposited from a hot solution of carbonate of lime, the occurrence of arragonite in any deposit, leads us to infer with certainty, that these deposits owe their origin to a hot spring. If, on the contrary, we find calcareous spar in any deposit, we may infer with equal certainty, that it was produced by a cold spring.‡

If the melted nucleus of the earth be the common seat of the volcanic activity of the whole earth, subterranean communica-

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* K. v. Nidda, loco cit. p. 282.

† Poggendorff's Annal. t. xl. p. 353.

‡ The following remark may not be entirely superfluous, viz. according to G. Rose, arragonite is formed in a higher temperature only in the moist way, but calcareous spar is formed in the dry way. Thus carbonate of lime crystallizes from a state of fusion under strong pressure only in the form of calcareous spar. Arragonite, exposed to a slight red heat, is easily converted into calcareous spar.

tions subsist between all volcanos. The existence of such communications cannot be doubted. Immediately after the earthquake which overthrew *Caraccas*, there followed the great eruption of the volcano of *St. Vincent*, and the earth no longer trembled at *Venezuela*. When the dense, black column of smoke, which, in the year of 1797, had issued for several months from the volcano near that city, disappeared, the cities of *Riobamba*, *Hambato*, and *Tacunga*, 280 English miles distant, were at the same hour destroyed by a violent shock.* Other instances of this kind will be mentioned afterwards.

Andrea Lorenzo Curbeto's description of the great volcanic eruption in the island of *Lancerote*, for which we are indebted to Von Buch,† also shows how, for six years, from 1730 to 1736, the gaseous fluids in the interior found new vents in all directions, sometimes here and sometimes there, and yet were not capable of preserving a single one permanently open. Sometimes two or three openings were formed at once, with a tremendous crash, accompanied with flames,(?) which alarmed the whole island. At one time, three apertures united suddenly into one very high cone; lava flowed out below and reached the sea. If, says that acute geologist, the unhappy *Lancerote* had, like *Teneriffe*, possessed a volcano, perhaps not one of those numerous cones would have been thrown up, and probably not a single village would have been destroyed.‡ He thinks it highly probable that this eruption took place entirely from one great rent.

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* Von Humboldt Reise, t. 1. p. 498. † Loco cit.

‡ Von Buch supposes that only the gaseous matters, but not solid substances, viz. lavas, slags, lapilli, and ashes, proceed from the focus of the volcanic phenomena. He observes that these masses always show themselves to be of a nature corresponding to the rocks out of which they are ejected.

We must not forget that Von Buch was at that time still attached to Davy's hypothesis, which ascribes volcanic phenomena to the combustion of the metals of the alkalies and earths, and which does not require us to suppose the origin of volcanic action to lie at any great depth. It is indeed, very different, according to the hypothesis which we are endeavoring to defend. In this, the seat of the volcanic actions is supposed to be identical with the place where the elastic forces producing them act. The connection between the lavas, and the slags, lapilli, and ashes resulting from them, and the rocks at the surface, would only then show that the same material which composed the rocks, raised at a former period, and now spread over the surface, has also served for the production of the more recent volcanic formations. But it still remains to be taken into consideration, that aqueous vapor, generated in the lowest point of the volcanic focus, possessing its maximum of elasticity, and heated to the melting point of lava, or above it, is capable, as we have already said, without the assistance of any other power, of converting fusible rocks into a state of hydro-igneous fusion.

During the violent eruption in the low country of *Skaptar Jokul* in *Iceland*, in 1783, which suddenly brought up the most enormous masses to the surface, the lava burst forth at three different points, more than two geographical miles distant from one another, and spread over a surface in the plain,* which is supposed to equal in extent sixty geographical square miles. This mass is so considerable as to surpass in magnitude that of *Mont Blanc*.† Under almost the whole of *Iceland*, there is a volcanic furnace, which communicates by many apertures with the surface. The masses of melted matter, therefore, seek an outlet at various points, and many places are mentioned, at which the lava has only been ejected once within historical times. The volcanic phenomena are not confined to the island alone, they also break through in the neighboring sea. In January, 1783, such an irruption took place in the sea, eight geographical miles from *Cape Reikianes*, several islands were raised, and great quantities of pumice and light slags were floated on the coast. In June, the whole island was shaken by earthquakes. The submarine eruption discontinued, and at a distance of fifty geographical miles, the grand eruption of *Skaptar Jokul* commenced. On the 13th June, 1830, a similar submarine eruption was repeated.‡

The immense masses of lava ejected from a single volcano, and the enormous extent in which volcanic actions are felt at the same time, scarcely leave room to doubt that every active volcano is in immediate communication with the whole melted matter in the interior. In this manner alone can it be conceived, how, for instance, the masses ejected at different times from *Vesuvius* vastly exceed the whole bulk of the mountain,§ while the latter seems upon the whole to undergo no diminution, for

* See Om Tordbranden paa Island i Aaret 1783, ved Student Soemund Magnussen. Kort beskrivelse over den eye Vulkans, Ildsprudning i Vester Sköptefells Syssel paa Island i Aaret 1783 of Magnus Stephen sen. Kiöbenhavn 1785. Sir G. Makenzie's Travels in Iceland. Ganlieb's Island, 1819, p. 64. Th. Gliemann geogr. Beschreibung von Island, 1824, p. 107. Pennant le Nord de Globe, t. i.

† Barghaus Almanac for 1838, p. 75.

‡ Journ. de Géologie, t. i.

§ This was remarked even by the ancients; and Seneca, Letter 79, after stating the difficulty, solves it by remarking, that the fire of the volcano, "in ipso monte non alimentum habet, sed viam."—Daubeny on Volcanos, p. 155.

the falling in of its cone at one period, appears to be balanced by the accumulation of ashes at another.

If a rent, reaching from the surface to the melted matters in the interior, be of great length, but not open throughout its whole extent, the first eruption will take place where there is the least resistance.

If this channel become obstructed, the volcanic fire will seek another vent.* Violent concussions may open new fissures† and close old ones, by which frequent changes may be produced in the channels of the lava and water. Fissures obstructed by lava are closed so firmly as to be incapable of being re-opened; new ones, therefore, are formed. Thus it is, at least, if a volcano produce eruptions from its sides. If it happen that a wide and lasting vent be formed, all partial workings in the neighborhood will cease. A similar combination, although on a somewhat limited scale, is presented by groups of mineral springs, especially of hot springs. In such groups, new channels are seen to open, new springs to rise, and old ones to close. The only difference is, that, as these changes are not accompanied with any violent action, as is the case with volcanos, they require a greater length of time for their accomplishment.

We have, in the preceding inquiries, as yet only supposed the admission of water from the sea. But this does not seem always to be the case, even in volcanos situated near the sea. According to Hamilton,‡ the water of the springs and wells of *Torre del Greco* diminished so much a few days before the great eruption of *Vesuvius*, on the 15th June, 1794, that the corn mills at the principal spring were nearly stopped, and it was daily necessary to lengthen the ropes in the wells, in order to reach the water. Some wells dried quite up, and on the morning of the 12th June, at *Resina*, a subterranean rumbling noise was heard after a heavy rain. Monticelli and Covelli§ relate that, before

* Thus the interior of the crater of the *Peak* of *Teneriffe*, shows it to be a volcano, which for thousands of years has thrown out fire only from its sides. V. Humboldt, Reise, t. i. p. 195.

† According to the inhabitants of *New Andalusia*, the soil in various districts in their province has become more and more arid, in consequence of the frequent earthquakes with which they are visited from time to time.—V. Humboldt, Reise, t. ii. p. 21.

‡ Phil. Trans. for 1795, p. 79.

§ Loco cit. pp. 12 and 63. See also Monticelli, in Leonard's Taschenbuch für die gesammte Mineralogie, vol. xiv, p. 87.

the great eruption of this volcano in 1822, at the beginning of January, the springs at *Resina*, *St. Jorio*, and particularly in the places in the immediate vicinity of *Vesuvius*, diminished perceptibly.* Monticelli observed similar phenomena before the eruption in 1813, and he thinks that, in general, they are a sure sign of one. It is hardly to be doubted that rents were opened by the earthquakes, through which the water descended to greater depths, accumulating, perhaps, in great caverns, and from thence found its way to the source of the volcanic action.

We find considerable accumulations of water in all mountains traversed by numerous fissures. We will only now mention the western declivity of the *Teutoburger Wald*, in which such considerable rivers have their source; the *Jura* mountains; and the *Gemmi*.† The volcanic inundations, of which Von Humboldt gives such extraordinary examples,‡ are an additional evidence of the existence of such great subterranean accumulations of water, in the vicinity of volcanos. Lastly, we have, further, examples of volcanos coming into action after violent storms of rain; for instance, the *Mer-Api*, in *Java*.§ In the *Andes* of *Quito*, the Indians imagine they have observed, that the quanity of percolating snow-water increases the activity of volcanos.|| Can it, then, any longer be doubted, that the proximity of the ocean is by no

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* The same was observed twenty three days before the earthquake in *Calabria*; and also in the *Peak of Teneriffe*, in 1706. Von Humboldt, Relat. Hist. t. i. p. 393. In *Iceland*, this phenomenon was observed before the terrible eruption of *Skaptar Jokul*, in 1784. In general, in volcanic districts, the porous and much fissured rocks swallow up the rain-water, and carry it down to very great depths. Von Humboldt gives this as the cause of the extreme aridity which reigns in most of the *Canary Islands*, notwithstanding the height of the mountains, and the mass of clouds which travellers always see collected over this Archipelago. Reise, t. i. p. 173.

† Von Humboldt (Reise, t. iii, p. 229) mentions several rivers which lose themselves in the gneiss rocks. When these gneiss mountains were upraised, considerable caverns may have been formed, which were afterwards filled with water.

‡ Annal. de Chim. et de Phys. t. xxvii, p. 128. This circumstance, however, must be considered, that the strong heat over the active volcano dilates the atmosphere, and produces a rising stream of air. The consequence of that is an influx of air from all sides. But this air is accompanied with moisture, which, rising with it, is condensed in the higher regions of the atmosphere, and falls down in showers. Therefore, an active volcano affords not only water, which immediately issues from its interior, but it also deprives all the environs of water. Du Carta sur les inondat. Volcaniques. Journ. de Physique, t. xx, p. 103.

§ Memoir of the Conquest of Java. London, 1815, p. 40

|| Von Humboldt's Reise, t. i, p. 263.

means a necessary condition in the production of volcanic phenomena? But all that has been said respecting the channels by which the sea-water is admitted to the volcanic focus, holds equally good with respect to those admitting springs or rain-water; only with this difference, that, in the more lofty volcanos of *America*, the volcanic focus may be imagined much higher, and yet columns of water of considerable pressure will not be wanting, provided those accumulations of water be situated at a great height in the mountains.

The same power by which masses of lava are forced up, sometimes so as to reach the surface and flow over it, or in other cases becoming solidified in their channels, will also raise whole mountains. These elevations may take place through rents of more or less considerable width; and partly form dykes, or mountains of some magnitude; or raise up or break through the upper strata of the earth. Thus Von Buch* informs us that on the island of *Lancerote*, during an eruption in 1730, a rent was formed above two German miles in length, on which about twelve conical hills had risen, whose summits were from 600 to 800 feet in height. In like manner basaltic cones (also even porphyritic and granitic hills) are situated in a line, and of which two or more are connected by rents, which are filled up by basalt. Remarkable phenomena of the kind are seen near *Mural* in *Auvergne*.†

We have abundance of proofs of the rising of masses of melted or at least semifluid matter,‡ out of the interior of the earth, in the filling up of dykes with compact crystalline rocks, in all of which, as in the rocks of undoubted volcanic origin, felspar forms a necessary and principal ingredient.§ We find these rocks in contact with all the stratified and superficial formations, even with those which are going on at the present day. But similar masses, which have evidently flowed in streams from craters, are

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* Leonhard's Taschenbuch, 1824, Abth. ii, p. 439.

† Leonhard die Basalt Gebilde, t. i, p. 408.

‡ Cones of basalt, trachyte, and phonolite, whose inclination is often very considerable, cannot have risen in such a thin liquid state, as that in which lava issues from volcanos; for, according to the observations of Elie de Beaumont, already mentioned, lava streams having an inclination of only 6° cannot form a continuous mass. See on this subject, Leonhard, loco cit. t. i, p. 417, &c.

§ Felspar may certainly be considered as a characteristic sign of an igneous origin in rocks, as this mineral is never found in rocks, in the formation of which the action of volcanic power can be proved to have been wholly excluded.

also found in positions which shew that they must have risen from the interior of the earth, after the formation of the stratified rocks, and found their way into fissures, which in many cases do not reach the surface. Thus, granite, syenite, trachyte, the porphyries, the greenstone, and so on, up to the basalts, form dykes in the stratified rocks as well as in one another. They also not unfrequently appear in beds between the strata of the Neptunian rocks. Granites have been forced up to the surface at the most widely different periods; we find them most commonly in clay-slate, and in the greywacke formation, in gneiss and in mica-slate, and they are sometimes connected with other more considerable masses of granite. Even after the formation of the oolitic and chalk groups, they have been ejected; but there are no granitic dykes described as intersecting these rocks. The stratified rocks are usually altered in the immediate vicinity of masses or dykes of granite; and their stratification becomes indistinct and confused. The porphyries, like the granites, exist as independent formations; but these are not so frequent or so extensive, and are more frequently in contact with more recent stratified formations than the granites. The trap rocks traverse all the stratified rocks from the gneiss and greywacke group, at least to the oolites inclusively. The basalts are found in all formations, from the transition and secondary rocks to the lignite inclusively, nay, in the newest formations.*

In general, some alteration in the adjacent rock and some new mineral productions,† are found where such masses have been forced up, and large and small fragments of the rock are not uncommonly found firmly imbedded in the latter. We may here, by way of example, mention the conversion of compact limestones into marble, exactly as Hall changed limestones by heating them in close vessels or under pressure; and again, the disappearance of the black color and the bitumen in the coal sandstone.‡

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* Leonhard's Basalt Gebilde, t. ii, p. 6, &c.

† The adjacent rock, heated by the melting mass, might, by their both cooling very slowly together, give rise to the production of crystalline substances (as hornblende, felspar, mica, by the contact of granite with clay-slate.) But the rock would probably also take up substances from the melting mass (alkalies) which would serve as a flux.

‡ The combustion of beds of brown coal seems also to have been effected by igneous fluid masses which had risen from the interior. Thus the remains of such combustions always occur in *Bohemia*, according to Dr. Reuss, (Nöggerath Ausflug

The conglomerates which frequently surround these volcanic masses, and which are not confined to the basalts and trachytes, but are also found accompanying the greenstones, porphyries, and granites, Von Buch considers to be produced by the friction of the rising matter against the rock; and their existence is a further proof of the pyrogenetic origin of these masses.

Other phenomena lead us also to infer that crystalline rocks have risen in a melted state. If, for instance, such rocks are separated by rents, crystals are often found in them, broken through the middle, and both pieces are imbedded in the separated rocks. Thus, my friend Prof. Nöggerath has observed, that many of the larger crystals of glassy felspar in the trachyte of the *Drachenfels* are broken through in this manner, and that the one piece is displaced several lines from the other. He observed the same phenomenon more frequently in the porphyritic granite near *Göpfersgrün* in the *Fichtelgebirge.** The olivine in the basalt of *Burzet* in *Vivarais*, presents the same appearance, according to Scrope,† and the separated portions of crystals exactly correspond. Faujas observed among the basalts of the bridge of *Bridon* adjacent columns, with included fragments of granite broken through, in consequence of the formation of the columns. All these phenomena prove that these crystalline rocks must have been still soft, after the imbedded crystals had arrived at the stage of perfect solidification, and that the breaking of the crystals is a consequence of cooling.

The occurrence of arragonite in the fissures and cavities of crystalline rocks, basalt, for instance, seems also, according to the above-mentioned experiments of G. Rose, to prove, that these rocks were at least still hot, when cold solutions of carbonate of lime penetrated into the fissures.

Lastly, instances of the formation of dykes of volcanic matter at the present day, offer a further proof, if further proof be neccessary, of their igneous origin, and the accounts given of the recent eruptions at Ponohohoa in *Owhyhee*,‡ establish the possibility of eruptions through rents.

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nach Böhmen. Bonn. 1838, p. 171,) in the neighborhood of basalts, and these phenomena are so enormous, that they cannot be considered as caused by accidental combustion.

* Nöggerath loco cit. p. 71. See also Goldfuss and Bischof, Physikalisch-statistische Beschreibung des Fichtelbirges, t. ii, p. 114.

† Consider. p. 136.

‡ Poggendorff's Annal. t. ix, p. 141.

If alterations in the adjacent rocks, or other phenomena already mentioned, are not observed, we may infer that the elevations have taken place in a solid state. Notwithstanding this solidity, the highly elastic and exceedingly hot vapors may certainly cause considerable chemical alterations in the elevated masses, as well as in the adjacent rocks.

It is impossible to determine any regular order of succession in the elevation of the pyrogenetic rocks. They occur in every period of the stratified formations. Older ones have very commonly received those of more recent date into their fissures. There scarcely exists a single unstratified rock which is not somewhere to be found filling up dykes in granite. Basalt-dykes traverse many unstratified rocks, such as trachyte, conglomerate, and others. In *Iceland*, tufa is found alternating with slaggy lava; and dykes of a porous trachytic rock traverse the tufa of *Stromboli* and *Vulcanello* in the *Lipari Islands*, &c.*

Masses of melted matter will break through the bottom of the sea more easily, because resistance is there the least considerable. To this may be ascribed the frequent elevation of islands from the bottom of the sea, not only in historical times, but also at the present day, and under the eyes of observers, in whom the utmost confidence may be placed. The most extraordinary and instructive island in this respect is *Santorin*, because it unites the whole history of volcanic islands and islands of elevation. A more beautiful, regular, and perfect crater or elevation is not to be found, than in the space which is almost entirely surrounded by the inner circle of *Santorin* (which encompasses more than one-half of it) and by its continuation as exhibited in the islands of *Therasia* and *Aspronisi*.† Here it is probable that the clay-slate was broken through and upraised. These islands, therefore, form an inseparable whole, and cannot have been raised one after another. On the other hand, history and tradition inform us, that nature has never ceased in its endeavors to create a volcano in the centre of this crater of elevation. One hundred and eighty four years before the birth of Christ, the *Island* of *Hiera* (now called

* De la Beche, Handbuch der Geognosie Von v. Dechen. Berlin, 1832. Abschnitt xi.

† Von Buch in Poggendorf's Annal. v. x, p. 172. See the drawing in his splendid atlas, and the sketch in these Annal. v. xxiv, p. 1.

*Palaia Kameni**) was formed, and since that, as it seems, many other rocks have been raised in its centre. In 1427, this island was increased. In 1573, the *Little Kameni* was thrown up, exactly in the centre of the basin, accompanied with an ejection of steam and pumice; and between 1707 and 1709, was raised the *New Kameni*, which still continues to send forth sulphurous vapors.† Lastly, in the present moment another new island seems to be about to appear to the east of *Kameni*, about 900 feet from the coast of *Santorin*, according to the report of a naval officer of *Santorin*,‡ (*Nauplia*, 4th December, 1834.) The inhabitants of the island assert, that thirty years ago this bank lay at the depth of 90 feet; in 1820, it was only 60 feet below the surface; and at present the sea is only 20 feet deep over it. According to later accounts given in the public journals, this bank continues to rise so rapidly, that if it meet with no interruption in its progress, it will, by the year 1840, be able to lay claim to the denomination of an island. In the year 1713, it is said an island arose among the small islands near *Venice*, accompanied with flames, smoke, and the most vehement shocks. This phenomenon, which continued four weeks, drove away the inhabitants from the adjacent islands. After about two years a similar occurrence was repeated, and a second island was thrown up under the same circumstances. These two islands are now, as the neighboring ones, inhabited and cultivated.§

From Leop. Von Buch's instructive exposition of the nature of volcanic phenomena,‖ which, together with the careful works of Von Hoff, contain a critical compilation of all cases yet known of the production of new mountains and islands by volcanic action, we will borrow only the following examples of recent date. The first I shall mention is the island of *Sabrina*, near *St. Miguel*, in the *Azores*, which is celebrated for the many islands that have

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* Von Hoff, Geschichte der natürlichen Veränderungen der Erdoberfläche, t. ii, p. 137. For an account of some crater-shaped islands, see Poggendorff's Annal. v. xxiv, p. 101.

† See the account of Father Bourignon in Raspe's specimen, &c. de novis a mare natis insulis, 1763, p. 48.

‡ Allgemeines Organ für Handel und Gewerbe, &c. No. 23. 1835; and Jameson's Phil. Journal, vol. xxi, p. 175.

§ Justi's Geschichte des Erdkörpers, p. 135.

‖ Poggendorff's Ann. v. x, p. 1 and following; p. 169, 345, and 514 and following.

attempted to rise in its vicinity, and which made its appearance on the 13th or 15th June, 1811; it began to disappear in October, and towards the end of February, 1812, steam was only occasionally seen to rise out of the sea at the spot where the island was formerly seen.* Secondly, The rising of a new island near *Unalaschka*, in May, 1796, which not only remained, but, up to 1806, had increased in circumference, as well as the peak in height. It required six hours to row round it, and rather more than five hours to ascend in a direct line from the shore to the summit of the peak.† The creation of both these islands was preceded by violent earthquakes, and columns of smoke, which ascended from the sea, whilst stones were thrown to a great distance. Of *Sabrina* this surprising circumstance is related—that the stones, on leaving the sea, were black, but suddenly became red hot when they emerged from the columns of smoke. Tillard found on this island the skeleton of a shark so calcined, that the bones fell to powder on lifting it up. Of the other island it is only said, that during the night fire rose, which was sometimes so bright, that all objects were distinctly visible in *Unalaschka*, at a distance of twenty leagues. Smoke continued to rise for four years.

Phenomena of this kind have taken place still more recently among the Molucca Isles, as we are informed by Prof. Reinwardt.‡ Near the active volcano of *Gonung Api*, in the group of the *Banda Islands*, a considerable mass of black rock rose up in a bay, out of the sea, without any noise. When Reinwardt visited this extraordinary spot in 1821, he found it still very hot, and the newly raised mass sent forth boiling hot vapors. A precisely similar occurrence took place on the coast of *Ternate*. On *Lancerote* also, on the 31st August, 1824, after several days of violent earthquakes, accompanied with a subterranean thunder like noise, a new volcano burst forth with a terrific crash, emitting streams of fire, so that the whole island was illuminated, and

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* See also V. Humboldt's Reise, t. i, p. 254, and t. iii, p. 6. It is worthy of remark, that the small island of 1720 has reached exactly the same height as *Sabrina* attained in 1811.

† It was, consequently, more than 1000 feet high. Unfortunately, the depth of the sea at that place is not given. But it certainly offers an example of one of the greatest elevations of the present day.

‡ De incendiis montium igni ardentium insulæ Javæ, &c. disputatio geologica. Auctore van der Boon Mesch. Lugduni Batav. 1826.

throwing up so many red hot stones and fragments of rock, as to form a mountain within twenty-four hours.*

The last occurrence we shall mention, and which is still fresh in our memory, namely, the volcanic island which appeared in July, 1830, in the *Mediterranean*, between the southwest coast of *Sicily* and *Pantellaria*, shews, that these phenomena may take place in two different ways. New islands may be formed in the sea either by the elevation of solid rock, by violently breaking and raising up the original strata, or merely by the heaping up of the loose masses which are ejected.† This event was of the latter description, and in its ephemeral existence exactly resembles the above-mentioned case in the *Azores*. Under which of these forms such volcanic productions appear, may depend on the nature and thickness of the rocks to be broken through, on the depth of the sea at the place of the eruption, and the strength of the volcanic force. However, the visible part of this island may, perhaps, as is the case with many others, only have been the summit of a peak situated in the centre of a crater of elevation, which remained buried in the sea, similar to the cones of many land volcanos, which, if they had been situated in the sea, would have been unable long to withstand the action of the waves, as is the case with most of these islands. Hoffmann,‡ who approached very near to this island, shortly after its appearance, saw quite plainly, that it was nothing else than the edge of a crater, the walls of which were gradually raised above the surface of the water by the materials ejected from it. From this crater vapors rose uninterruptedly with great violence, yet without noise, which were succeeded by the ejection of slags, sand, and ashes. The appearance of this island was also preceded by a noise resembling thunder, and by the elevation of a mass of black colored water to a height of eighty-two feet, columns of smoke rising at the same time to a great height. The accounts leave us in uncertainty respecting one of the most important circumstances—whether fire rose out of the crater or not. However, Hoffmann and his companions are inclined to the more probable opinion, that this volcano vomited no fire, and that what some observers took for

* Annal. de Chim. et de Phys. t. xxvii, p. 382.
† See, on the contrary, Von Humboldt in his Reise, t. i, p. 254, note.
‡ Poggendorff's Ann. t. xxiv, p. 75.

flames, was only the *ferilli* in the smoke.* Lightning, caused by the electricity excited by the rapid evaporation, was observed there, as it is during the eruptions of *Vesuvius* and other igneous mountains. At the end of December, 1830, this island, which was 2100 feet in circumference, and the highest point of which rose 210 feet above the sea, shared the fate of *Sabrina*, and disappeared. From the bottom of the sea it had risen between 700 and 900 feet; and from what depth below, may be conjectured from the calculations previously given.

Thus, then, the rising of islands out of the sea, is a well authenticated fact, and if we should for a moment be left in doubt concerning the cause of this phenomenon, by the appearance of steam in the presence of the sea-water, yet the evolution of aqueous vapor from volcanic islands, enclosed on all sides by solid rock, seems to dispel such doubts.

Examples of elevations on land in historical times are much more rare. Of these we are only acquainted with the elevation of *Monte Nuovo*, near *Puzzuoli*, in 1528, which rose 400 feet in about three days; that of *Monte Rosso*, near *Catania*, in Sicily, in 1669, which rose to a height of 820 feet in about four weeks, and that of *Jorullo*, which rose to a height of 1480 feet above the plain, in one day, on the 29th September, 1759.†

These are also formed, like the volcanic islands, in two different ways. The *Monte Nuovo* was formed by the accumulation of the loose masses ejected from the volcano, whilst mountains of basalt, trachyte, phonolite, &c. which are so abundantly scattered over the surface of the earth, have been formed by the upraising of solid rocks.‡

Vesuvius, or rather its cone, seems also to present an example of an elevation in the historic area. Its formation perhaps does not go farther back than the period of the famous eruption of 79 after the Christian era, in which *Herculaneum* and *Pompeii* were destroyed; for ancient writers never speak of the mountain as

* Without exactly wishing to generalize, this circumstance is yet sufficient to render us distrustful in judging of descriptions of similar phenomena in which flames are so often mentioned.

† Von Humboldt, Nouv. Espagne. v. ii. p. 290. See Burkart loco cit. vol. i, p. 226.

‡ The late investigations of Buch, Dufrenoy, and Elie Beaumont, show that the *Monte Nuovo* is a crater of elevation, therefore not entirely or chiefly composed of loose masses of ejected rocks.—*Ed. New. Phil. Journ.*

consisting of two peaks, which they probably would have done, if the *Monte Somma* had stood, as at present, distinct from the cone of *Vesuvius*.* It is also remarked that the distance mentioned in ancient writers, as intervening between the foot of *Vesuvius* and the towns of *Pompeii* and *Stabiae*, appears to have been greater than exists at present, unless we measure it from the foot of *Monte Somma*, so that this affords an additional probability, that the latter mountain was then viewed as a part of the former, and that no separation between them had at that time occurred. We may also be sure from the semicircular figure which the southern escarpment of the *Monte Somma* presents towards *Vesuvius*, that it constituted a portion of the walls of the original crater; and Visconti, it is said, has proved by actual measurements, that the centre of the circle, of which it is a segment, coincides as nearly as possible with that of the present crater. There seems, therefore, little room to doubt, that the old mouth of the volcano occupied the spot now known by the name of the *Attrio del Cavallo*, but that it was greatly more extensive than this hollow, as it comprehended likewise the space now covered by the cone, which was thrown up afterwards in consequence of the renewal of the volcanic action that had been suspended during so many ages. This view likewise tends, as it seems, to reconcile the accounts which ancient writers have given of the structure of the mountain, antecedently to the period before mentioned.†

As for the mode of action of the vapors, it is indifferent whether they have to contend with loose and unconnected, or with melting masses, only that the former are propelled into the air like cannon balls,‡ and falling into a parabolic curve, accumulate and

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* Daubeny, a Description of Active and Extinct Volcanos, &c. p. 144. See also Von Buch in Poggendorff's Ann. t. xxxvii, p. 173.

† See the Historical Notices given by Daubeny, loco cit. p. 145, and following.

‡ V. Humb. (Reise, v. i, p. 226) calculates from the time the stones thrown out during the lateral eruption of the *Peak of Teneriffe*, on the 9th June 1798, took in falling (which according to *Cologan* was from twelve to fifteen seconds, reckoning from the moment they reached their greatest height,) that they were projected to a height of more than 3000 feet. In some similar observations made by Von Humboldt during the eruptions of *Vesuvius* in 1805, he satisfied himself that such observations are capable of a great degree of exactitude. Similar calculations made by other observers, give still greater heights. The maximum height of such projections was observed at *Cotopaxi* by La Condamine (Voyage à l'Equateur.) He saw propelled laterally, a block of about 1000 square feet, to a distance of nearly 1½ geographical miles.

produce a mountain, whilst the latter remain at the height to which they are borne up by the elastic fluids.

In elevations of the latter description, the vapor cannot escape through the uplifted mass. This mass is supported by the elastic force of the vapor, cools gradually, and then remains, as it were, wedged in between the strata it has broken through. But according to Von Buch's* observations on *Palma* and *Gran Canaria*, it may happen, that the vapor bursts forth from the centre of the mass it has raised, and thus exposes its interior. Such a crater would thus be the effect of the elevation of the island, for which reason he gives it the name of crater of elevation, (Erhebungs Krater,) to distinguish it from the craters of eruption, by which true volcanos open a communication with the atmosphere.

Further, this philosopher has pointed out,† that volcanic cones cannot be generated by the building up of streams of lava. He infers this from observations made by Elie de Beaumont, and which have been already alluded to. This philosopher measured the mean inclination of about thirty lava streams of *Etna*, and of a great many of *Vesuvius*, and found that a stream having an inclination of 6°, or even more, forms no continuous mass. Such a stream inclines too much to be able to attain more than a thickness of a few feet. When its inclination is only 3° or less, the mass may be spread, and accumulated to a considerable height.‡

Lastly, we have to notice the upraisings which are the consequences of earthquakes, and often extend to large islands and whole tracts of country. Elevations of small compass, accompanied by partial depression, which is no doubt merely a consequence of the elevations, were observed before,§ and during|| the famous earthquake of *Lisbon*. Small elevations also took place during that in *Calabria*.¶ The commissioners who were employed to make observations of the earthquakes in the county of *Pignerol*, relate, that the very day (2d April, 1808) when one

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* Abhandlungen der Berliner Acad. loco cit. p. 58.

† Poggendorff's Annal. t. xxxvii. p. 170, &c.

‡ Vied Memoire of Elie de Beaumont, in vol. xx. p. 376, &c. Edin. New Phil. Journ.; and Description Geologique de la France, t. iv.

§ Palassou Mém. pour. servir à l'Histoire Nat. des Pyren. p. 260.

|| Philos. Trans. t. xlix. p. 417.

¶ Jour. de Phys. lxii. 1806. p. 264.

of the most violent shocks was felt, the masting engine at *Toulon* was elevated more than an inch.* This observation is worthy of note, as it shows that many effects of earthquakes may often take place at great distances from their seat, which, owing to their minuteness, may escape observation, unless casually discovered. For accounts of elevations of a more considerable kind in equatorial countries, we are indebted to Humboldt. The elevations in the island of *Lancerote*,† and those on the coast of *Cumana*,‡ are of this kind.

The most remarkable instance of the elevation of great tracts of country of late years, is that which took place in *Chili*, on the 19th November, 1822. For the account of this important phenomenon we are indebted to Mrs. Maria Graham, a well informed observer.§ After violent earthquakes, which were felt through an extent of country 1400 English miles in length, and during which, it appeared as if the soil was suddenly raised and immediately sunk again, or as if the earth had an undulating motion from north to south, accompanied with a noise like the rushing of steam, the whole coast for an extent of about 100 English miles, actually rose between three and four feet within twenty four hours.‖ In all the small valleys the earth in the gardens was disturbed, and sand and water rose in quantities through the cracks. The granite rocks near the coast, which are traversed by small parallel dykes, showed many narrow rents parallel to the old ones in some instances. The former were traced one mile and a half inland. The phenomena which most forcibly arrested the attention of Mrs. Graham, were evident marks of this coast having been raised in a similar manner by earthquakes in former times, and indeed to a height of fifty feet above the sea level.

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* Idem, t. lxvii. 1808. p. 308.

† Relat. Hist. t. i. p. 188.

‡ Ibid. t. ii. p. 279.

§ Geol. Transact. v. i., Sec. Series, part ii. p. 413. Mr. Greenough felt disposed to call in question the observations of Mrs. Graham, but she has defended her statements very creditably, and has been supported by Mr. Meyen, Berghaus Annal. der Erdkunde, t. xi. p. 129.

‖ Fr. Place also confirms this account of the extent of the elevation, in Journ. of Sc. No. xxxiii, p. 36. According to the reports in the Ann. de Chim. et de Phys. t. xxvii, p. 350, two volcanos, in the neighborhood of *Valdivia*, presented a sudden eruption with a loud noise, and illuminated the whole country for some seconds, but they soon subsided again. At the same time a slight shock was felt in that town.

The latter phenomena are so much the more important the more frequently they occur. We can, therefore, have no difficulty in admitting most earthquakes to have been the causes of such elevations. Many coasts, as is well known, bear evident marks of having been raised in former times. Thus Vetch* observed on the coast of the island of *Jura*, in Scotland, six to seven terraces one above another, the lowest at the level of the sea, the highest about forty feet above it, all covered on their horizontal surfaces with pebbles like those which the sea still throws up. Mr. Smith of Jordanhill has also pointed out, that in a former time an elevation of the west coast of *Scotland* has taken place.† Peron noticed a similar phenomenon on the coasts of some islands in the neighborhood of *Van Diemen's Land.* Many other instances of this kind occur, which present traces of elevations, some of them perfectly incontestable,‡ others very probable.§ In conformity with this, are also the assertions of the inhabitants of *Otaheite*,|| and those of the *Moluccas*,¶ that their islands still continue to rise.

The latest earthquakes, which, in the month of February, 1835, destroyed a great part of *Chili*, (*Conception*, and many other towns,) offer also evident proofs of elevations occasioned through their agency. Some days after this devastation the sea did not rise to its ordinary level, the difference amounting to four or five feet in height. This difference decreased gradually; in the middle of April it was still two feet. The fact that the island of *Santa Maria* has risen nine feet, proves the actual elevation of the country. Near *Tubul*, southeast of *Santa Maria*, the country has risen six feet, and the island of *Mocha* seems to have risen about two feet.**

The gradual elevation of *Scandinavia* and *Finland* is peculiarly interesting. More than a century ago, Celsius called attention to this phenomenon, and endeavored to account for it by

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* Geological Trans. Sec. Series, v. i. part ii. p. 416.

† Phil. Mag. v. x. p. 136; Jameson's Phil. Journal, vol. xxv. p. 378; and Mem. Wernerian Soc. vol. viii. part i. in the press.

‡ Dolomieu Oryktol. Bemerk. über Calabrien. Frankf. u. Mainz 1789, p. 157.

§ Brochi in Biblioteca Italiana 1821. Sept. Breislak Reisen in Campanien, t. ii. p. 115.

|| Correspondence Astronomique, v. x. p. 266.

¶ Poggendorff's Ann. t. ii. p. 444, according to Prof. Reinwardt.

** Nautical Magazine, No. 49 and 51. March and June, 1836.

a gradual sinking of the level of the *Baltic.* Playfair,* however, remarked, as early as the year 1802, that an elevation of the land may be assigned as the cause of this phenomenon with more probability than a sinking of the water. This supposition, he thinks, accords with Hutton's theory, according to which the continents have been actually raised by subterraneous powers, and are even now supported by them in their place. Lastly, Von Buch,† without having seen Playfair's work, gave his opinion, "that the whole country, from *Frederickshall* in *Sweden* to *Abo* in *Finland,* is in the act of rising slowly and insensibly." The rising of the Gulf of *Bothnia* amounts, according to the observations communicated by Hällström, from 3.71 to 4.61 feet; on an average 4.26 feet during a century.‡ Beds of sea-shells, found sometimes 200 feet above the present level of the sea, as, for instance, on the sea-coast and on the islands of *Uddevalla,* as also on all the sea-coasts of the south of Norway, and which sea-shells consist of such kinds as are still found living at these places in the sea, prove how much the level of the *Baltic* has changed even during the time that the present testacea have inhabited it.§ But the rising seems to be very unequal at various places. In the north it is more considerable than in the south. On the eastern coast of the *Danish* islands of *Möen* and *Seeland,* Lyell|| found no indication of a recent elevation of land. The first place along the whole coast of the *Baltic,* where an elevation is said to have taken place, is the town of *Calmar.* Beyond the *Swedish* coast, on the coast of *Finland,* the inhabitants are perfectly convinced, either that the water sinks or the land rises. This remarkable phenomenon has excited a general interest among the Swedish naturalists, and caused continual exact observations of the marks inscribed on the shores of the Gulf of *Bothnia.* Thus Nilson¶ thinks he has found convincing proofs that the most southern part of *Sweden* is sinking, whilst the remaining part is rising. He has also endeavored to

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* Illustrations of the Huttonian theory.
† Reise durch Norwegen und Lappland, t. ii. p. 389.
‡ Bruncrona u. Hällström in Poggend. Ann. t. ii. p. 308.
§ Berzelius Jahresbericht, 1826, p. 292.
|| Poggendorff's Ann. t. xxxviii, p. 64.
¶ Berzelius Jahresbericht, No. 18, p. 386, and Poggendorff's Ann. t. xlii, p. 472.

give probability to the supposition, that the sinking took place, and still takes place, not suddenly, but gradually. Forchhammer* likewise alluded to similar phenomena, in order to prove that elevations in *Scandinavia* take place not only in different proportions, but that a depression is also going on. He infers from his observations, that the level of the coast of Denmark has varied in a different proportion from that of the *Swedish* coast, which he ascribes to the feeble earthquakes that have been felt so often in *Sweden*, but never in *Denmark.* He estimates, according to rough calculations, the elevation of the island *Bornholm*, to amount to one foot in the course of a century.

If elevations of countries, in which volcanic actions are felt, and which are agitated by violent earthquakes, be produced, as is very probable, by the same causes as these phenomena, yet it is difficult to imagine these causes to operate in elevating countries where no such phenomena occur, or where, at least, they take place but rarely, or to a small extent. The latter is the case in the *Scandinavian* Peninsula. That region has no active volcanos, no hot springs—even thermal springs bearing a temperature of but a few degrees higher than the mean temperature of the place, are considered as rarities; whilst, in other countries, they are of very frequent occurrence. All this proves that the crust of the earth in this country must be very solid, and traversed by comparatively few rents or fissures.

Berzelius assigns as the cause of this rising of the *Swedish* coast, the gradual cooling of the earth; and says: "Its diameter, in this manner, decreases, and the consolidated crust leaves either empty spaces between itself and the fluid mass, or sinks downwards. Being, however, of so large an extent, that foldings and bendings must occur, portions must rise up on one side and sink on the other. This supposition seems to be supported by the sinking of the western coast of *Greenland*, and of an island situated in the Gulf of *Youghall*, a phenomenon which has been recently pointed out by Elie de Beaumont and Pingel. Klöden also has recently given much probability to the supposition of a sinking of the *Dalmatian* coast.†

* Phil. Mag. ser. iii, v. ii, p. 309, and Poggend. Ann. t. xlii, p. 476.
† Poggendorff's Ann., t. xliii. p. 361.

We shall endeavor to show in our next section what effect might be expected on the surface of the earth, if its solid crust should still continue to increase in thickness towards the interior by gradual consolidation of the fluid centre. Besides, I think that a sinking of the outer crust can scarcely be supposed to occur, but that it is much more probable that caverns should be formed at the moment when the fluid mass becomes solid. At least the latter effect was seen in fusing two basalt balls, two feet in diameter, in which many larger and smaller cavities were found. I shall allude to these phenomena in another section.

If we take into consideration all that has been already said on ejections and elevations, (*soulevèmens,*) we shall be induced to adopt the following inferences. Masses of our earth, still in a fluid state, may be raised through and above its solid crust. The rising of the lava in the craters of volcanos is a satisfactory proof of this circumstance. Solid rocky masses, strongly heated, may be pushed upwards during violent convulsions, and elevations of the original rocky covering, or be thrown up in the form of loose masses, more or less heated. The not unfrequent rising of small islands from the bottom of the sea, and the elevations (*soulèvemens*) actually observed to take place in the continents, are evidences of these operations. All these phenomena are effects of forces, which develope their whole intensity in a very short time, often in a few moments. But large islands, and even whole countries may, in a very short time, be raised several feet, as was shown in the cases of *Chili* and *Santa Maria.* On the other hand, *Scandinavia* presents us with an instance of an elevation which, compared with the preceding, takes place with extraordinary slowness.

Besides all these elevations which have been actually observed, other appearances occur, which lead us to infer that elevations have taken place previous to the existence of any record. These are the elevations of old volcanic masses, as basalt, trachyte, &c., their penetration into fissures, and the elevation of whole systems of mountains. In regard to the first, the conclusion may, as has been already shown, be considered as well founded as it is generally possible to be, when drawn from phenomena which have taken place before any records were in existence. The similarity between these phenomena, and those which have taken, and still take place, before our eyes, render it extremely probable that they were produced by forces which were in operation for a very short period only. Changes in the contiguous rocks, and the imbedment of fragments of them in the volcanic rocks, render it also equally probable that these masses were raised in a fluid, or at least softened state, and either rose above the surface of the earth in the form of conical mountains, or remained adhering in rents of the rocks. These phenomena, then, belong entirely to the same class as the elevations of lava in volcanic craters. When, on the other hand, no changes are perceived in the contiguous rocks, when these have been simply broken through and upraised, when the broken masses consist of acute-angled fragments of all dimensions heaped one upon another, then we cannot assume that the elevations took place in a fluid or softened state.

Were elevations of this kind the work of a short space of time, or did they proceed slowly? In vain do we look around us for some clew to the solution of this question. From physical grounds we are led to the following conclusions. If fused rock come in contact with water in the interior of the earth, the watery vapor disengaged, will operate, with the whole expansive force which it can acquire from the heat of the rock, in a short time; provided that the continued formation of vapor be not limited by want of water. It is the same process as that which takes place in the glass-blower's blow-pipe when he forms large globes. If, then, water acts on fused masses in a confined space, we have the conditions requisite for producing a rapid elevation, and therefore, as a general rule, we may regard elevations of fused masses and rapid elevations as co-ordinate phenomena. If, on the other hand, we imagine a solid rock deep under the surface, whose temperature is far below a red heat, then its elevation can take place only when a considerable source of heat exists under the rock, which gives rise to the formation of vapor. But the more the heat of the vapor exceeds that of the rock, which is to be raised and supported by it, the more will it become condensed, and thus a great part of the effect is lost. If the condensed vapor return to the source of heat, it will again assume the form of vapor, and thus a constant circulation will ensue. It is actually a process of heating by steam. If the solid rock be a very bad conductor of heat, then that surface which is in contact with the vapor, may gradually acquire its temperature, and the vapor thus attain its maximum of operative force. It naturally depends on the weight of the solid mass, whether the vapor can effect its elevation, and by what elasticity. Although we must suppose that the elastic force of the vapor progressively increases, in proportion as the temperature of the surface of rock in contact with it rises; yet, on the other hand, we must consider, that when the vapor, which had not yet attained its maximum of expansive force, has effected an elevation, then, a regressive effect, as regards duration of time, will ensue, because, by the elevation, the space which confined the vapor has become enlarged. Secondly, if the conducting power of the solid mass be greater than we have just assumed it to be, then the heat, which is communicated to the surface of contact by condensation of vapor, is as quickly diffused above, as it can be conveyed from the vapor below, and if the latter produce a continued elevation, the effect must inevitably be regressive. We can therefore conceive it possible, under the conditions stated, that the same force, viz. vapor of water, which, when in contact with a fused mass, developes its whole intensity in a short time, can produce only a gradual effect, when in contact with solid masses whose temperature is far below that of the vapor. We thus see the possibility of fused masses being raised by vapor in a short time, while solid masses may be raised very slowly by the same agent, and that the latter elevation may go on in a regressive ratio. Lastly, it is even possible that a gradual elevation of a solid mass may continue, although the elevating effect of the vapor has long ceased. For instance, if the subterraneous heating by steam continue, and if the heat, communicated to the surface of contact by condensation of the vapor, be diffused above more slowly than it is conveyed below, then it is clear that the solid mass, supported by the vapor, will gradually be expanded.

These remarks have shown that the operations of vapor, as an elevating force, may be very various as regards the relations of time and space, and that its effects depend not only on its own temperature, but also on that of the masses it has to elevate, on their relative conducting power, and lastly, on the capacity of the space within which its operations take place.

We can therefore understand how the slow elevation of *Scandinavia* may be the result of the operation of watery vapor, taking place in a diminishing ratio, and how therefore this phenomenon stands in close connexion with the original elevation of that country, which is principally composed of masses of igneous origin. We shall pass over the consideration of the question, whether this original elevation took place in a fluid or solid state, that is, whether in earlier times these masses rose suddenly and continued to rise more and more slowly as they gradually cooled, or whether this gradually decreasing ratio has always existed. We may, however, be allowed the remark, that the slow elevation which still continues when the operation of the vapor, as an elevating power, has long ceased, may be regarded, according to what has been stated above, as the result of an expansion produced by the caloric disengaged from the vapor during its condensation. For example, let us assume that the solid crust of the earth in *Scandinavia* was 139,840 feet thick, that the expansion of this crust by heat takes place in the same ratio as in earthern ware; then, an average increase of heat of 2°.9 R. during the space of 1000 years, would be sufficient to effect an expansion of 4.26 feet in a stratum of the above-mentioned thickness. And this is the average ratio of the rising of that country.

Be the cause of the elevation of *Scandinavia* what it may, this circumstance is remarkable, that in the southern part of *Sweden*, where the country, according to Nilson's statement, sinks, secondary formations, viz. chalk, occur in great abundance, while in the north of *Sweden*, as well as in *Finland*, the gneiss-granite formation predominates. We must not, however, attach too much importance to the connexion which appears to exist between the elevation of the northern part of *Sweden* and the prevalence of the latter formation, as Nilson* says, the chalk also lies on gneiss, and less frequently on greywacke. It is neverthless remarkable that the granite island of *Bornholm*, which is situated opposite to the sinking coast of *Schonen*, is still in the act of rising, according to the observations of Forchhammer above alluded to.

As regards the sinking of countries, there is no difficulty in regarding it as the result of an elevation of neighboring countries. Yet we can imagine many causes, independent of such elevations, which may produce depressions. It does not, however, lie within the scope of these remarks to enumerate these causes.

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* Petrificata Suecana Form. Cretaceae, &c. 1827, p. 81.

It remains to consider the elevations of whole systems of rocks, events which must have taken place prior to the existence of our records. There is doubtless no difficulty in also explaining these phenomena through the agency of steam. Elie de Beaumont,* however, is of opinion, that these elevations are a consequence of the inequality between the cooling of the interior and exterior of the earth. We shall examine this subject, after pointing out the laws that prevail during the cooling of large masses of fused matter.

To be continued.

ART. III.—*Descriptive Catalogue of the North American Insects belonging to the Linnæan Genus* SPHINX *in the Cabinet of* THADDEUS WILLIAM HARRIS, M. D., Librarian of Harvard University.

THE insects belonging to the order Lepidoptera have peculiar claims to our attention. In the adult or winged state they are among the most beautiful, and in their previous or caterpillar state are the most injurious of insects. Living while young principally on the leaves of plants, they are at all times more or less exposed to our observation, and too often obtrude themselves on our notice by their extensive ravages. While it is comparatively easy to discover these insects and observe their transformations, the determination of their names and their places in a scientific arrangement is rendered in many cases impossible, and in all exceedingly difficult, to the American student, from the want of suitable descriptive works on this branch of entomology. Having overcome these difficulties myself only at a great expense and much loss of time, it has occurred to me that a descriptive catalogue of our Lepidoptera might be useful to others, while it would serve to confirm the names given to these insects in my cabinet, and transmitted in return for specimens to my friends. My own collection has now become quite extensive, and contains a large number of undescribed species from various parts of the United States. Passing by our Butterflies, nearly all of which have been

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* Poggendorff's Annal. vol. xxv, p. 55.

figured and for the most part described in Dr. Boisduval's "Histoire et Iconographie des Lepidoptères de l'Amérique Septentrionale," I propose, at the present time, to offer for publication descriptions of the native insects in my collection belonging to the second grand division of the order Lepidoptera, comprising the Sphinges of Linnæus. Should these be favorably received, they may hereafter be followed by descriptions of our Phalænæ or moths. The larvæ or caterpillars of many of the species are described partly from my own observations, and partly from the figures given by Mr. Abbot in his great work, on the Lepidoptera of Georgia, edited by Sir James E. Smith. My obligations to the gentlemen who have favored me with specimens will be found recorded on almost every page of this catalogue, and I beg leave to tender to them my most grateful acknowledgments, and to solicit from them, and from others, a continuation of similar favors.

Linnæus was led to give the name of Sphinx to the insects in his second group of the Lepidoptera, from a fancied resemblance which some of their larvæ, when at rest, have to the Sphinx of the Egyptians. The attitude of these larvæ is indeed very remarkable. Supporting themselves by their four or six hind-legs, they elevate the fore-part of the body, and remain immovably fixed in this posture for hours together. In the winged state the true Sphinges are known by the name of humming-bird moths, from the sound which they make in flying, and hawk-moths, from their habit of hovering in the air while taking their food. These humming-bird or hawk-moths may be seen during the morning and evening twilight flying with great swiftness from flower to flower. Their wings are long, narrow, and pointed, and are moved by powerful muscles, to accommodate which their bodies are very thick and robust. They delight most in the honeysuckle and scarlet Bignonia, from the tubular blossoms of which they extract the honey, while on the wing, by means of their excessively long maxillæ or tongue. Other Sphinges fly during the day-time only, and in the bright sunshine. Then it is that our large clear-winged Sesiæ make their appearance among the flowers, and regale themselves with their sweets. The fragrant Phlox is their especial favorite. From their size and form and fan-like tails, from their brilliant colors, the swiftness of their flight, and the manner in which they take their food, poised upon rapidly vibrating wings above the blossoms, they might readily be mistaken for humming-birds. The Ægeriæ are also diurnal in their habits. Their flight is swift, but not prolonged, and they usually alight while feeding. In form and color they so much resemble bees and wasps as hardly to be distinguished from them. The Smerinthi are heavy and sluggish in their motions. They fly only during the night, and apparently take no food in the winged state, their maxillæ or tongues being so short as to be useless for this purpose. The Glaucopididæ, or Sphinges with feathered antennæ, fly mostly by day, and alight to take their food like the Ægeriæ, to which some of them bear a resemblance, while others have nearly the form of Phalænæ or moths, with which also they agree in their previous transformations.

SYNOPSIS OF THE FAMILIES AND GENERA.

It was not my intention originally to give here the characters of the genera, but to refer the student for them to the works of Latreille and other entomologists. Upon further consideration, however, I have thought that the labor of determining our Sphinges by means of the catalogue would be much abridged, if a synopsis of the families and genera were to be prefixed to it.

Class Insecta.

Animals with jointed bodies, breathing through lateral holes or spiracles, produced from eggs; while growing subject to a transformation of three stages; in the first stage called larvæ, caterpillars, grubs, or maggots; in the second pupæ, nymphs, or chrysalids; in the third stage provided with wings, a body composed of three distinct parts, the head, thorax or trunk, and the abdomen, and having two compound eyes, two antennæ, from two to six palpi or feelers, and six legs.

Order Lepidoptera.

The young, called larvæ or caterpillars, are provided with jaws, and from ten to sixteen legs. They feed principally upon vegetable substances. The pupæ take no food, are incapable of moving about, are apparently without legs, these parts with their other members being folded up and firmly soldered to the body. In the third stage they are, with few exceptions, provided with four wings, which, with the body, are more or less covered with little colored branny scales, lapping over each other like the scales of fishes; their jaws are transformed to a tongue, more or less long, and, when not in use, spirally rolled and concealed between the palpi.

Section I.—Papiliones.

Antennæ threadlike and knobbed or thickened at the end. Wings not confined by a bristle and hook; all of them, or the first pair at least, elevated perpendicularly, and turned back to back when at rest. Only one pair of spurs to the hind-legs in the greater number. Thorax moderate; abdomen rather slender. Flight diurnal. Larvæ with sixteen feet; transformation in the open air. Pupæ angulated, and fastened by silken threads, or ovoid, and enclosed in an imperfect cocoon.

Section II.—Sphinges.

Antennæ thickened in or just beyond the middle, tapering at each end, and most often hooked at the tip; more rarely slender and nearly setaceous, with a double row of slender teeth or hairs on the under side in the males. Wings confined by a bristle or bunch of stiff hairs on the front edge near the shoulder of each hind-wing, which is retained by a hook on the under side of each fore-wing; when at rest horizontal, or inclined on the sides of the body, the fore-wings covering and concealing the hind pair. Two pairs of spurs to the hind-legs. Thorax thick and robust; abdomen mostly conical. Flight of some in the morning and evening twilight, of a few nocturnal, and of others during the day. Larvæ with sixteen legs; transformation in or upon the ground, or in a silken cocoon. Pupæ elongated ovoid.

Section III.—Phalænæ.

Antennæ (never knobbed at the end or thickened in the middle) slender and tapering to a point, in some pectinated or feathered, in others simple or bristle-formed. Wings confined together by bristles and hooks, the first pair covering the hind-wings and horizontal or sloping when at rest. Two pairs of spurs to the hind-legs. Flight for the most part nocturnal. Larvæ with from ten to sixteen legs, transforming in a silken cocoon or in the ground. Pupæ ovoid.

The Sphinges may be divided into two tribes.

Tribe I.—Sphinges legitimæ.

Larvæ colored, naked, for the most part horned on the tail, and feeding on the leaves of plants; or whitish, slightly hairy, not horned, and living on woody matter within the stems of plants. Antennæ of the winged insects tipped with a minute bristly tuft.* Palpi (except in the Ægeriadæ) with the third joint minute and indistinct.

Tribe II.—Sphinges adscitæ.

Larvæ always colored, more or less hairy, never horned, feeding on leaves, and transforming in a silken cocoon, which is fastened to the plants on which they live. Antennæ of the winged insects not tufted at the end. Palpi distinctly three-jointed.

The first tribe, or Sphinges legitimæ, may be divided into three families.

Family I.—Sphingiadæ.

Antennæ fusiform and prismatic; ending in a hook, and, in the males, transversely biciliated beneath; or, more rarely, curved, and, in the males, bipectina-

* This little tuft is obsolete or wanting in the *Smerinthi*.

ted beneath. Palpi pressed close to the face, short, thick, and obtuse, with the third joint minute and concealed. Body thick; abdomen conical and not tufted at the end. Flight crepuscular. Larvæ colored, naked, with a caudal horn, which is sometimes obsolete and replaced by a callous spot; they devour the leaves of plants, and go deep into the earth to transform, or conceal themselves upon the surface, under leaves, in an imperfect cocoon.

The North American genera in this family are six.

Genus I.—Smerinthus.

Wings more or less angular and indented, the front margin of the hind-wings projecting beyond the upper or fore-wings when at rest. Antennæ short, prismatical and fusiform, arcuated or curved near the tip, transversely biciliated or bipectinated beneath in the males. Tongue obsolete. Larvæ granulated, with the head triangular, horned on the tail, obliquely banded on each side, and transforming in the earth.

Genus II.—Ceratomia.

Wings entire. Antennæ elongated, abruptly ending in a short and slender hook, transversely biciliated beneath in the males. Palpi horizontal and nearly cylindrical. Tongue moderate. Abdomen longitudinally striped. Larvæ with horns on the fore-part of the body, a row of little teeth on the back, a long caudal horn, and oblique bands on each side; it transforms in the earth.

Genus III.—Sphinx.

Wings entire. Antennæ long, abruptly ending in a short and slender hook, and transversely biciliated beneath in the males. Palpi rising and enlarged at the end. Tongue long. Abdomen spotted or transversely banded at the sides. Larvæ with oblique bands on the sides and a caudal horn, and transforming in the earth.

Genus IV.—Philampelus.

Wings sinous. Antennæ long, attenuated at the end, with a long terminal hook, and transversely biciliated beneath in the males. Tongue moderate. Abdomen not transversely banded or spotted at the sides. Larva short, thick, with the head and first three segments rather small and capable of being drawn more or less within the fourth segment; when young with a long, slender, recurved caudal horn, which subsequently disappears and is replaced by a callous spot; sides with oblique spots sloping backwards and downwards; transforms in the earth.

Genus V.—Chœrocampa.

Wings sinous or angulated. Antennæ rather short and slender, generally arcuated, tapering, and ending in a long hook; more rarely straight, with a short terminal hook; transversely biciliated beneath in the males. Tongue moderate. Abdomen immaculate, or longitudinally striped, but never transversely banded at the sides. Larvæ elongated, the fore-part of the body tapering and retractile; with from one to three eye-like spots, or a series of oblique bands on each side; caudal horn short, sometimes obsolete and replaced by a callous spot; transforms on the surface of the ground, under leaves, in an imperfect cocoon.

Genus VI.—Deilephila.

Wings entire, upper ones acute. Antennæ rather short, straight, gradually thickening nearly to the end, which suddenly terminates in a small and short hook; in the males transversely biciliated beneath. Tongue moderate. Abdomen conical, pointed, and transversely banded at the sides. Larva elongated, not tapering before, and the head and first three segments not retractile, with a series of nine or ten round spots on each side, and a long caudal horn; transforms in the earth.

Family II.—Macroglossiadæ.

Antennæ fusiform, prismatic, ending with a hook, and transversely biciliated beneath in the males. Palpi pressed close to the face, with the third joint minute and concealed; short, thick, and obtuse at the end in some; slightly elongated and subacute in others. Body short and thick, or flattened a little; abdomen tufted at the end. Flight diurnal. Larvæ colored, naked, with a caudal horn, which is sometimes obsolete and replaced by a callous spot; they devour the leaves of plants, and enter the earth to transform, or conceal themselves upon the surface in an imperfect cocoon under leaves.

In this family we have three genera, Pterogon, Thyreus, and Sesia.

Genus VII.—Pterogon.

Wings angulated and indented. Antennæ long, arcuated, tapering at the end, with a long, terminal hook. ——— Tongue as long as the body. Abdomen short and conical. Larvæ attenuated before, with a series of spots, on each side, sloping obliquely backwards and downwards, and a caudal horn, which is frequently obsolete and replaced by a callous spot: they transform in an imperfect cocoon under leaves.

Genus VIII.—Thyreus.

Wings angulated and indented. Antennæ long, and ending with a long hook. Palpi short, thick, and obtuse at the end. Tongue moderate. Abdomen ovoid. Larvæ elongated, not attenuated before, longitudinally striped on the back, obliquely banded at the sides, with a long and straight caudal horn: they transform in the earth.

Genus IX.—Sesia.

Wings entire, upper ones acute, all of them transparent in the middle. Antennæ short, straight, gradually thickened towards the end, with the terminal hook obsolete, and obliquely biciliated beneath in the males. Palpi somewhat elongated, subacute, and forming a conical beak. Tongue long. Abdomen short ovoid, slightly flattened. Larvæ not attenuated before, longitudinally striped on the back, with a short, slightly recurved caudal horn: they transform in an imperfect cocoon under leaves on the surface of the ground.

Family III.—Ægeriadæ.

Antennæ arcuated; either thickening to beyond the middle, attenuated and curved but not hooked at the end, and biciliated beneath in the males; or very slightly fusiform and almost threadlike, and simple in both sexes. Palpi elongated, slender, distinctly three-jointed, prominent, separated and not pressed close to the head, nearly cylindrical, covered with very small scales and almost naked except at the base, which is hairy, and pointed at the tip. Wings more or less transparent. Abdomen with a caudal tuft. Flight diurnal. Larvæ whitish, soft, slightly downy, living within the stems of plants, and generally transforming in a cocoon made of fragments of wood and bark cemented by a gummy matter. Pupæ with the edges of the abdominal segments armed with transverse rows of small teeth.

The American species in this family may be disposed in the genera Trochilium, Ægeria, and Thyris.

Genus X.—Trochilium.

Wings narrow, entire, all of them, or the hind-pair at least, transparent. Antennæ short, stout, arcuated, gradually thickened nearly to the end, which is curved but not hooked; underside generally fringed with a double row of very short bristles in the males. Tongue very short. Body thick; abdomen slightly tufted at the end.

Genus XI.—Ægeria.

Wings narrow, entire, all of them, or the hind-pair at least, transparent. Antennæ mostly elongated, sometimes short, arcuated, gradually thickened nearly to the end, which is curved but not hooked; underside generally fringed with a double row of short bristles in the males. Tongue long. Body slender; abdomen nearly or quite cylindrical, ending with a flat or trilobed tuft.

Genus XII.—Thyris.

Wings broad, subtriangular, more or less angulated and indented, opaque, with small semitransparent spots. Antennæ fusiform, but slender and only slightly thickened in the middle, arcuated, and simple in both sexes. Tongue moderate. Body short and thick; abdomen conical, and tufted at the end.

Tribe II.—Sphinges adscitæ.

The species described in this catalogue may be disposed in three families, Agaristiadæ, Zygæniadæ, and Glaucopididæ.

Family IV.—Agaristiadæ.

Antennæ straight, slightly thickened in or beyond the middle, and curved at the tip. Palpi elongated, slender, not pressed to the face, hairy at base, with the terminal joint cylindrical, scaly or almost naked. Wings broad, subtriangular. Tail hairy or tufted. Flight diurnal. Larvæ elongated, cylindrical, or enlarged a little behind, slightly hairy, transversely banded or spotted, and without a caudal horn.

Genus XIII.—Alypia.

Wings broad, subtriangular, entire, and opaque, with large whitish spots. Antennæ somewhat elongated and slender, thickened very gradually from beyond the middle nearly to the tip, which is slightly curved, obtuse, and not tufted. Palpi long, porrect, separate, with the first two joints very hairy. and the third joint cylindrical, scaly, and obtuse. Tongue moderate, and spirally rolled. Abdomen somewhat elongated, nearly cylindrical, fringed at the sides and tip with short hairs. Anterior and intermediate tibiæ thickly clothed with hairs. Posterior tibiæ with two pairs of pretty long unequal spurs.

Family V.—Zygæniadæ.

Antennæ arcuated, abruptly thickened and curved beyond the middle. Palpi generally elongated, sometimes short, not pressed to the face, hairy at base, with the terminal joint scaly or almost naked. Wings narrow, opaque, often spotted, the hind-pair rather small. Abdomen more or less cylindrical, obtuse, and not tufted at the end. Flight diurnal. Larvæ short, contracted, variegated with spots, slightly hairy, and not horned on the tail.

Genus XIV.—Mastigocera.

Wings long, narrow, entire, opaque, the hind-pair quite small. Antennæ simple in both sexes, filiform at base, suddenly thickened and fusiform beyond the middle, very much attenuated towards the tip, and ending in a long curved point. Labial palpi somewhat curved, extending considerably beyond the clypeus, separated, well covered with hairs beneath the base; the penultimate joint longest, cylindrical, and scaly; the last joint also cylindrical, obtusely rounded at the end, and covered with small, close scales. Maxillæ (tongue) nearly as long as the body. Abdomen nearly cylindrical, obtusely rounded at the end, longitudinally grooved at the sides before, with the basal segment strongly marked, and swelling on each side into a little tubercle. Legs long and slender; posterior tarsi laterally compressed, and hairy on the outside, in the males.

Family VI.—Glaucopididæ.

Antennæ slender, almost setaceous, or very slightly thickened in the middle, and distinctly bipectinated beneath in the males. Palpi slender, more or less elongated, not pressed to the face. Wings sometimes narrow, and sometimes widened, entire, and for the most part opaque. Abdomen nearly cylindrical, and frequently tufted at the end. Flight diurnal. Larvæ cylindrical, hairy, without a caudal horn.

Genus XV.—Procris.

Wings narrow, elongated, opaque, and immaculate. Antennæ slender, tapering at each end, and bipectinated beneath in the males. Palpi small, short, pendent, and nearly naked. Tongue short, but distinct, and spirally rolled. Abdomen slender and nearly cylindrical in the males, thicker in the females, and tufted at the end. Spurs of the hind tibiæ two in number, and very minute.

Genus XVI.—Glaucopis.

Wings narrow in some, broad in others, entire, for the most part opaque, and with the body more or less glossed with blue, sometimes spotted or partially transparent. Antennæ feathered or bipectinated in both sexes, the pectinations elongated in the males, and short in the females. Palpi more or less elongated and recurved. Tongue moderate, spirally rolled. Caudal tuft minute or wanting in the greater number. Posterior tibiæ with three or four spurs of moderate size.

From this Synopsis it will be seen that the divisions and arrangement which I have adopted, differ somewhat from those of the entomologists of the present time. The affinities or resemblances of the Lepidoptera, in their different states, are so various, that it is impossible to preserve a natural connection between them in a linear series. After repeated trials, I have concluded still to adhere to the views of our great masters in Entomology, Linnæus and Fabricius, especially as modern entomologists are by no means agreed upon the limits of the larger divisions of the Lepidoptera, and the order of the genera.

ORDER LEPIDOPTERA. L.

SPHINGES. L.

Crepuscularia. Latr. *Clostérocères.* Duméril. *Hétérocères.* Boisduval. (Part.)

Tribe I. SPHINGES LEGITIMÆ. L.

Family I. SPHINGIADÆ. H. *The Sphingians.*

§ *Alis angulatis.* L.

Genus I. Smerinthus. Latr.

* *Antennæ transversely biciliated beneath in the males.*

1. *S. excæcata.* Smith–Abbot.

Fawn-colored; fore-wings deeply scalloped and toothed on the outer edge, clouded and banded with brown; hind-wings rose-colored in the middle, with a large round eye-like black spot, having a pale blue centre, near the anal angle; fringes narrow, white; thorax with a central lance-shaped chestnut-colored spot, the point of which extends upon the head. Expands two and a half to three inches and a half. *Larva* granulated, apple-green, with two short pale lines before, seven oblique yellowish white lines on each side, and a bluish caudal horn. It feeds upon the leaves of the apple-tree, and upon those of *Rosa Carolina* also, according to Abbot, who (in his Insects of Georgia, p. 49, pl. 25,) has represented a variety of the larva of a yellow color, and greenish at the sides, which are obliquely banded with yellow, and have two longitudinal rows of rust-red spots upon them. It enters the earth to undergo its transformations. *Pupa* chestnut-brown, with a short obtuse anal spine.

2. *S. Astylus.* Drury. = *integerrima.* H. Catalogue Ins. Mass.*

Cinnamon-colored; fore-wings angulated but entire, tinged with rosy white at base, with whitish wavy bands near the tip, a bluish mark along the inner margin, and a tawny yellow spot on each outer angle; hind-wings tawny yellow at base, with a round black eye-like spot, having a pale blue centre, near the anal angle; middle of the thorax cinnamon-red, shoulder-covers paler

* Catalogue of the Insects of Massachusetts, by T. W. Harris; appended to Prof. Hitchcock's Report on the Geology, &c. of Massachusetts.

with a rosy white tinge, and a brown edge above; abdomen with a longitudinal dorsal brown line. Expands from two and a half to two inches and three quarters.

My specimens, a male and a female, were captured at Cambridge on the *Azalea viscosa*.

3. *S. Myops.* Smith–Abbot. = *Rosacearum.* Boisd.

Chocolate-brown; fore-wings sinuated and angulated on the outer edge, varied with wavy whitish and brown bands, with a white Z at tip, and a tawny yellow spot on each of the outer angles; hind-wings with abbreviated whitish and brown bands upon the front edge, ochre-yellow next to the body, with a round black eye-spot having a pale blue centre near the anal angle; head and shoulder-covers glossed with bluish white; a rusty brown stripe in the middle of the thorax; abdomen with a few tawny yellow spots on each side. Expands from two inches and three lines to two inches and six lines. *Larva*, as figured by Abbot, (Ins. Georg. p. 51, pl. 26,) apple-green, the head margined with yellow, and two rows of rust-red spots with six oblique yellowish bands on each side of the body. Abbot says that it eats the leaves of the wild cherry-tree, and buries itself in the ground to undergo its transformations. *Pupa* deep brown.

M. Boisduval has named and figured but has not described this species, in the first volume of his Species Général des Lepidoptères, pl. 15, fig. 4; moreover the name given by him is subsequent to that of Sir J. E. Smith, which is an additional reason why it cannot be adopted.

* * *Antennæ pectinated on both sides in the males.*

4. *S. geminata.* Say.

Rosy ash-gray; fore-wings angulated and with a sinuous outer margin, varied with transverse wavy rosy gray and brown lines, a brown spot and angulated band near the middle, and a deep brown semioval spot at tip; hind-wings rose-colored in the middle, with a large semioval black spot including two pale blue spots near the anal angle; thorax with a large central semioval brown spot. Expands from two and a quarter to more than two inches and a half.

I am indebted to the Rev. L. W. Leonard, of Dublin, N. H., for my specimens, both of which are males. The figure of *S. ocellatus Jamaicensis*, in Drury's Illustrations, Vol. II, pl. 25, fig. 2, 3, very nearly resembles the *geminata*, but it has only one blue pupil in the eye-spot of the hind-wings. Mr. Kirby's *S. Cerisii*, (Faun. Bor. Amer. IV, p. 301, pl. 4, fig. 4,) is probably identical with Drury's species.

* * * *Antennæ, in the males, with the joints distinct and doubly bipectinated.*

5. *S. Juglandis.* Smith–Abbot.

Rosy gray, drab, or dusky brown; wings indented on the outer edges; fore-wings with a dusky outer margin, a short brownish dash near the middle, and four transverse brown lines converging behind and enclosing a square dark brown spot adjacent to the middle of the inner margin; hind wings with two narrow transverse brown lines between two brownish bands; thorax with a central brown line; abdominal segments plaited and prominent at the sides. Expands from two and a quarter to three inches. The females are much larger and of a lighter brownish gray color than the males, with the square spot on the fore-wings less distinct. *Larva* with the head small, and the body attenuated before and behind, pale blue-green, with a long caudal horn, and seven oblique white bands on each side. When disturbed it makes a creaking noise by rubbing together the joints of the forepart of its body. It eats the leaves of the black walnut, and enters the earth to undergo its transformations. Mr. Abbot (Ins. Georg. p. 57, pl. 29) has figured a remarkable variety of the larva, which is of a crimson color, with the fore-part of the body and the oblique bands yellow. *Pupa* deep chestnut-brown, granulated, with six little tubercles on the head-case, a transverse row of acuminated granules on the hinder edges of the abdominal segments, the last three of which segments are flattened beneath and angularly dilated at the sides, with the tip broad, truncated, and externally bidentate.

The antennæ of the males of this species differ from those of the preceding in having the joints distinct to the naked eye, and each joint furnished with two teeth or short pectinations on each side. Mr. Doubleday presented me with specimens, from Florida, which differ from our northern specimens only in being of a darker color.

* * * * *Antennæ, in the males,* ———.

6. *S. modesta.* H.

Drab-colored; fore-wings scalloped, with a transverse dusky band before the middle; hind-wings purplish-red in the middle, deeper red next to the base, and with a blackish spot near the anal angle. Expands four inches and one quarter.

I have never seen but one specimen, which was much rubbed before it came into my possession. It is a female, with a very thick and robust body, and simple antennæ, and probably is the North American representative of *S. Tiliæ* and *Quercus.*

§ *Alis integris, ano simplici.* L.

Genus II. Ceratomia. H.

I have been induced to propose a new genus for the reception of a single species, presenting characters, in the larva and winged state, which do not allow it to be included in the genus Sphinx as now received. The larva of this species, in the possession of horns on the fore-part of the body, exhibits a peculiarity which hitherto appears to have been unnoticed or undescribed among the Sphinges. The name of the genus, derived from κέρατα, *horns*, and ὦμια, *the shoulder*, alludes to this peculiarity. An analogous and still more imposing form is found in the larvæ of the *Phalænæ*, belonging to the genus *Ceratocampa.*

C. quadricornis. H.

Light brown; fore-wings with zigzag and wavy brown and whitish bands, dusky in the middle to the inner margin, the anterior edge whitish, and a large white dot near the middle; hind-wings with three dusky transverse bands, and a broad blackish hind-border; fringes dotted with white; head and a broad line on each side of the thorax to the shoulders white; shoulder-covers with three and abdomen with five longitudinal brown lines. Expands four and a half to nearly five inches. *Larva* pale blue-green, longitudinally wrinkled, with a pair of short denticulated horns on the second segment, a similar pair on the third, two parallel series of little teeth on the first four segments, a dorsal row of larger teeth extending to the tail, a long bluish caudal horn, and seven narrow oblique white lines on each side of the body. It feeds upon the leaves of *Ulmus Americana,* and transforms in the earth.

Genus III. Sphinx. L.

* *Tongue-case of the pupa detached from the breast.*

1. *S. cingulata.* F. = *Convolvuli.* Smith–Abbot.

Dark ash-gray, variegated with brown, body beneath white; middle of the hind-wings pink, with three or four black bands; fringes of the wings spotted with white; and five pink-colored spots separated by short transverse black lines on each side of the abdomen. Expands about four inches. Larva, as represented by Abbot, (Ins. Geog. p. 63, pl. 32) dark brown, with a double chain-like rust-red dorsal line, a paler lateral line, a series of eight hook-shaped yellowish spots on each side enclosing the spiracles, and a short curved horn on the tail. Eats the leaves of the sweet potato (*Convolvulus batatas*,) and enters the earth to undergo its transformation. *Pupa* with a long hooked tongue-case spirally recurved at its extremity. Inhabits the Middle and Southern States.

I am indebted to Dr. J. E. Holbrook, of Charleston, S. C., for a specimen.

2. *S. Carolina*. L.

Ash-gray; fore-wings with blackish wavy lines; hind-wings whitish in the middle, with four black bands, the two central ones narrow and jagged; fringes spotted with white; five orange-colored spots encircled with black on each side of the abdomen; and the tongue excessively long. Expands about five inches. *Larva* apple-green, transversely wrinkled, with seven oblique white lines on each side, and a rust-colored caudal horn. Commonly known by the names of *potato-worm* and *tobacco-worm*, from the plants on which it is found; transforms deep in the earth. *Pupa* with a long tongue-case, curved near the head, straight and touching the breast only at the end, representing the handle of a vase.

3. *S. Drupiferarum*. Smith–Abbot.

Pale reddish-gray; fore-wings with a dark brown band extending from the inner margin to the tip, and crossed by slender black lines between the nervures;* hind-wings with two transverse blackish bands; thorax dark chestnut, with the sides and the head white; abdomen dark brown above, with a slender dorsal black line and about five whitish lateral spots margined with black. Expands three and a half to four inches. *Larva*, according to Abbot, (Ins. Geog. p. 71, pl. 36) apple-green, with seven oblique lateral bands, which are violet above and white below, a line on each side of the head and the caudal horn violet. Feeds on the leaves of the *Celtis* and plum, and is transformed in the earth. *Pupa*, like that of *S. Ligustri*, with a short tongue-case detached from the breast.

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* The veins, or elevated and branching lines on the wings of insects, are called *nervures* by Mr. Kirby.

4. *S. Kalmiæ.* Smith–Abbot.

Rusty-buff; fore-wings streaked with light brown, and with a narrow whitish band near the outer margin; hind-wings with a narrow central and a broad marginal blackish band; fringes brown spotted with white; shoulder-covers white edged with brown; abdomen with a slender dorsal black line and short transverse bands alternately black and white at the sides; beneath dull reddish white. Expands three and a half to four and a quarter inches. *Larva*, according to Abbot, (Ins. Georg. p. 73, pl. 37) pale green, with seven oblique yellow bands, edged above with violet, on each side, the caudal horn and a line on each side of the head blue, and the hinder pair of legs yellow. Feeds on the leaves of *Kalmia latifolia*, and transforms in the earth. *Pupa* with a short detached tongue-case.

5. *S. Gordius.* Cramer.

Brownish ash-gray; fore-wings streaked with black between the nervures, with the anterior and inner margin dusky-brown, a white dot near the middle, and a large gray spot at base; fringe spotted with white; hind-wings with a narrow central and a broad marginal dusky brown band, and a white fringe; thorax deep chestnut, with the sides and the head above whitish; abdomen with a central black line, and the sides ash-white transversely banded with black. Expands three to three inches and a half. *Larva* apple-green, with seven oblique white lateral bands, slightly edged above with violet, a rust-red caudal horn, and a brownish line on each side of the head. It lives on the apple-tree, and enters the earth to be transformed. *Pupa* with a very short detached tongue-case.

6. *S. cinerea.* H.

Ash-gray; fore-wings long, narrow, and entire, with five short oblique lines between the nervures; hind-wings with two blackish bands; shoulder-covers slightly edged with black above; abdomen with a narrow dorsal black line, and short alternate bands of black and dirty white on the sides. Expands four and a half to five inches and a quarter.

The specimens from which this description is taken were raised many years ago from larvæ, which, at the time, I neglected to figure and describe. To the best of my recollection, these larvæ were found on the lilac, and, with the pupæ, corresponded very nearly in form, color, and size, to those of the European *S.*

Ligustri. The present species is remarkable for the length and sharpness of the wings, which are of a fine neutral gray tint, and for the prominence of the head and palpi.

* * *Tongue-case of the pupa not detached, but buried, and soldered to the breast.*

7. *S. sordida.* H.

Dark gray; fore-wings variegated with dark brown, dashed with a few blackish lines, and with a whitish dot near the middle; hind-wings with a blackish basal spot, and two broad black bands; a dark brown line on each shoulder-cover; abdomen with a dorsal black line, and alternate black and light gray bands on the sides. Expands two inches and three quarters.

Although the larva and pupa of this species are unknown to me, I judge from analogy that it belongs to this division of the genus Sphinx.

8. *S. Hylæus.* Drury.=*Prini.* Smith–Abbot.

Rusty brown; fore-wings mottled with white, banded with jagged dark brown lines, with a white dot near the middle, and a spot of the same color at tip; hind-wings whitish with a narrow indented brown band across the middle, and a broad one on the outer margin; fringes spotted with white; a whitish line above the eyes extending on each side of the thorax; two longitudinal rows of white dots on the top of the abdomen, and a series of short narrow white bands on each side. Expands two and a quarter to two inches and three quarters. *Larva* pea-green, with six or seven oblique lateral whitish bands edged above with pink, a purple caudal horn, and a pale blue line on each side of the head. It feeds on the leaves of *Prinos glaber* and various species of *Vaccinium*, and enters the earth to be transformed.

This insect is much like the *Brontes* of Drury, which, however, is a much larger species, more distinctly banded with white, &c.

9. *S. Plebeja.* F.

Gray; fore-wings with a white dot near the middle, and five or six short oblique blackish lines between the nervures; hind-wings sooty black, dirty white at base; fringes white, spotted with dark brown; abdomen with three black lines, one dorsal, and two on each side, the latter enclosing a longitudinal series of dirty white spots. Expands three inches. Inhabits the Southern States.

The only specimen which I have seen was taken by Prof. Hentz in North Carolina, and now belongs to the Boston Society of Natural History.

10. *S. Coniferarum.* Smith–Abbot.

Gray; fore-wings with about three narrow and indented brownish bands, a spot near the middle, one or two streaks beyond the middle, and the nervures near the outer margin brown; hind-wings dusky or blackish gradually fading into gray towards the base; fringes spotted with brown and white; abdomen gray with brownish incisures. Expands one inch and three quarters to two inches and three quarters. *Larva*, as figured by Abbot, (Ins. Georg. p. 83, pl. 42,) chequered with brown and white spots, with a dorsal whitish line, and a short caudal horn. It eats the leaves of various kinds of pine, and enters the earth to transform. Mr. Leonard informs me that the tongue-case of the *Pupa* is short, and buried so as not to rise above the leg-cases.

For my specimen I am indebted to the Rev. L. W. Leonard, who raised it from a larva found on the pine in Burlington, Vt. In the cabinet of the Boston Society of Natural History there is a larger specimen, which was taken in North Carolina by Prof. Hentz; the bands on the wings in the latter are less distinct than in my specimen.

11. *S. Ello.* L.

Gray; fore-wings slightly indented on the outer margin, with a few irregularly scattered black dots, and a blackish stripe extending from the base to the tip; hind-wings rust-red, with a broad black hind-border; thorax with five longitudinal black lines, and abdomen on each side banded with black. In the female the blackish stripe on the fore-wings and the lines on the thorax are usually wanting or indistinct. Expands three and a quarter to four inches. Inhabits the Southern States, the West Indies, and South America.

In the cabinet of the Boston Society of Natural History there is a specimen of this tropical insect, which was captured by Prof. Hentz in the interior of North Carolina, where eventually the species may become common. According to Madam Merian (Insectes de Surinam, page and plate 61) the *larva*, in Surinam, lives on the leaves of a species of *Psidium* or Guava, is of an obscure brown color, with a black dorsal line, some small irregular white spots on the sides, and the head and caudal horn purple.

The tongue-case of the *pupa*, from the figure, seems to be short and soldered to the breast. From the shape of its body and wings, this insect must belong to a very distinct group in the Linnean genus Sphinx; but, without knowing more of the larva and its transformations, I do not feel authorized to separate it from the present genus.

Genus IV. PHILAMPELUS. H.

The insects belonging to this genus cannot with propriety be included in the genus *Chœrocampa* of Duponchel, or *Metopsilus* of Duncan, to which they approach the nearest; and, therefore, I have considered it proper to institute a new genus for their reception. They, indeed, seem to form a characteristic and typical group, peculiar to the New World, being found only in the United States, Mexico, the West Indies, and the tropical parts of South America. The larvæ feed chiefly on the vine and the plants allied to it, which suggested the name of the genus, derived from φιλέω, *I love*, and ἄμπελος, *a grape-vine.* In those species whose transformations have passed under my own observation, the larvæ when young were furnished with a long slender caudal horn, recurved over the back like the tail of a dog; when about half grown, the caudal horn is shed with the skin, and is replaced by a prominent, eye-like, polished spot. The oblique spots on the sides of these larvæ slope downwards and backwards; this is also the direction of the bands in the larvæ of *Pterogon;* but in those of all the other *Sphinges* the oblique lateral bands slope upwards and backwards. The *pupa* is elongated, attenuated at the fore-part, with a pretty long, robust, rough, anal horn, notched at the tip; the tongue-case is buried and soldered to the breast, and slightly longer than the wing-cases; and the fore-part of the abdominal rings is roughened with deep punctures. In the perfect state, the fore-wings are entire, acute, slightly emarginated below the tip in the males, and almost falcated, with a sinous inner margin, and well-marked hind-angle; the outer margin of the hind-wings is undulated or slightly crenated; the shoulder-covers are large; and the abdomen is short, thick, conical, and usually immaculate. Madame Merian in her Insectes de Surinam, plates 34 and 47, has represented the transformations of three species of this genus; and two are also figured by Mr. Abbot in the Insects of Georgia, plates 40 and 41.

1. *P. Vitis.* L.

Grayish flesh-colored; fore-wings, except the anterior and outer margins, dark olive, with a broad stripe from base to tip, crossed by another from the middle of the inner margin, a small hook-shaped spot near the middle, and the nervures behind, of a pale flesh-color; hind-wings pale green at base, with the inner and hinder margins rose-red, a black spot near the middle and a black transverse band behind; a longitudinal line on the head and thorax, the shoulder-covers, two broad stripes on the abdomen, and a round spot on each side of its base of a dark olive color. Expands about four inches. Larva, as represented by Abbot, (Ins. Georg. p. 79, pl. 40,) pale pea-green, longitudinally striped on the top of the back and transversely at the sides with brown, and with seven oval, oblique, cream-colored spots on each side. According to Linnæus and Mad. Merian, it lives on the grape-vine; but Mr. Abbot has represented it upon *Jussiæa erecta.* Inhabits the Southern States, South America, &c.

This insect fades very much by age, which changes the flesh-colored portions to a pale reddish buff or nankin color. My specimens were received from Dr. J. E. Holbrook, of Charleston, S. Carolina.*

2. *P. Satellitia.* L. = *Licaon?* Cramer.

Light olive, variegated with dark olive; fore-wings with an abbreviated band beyond the middle, an oblong patch on the basal half of the hind margin including a square darker spot, a semi-oval spot near the tip, and a triangular one near the hind angle, of a dark olive color, and two approximated brownish dots near the middle; hind-wings with a black spot near the middle of the inner margin, and a transverse blackish band behind, obsolete near the anal angle and ending there in a few small black spots;

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* I have received from Dr. H. B. Hornbeck, King's physician, in the island of St. Thomas, W. I., a species which is closely allied to *P. Vitis;* and, as it is not described in any of my books, I am happy to describe it here under the name of

P. Hornbeckiana.

Above olive-gray; fore-wings dark olive, with two silvery white stripes crossing each other in the middle of the wing, the longest stripe toothed near the base of the wing and obsolete thence to the middle, three of the nervures and a band on the outer margin whitish, and two approximated black dots near the middle; hind-wings on the inner margin pink, with a large square olive-colored spot, dusky behind with a black transverse band; an olive-colored line on the head and thorax; the shoulder-covers and first segment of the abdomen olive, bordered with white; upper part of the abdomen olive, with a central gray line; outer sides of the legs and antennæ white. Expands about four inches. Inhabits St. Thomas, W. I.

a slender line on the head and thorax, the shoulder-covers, and a transverse patch on the top of the first abdominal segment, dark olive. Expands from four to four inches and three quarters. *Larva*, when young, pea-green, with a slender recurved caudal horn, and of the same color or of a clear light brown and without a tail afterwards, with six oblique broad oval cream-colored spots on each side of the body; feeds on the leaves of indigenous and exotic grape-vines, and on those of *Ampelopsis hederacea*, and enters the earth to transform.

3. *P. Achemon.* Drury. = *Crantor?* F.

Red-ash colored; fore-wings with a few short transverse brown lines, and shaded with brown from the middle to the hind margin, with a square spot near the middle of the inner margin, another near the tip, and a triangular spot near the hind angle, of a deep brown color; hind-wings pink, with a deeper red spot near the inner margin, a dusky hind border, and a transverse row of small black spots; palpi and a large triangular spot on each shoulder-cover deep brown. Expands from three to four inches. *Larva* pea-green with a slender recurved tail when young, of the same color or light brown and without a tail subsequently, with six oblique oblong oval scalloped cream-colored spots on each side. It eats the leaves of grape-vines and of the common creeper or *Ampelopsis*.

This and the preceding species, in the larva state, are very injurious to our cultivated grape-vines.

Genus V. Chœrocampa. Duponchel.

Metopsilus. Duncan. *Deilephila.* (section.) Boisduval.

This genus was established, in 1835, by M. Duponchel,* to receive certain European Sphinges the larvæ of which have the head and fore-part of the body retractile, the head being very small, and the first three segments abruptly diminishing in size from the fourth, which gives to the fore-part of the body a resemblance to the head and snout of a hog. Hence the French name of these larvæ, *cochonnes*, and the generical name proposed by Duponchel, which is derived from χοῖρος, *a hog*, and κάμπη, *a caterpillar*. This peculiarity in the form of the larvæ seems to have suggested to Linnæus the names that he has given to two

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* Godart and Duponchel. Lepidoptères de France. Supplément. Tome II, p. 159. (1835.)

of the species, to wit, *porcellus*, *the pig*, and *Elpenor*, the name of one of the companions of Ulysses, who was changed to a hog by Circe. In the year 1836, Mr. Duncan,* probably not aware of the previous establishment of this genus, pointed out its characters under the name of *Metopsilus*, derived from μέτωπον, *the front*, and ψιλὸς, *slender*, in allusion to the form of this part of the larva. These naturalists, in separating this new group from the genus *Sphinx*, or rather from *Deilephila*, seem to have had only European insects under consideration ; but in America there are several species, which, so far as similarity of form and habits, in all their states, indicates a natural affinity, ought certainly to be included in the same generical group, from which, however, they will be excluded unless the characters of the genus are somewhat modified to receive them. Believing the genus to be a good one, and susceptible of modification, I have changed the characters of it in the synopsis prefixed to this catalogue, so as to admit our American species. In *C. Pampinatrix*, *Chœrilus*, and *versicolor*, the antennæ are rather short and slender, arcuated, and end in a very long slender hook ; the fore-wings have the outer and inner margins sinuous, so as to exhibit prominent outer and hinder angles ; the hind-wings have a sinuous hind-margin, and a prominent angle near the tail ; and the abdomen is rather short, and conical at tip. The *larvæ* of the first two of these species have the eleventh segment conically prolonged above, forming a base for a very short slightly curved caudal horn, and the sides of the body are marked with oblique bands sloping upwards and backwards. They transform above ground, under fallen leaves, or slightly covered with grains of earth, connected by a few threads, so as to form a loose imperfect cocoon. The pupa is short, thick, obtusely rounded before, with the tongue-case imbedded, indistinct, and nearly as long as the wing-cases ; the tail is rather blunt, and ends in a long, slender point, which, under a magnifier, is found to be rough, and notched at the tip.

1. *C. Pampinatrix.* Smith–Abbot.

Light olive-gray above, shaded with olive ; fore-wings with a dot near the middle, a transverse band near the base, a broader band beyond the middle and a large triangular spot adjacent to each acute angle and almost forming a third band, of an olive color ; hind-wings rust-colored, dusky behind, and gray next the

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* Jardine's Naturalist's Library. Entomology. Vol. iv, p. 154. (1836.)

anal angle; head and shoulder-covers dark olive; and a white line on each side of the thorax at the origin of the wings. Expands two and a half to two inches and three quarters. *Larva* pale green, with a longitudinal series of six triangular orange-colored spots on the top of the back and a darker green lateral line; sides below this paler, almost white, sprinkled with rusty dots, and with six oblique green bands; caudal horn short, bluish green. It varies in being of a clear light brown color, with the back bounded on each side by a darker longitudinal line, meeting at the origin of the caudal horn, the sides tinged with pink, and obliquely banded with brown. Feeds on the leaves of the grape-vine. *Pupa* clay-colored, sprinkled and punctured with black, and with the incisures of the abdomen black.

Mr. Abbot, on plate 28 of his Insects of Georgia, has represented this larva with the caudal horn too long and too much curved, and the eleventh segment not so much produced behind as it ought to be. This species, in the winged state, comes very near to Cramer's *Sphinx Myron*, which, from the figure, seems to want the spot in the middle of the fore-wings, and, according to Cramer, has a very short tongue, a character that does not apply to the *Pampinatrix.* The larva, above described, is one of the most injurious to our cultivated grape-vines; for, not satisfied with devouring the leaves, it nips off the fruit-stalks when the grapes are not more than half grown. I have gathered under a single grape-vine above a quart of unripe grapes which had been detached thus during one night by these larvæ.

2. *C. Chœrilus.* Cramer. = *Azaleæ.* Smith–Abbot.

Rust-colored; fore-wings rusty gray tinged with blue, with a dot near the middle, a few spots between it and the base, and a very broad band beyond the middle, rust-colored; hind-wings rust-colored, dusky near the anal angle, with a whitish fringe; a spot at the sides and a slender line on the top of the thorax, the edges of the shoulder-covers and of the abdominal segments white. In the male the broad band of the fore-wings is marked by a pale and a dark zigzag line so as nearly to divide it into two bands. Expands two and a half to three inches. *Larva*, as represented by Abbot, (Ins. Georg. p. 53, pl. 27,) varying in color, being either pale green, with a narrow dusky dorsal line, a greenish line on each side, a blue-green caudal horn, and the sides obliquely banded with green; or clear pale red, with the lines and bands brownish, and the horn chestnut-colored. Mr. Abbot says that it lives on *Azalea nudiflora*, and that it spins itself up in a thin web on the leaves. *Pupa* like that of *C. Pampinatrix.*

3. *C. versicolor.* H.

Light olive, variegated with olive-green and white; fore-wings with narrow curved bands of white and olive-green, and a zigzag white line at tip; hind-wings rust-colored, with the inner and hind margin olive-green; tips of the palpi, a line on each side of the head above the eyes, a longitudinal dorsal line from the front to the tail, and the edges of the collar and of the shoulder-covers, white; two spots on the metathorax and the abdominal segments on each side of the dorsal line tinged with dark buff. Expands about three inches.

Although the larva and pupa of this species are unknown to me, I have ventured to place it in the genus *Chærocampa.* The palpi are rather thicker towards the tip than those of the two preceding species; the fore-wings are not quite so much emarginated, and consequently, their angles are not quite so prominent. The under-side is quite as prettily variegated as the upper-side; that of the fore-wings being pale olive, tinged with deep buff near the hind-angle, with rust-red in the middle, and mottled and streaked with olive-green and white; that of the hind-wings olive-green, banded with white, dark olive, and buff. My specimen was taken sitting upon the leaves of *Azalea viscosa;* it was quite fresh, and seemed to have been recently transformed.

Dr. Hornbeck has presented to me a species, from St. Thomas, resembling the *versicolor* very nearly in color and form; but the palpi are more prominent, the antennæ are not so much arcuated, and the terminal hook is much shorter. It evidently leads to the genus *Deilephila.*

4. *C. tersa.* L.

Grayish olive above; fore-wings streaked from base to tip with numerous narrow dusky and pale lines, and with a minute black dot near the middle; hind-wings black, paler round the edges, with the anal angle and the fringe cream-colored, and a transverse row of small wedge-shaped cream-colored spots near the hind-margin; a reddish white line on the sides of the head and thorax; shoulder-covers slightly edged above with rust-red; sides of the abdomen, and the body and wings beneath, rusty buff, streaked and sprinkled with dusky olive-gray. Expands two and three quarters to three inches. *Larva*, according to Abbot, (Ins. Georg. p. 75, pl. 38,) pea-green or brown, with seven white eye-like spots having a red centre and a black margin and connected by a longitudinal white line, on each side of the body, and a red caudal horn. It lives on *Spermacocce Hyssopifolia*, and, like the other species, is transformed in an imperfect cocoon which it spins above ground. *Pupa* clay-colored, freckled with dusky spots. It inhabits the Southern States, the West Indies, and South America.

I am indebted to Dr. J. E. Holbrook of Charleston, S. C., and to Dr. H. B. Hornbeck, of St. Thomas, W. I., for specimens. The antennæ are straight, with a shorter terminal hook than in the three preceding species; the outer margin of the fore-wings is not so sinuous, and the abdomen is much more elongated, slender and pointed. It may be necessary, hereafter, to institute a new genus for the reception of this and several other closely allied West-Indian and South-American species.

Genus VI. Deilephila. Ochsenheimer.

1. *D. lineata.* F. = *Daucus.* Cramer.

Olive-brown; fore-wings with a pale buff-colored stripe from the base of the inner margin to the tip, crossed by six white lines on the nervures, the outer margin ash-gray, the fringe and edge of the inner margin white; hind-wings rose-pink, with a white spot near the inner margin, a black band at base, another near the hind-margin, and the fringe, white; a white line on each side of the head above the eyes, and six lines, of the same color, placed in pairs, on the thorax; two rows of small black spots and a slender dorsal white line on the top of the abdomen, the sides reddish, with a short transverse black band on each side of the first abdominal segment, and a white band behind it, followed by a lateral series of alternately black and white spots. Expands from three to four inches. *Larva* pea-green, with a longitudinal series of nine or ten orange-colored oval spots encircled with black, on each side, and an orange-colored caudal horn. Feeds upon the leaves of the purslane and turnip, and of various other humble plants, and buries itself in the ground to undergo its transformations. *Pupa* light brown.

Contrary to what is usual among our Sphinges, there are two broods of this species in the course of one summer. This is the true *Sphinx lineata* of Fabricius, described by him as an American insect in his "Systema Entomologiæ." His description of the thorax, "*striis tribus albis duplicatis*," applies exactly to our insect, and not to the *Livornica* of Europe, with which it is often confounded, and which has only four white lines instead of six, on the thorax. The larva of the latter, moreover, differs from that of our *lineata*. Dr. Hornbeck has sent to me from St. Thomas, W. I., specimens which vary a little, but are not specifically distinct from the *lineata* of the United States.

2. *D. Chamænerii.* H. = *Epilobii.* H. (Catalogue.)

Olive-brown; fore-wings with a sinuous buff-colored stripe, indented before, beginning near the base of the inner margin and extending to the tip, and a dark olive-brown tapering stripe behind it, a black spot at base, a white dash and a diamond-shaped blackish spot before the middle; hind-wings dark brown, with a transverse rose-colored band, including a white spot near the body and a deep red one before the anal angle; inner edge of the fore-wings and fringe of the hind-wings whitish; palpi white below; a white line above each eye extending on the sides of the thorax, where it is bounded above by a black line; abdomen with a dorsal series of white dots, two black and two alternating white bands on each side of the base, and two narrow transverse white lateral lines near the tip; segments beneath edged with white. Expands from two and three quarters to three inches. *Larva* green, somewhat bronzed, dull red beneath; with nine round cream-colored spots, encircled with black, on each side, and a dull red caudal horn. It lives on the *Epilobium angustifolium*, and (as Mr. Leonard informs me) transforms in the ground, without making a cocoon. Inhabits New Hampshire.

The larva very closely resembles that of *D. Galii*, as figured by Roesel, III, Tab. VI, Fig. 1, 2. For a specimen of it, and for the insects in the winged state, I am indebted to Mr. Leonard, by whom they were raised. This species is the American representative of *D. Galii*, and is also allied to several other European species, such as *D. Epilobii*, *Esulæ*, *Amelia*, *Tithymali*, *Dahlii*, *Euphorbiæ*, &c.; but I am satisfied that it is perfectly distinct from all of them; and the long description which I have given of it will render it easy to discover in what respects it differs from them. Moreover it is a legitimate species, which is more than can be said of all of the above-named European insects, some of which are now admitted to be hybrids. Mr. Kirby (Fauna Boreali-Americana, IV, p. 302,) describes a North American species, under the name of *D. intermedia*, which, according to him, has the stripe on the fore-wings of a pale rose color, and wants the dorsal series of white dots on the abdomen; in other respects it seems nearly allied to the *Chamænerii*. When my Catalogues of the Insects of Massachusetts were published I was not aware that the specific name *Epilobii* had been previously appropriated; for the species to which I then applied it I have now substituted that of *Chamænerii* derived from Tournefort's name for the genus *Epilobium*.

§ *Legitimæ* —— *ano barbato*. L.

Family II. MACROGLOSSIADÆ. H. *The Macroglossians.*

Sesiidæ. Stephens. *Sesiadæ*. Kirby.

* *Wings angulated and indented; antennæ tapering at the end, with a long terminal hook.*

Genus VII. Pterogon. Boisduval.

P? inscriptum. H.

Ash-gray; wings angularly indented; first pair with two dusky bands near the base, connected on the inner margin by a blackish line, a few undulated and zigzag transverse lines beyond the middle, a dusky outer margin, a half-oval brown spot at tip, and a small deep brown patch including a white I near the tip; hind-wings reddish gray, with a dusky hind-margin; collar edged with brown; abdomen with two dorsal series of black dots. Expands two inches. Inhabits Indiana.

Of this species I have seen only two individuals, both females, having rather long slender and simple antennæ, attenuated and curved so as to form a hook at the end. In the shape of the wings and distribution of the colors this insect nearly resembles some species of *Smerinthus*, from which genus it is excluded by the length of the tongue, which nearly equals that of the body. *Pterogon Gauræ*, which I suppose to be the only legitimate species of the genus that has yet been discovered in the United States, is known to me only by Mr. Abbot's figure.

Genus VIII. Thyreus. Swainson.

1. *T. lugubris*. L.

Brown; wings sinuated and slightly angulated on the outer edge; first pair with an oblique streak and an eye-like dot before the middle, and a large triangular brown patch near the tip ; hind-wings with two or three obscure transverse brown lines ; male with a triple-tufted tail. Expands two and a half to three inches. Inhabits the Southern States. *Larva* pale green, with three darker longitudinal dorsal lines, nine oblique yellowish bands on each side, and a long, slender, nearly straight caudal horn. Mr. Abbot, from whose figure (Ins. Geog. p. 59, pl. 30) this description of the larva is taken, says that it feeds on Virginian creeper, *Ampelopsis Hederacea*, and that it enters the earth to transform. The *pupa* is elongated, chestnut-brown, with a short anal point.

My specimen of this insect was presented to me by Dr. J. E. Holbrook. It is closely allied to several South American species, figured by Cramer, such as his *Fegeus*, *Gorgon*, &c. ; and, indeed, the *Fegeus* may prove to be identical with it.

M. Boisduval (Icones Hist. des Lépidoptères d'Europe nouveaux, Vol. II, p. 15) refers the *Gorgon* of Cramer [?] to his genus *Pterogon* ; but, in my opinion, the genus *Thyreus* of Swainson, besides having the priority in point of time, is entitled to rank as a distinct genus. Is the European *Gorgon* of Esper, Hübner, and Ochsenheimer, quoted in Mr. Children's Abstract of the Characters of Ochsenheimer's Genera (Philos. Mag. N. S. Vol. V, p. 37), the same as the Surinam species named *Gorgon* by Cramer ? And if not, is M. Boisduval's citation of Cramer's name correct ?

2. *T. Abbotii.* = *Abbottii.* Swainson.

Chocolate-brown ; wings very much indented on the outer edge ; first pair with wavy and oblique blackish brown streaks, and a black dot near the middle ; hind-wings yellow, with a broad blackish brown hind-border ; edge of the collar and a transverse stripe across the thorax black ; abdomen banded with black at base, tufted at the sides of the hinder segments, and terminated by a triple-tufted rust-colored tail. Expands from two and one third to nearly three inches. *Larva*, as figured by Abbot, (Swainson's Zoological Illustrations, Part I, pl. 60) pea-green, with narrow dorsal brown lines, nine lateral oblique yellowish bands broadly bordered above with brown, and a long slender slightly curved caudal horn. It feeds on the grape-vine. *Pupa* chestnut-brown, with two yellowish abdominal incisures.

This species is not uncommon in the Southern States, and I have one specimen which was taken in Cambridge, Mass.

3. *T? Nessus.* Cramer.

Dark brown; fore-wings with a sinuous and angular outer edge, a blackish brown band across the middle, another near the outer margin, and a small rust-red spot near the tip; hind-wings rust-red, with a dark brown hind-border; abdomen with two pale yellow bands behind the middle, four rust-red spots on each side, and a triple-tufted tail. Expands from two to two inches and a quarter.

Of this species I have seen only females, in which the antennæ are similar to those of the same sex in *T. Abbotii.* The palpi, however, are more acuminated, and approach in form to those of *Sesia Pelasgus*, &c. It ought, perhaps, to be included in a new genus, which, without a knowledge of the larva and pupa, I shall not venture to propose.

* * *Wings entire; antennæ thickened towards the end, with a minute terminal hook.*

Genus IX. Sesia. F. (Syst. Gloss.)

1. *S. Pelasgus.* Cramer.

Wings transparent and iridescent, with a broad purple-brown border and nervures; antennæ and palpi, above, blue-black; head and thorax olive; breast and legs cream-white; abdomen purple-brown below, ochre-yellow above, with the two middle segments and a spot behind them purple-brown, and three lateral white spots; tip with a central fan-shaped brown tail, and two black tufts on each side of it. Expands from two to two inches and one quarter.

2. *P. diffinis.* Boisduval. = *fuciformis.* Smith–Abbot.

Wings transparent and iridescent, with a narrow blackish border and nervures, and a rust-red spot at tip; antennæ and palpi black above; thorax and breast covered with pale yellow hairs; abdomen black above, with two longitudinal patches of yellow hairs, the two middle segments black, the next two covered with yellow hairs, and the tip with a fan-shaped tail, which is yellow in the middle and tufted with black on each side. Expands from one inch and three quarters to two inches. *Larva*, according to Abbot, (Ins. Georg. p. 85, pl. 43.) pale pea-green, reddish beneath, with a longitudinal dorsal line, a lateral pale yellow stripe, and a short recurved caudal horn. In Georgia, it feeds upon the *Tabernæmontana Amsonia*, and forms an imperfect cocoon on the surface of the ground. *Pupa* brown with the abdominal incisures ochre-yellow.

My specimens were presented to me by Mr. Leonard, who captured them in New Hampshire, where the *Tabernæmontana* does not grow. The larva must, therefore, be sought upon some other plant; perhaps it may be found upon the *Apocynum.* M. Boisduval has named and given a figure of this species in his Hist. Nat. des Insectes Lépidoptères, Vol. I, pl. 15, fig. 2; and, as it is evidently distinct from the European *fuciformis*, I have retained the name proposed by M. Boisduval, although he has not established a claim to it by any description of the insect. Mr. Kirby's *S. ruficaudis* (Faun. Bor. Amer. IV, p. 303,) is evidently different from this species, and comes nearer to the *Pelasgus*, to which, however, the description does not very well apply, in many respects.

Family III. ÆGERIADÆ. H. *The Ægerians.*

Genus X. Trochilium. (Scop.) Stephens.

Sesia. F. (Entom. Syst.) Latr. Boisd. *Ægeria.* F. (Syst. Glossat.)

1. *T. marginatum.* H.

Black; wings transparent; first pair with a broad border, the tip, and a transverse band beyond the middle pale brown; hindwings with a broad black fringe; antennæ black; two longitudinal lines on the thorax, hind margins of the abdominal segments, orbits, palpi, and legs, except at base, yellow. Expands rather more than one inch and a quarter.

This insect was taken in New-Hampshire, and presented to me by the Rev. L. W. Leonard.

2. *T. tibiale.* H.

Brownish; wings transparent; first pair with a narrow border and an abbreviated band beyond the middle pale brown; hindwings with a narrow brownish fringe; antennæ black; orbits, two lines on the thorax, edges of the abdominal segments, and tibiæ yellow; hindmost tibiæ thickly covered with yellow hairs. Expands one inch and a half. The yellow bands on the abdomen are much narrower and less bright than in the *marginatum.*

Found in New-Hampshire on the *Populus candicans*, and presented to me by Mr. Leonard.

3. *T. denudatum.*

Chestnut-brown; fore-wings opaque, with a large triangular transparent spot adjacent to the outer hind-angle, a rust-red spot at base and another near the middle; hind-wings transparent, with the margin and fringe brown, and a rust-red costal spot; orbits, edges of the collar, incisures of the abdomen, tibiæ, and tarsi dull yellow; antennæ brownish above, rust-yellow at tip and beneath. Expands from one inch and a quarter to more than one inch and a half. The transparent spots at the tips of the fore-wings have the appearance of being caused by the removal of the colored scales.

The specimens, from which the descriptions of these three species are drawn up, had become somewhat oily, and it is possible that some of their characteristic markings may have become obliterated.

Genus XI. ÆGERIA. F. (Syst. Glossat.)

Sesia. F. (Entom. Syst.) Latr. Boisd. *Trochilium.* Scopoli.

1. *Æ. tricincta.* H. (Catalogue.)

Blue-black; fore-wings opaque; hind-wings transparent, with the border, fringe, and a short transverse line near the middle black; palpi at tip, collar, a spot on each shoulder, and three bands on the abdomen yellow; antennæ short, black; four posterior tibiæ banded with orange; tarsi yellow, tipped with black; tail flat, with two longitudinal yellow lines. Expands from one inch to one inch and two lines.

This species seems to come near to the European *Asiliformis;* but the male has only three yellow abdominal bands; while in the *Asiliformis* there are five bands in the male sex. The antennæ are shorter and thicker than in the following species, and are furnished beneath with a double row of short pectinations or teeth, which are thickly fringed with hairs. The sexes were captured together upon the common tansy.

2. *Æ. Cucurbitæ.* H. (New-England Farmer.)

Fore-wings opaque, lustrous olive-brown; hind-wings transparent, with the margin and fringe brown; antennæ greenish black; palpi pale yellow, with a little black tuft near the tip; thorax olive; abdomen deep orange, with a transverse basal black band, and a longitudinal row of five or six black spots; tibiæ and tarsi of the hind-legs thickly fringed on the inside with black, and on the outside with long orange-colored hairs; spurs covered with white hairs. Expands from thirteen to fifteen lines. *Larva*, similar in form and color to those of other species of the genus, lives in the pith of squash and pumpkin vines, which it leaves at the root, and forms in the ground a cocoon composed of grains of earth cemented by a gummy matter. *Pupa*, by the aid of the abdominal denticulations, almost entirely excluded from the cocoon during the last transformation.

The sudden death of the squash-vines, during midsummer, is occasioned by the ravages of the larva of this insect. For further particulars relating to it, a communication, by the author, in the New-England Farmer, Vol. VIII, p. 33, for 1828, may be consulted. This species seems to be closely allied to, but sufficiently distinct from the *tibialis* of Drury, and the *Bombiliformis* of Cramer.

3. *Æ. caudata.* H. = *fulvicornis.* H.* (Catalogue.)

Brown; *male* with the fore-wings transparent from the base to the middle; hind-wings transparent, with a brownish border, fringe, and subcostal spot; antennæ, palpi, collar, and tarsi tawny yellow; hind-legs yellow, end of the tibiæ and first tarsal joint fringed with tawny yellow and black hairs; tail slender, cylindrical, nearly as long as the body, tawny yellow, with a little black tuft on each side at base. The *female* differs from the male in having the fore-wings entirely opaque; the hind-legs black, with a rusty spot in the middle of the tibiæ, and fringed with black; caudal tuft of the ordinary form and size. Expands from one inch to one inch and three lines. *Larva* inhabits the stems of our indigenous currant, *Ribes Floridum.*

The *Zygæna caudata*, of Fabricius, has a somewhat similar tail, but does not belong to the genus *Ægeria.*

4. *Æ. Syringæ.* H.

Brown; fore-wings with a transparent line at base; hind-wings transparent, with a brown border, fringe, and subcostal spot; antennæ, palpi, collar, first and second pairs of tarsi, and middle of the intermediate tibiæ rust-red; middle of the tibiæ and the tarsi of the hind-legs yellow. Expands one inch and two lines. *Larva* lives in the trunks of *Syringa vulgaris*, the common lilac.

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* Credited to Mr. Say, in the Catalogue of the Insects of Massachusetts, by mistake.

5. *Æ. exitiosa.* Say.

Steel-blue; *male* with the wings transparent, the margins and fringes, and a band beyond the middle of the first pair steel-blue; palpi, collar, edges of the shoulder-covers and of the abdominal segments, two bands on the tibiæ including the spurs, anterior tarsi, and lateral edges of the wedge-shaped tail pale yellow; *female* with the fore-wings opaque; the hind-wings transparent, with a broad opaque front-margin and the fringe purple-black; antennæ, palpi, legs, and abdomen steel-blue, the latter encircled in the middle by a broad saffron-colored band. Male expands from nine to thirteen lines; female from fifteen to seventeen lines. *Larva* inhabits the trunks and roots of the peach and cherry trees, beneath the bark.

The larva is the well-known peach-tree borer, which annually injures to a great extent or destroys numbers of these trees. For the means of preventing its ravages, see Say's Entomology, Vol. II, and my communication in the New England Farmer, Vol. V, p. 33. The insects above described, though very dissimilar, are really the sexes of one species. I have raised many of them from the larvæ, and have also repeatedly captured them, in connection, on the trunks of peach and cherry trees.

6. *Æ. fulvipes.* H. (Catalogue.)

Blue-black; wings transparent, margin and fringes, and a transverse band beyond the middle of the first pair blue-black; antennæ black, yellowish at the end; palpi beneath, a spot on the thorax under the origin of the wings, intermediate and hindmost tibiæ, all the tarsi, and the basal half of the underside of the abdomen orange-colored; hindmost tibiæ somewhat thickened by a covering of tawny hairs. Expands thirteen lines.

7. *Æ. Tipuliformis.* L.

Blue-black; wings transparent, with the margin and fringes blackish; the first pair with a transverse blue-black band beyond the middle, and a broad one at tip streaked with copper-color; antennæ black; palpi beneath, collar, upper edges of the shoulder-covers, a spot on each side of the breast, three narrow rings on the abdomen, ends of the tibiæ and the spurs pale golden yellow; tail fan-shaped, blue-black. The male has an additional transverse yellow line between the second and third abdominal bands. Expands from seven and a half to nine inches. *Larva* lives in the pith of the currant-bush.

This destructive insect is not a native, but has been introduced from Europe with the cultivated currant-bush.

8. *Æ. scitula.* H.

Purple-black; wings transparent, with the margins golden yellow; the first pair with a narrow purple-brown band beyond the middle and a broad one at the tip ornamented with golden yellow lines; fringes blackish; front and orbits covered with silvery white hairs; antennæ black; palpi, collar, upper edges of the shoulder-covers, a narrow band at the base of the abdomen, a dorsal spot behind it, a broad band around the middle, the lateral edges of the fan-shaped tail, anterior coxæ, sides of the breast, tibiæ and tarsi except at the joints, with the spurs golden yellow. Expands about eight lines.

This beautiful little species is easily distinguished by the prevalence of yellow on the under-side of the body and legs.

9. *Æ. Pyri.* H. (New-England Farmer.)

Purple-black; wings transparent, with the margins, a narrow band beyond the middle of the first pair, and a broad one at tip purple-black, the latter streaked with brassy yellow; antennæ blackish; palpi beneath, collar, edges of the shoulder-covers, a broad band across the middle of the abdomen, a narrow one before it, an indistinct transverse line at base, the posterior half of the abdomen beneath, the sides of the breast, anterior coxæ, legs except the joints of the tibiæ, and the lateral edges of the wedge-shaped tail golden yellow. Expands six lines and a half. *Larva* lives under the bark of the pear-tree.

For some further particulars respecting this species, see my communication in the New-England Farmer, Vol. IX. p. 2, 1830.

Mr. Edward Doubleday presented me with a new species of *Ægeria* which he captured in Florida, and Dr. J. W. Randall has still another which was taken in Massachusetts. To these gentlemen belongs the right of first naming and describing these species which they have discovered, and I do not feel myself authorized to anticipate them.

Genus XII. Thyris. Illiger.

T. maculata. H. (Catalogue.)

Brownish black, sprinkled with rust-yellow dots; hind-margins of the wings deeply scalloped, with the edges of the indentations white; each of the wings with a transparent white spot, which in the fore-wings is nearly oval and slightly narrowed in the middle, in the hind-wings larger, kidney-shaped and almost divided in two; palpi beneath, a spot before the anterior coxæ, the tips of the tarsal joints above, and the hind-edges of the last three or four abdominal segments white. Expands from six to eight lines.

This species comes very near to the *fenestrata* of Europe, but is sufficiently distinct from it.

Mr. Doubleday has presented to me a much larger species of *Thyris*, which was captured by him in Florida, and was new to my collection. There is a figure of it in M. Boisduval's Hist. Nat. Ins. Lépidopt. Vol. I, pl. 14, where it is named *T. lugubris*. This name has not yet received the proper sanction of a description; but, taking into consideration the circumstances under which this nondescript came into my possession, I do not think proper to describe it myself at this time.

Tribe II. SPHINGES ADSCITÆ. L.

Family IV. AGARISTIADÆ. H. *The Agaristians.*

Hesperi-Sphinges. Latr. *Agaristides.* Boisd. *Zygænidæ.* Kirby.

Genus XIII. Alypia. (Hübner.) Kirby.

Zygæna and *Sesia.* F. *Agarista.* Latr.

A. octomaculata. F.

Black; with two sulphur-yellow spots on the fore-wings, and two white ones on the hind-wings; shoulder-covers and front sulphur-yellow; first and second pairs of tibiæ thickly covered with orange-colored hairs. Expands from eleven to fifteen lines. *Larva*, as represented by Abbot, (Ins. Georg. p. 8, pl. 44,) cylindrical, elongated; yellow, with transverse rows of black points, slightly hairy, and without a caudal horn. It lives on the grape-vine, and encloses itself in a cocoon in the earth.

In some individuals there is a white spot near the end of the abdomen, and the inner white spots of the hind-wings are enlarged and cover the whole base of the wings. Mr. Kirby (Fauna Bor. Amer. IV, p. 301, pl. 4, fig. 5,) has described another species of Alypia, a native of Nova Scotia and Canada, and names it A. MacCullochii.

Family V. ZYGÆNIADÆ. H. *The Zygænians.*

Zygænidæ. Stephens. *Zygénides.* Boisd.

Hitherto I have not met with any insects in the United States belonging to this family; but Dr. Hornbeck has sent to me, from St. Thomas, a species which not only seems to be undescribed, but must constitute a new genus, the characters of which are given in the Synopsis, and those of the species in the note below.*

Family VI. GLAUCOPIDIDÆ. H. *The Glaucopidians.*

Procrides and *Zygénides.* Boisd. *Zygæniadæ.* H. Cat. *Ctenuchidæ.* Kirby. *Callimorphæ.* Westwood.

Genus XV. Procris. F.

Ino. Leach.

P. Americana. = *Aglaope Americana?* Boisd. = *dispar.* H. (Cat.)

Blue-black; with a saffron-colored collar, and a fan-shaped, somewhat bilobed, black caudal tuft. Expands from ten lines to one inch. *Larva*, according to Prof. Hentz, hairy, green, with black bands. It is gregarious, and devours the leaves of the grape-vine, and undergoes its transformations in an oblong-oval, tough, whitish cocoon, which is fastened to a leaf.

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* Genus XIV. Mastigocera. H.

From *μάστιξ, a whip or thong*, and *κέρα, horns;* the antennæ being thickened in the middle and tapering at each end like a whip lash. In the West Indian insect to which I have applied this name, the antennæ agree, in the main, with those of *Ægocera*, as described by Latreille and other authors; but most of its other characters disagree, and it has an entirely different form from that of the type of the genus. These characters are so very striking, that I have ventured to propose this new genus, although the transformations of the species are unknown to me.

M. vespina. H.

Light rust-brown; wings immaculate; collar, first abdominal segments above, third below, and a triangular spot on each side, white; head, thickened part of the antennæ, edge of the thorax behind the collar, and a large triangular spot on each side of the second abdominal segment, black; breast black, spotted with white; first and second pairs of thighs, except at base, middle of the hind-pair, and extremity of the tibiæ, black. Expands from one and a half to one inch and three quarters. Inhabits the island of St. Thomas, W. I.

The *Zygæna Eunolphus* of Fabricius, and the *Pretus* of Cramer are probably congenerical and closely allied to this species.

This insect appears to be the same as the one figured in Guérin's Iconographie and in Griffith's Cuvier, under the name of *Aglaope Americana*, Boisduval; but it is not an *Aglaope*, for it has a distinct, spirally-rolled tongue.

Genus XVI. Glaucopis. F.

The insects which, at present, I refer to this genus, belong to *Zygæna* of the *Entomologia Systematica* of Fabricius; whose *Z. Glaucopis*, if it was not actually the type, furnished the generical name which this author gave, in his last work, the *Systema Glossatorum*, to this group of his former *Zygænæ.* Several of the insects, which Mr. Westwood, in his edition of Drury's Illustrations, refers to the genus *Callimorpha*, without doubt belong to the family *Glaucopididæ.* Mr. Kirby has placed one species, after *Lithosia*, in a family which he names *Ctenuchidæ.* These insects seem to me much more nearly allied to the *Sphinges adscitæ* than to the *Phalænæ* of Linnæus, with which also they agree in their diurnal flight, and in their transformations, so far as the latter are known. Although they do not appear to be strictly congenerical, I prefer to arrange them, for the present, under the genus *Glaucopis*, in groups or subgenera, which, when the larvæ and their transformations are better known, it may be proper to raise to the rank of independent genera.

Subgenus *Syntomeida.* H.

Antennæ bipectinated, tapering at each end. Tongue moderate, spirally rolled. Palpi short, not extending beyond the clypeus, slightly curved and hairy at base, covered with short close scales; terminal joint somewhat acuminated. Wings elongated, hind-pair small, with the discoidal cell closed behind by an acute-angled nervure, the anterior branch of which crosses the subcostal nervure and ends near the tip of the wing. Body cylindrical, rounded and not tufted behind, and with a rounded tubercle on each side of the first abdominal segment. Spurs of the posterior tibiæ four, small, and approximated.

1. *G.* (*S.*) *Ipomææ.* = *Sesia Ipomææ.* Œmler, in letters.

Fore-wings greenish black, with three yellowish white dots near the front margin and two others close together beyond the middle; hind-wings violet-black, with a transparent colorless spot at base; body tawny orange; antennæ and head black, the latter spotted with orange; a broad stripe on the shoulder-covers, a transverse spot on the thorax behind, and the incisures of the abdomen, black; legs violet-black; coxæ beneath, and a spot on the thighs, orange-colored. Expands one inch and three quarters.

I received this species from Dr. A. G. Œmler, of Savannah, Georgia, and have adopted the specific name that he gave to it, and from which it is to be presumed that the larva lives upon the *Ipomœa*. The *Melanthus* and *Nycteus* of Cramer resemble it somewhat, and are probably congenerical with it.

Subgenus *Cosmosoma*. Hübner.

Antennæ long, very much attenuated at the end, and with a double row of very short pectinations beneath. Tongue moderate, spirally rolled. Palpi long, curved upwards, and extending beyond the clypeus; the joints cylindrical, covered with small scales, a little hairy at base, and obtuse at tip. Wings elongated, hind pair rather small, and with the discoidal cell and nervures as in *Syntomeida*. Body cylindrical, rounded and not tufted behind, and with a small tubercle on each side of the first abdominal segment. Spurs of the hindmost tibiæ four and of moderate size.

2. *G.* (*C.*) *Omphale.* Hübner (according to Say). = *Ægeria Omphale.* Say.

Scarlet; wings transparent, veined and bordered with black, the first pair with a small black subcostal spot, and the black border very much widened at tip; head azure-blue; antennæ black, with the tips white; two terminal joints of the palpi, and a line on each shoulder-cover black; four azure-blue dots in a transverse row on the fore-part of the thorax; last four segments of the abdomen black, with four azure-blue spots on each side, and a dorsal black line extending from the middle of the second segment including in it seven azure-blue spots; belly and outside of the second pair of tibiæ black. Expands one inch and a half or more. Inhabits Florida.

For a specimen of this beautiful insect I am indebted to Mr. Doubleday. It cannot belong to the genus *Ægeria*, to which it was referred by Mr. Say, in his American Entomology, where it is figured. As Hübner's works are not accessible to me, I have drawn up the characters of the subgenus *Cosmosoma* from the specimen of the *Omphale* in my possession. *Zygæna Andromacha* of Fabricius and the *Caunus* of Cramer probably belong to the same subgenus.

Subgenus *Lycomorpha*. H.

Antennæ rather short, curved, toothed or with very short pectinations on each side, which give to the joints, when seen from beneath, a cordate or bilobed appearance. Tongue about half as long as the body, spirally rolled. Palpi short, hardly extending beyond the clypeus, nearly horizontal and but slightly curved at base, and covered with large and rather loose scales. Wings not elongated, rounded at tip; discoidal cell of the hind pair long, extending nearly to the hind-margin, and closed by an oblique nervure. Body rather short, nearly cylindrical, not tufted behind. Spurs of the hind-legs three, two at the end and one beyond the middle of the tibiæ.

3. *G.* (*L.*) *Pholus.* Drury.

Blue-black, or deep indigo-blue, wings at base and shoulder-covers orange-colored. Expands fourteen or fifteen lines. *Larva,* according to Mr. Leonard, pale green, with yellowish spots running into the green (in a specimen preserved in spirit, pale green mottled with red;) head black, covered with a few short whitish hairs; body sparingly clothed with rather long hairs, which are white at the sides and black on the back, the hairs arising singly from minute tubercles, those on the third segment the longest and with the others before them directed forwards. It eats the lichens on stone heaps and walls in shady places, and undergoes its transformations in a thin silky cocoon.

This pretty species is often seen flying in considerable numbers in the fields, throughout the day, and at first sight would be mistaken for a species of *Lycus.*

Subgenus. *Ctenucha.* Kirby.

Antennæ pectinated on both sides in the males, thickened in the middle with extremely short pectinations in the females. Tongue moderate, spirally rolled. Palpi slender, rising beyond the clypeus, nearly cylindrical and obtuse, covered with small close scales, and somewhat hairy at base. Wings in some rather narrow, in others widened and rounded at the tip; discoidal cell of the hind pair closed by an angulated nervure. Body nearly cylindrical, enlarged a little behind in the females, with a few minute tufts at the sides of the segments, obtuse and slightly tufted at tip; first abdominal segment with a conspicuous tubercle on each side. Spurs of the hind-legs small, four in number, two terminal, and two beyond the middle of the tibiæ.

4. *G.* (*C.*) *semidiaphana.* H.

Slate-colored; wings rather narrow and subacute; first pair brownish slate, with the anterior edge clay-colored; hind-wings semitransparent in the middle; head and antennæ black; collar, front edge of the breast, and base of the palpi, orange-colored. Expands fifteen to sixteen lines. Inhabits the Middle and Southern States.

Dr. Charles Pickering, several years ago, gave me specimens of this insect, which he captured near Philadelphia; there are also specimens of it, in the cabinet of the Boston Society of Natural History, taken in North Carolina by Prof. Hentz; and I have recently received several individuals, in fine preservation, which were found by Mr. Doubleday in Florida. This species somewhat resembles, in form and color, the *Thetis* of Linnæus and Drury.

5. *G.* (*C.*) *Latreillana.* = *Ctenucha Latreillana.* Kirby.

Fore-wings dusky drab, with a silky lustre, and the anterior edge clay-colored; hind-wings rusty black; fringes of all the wings white, interrupted with black in the middle; top of the head, orbits behind, base of the palpi, front of the breast, and a spot on the fore-part of each shoulder-cover orange-colored; thorax, abdomen, and coxæ, glaucous or greenish blue with a silky lustre; belly and legs light brown. Expands almost two inches. Inhabits New-Hampshire and Maine, and, according to Mr. Kirby, Canada and Nova-Scotia.

I am indebted to the Rev. L. W. Leonard for one specimen, taken by him in New-Hampshire, and to Dr. J. W. Randall for another from Maine. Although they are rather smaller than Mr. Kirby's *Latreillana*, and do not exactly agree with the description in the Fauna Bor. Amer. Vol. IV, p. 305, I think that they must be referred to his species. This insect has precisely the same antennæ and nearly the same form as the *Glaucopis* of Drury and Fabricius, stated by the latter author to be a native of Carolina, and is, without doubt, generically allied to it, and probably also to several other American species, such as the *Pylotis* and *collaris* of Drury. The following species, from the figures given of them, seem also to belong to the same generical group; viz. *Glauca*, *Celadon*, *Circe*, *Cœlestina*, *Asterea*, *Cephise*, *Alecton*, *Cassandra*, and *Porphyria* of Cramer.

Subgenus *Psychomorpha.* H. (Catalogue) = *Callimorpha.* Westwood.

Antennæ in the males pectinated on both sides, the pectinations rather short, setaceous in the female, according to Drury. Tongue moderate, spirally rolled. Palpi slender, nearly horizontal, extending a little beyond the clypeus, covered with loose hairs so as to conceal the joints. Wings short, somewhat triangular, with the outer margins rounded; discoidal cell of the hind pair short, closed by a sinuous nervure. Body slender, hairy at tip. Legs short, hairy; spurs of the hind tibiæ three, slender, nearly concealed by the hairs.

6. *G.* (*P.*) *Epimenis.* Drury. = *Psychomorpha maculata.* H. (Catalogue.)

Brownish black; fore-wings sprinkled in spots with light blue scales, which form a narrow band near the hinder margin, and marked with a large yellowish white patch beyond the middle; hind-wings with a broad dark orange-red band behind the middle. The white spot of the fore-wings is indented towards the middle of the wing, and on the under side there is a small triangular spot near the base of the wing, and a short transverse one beyond it which unites behind with the angular projection of the large white patch. Expands rather more than one inch.

I captured this beautiful insect on the wing at midday, in Milton, Mass., and have since seen it flying among the shrubbery at Mount Auburn, Cambridge. There is also a broken specimen, among Mr. Say's insects, which was taken in Indiana. My specimen is a male, as is also the one in Mr. Say's cabinet, and they have the anal organs very large and hairy. Drury's specimen seems to have been a female, for he says the antennæ are setaceous. It is possible that this insect is not one of the *Sphinges adscitæ;* but I place it here on account of its diurnal habits, and a certain resemblance, more easily seen than described, which it bears to some of the *Glaucopididæ.* It does not agree generically with the types of Latreille's genus *Callimorpha.* When my Catalogue of the Insects of Massachusetts was published, I had not seen a colored copy of Drury's Illustrations, and failed to recognize this insect in the uncolored one which I used.

Cambridge, Mass., Feb. 1, 1839.

Art. IV.—*On American Amphibia;* by Abm. Sager, M. D.

Detroit, (Mich.) March 5, 1839.

TO PROF. SILLIMAN.

Sir—If the following observations upon some of the American Amphibia, and description of some new ones, appear worthy of publication, you will confer a favor by inserting them in your valuable journal.

The structure and arrangement of the teeth, are of acknowledged classific importance in distributing animals in a natural series, and like most other characters are of variable importance in different classes, depending upon the constancy and generality of their existence, structure and arrangement. In the Class Amphibia, Lat., Order Batrachia, Brongn., they are generally regarded as of generic value, (and here let me say that I have frequently verified the truth of the observations of Drs. Davy, Weber and others with regard to the biauriculate structure of the heart in this class, by which the ordinal character of M. Brongn. is invalidated,) thus Rana and Hyla are distinguished from Bufo, by the presence of teeth in the upper jaw, and in two transverse processes of the palate, generally anterior to the internal nares, sometimes between, but never behind them, the toads being quite destitute of both. The Salamandrae possess not only teeth in both jaws, but also palatines, which according to most authors, are arranged in two longitudinal rows. This character does not agree with my observations upon our Salamandrae. Indeed so varied is the arrangement of the palatine teeth in those American Salamanders which have fallen under my observation, that if much importance be attached to this character, they might be divided into several sub-genera. My observations have not been sufficiently extensive, to enable me to determine whether a classification founded upon agreement in the general dental arrangement of the palatines in this class, would be natural or coincident with one based upon a general correspondence in all the generic characters. Future investigation may settle that point. At all events it is believed that the modifications in the arrangement of the palatine teeth from their constancy will be found to be of essential importance in determining species, the more so from the admitted fact that the color of these animals (a character much employed for this purpose) is extremely variable. I shall content myself by submitting the result of my investigations. The palatine teeth of the Salamandra erythronota, Raf., are arranged in two longitudinal palatine rows, slightly diverging as they proceed backward. This is the only species that agrees generically with the description. The Sal. interrupta, Gr., has two longitudinal patches of palatine teeth, each composed of several rows, nearly in juxta-position centrally. In the Sal. *agilis*, there is but a single longitudinal patch of palatines composed of several rows so arranged as to form very acute angles pointing forwards. The Sal. variolata, Gill., has beside an armation of the longitudinal palatine ridge similar to the last, two partial rows on the transverse palatine ridge, interrupted in the middle, curved backward and joined to the longitudinal patch. Those of the Sal. maculata, Gr., are similar to the last, but the longitudinal patch has fewer rows. The palatines of the Sal. rubriventris, Gr., differ only from the Sal. variolata in having the transverse and longitudinal rows separate. The Sal. bilineata, has no longitudinal rows, and the straight transverse row has a wide central interruption. The Sal. *lurida*, has an uninterrupted transverse palatine row forming an obtuse angle directed forward. The Sal. subviolacea, Bart., corresponds with the last in having but a transverse row, but may easily be distinguished by this row being undulating with a slight central angle. The palatine teeth in all are curved backward and very acute. It will be perceived that these nine species may be divided somewhat into three groups, founded upon the possession of longitudinal or transverse teeth only, or both combined. In nearly all, the general structure of the tongue is similar to that of the Ranae, but is more closely bound down; the sides and the posterior extremity which is quite short and rounded, are free but not capable of being projected from the mouth as in the Ranae.

In the Sal. lurida and subviolacea, it is almost perfectly bound down all its length. I would here remark that the expression, "tongue not attached at the bottom of the gullet but to the edges of the jaw," found in the works of the most eminent authors, when applied to the Ranae, conveys an erroneous idea. I believe in all the species of the restricted genus Rana, the tongue is composed of two muscles a hyo-glossus and genio-glossus, the former attached to the horns of the hyoid cartilage, the other to the angle of the lower jaw. Such is the structure in all the species of Rana, Bufo and Salamandra I have examined. In the male Bufo Americanus, Le Conte, as well as in the Hylae, there is a sac beneath the tongue opening by an orifice on each side of it; a fact not mentioned in any of the books to which I have had access. In the works of some of our American Herpetologists, the fact of the existence of the external branchiae in the early period of the development of the young tadpole, appears to be doubted. I possess many specimens illustrative of this fact, as well as the development of the anterior extremities of the tadpole of the Ranae, previous to their protrusion.

The following appear to be nondescript species:

Sal. *agilis*, Nob. Palatine teeth an oblong patch, composed of several rows so arranged as to form very acute angles pointing forward; curved backward; length $2\frac{3}{4}$ in.; head $\frac{1}{4}$ in.; tail $1\frac{1}{4}$ in.; fore legs $\frac{1}{4}$ in.; hind legs $\frac{1}{3}$ in.; head oval, flattish; snout obtuse; nostrils lateral, small, round; eyes prominent; body and tail round, the last terete, pointed; toes minute, four anterior, five posterior. Color of the head, back and tail above testaceous or lateritious, dotted with livid; the head so thickly dotted as to obscure the ground color; sides deep livid, spotted with straw color; beneath straw colored, spotted with livid—sometimes the back as well as sides, uniformly deep livid with minute pale yellow dots; (a difference not depending upon age, sex or season.) Skin smooth.

Sal. *lurida*, Nob. Palatine teeth a single transverse row, forming a very obtuse angle, pointing forward; body somewhat granulated, sub-quadrangular; tail compressed, three fourths the length of the body lanceolate, sub-acute; skin beneath the throat folded; color above dark olive brown; beneath sub-fuscus; sides, tail and beneath spotted with pale yellow.

Dimensions.—Total length $4\frac{1}{8}$ in.; head and neck $\frac{5}{8}$ in.; head $\frac{5}{8}$ in. wide; body $1\frac{3}{4}$ in.; tail $1\frac{3}{4}$ in.; fore legs $\frac{3}{4}$ in.; hind legs $\frac{7}{8}$ in.

Description.—Head rather large, gibbous, short, oval; snout quite round before; commissure of the jaws extends to the centre of the eyes; eyes large, prominent; nostrils minute, subovate; neck thicker than the body; skin beneath plaited; body thick; the spine forms a prominent ridge; tail compressed, linear lanceolate, somewhat obtuse at tip, the edges obtuse; legs short, but broad; toes much depressed; head above smooth, shining with minute pores; body and tail somewhat granulated; color above very dark brown, tinged faintly with olive; beneath yellowish brown; an irregular row of yellow spots along the sides and inferior part of the tail; beneath irregularly spotted with the same. The whole abdomen and inferior part of the sides appear to have a pure pale yellow ground. When viewed with a glass, numerous minute depressions are visible which except in a few spots are bounded with dark brown; Iris dusky golden. Perhaps a variety of Salspicta, Harl.

Scincus *lateralis*, Say. var? Perhaps a distinct species.

Description.—Total length $6\frac{1}{4}$ in.; length of head $1\frac{1}{4}$ in.; width $\frac{5}{8}$ in.; head and trunk $2\frac{5}{8}$ in.; tail $3\frac{1}{2}$ in.; form of head ophioid; trunk sub-quadrangular; tail round, terete; a single row of obtuse teeth in each jaw; no palatine teeth; tongue non-extensile, emarginate at tip, soft, free; nostrils near the tip of the snout, lateral, oval, bordered by a membrane; eyes dark, a rudimentary third eye-lid; the true lid covered with tetragonal scales; tympanum a little below the surface, meatus auditorius externus $\frac{1}{12}$ in. long, oblong oval, transverse, its outer margin serrated anteriorly; the anterior legs including the toes $\frac{3}{4}$ in.; toes 5, free; order of length 3 and 4 equal, 2–5–1; 1st, about half the length of 2d, which is one third shorter than 3d and 4th; nails all much compressed, deep, much curved at point and very acute; posterior extremities $1\frac{1}{16}$ in.; toes five, much longer than the anterior ones; order of length 4–3–5–2–1 a regular gradation from $\frac{1}{8}$ to $\frac{7}{16}$ of an inch, the fifth opposable to the others; nails as on the anteriors. Head covered with plates; scales all round, imbricate and wider than long; two rows of larger ones sub-quadrangular on the sides of the lower jaw and beneath it, a large triangular one beneath its extremity; scales of the tail larger and wider in proportion to their length than those of the body; the central inferior row much larger than the others; toward the end of the tail the scales become sub-verticillate, the tip sub-acute; 28 rows of scales surround the trunk; the scales beneath the toes sub-serrate, beneath the feet tuberculate; anus a transverse slit; color above olive brown; head immaculate; a narrow line of dark brown through the first lateral row of scales; another through the third, extending from the head to the tail, then approximating and passing on the first and second rows, one third the length of the tail; on the neck an oblique line, between them; a broader stripe of the same color separates the back and sides, includes a row, and half the two adjoining rows of scales, and extends from the eye to the middle of the tail becoming narrower on the tail; another somewhat obscure line of the same color, extends from the lower angle of the tympanum to the tail where it is lost; legs above of the color of the back with three irregular dark longitudinal stripes, the central one wider; sides and trunk beneath with a tinge of yellow on the latter; tail and legs beneath pale lead color.

The species sometimes attains a size from $\frac{1}{2}$ to $\frac{2}{3}$ larger than the specimen from which this description was drawn. It probably belongs to the genus Siliqua of Gray. Frequents houses. Found, though rarely, in Detroit.

This drawing represents the upper surface of the head.

Art. V.—*Translations relative to Bowlders and Cobalt Ores, from the Néues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefaktenkunde, herausgegeben von Dr.* Leonhard *und Dr.* Brown. *Jahrgang*, 1838. *Rev.* W. A. Larned.

I. *On the Recent Explanations of the Phenomenon of Erratic Blocks;* by Hr. Prof. B. Struder.

The wish expressed in your last letter of publishing in the Jahrbuch, my geological remarks upon the recent explanation of the phenomenon of erratic blocks, is the occasion of the following communication.

After all the endeavors, observations, and speculations of the last ten years, we see the phenomenon of erratic blocks still veiled in a mist, which hinders us from taking a full and exact view of them, and which has not as yet permitted a general elucidation. Hence we are disposed to view every new theory with favor, and we overlook at first its difficult points, though they may be not a few, because of the satisfactory explanation of others, on which we have hitherto labored in vain.

The floating or forcing of bowlders by powerful currents of water, still appears to me, to afford the explanation, which best agrees with the facts, although at the same time I confess that I am not prepared with an entirely satisfactory answer to several admitted and recent objections. In order to hold up the blocks while floating from the Alps to the Jura, we suppose instead of streams of pure water, streams of mud and detritus, without being able fully to show what became of this smaller rubbish. In order to carry them over the deep Swiss lakes or the Baltic Sea, we assume a kind of lateral impulse, while we make the avulsion of the blocks cotemporaneous with the rise of the mountain and the sinking of the sea: but, it is clear from examinations in Switzerland, that the spread of the blocks must have been later than the formation of the present molasse-vallies,* which however we deduce from the last heaving process of the Alpine range; that, moreover, in the later epoch of the molasse formation, the sea in

* Molasse is a term, descriptive of a soft green sandstone, occurring throughout the lower country of Switzerland.—*Lyell, Principles of Geology, Vol.* 4, p. 75.—Tr.

the interior of Switzerland, had only a very small depth and alternated with dry land such as we now regard as low land, (tief land); and, finally, that the elevation of the Alpine chain could scarcely have been an instantaneous thrusting up of the whole mountain mass, in which the sea might have been slung on high with it, but a very complicated process continued through a long space of time.* The great depth of the Swiss lakes has ever been the principal objection with the opponents of that explanation, and the ease with which the new ice and glacier theory sets aside this difficulty, accounts of itself for the interest with which it has been received. The difficulty lies not, as I think, in carrying the detritous streams and blocks over the lakes. The water-course could do no more than force a part of the water of the lake, and, considering the small difference of specific gravity, the height and rapidity of the streams, hardly a very important part, out of its basin and mingle with it; had the stream at once poured itself out entirely over the whole lake, in that case the back portion of the detritus would flow on over it, as we see the upper water in our lake move over the deep, still water. The separation of the solid materials from the detritous water might to be sure raise the bottom of the lake, yet not more than we see the bottom of the molasse-vallies now elevated in many places by diluvial ruins, that is, at the highest one hundred feet. Nor is it difficult of solution why the basins of the lakes have not been entirely filled up by the later transportation of smaller blocks such as have occurred in part within the historical period; for, originally these blocks were not, as is generally supposed, so naked and free, as we now see them, but covered with thick coatings of rubbish. This appears very clearly, among other examples, in the immediate neighborhood of Berne. A row of low hills stretches in an arch convex to the west across the Aar-valley close to the west end of our city, which has used its contiguous eminences for breast-works. In the late demolition of the fortifications, these eminences which were universally supposed to be works of art thrown up on the common level of the ground, were penetrated to their center and it was found that they consisted for the most part of enormous heaps of Alpine

* The imbedding among the diluvial ruins of the blocks at Strâtligen and Utznach, of unchanged pines and firs, plants and insects of the present time in brown coal, appears to place the spread of this detritus at a very recent epoch.

blocks, whose interstices were entirely filled up with smaller gravel and sand, which also occurred independently, in great masses, as well over as underneath and along side the accumulation of blocks. This chain of hills is manifestly the last remains of a much more general overspreading of detritus, which has been torn to pieces and carried away by later water-courses. A glazier-mound (Gletscher-Gandecke) it is not, as I at first supposed, on becoming acquainted with the new veins, and Hr. v. Charpentier himself is the person who corrected my mistake; as just at the time of our visit to the diggings, clear traces were brought to light of orderly arrangement and a quiet subsidence from water. In the mean while, the difficulty, in which the masses of smaller rubbish place us, will be no reason in geology, which has grown hardened against difficulties of this kind, for rejecting the whole theory of diluvial currents, in favor of which there are so many other facts. Indeed we have only to suppose the original lakes to have been some hundred feet larger in extent than at present, and then we have surrounding our lakes considerable plains and broad valley flats, which the eye at once perceives arose from the emptying of earlier, much more extended lake basins, and which have in fact received very large quantities of that rubbish.

The ingenious theory Hr. Venetz has constructed, on the phenomenon of bowlders, and which Hr. v. Charpentier has been able with so much acuteness to bring into consistency with the more recent geological views, builds for the blocks a bridge of ice over the Swiss lowland and the abysses of her lakes and has them sledded down by the advancing glacier, in rows (tragen in Guferlinien) to its outermost limit, where they heap up in ice-piles or glacier-walls. The glaciers, hitherto blocked up on the back central chain, broke out from all the slope vallies upon lower Switzerland, for the most part overspread it, and then mounted to a considerable height up the Jura. The rubbing of the ice occasioned the jags and erosions often visible to a great height on the rocky walls of our slope vallies and which have hitherto been regarded as evidence of the ancient water-courses. And in order to support the assumption of so great a cooling of the climate, a general elevation and distension of the whole Alpine region and its contiguous parts is presumed to such a height as to sink the mean annual temperature of the lowland down to that of Chamouni. This theory rests principally, if not exclusively, on observations made in the vallies of Valais, Savoy, and Vaud. The appearances in the Aar-valley are less favorable to it. We see around Berne not only the declivities on both sides of the valley but the valley-bottom itself covered with blocks, and these are not in any respect, as we have just seen, accordant with glacier ramparts. Moreover, on the plateau of Langenberg and Belpberg, elevated nigh a thousand feet above Berne, bowlder almost strings itself to bowlder; the whole surface of these hills, which lie in the midst of the Aar-valley, is thickly strewn with blocks, and although here and there we may suppose ourselves to have observed a linear accumulation like the Swedish osar,* yet is the direction of these ramparts usually parallel with the direction of the valley; they appear to be the remnants of an earlier detrital coating mostly carried away by later streams, and not moraines.† Moreover, in the upper Aar-valley, in the region of Meiringen, exist facts, which if not in direct opposition, are yet not in the desired coincidence with the glacier theory. There, too, we see no old moraine. The blocks occur at very different heights; they have been transported high over the Brunig, indeed more than two thousand feet high over the Aar-valley; we find them in multitudes at the Scheideck-pass and at Zaun perhaps a thousand feet above the valley-bottom; then again at Rüti above Meiringen, which may be situated some hundred feet lower than Zaun; finally, almost in the valley-bottom itself, by Willigen, and on the Kirchet, and lower in the valley by Brienzwiler, Brienz, Oberried, &c. But the glacier theory seems to me to be pressed with the most weighty objections on the side of physics. Supposing the present quantity of snow on the surface of Switzerland to have remained unchanged, while the requisite refrigeration is derived from an alteration of the earth's axis or any other source, still the question at once arises whether in fact all the vallies would fill with ice and then this flow together towards Switzerland in one enormous, almost horizontal glacier? Leaving too unsettled, the mode in which the as yet enigmatical movement of the glaciers is effected, granting the hitherto gene-

* Oasar, elongated hills. Phillips, Geol. p. 208. In Swedish *ås* is a chain of hills, and *åsar* is the plural form and is more properly written *osar*.—Tr.

† Moraine, the rubbish brought down by glaciers and left after the ice has melted.—Tr.

rally received explanation of Saussure and Escher, that it is by the pressure of snow on the heights falling down, to be untenable, still we are justified in asking for analogies, in the countries where the state of things, which they assume, actually exists. If it requires a fall of temperature of only 6° at the highest in order to secure the forming of glaciers at the foot of the higher snow mountain ranges, why do so many Alpine valleys, whose annual temperature falls below the requisite degree remain destitute of them? Why is not the Altai entirely encircled with ice, where the temperature of the surrounding lowland scarcely rises above 1°? Why hear we not of such colossal glaciers and immense plains in Scandinavia and Greenland covered several thousand feet entirely with ice? Why are not Chamouni, Latschthal, Bagne, &c., filled with glaciers? Manifestly the origination of glaciers is not dependant solely on the relations of temperature; there appears also to be required in order to its being filled with glaciers, a depth and breadth of the valley fixed in relation to the height of the adjacent snow mountain range, which ought not to be passed over. This simple remark must at once have forced itself upon geologists, so well acquainted with the Alps as those who have attempted to establish the new theory; and, apparently in order to meet this objection, Hr. v. Charpentier thought it necessary to make the lowering of the mean temperature cotemporaneous with a considerable elevation of the mountain range, in which however, it has not become clear to me, how it is consistent that the land should be powerfully swollen by internal heat, and at the same time while this higher heat is streaming out, cover itself with ice? Granting, meanwhile, the possibility of such a state of things, inasmuch as no rise of annual temperature is reported of Scandinavia at the present time in the process of elevation, we are obliged again to inquire, here too, after analogies, and the Himalaya at once offers itself to us as a mountain range, which might well be likened to elevated Alps. This lies, to be sure, 15° farther south than the Alps, but its summits considerably *exceed* the height, (about 20,000 feet,) which H. v. C. requires for the loftiest Alpine top in the diluvial era, and in still stronger contrast does the elevation of its valley-bottoms and plateaux surpass that (5 or 6000 feet) to which the valley-bottom of Switzerland ought according to the theory to have been raised at that time. The state of things of the one mountain will allow of being transferred, with sufficient accuracy for our object, to the other, if we deduct about 3500 feet from the Himalaya heights in comparison with the Alps—which is about the difference of the snow limits on the south slope of both ranges. And what state of things do we find in the Indian Alps? "It is remarkable," says Ritter, "that there never has been any report of a single glacier formation throughout Himalaya. The sublime phenomenon of glaciers, which appear to have attained their most perfect development in the European Alp-formation, according to any observations hitherto made, never occurs in the Himalayan Alp-region." Thus, at first sight we are cut off from any comparison here and instead of immeasurable fields of ice, many thousand feet thick, which we expected to see, we only meet with snow on the peaks and caps in no greater, rather in smaller quantities than on the Alps at their present heights. But a closer view, points out another result, which may be pronounced almost decisive of our question. With the elevation of the ground, all the isothermal lines mount up rapidly in height. On the south slope of the Himalaya, we meet with the extreme limit of cultivation at 9400 feet; in the deep indented vallies of the interior, it mounts up to 10,700 feet; on the plateau land, to 12,800 feet; and on the interior table land of Thibet, which can be best compared with the upraised lowland of the molasse region, the same appears at 14,000 feet, whence it goes no higher. This elevation would correspond to perhaps 10,000 feet, in our latitude, or to the heights of Diableret and Fitlis. Hence, a rise of ground, even twice as great as that required by H. v. C., never appears to produce the formation of such extraordinary glaciers as must be assumed in order for the glacier to have formed the ice-piles of the Rhone-valley, which at the Jura, must have mounted over the valley-bottom about 2000 feet, and which must have extended below to Soleure. We should arrive at still more striking conclusion, were we to apply the glaciers theory to the Scandinavian blocks, and yet it is scarcely allowable to explain such similar appearances as occur in North Germany and Switzerland, by two altogether different theories. What if in the hill country, at the foot of the glacierless Himalaya, the phenomenon of erratic block should reappear? Several accounts seems to establish the fact beyond a doubt.

We can avoid a part of these difficult questions, if we assume with HH. Agassiz and Schimpfer a general ice-covering of the earth, a freezing of the water in seas, lakes and streams from the poles to the equator. On the frozen inland sea, which thus in part overspread Switzerland, the Alpine fragments might have been slid to the Jura and to the slopes of the outjutting molasse hills, and in the same manner the Swedish blocks could have been shoved across the Baltic. The sudden occurrence of this ice-epoch was the cause of the destruction of the antediluvian animal races and vegetable species, of which not a single sort has survived to our time: and thus even in the earlier geological epochs, the periods of heat and life have been interrupted by periods of freezing and death. This originally Indian view of nature is capable of taking a very poetical form; and Hr. Schimpfer has given us a specimen of it. It looses, moreover, with the sword of Alexander to be sure, several of the most ravelled knots in Geology and Paleontology, but to make it harmonize with facts and with the prose of physical investigations, is a problem which far surpasses at least my powers,—the striking relations between the dispersion of the blocks and the shape of the vallies, which must ever lie at the foundation of any satisfactory theory, are left in the one lately proposed unregarded and unexplained. We see not how the blocks could have alighted, as they often have done in great numbers, behind outjutting hills, or pressed in upon the sides of the vallies; why, farther, their zone rises so high on the Jura opposite the Rhone-valley, and then towards Soleure gradually sinks down till it reaches the present valley-bottom; wherefore in the narrows of the vallies, the blocks are altogether wanting, while on the contrary in the wide portions they occur in the greatest number. But still more difficult is it to see from whence this periodical freezing, this alternation of heat and cold, of life and death, could have been derived. Not from a change of internal heat, for we know from Fourier, that at present, the influence of the internal heat upon the temperature of the surface scarcely amounts to $\frac{1}{30}$° c. The warmth in which we live, and which remains constant at different depths of the ground according to latitude, and also agrees with the mean annual warmth of the atmosphere, is almost exclusively an effect of the sun. We might accordingly be referred to a periodical change in the intensity of solar heat,—a problem, with which Herschel has recently busied himself without being able to find any ground, in all the depths of astronomy, for a greater change of annual heat than at the highest from 3° to 4°, and besides this change could only have come on very gradually, and could never have produced a sudden destruction of all organic nature. Still less do we find in the unequal temperature of space surrounding the earth, as assumed by Poisson, an explanation of the cause of these changes of heat and cold in terrestrial bodies; for, while a considerable increase in the coldness of the space in which the earth moves, would indeed produce a greater dissipation of the warmth of the earth, a lower temperature of the polar nights and more rapid loss of heat in our nights, it could scarcely be the means of freezing over all the bodies of water on its surface; and furthermore, these changes could only after a long space of time exert an influence—and that a very gradual one—on the annual temperature and organic life. We are thence peremptorily referred to hypotheses to account for that change of temperature, but hypotheses are justly regarded as unproductive, and, although they played an important part in the geology of the last century, yet certainly physical inquirers, who do so much honor to our age as HH. Agassiz and Schimpfer, will again and again visit the smooth worn rocks before they resort to this extreme expedient, and repeat the question to themselves and others, whether this polishing could only be the effect of ice, or whether every possibility is cut off, that they may have been produced by water currents, as previous to their labors was generally believed.

II. *On two new Cobalt Minerals, from Modum in Norway;* by Hr. Prof. Dr. Wöhler, (with a note by Prof. Shepard,) from a letter to Hr. Dr. Blum.

We were too late with our examination of the new Modum Cobalt minerals, which you gave me last autumn. My analysis of them had been completed for some time, and I was about arranging the results, when I came across an acticle by Scheerer of Modum, in the last number of Poggendorff's Annals, where the same minerals are accurately and fully described.* Scheerer's

* The cobaltic-arsenical-pyrites here mentioned, is described by Scheerer, as occurring in two varieties; one of which is crystallized and compact, and as having

analysis agrees quite exactly with mine, and leads to the same formula of composition. The arsenic-pyritical one has exactly the same form as the arsenic-pyrites, and is distinguished from it by a reddish color resembling cobalt-glance; points it directly to the composition of arsenical-pyrites, wherein a part of the iron is replaced by a quantity of cobalt varying in different individuals. From the crystals examined by me, I found the following compositions :

Iron, - - - -	30.9
Cobalt, - - - -	4.7

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the exact mispickel lustre and crystalline form, even to the streaking of the prisms. Sp. Gr. = 6.23. The analysis of crystals from two to three lines in length gave

Sulphur, - - - - . - -	17.57
Arsenic, - - - - - - -	47.55
Iron, - - - - - - -	26.54
Cobalt, - - - - - - -	8.31
	99.97

It would appear moreover, that the proportion of cobalt varies with the size of the crystal,—the larger the crystal, the smaller being the content of cobalt. Scheerer supposes that its presence is not attributable to a mechanical source, but that it aids in forming a strictly chemical compound, inasmuch as the cobalt replaces the iron. He adds some account likewise of the geological position of the ore with reference to the occurrence of the cobalt mine of Skutterud. This last forms a vertical bed, or stratum whose direction is north and south, and terminates suddenly at the southern declivity of a mountain. Following the direction of this stratum nearly a mile, there is found on the opposite side of the Storcte river, the cobaltic-arsenical-pyrites bed, having the identical arrangement with that affording the cobalt glance. It would hence appear that the cobaltic stratum had supplied cobalt to that containing the mispickel as long as the metal held out.

The other variety has a tin or silver lustre, and a Sp. Gr. =6.78. It occurs compact, with a conchoidal fracture, and a more or less distinct tesseral cleavage : also in single crystals exhibiting octahedral, cubic rhombo-dodecahedral and icositetrahedral faces. According to Scheerer, it contained,

Arsenic, - - - - - - -	77.84
Cobalt, - - - - - - -	20.01
Sulphur, - - - - - - -	0.69
Iron, - - - - - - -	1.51
Copper, - - - - - - -	in traces.
	100.05

Breithaupt has described this ore under the name of *Tesseralkies*.—Poggend. *Ann. d. Phys. B. XLII, S.* 546 *ff.*

The first mentioned ore here described, is without doubt, the same substance which was noticed at Franconia, N. H., in 1824 by Dr. J. F. Dana of Dartmouth College, (Vol. viii, p. 301, this Journal,) and subsequently in 1833 by Mr. A. A.

Sulphur, - - - -	17.7
Arsenic, - - - -	47.4

Scheerer found in two crystals 8.3 and 6.5 parts of cobalt.

We may name this spieces to distinguish it from the common Arsenic-pyrites, cobalt-arsenic-pyrites.

In all the crystals examined by me, a circumstance was remarked, which Scheerer has not mentioned, that the apparently purest and best formed crystals were more or less penetrated with clear crystalline quartz, the quantity of which in some specimens made up almost a quarter of the weight, in which case the internal structure could be seen on the outside. This commingling remained in all the crystalline portions, even when the whole crystal was dissolved in aqua regis. Besides, there remained small black spangles, still undissolved, which had altogether the appearance of graphite, and are in fact nothing else. I have also observed in this undissolved residuum still a third mineral, in very hard, brownish yellow, but quite microscopic crystals, which is certainly not quartz, but nothing could be determined concerning its nature.

The second mineral, with limewhite color mingled with lead gray, very definitely distinguished from that of arsenical-cobalt, and which occurs both compact with scaly grooves and beautifully crystallized in tesseral forms, the crystals oftener growing together with crystals of cobalt-glance, is arsenical-cobalt with ⅓ more arsenic than usual. According to my analysis, it contains,

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Hayes of Roxbury, (Vol. xxiv, p. 387, this Journal.) Dr. Dana describes it as occurring in crystals analogous, if not identical with those of mispickel; and Mr. Hayes found their Sp. Gr. = 6.214, according to the analysis of the latter it contains,

Sulphur, - - - - - - -	17.84
Arsenic, - - - - - - -	41.44
Iron, - - - - - - -	32.94
Cobalt, - - - - - - -	6.45
	98.67

Loss partly iron.

Mr. Hayes proposed for it, the name of *Danaite*. Henry examined and described numerous forms of this ore from Franconia (see my treatise.) I perceive no sufficient reason for separating it from mispickel, with which it agrees in every respect save in the substitution of a small per-centage of cobalt for iron.

The second variety of cobalt ore, described by Scheerer and Wöhler does not appear to differ from the normal varieties of smalentine (*arsenical-cobalt.*)

C. U. Shepard.

	Crystalline.	Compact.
Cobalt, - -	18.5 - -	19.5
Iron, - -	1.3 - -	1.4
Arsenic, - -	79.2 - -	19.

If we assume the trifling unessential commixture of iron to be a substitution for cobalt, then this composition corresponds to the formula $Co\,As^3$, a combination, which must contain according to estimate 20.74 parts of cobalt and 79.16 of arsenic.

The name proposed by Scheerer for this mineral, arsenic-cobalt-pyrites, appears to me in other respects little appropriate.

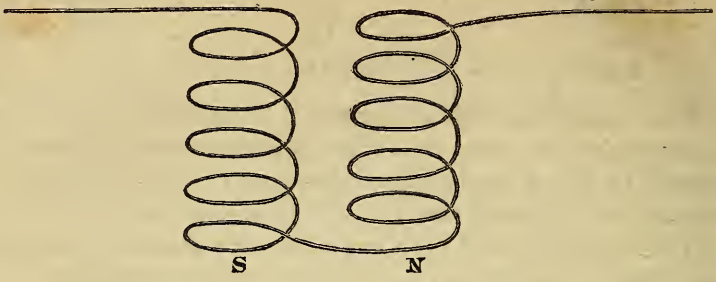
It is a striking circumstance that neither of these minerals contains nickle, which is elsewhere so constant a concomitant of cobalt; at least, it must have occurred in so minute a quantity as not to be observed in the small portions of the minerals subjected to analysis.

Art. VI.—*A New Method of Making Permanent Artificial Magnets by Galvanism;* by J. Lawrence Smith, Student of the Medical College of the State of South Carolina.

Ever since galvanism has been known to produce magnetism especially under certain forms of apparatus, it has been a great desideratum to retain permanently, the great power that is generated within the limits of a few square inches of metal.

A few years since, having seen what an intense degree of magnetic force could be generated in a bar of soft iron, by passing galvanic currents around it; the idea (very natural to most persons witnessing the same experiment) occurred to me, whether this magnetism could not in some manner be retained; I was aware that so long as soft iron was made the agent it could not; and if tempered steel was used a difficulty would also present itself, and it was not until about eight or ten months since that the following experiments were put into operation. The object that I had in view, was to substitute for the iron used in the electro-magnet, red hot steel and cool it suddenly.

A few feet of copper wire were coiled as shown in the figure, the arrangement being such, that the galvanism in its circuit would generate north and south polarities, at the end of the re-



spective coils. The coils were varnished in order that they might be immersed in water, without any interruption taking place in the current of the galvanic fluid. The two extremities of the wire were attached to a battery, consisting of a single pair of plates, each plate of about twelve square inches. A horse-shoe of soft iron was then introduced into the coils to test their magnetic power; the iron was found capable of sustaining about one and a half pounds. After withdrawing the iron, a piece of steel, of the same shape, made red hot, was introduced and both steel and wire were plunged into cold water, and contrary to my expectation the steel was found to be but feebly magnetic. I then repeated the experiment, with this difference, that before cooling the steel, I united its two extremities (projecting below the ends of the coils) by a piece of soft iron, which by keeping up the circulation of the magnetic fluid, enabled me to procure a magnet of some power, that is to say, the steel used weighing one ounce, after undergoing this process, was able to sustain six ounces. It must be recollected that the instruments used were of a rude character, and that they could not create a temporary magnet, of more than one and a half pounds power. By this experiment it will be seen that one fourth the maximum power developed was secured permanently, but it is not to be supposed that in all instances the ratio of the power secured, to the power developed will be as great as in this, but I believe if proper proportions be observed in the steel used, there will be an approximation to this ratio, even when the magnetic force is of great intensity.

This method of making magnets may be of some practical utility, for the apparatus required is of the simplest kind, consisting merely of a few square inches of copper and zink, and a few feet of wire; moreover the magnets produced are of a greater power in proportion to the generating energy, than those made by any other process, with which I am acquainted.

I will here mention an experiment which I have tried in common with others, of making magnets by attaching red hot pieces of steel to an artificial magnet, or to the temporary electro-magnet, and cooling them suddenly.

To an artificial magnet capable of sustaining eight pounds, I applied a piece of ignited steel weighing one ounce, semicircular in form, and immersed it in water; it was found capable of sustaining three ounces, only about one fortieth of the power used, and in no experiment, although many were made, was the ratio between the produced and the producing powers greater.

The reason of this great disproportion appears to be, that when the metal is raised to a red heat, magnetism is not easily induced in it, and that it is only when it arrives at a lower temperature in the cooling process, that it receives that magnetic virtue which it retains, and this no doubt also accounts for its inferiority to the first method mentioned—for there the galvanic fluid is made to circulate around the steel; and the current of the magnetic fluid is also kept continuous by the soft iron uniting the two poles.

Art. VII.—*Remarks on the "Natural History of the Fishes of Massachusetts, embracing a Practical Essay on Angling;* by Jerome V. C. Smith, M. D." Read before the Boston Society of Natural History, March 20, 1839. By D. Humphreys Storer, M. D.

My report upon the Fishes of our State having been presented to the chairman of the Zoological Commissioners, I feel that, as their ichthyological curator, a duty is expected of me by this society, before ceasing from my labors. In the year 1833, a volume entitled "Natural History of the Fishes of Massachusetts" was published by one of our number. To many persons, various inaccuracies contained in that work are at once obvious; by others, who have a slighter acquaintance with natural history, all is supposed scientific and true; while if errors really exist, it is certainly the duty of some one to correct them. I have thought it would very naturally be expected of him to whom you have ever entrusted the care of the subjects upon which the work in question treats; and with this feeling, I have thrown together the following observations, which I now offer without further remark.

Commencing with the Cartilaginous Fishes, the first ten pages are occupied with the history of two foreign species of *Petromyzon*, neither of which is found in our waters.

The *marinus* and *fluviatilis* should have been *Americanus* and *nigricans;* both of which were accurately described by *Le Sueur* in the "Transactions of the Philosophical Society" in 1818—fifteen years before the appearance of this work. These two foreign species are accompanied by figures copied from the German plates of *Strack;* and one or two points require to be noticed. It is well known that one of the characteristics of this genus is "its seven branchial orifices." Now it happens, that the engraver of Strack's plates thought that six would suffice, and accordingly omitted one in his figure. The American copyist, while he has attempted to exhibit the very attitude of the fish, has carefully followed his original, and the specimen before us is minus a branchial hole. The German did however continue the dorsal fin to the caudal, as is natural. The plate before us represents it as terminating at some distance in front of that fin.

The plate of the second species exhibits in Strack the true number of branchial openings; this copy has but five!

I suspect that foreign ichthyologists will scarcely pardon the presumption which would assert that these two species, which are described as distinct by Linneus, and have been thus acknowledged by all succeeding naturalists, "are to all intents and purposes the same fish."

The thirty four following pages contain the order Selachii. In the prefatory remarks to this order, Dr. Smith observes, that the male shark may at once be recognized by the appendages to the ventrals, though he says "their use is totally unknown." Had he consulted standard works on the subject, he would have found that these appendages were called "*claspers;*" and knowing that the female did not possess them, their *use* might without much stretch of the imagination be inferred.

Eight species of sharks are here catalogued. The *Scyllium canicula* and *catulus* I have never seen, nor heard of, on our coast, They have undoubtedly been mistaken for the *Squalus canis* or rather *Spinax acanthias—picked dog fish.*

Eight pages are appropriated to the *Carcharias vulgaris—white shark;* and its history is illustrated by a figure from Strack, while its appearance in our waters remains to be proved.

The *Carcharias glaucus—blue shark*—is evidently confounded with the *scyllium punctatum—mackerel shark*—a common species with us.

A species of *Zygœna* is found in our waters; but as we have no proof given us of its being the *vulgaris*, our species must be seen and described before it is acknowledged to be that species; and before we can receive the assertion in the pages before us, that "scarcely a season passes by, in which fine specimens are not taken in the vicinity of Nahant, about the Cape, &c." To be sure, we are told that "but a little time since, a sailor offered one, recently caught, for sale, which he wheeled through the streets of Boston on a barrow, attracting crowds of people who gazed upon it in perfect wonder;" but it was not the specimen of which we have a figure, surely, which created such surprise in this good city, because this is a copy from a German plate!

Of the species here registered as *Selache maximus—basking shark*—I have not been able to obtain the slightest information, and have no doubt that it is the *Somniosus brevipinna*, (Le Sueur) *nurse or sleeper*—described from a specimen taken by the fishermen at Marblehead.

That a species of *Torpedo* exists on our coast, we have undoubted authority for believing; but as no naturalist has as yet seen it, the species remains to be distinguished more definitely. We have here an inaccurate figure of the *Torpedo vulgaris* copied from Strack to illustrate our fish, when that species has been much more correctly exhibited by Pennant in his "*British Zoology.*"

Strack is again called upon for a plate of the *Raia clavata-thornback.* The species called *thornback* in Massachusetts, I have not had a proper opportunity to examine, having never seen more than one specimen, and that previous to my determination to describe our fishes from recent specimens; if I am not in error, however, it will prove to be the *Raia radiata—starry ray.*

A species of *Trygon* is occasionally seen on our coast; but its characters have not yet been pointed out, so that it is premature to introduce it here with a plate of the *pastinaca*—the *European species*—especially as other species of this genus have been found on the coast of Rhode Island, to which this is much more likely to belong.

An elaborate account of the *Sturgeon—acipenser sturio*—accompanied by a figure, follows the SELACHII: the Massachusetts sturgeon is the *sturio oxyrinchus.*

Four species are here included in the PLECTOGNATHI. The *aluteres monoceros* proves to be a new species to which I have affixed the name of "*Massachusetensis*" in my report to the Governor: neither the *ostracion triqueter* nor *bicaudalis* have I ever heard of on our coast. The specimen which Dr. Smith supposed to be the latter fish, is a new species to which I gave the name of *Yalei*, in a communication read to this society in 1836.

Under the head of *Tetraodon turgidus—swell fish*—we find the following sentence, which cannot be passed over unnoticed, however unwilling we may feel to write a line of unmixed censure. "The only apology we can make for not having dissected one of them with reference to explaining their internal organization, is the poor one, that there has not been time since the commencement of this essay." Here we see an author voluntarily coming before the public, dedicating his labors to a distinguished LL. D., and offering as an apology for a neglect so palpable that his own conscience accuses him, that he *needed time!* It is humiliating enough for him who has but a certain time allowed him in which to perform a duty, to be compelled to offer such an excuse, although he has a right to expect the circumstances of his case will be considered; but, when an individual to consult his own convenience, chooses to publish a superficial treatise with his name prefixed as its responsible author, such an apology cannot be received by naturalists—regardless as he appears alike of his own reputation and the true interests of science.

Although in the LOPHOBRANCHII, the *Syngnathus typhle* is described, and illustrated by a figure, I have not heard of its having been seen in Massachusetts. Two species have been sent me by correspondents, both of which are new, and will appear in my report.

Having reached the order MALACOPTERYGII ABDOMINALES, in the genus *Salmo*, three species of trout are introduced, the "*trutta*, and "*fario*," and "*hucho*," while the only one I have been able to learn any thing respecting, after two years' labor, the "*fontinalis*," is omitted altogether.

Nine pages are devoted to the "*Clupea harengus*"—European herring; our species is the "*elongata*," described by Le Sueur in the first volume of the "*Journal of the Academy of Natural Sciences.*"

Upon page 165, we have a figure of the "*Esox lucius*"—*pickerel*—whose history is spread over nearly twelve pages. Our fish, is the "*reticulatus*," which cannot for a moment be mistaken for the European species, by any person of common observation: we are here told that Dr. Williams, author of the history of Vermont, states that the pike bears in that state the name of *muschilongae*:—the *maskinongé*, is the "*esox estor.*"

I have thought that little if any change was produced in the color of our species by age; the largest I have ever seen was as brilliant as smaller specimens. I suspect the brightness of their coloring depends principally upon the locality; thus, those brought from a pond in Brewster upon the Cape, which has a sandy bottom, are perfectly beautiful; while those caught at West Cambridge Pond, and others in this neighborhood, are far less attractive in their colors.

But one species of the genus "*Belone*," the "*truncata*," (Le Sueur,) is found on our coast; this however is here omitted, and a foreign species is introduced, with a figure as usual from *Strack.*

That one or more species of "*Exocetus*"—*flying fish*, are occasionally taken on board vessels in our waters is undoubted; but that the "*mesogaster*" is one of these species, is far from being proved.

The "*Cyprinus crysoleucas*" could not have been known to the writer of the volume before us: he says "Though we have seen individuals two inches in length, they are oftener less than one." Of great numbers which have fallen under my notice, the average is from four to six inches.

The "*Cyprinus oblongus*" and "*teres*," I have not seen: the writer seems not to have known that there existed more than one species of *sucker*; for he says, "from the earliest period of our boyhood, we have been familiar with the fresh water sucker, a lazy, still fish, of a dingy color," &c. &c.

Under the head of "*Cyprinus teres*," the writer speaks of a fish which was taken by the keeper of the Boston light house in a *lobster-pot*, and calls it the *sea-sucker;* he observes, it "has a mouth precisely like the fish above described," &c.; and from the fact of its being introduced here, we infer it was considered a neighboring species. The fish here spoken of, formed a part of the collection of fishes purchased of Dr. Smith, and is the "*Umbrina nebulosa*" described and figured by Mitchill in his "*Fishes of New York.*"

The author is guilty of a gross and altogether inexcusable error in the following species; he speaks of the "*Abramis chrysoptera*"—*bream:* now the common European bream is the "*Abramis brama*," and as yet we know of no "*abramis*" with us. The "*Pomotis vulgaris*" is generally known as the *bream;* it is the only species I ever heard of as being called *bream* in New England, and as the "*Pomotis vulgaris*" is not mentioned in the pages under examination, the inference is irresistible that what is here called "*Abramis chrysoptera* is the "*Pomotis vulgaris.*" So that we have a foreign fish catalogued as being found in our waters, which is included in the family Cyprinidae, order Malacopterygii, instead of our own beautiful species, to receive which, a genus was formed by Cuvier, and included in his family Percoides, order Acanthopterygii, showing conclusively, that the *common name* being given, the *scientific name* of a foreign species is attached, whose common name was the same as ours.

Respecting the four following species, I have only to say, they are all unknown in Massachusetts: the fishes which are known as the "*Roach*" and "*Dace*" are not the European species "*Leuciscus rutilus*" and "*vulgaris*," but undescribed fishes.

The "*L. alburnus*" and "*cephalus*" I have never seen; and as no foreign fluviatile species has as yet been met with in our state, I feel it is just to doubt their existence. That many of the Cyprinidae would thrive in our waters if transplanted to them, may reasonably be concluded from the rapid increase of the "*Cyprinus auratus*—*gold fish*, in our ponds; and my friend, Rev. J. E. Russell, of Salem, informs me that an English gentleman residing in Newburgh, New York, has stocked his ponds with the *English carp*—"*Cyprinus carpio*," from a few he imported.

On page 189, is a figure of the "*Silurus glanis*," an European fish, copied with considerable accuracy from Strack's plates, designated as the "*Horn pout*," and described as our fish, which belongs to a distinct genus. Dr. Smith observes, "there are two species (of Silurus) in this vicinity. I never heard of one.

From a careful inspection of our market for two years, and a constant intercourse with fishermen during that period, several of whom for a long time were *bank fishermen*, I am satisfied the Bank cod—"*Morrhua vulgaris*," is not taken in our waters. I have accordingly described our species in my report under the name of "*M. Americana.*"

The "*Merlucius vulgaris*"—*Hake*, is called by our fishermen the "*Whiting*;" our author, learning therefore that the *Whiting* was found on our coast, has supposed of course that it was the *European Whiting*, and we accordingly have here an account of the "*merlangus vulgaris*," which is not seen with us.

Our "*Pollock*" is not the European fish, but the "*purpureus*" of Mitchill.

What can be more amusing than the remarks which we find under the genus "*Raniceps.*" The "*Blennius viviparous*" and "*Raniceps trifurcatus*" are here side by side as synonymes of the same fish—*Blenny*. The one belonging to the order Acanthopterygii, family Gobioidae; the other, to the order Malacopterygii, family Gadidae. This is not all; a perfect burlesque of the "*viviparous blenny*," appears in the form of a figure copied from Strack, with these remarks accompanying it; "on looking over that splendid series of German lithographic plates of fishes, by Dr. Strack, 1828, an exact figure even to the coloring was noticed, which truly exhibits the blenny of the harbors of Massachusetts, and must therefore, we strongly suspect, have been drawn from the American blenny." After reading the above, what can the student think, when we tell him that *this fish* was never found in our waters; that *our blenny* is totally unlike the "*viviparous*," and instead of being caricatured in "the splendid series of German plates," was, years ago, figured by Professor Peck, in the American Academy's Transactions, as the "*anguillaris*," formed by nature.

Determined to have a "*Raniceps*," we find that Dr. Smith has here introduced the "*blennioides*;" the individual which he speaks of, as "a cream colored fish truly disgusting in appearance," was purchased of him by this society, and proves to be a specimen with *the cuticle abraded*, of what he upon page 243 calls incorrectly "*muraena conger*;" but more of this in its appropriate place.

Five species are mentioned in the family "PLEURONECTES," but one of these, "*Hippoglossus vulgaris*"—*holibut*, is found on our coast.

Under the head of "*Platessa vulgaris*," our compiler gives the appearance and habits of the *European flounder*, and says "it is one of the most common fish in Massachusetts Bay;" and for a *figure*, he introduces a wretched copy of Strack's plate of the "*P. vulgaris*"—*plaice!*

Two pages beyond, we have a copy of the "*flesus*"—"*flounder*, from Strack, described as the "*plaice*; and both the *flounder* and *plaice* described as the "*Platessa vulgaris.*" It will at once be perceived that these two copies of foreign fishes should be transposed: the plate on page 214 should take the place of that on page 216, and vice versa. Neither of these species however, the "*vulgaris*" nor "*flesus*" is found with us.

Reference is made on page 216, to a species which is called the "*American turbot*," supposed to be the "*European pearl*," it is the "*Rhombus aquosus*"—"*watery flounder.*"

Neither the "*Solea vulgaris*"—"*Sole*," nor "*Rhombus maximus*"—"*Turbot*," were ever seen by any of our fishermen upon this coast; the opinion was so firmly established, that what is called in our market the "*turbot*" was the same as the *foreign turbot*, that I could not persuade the fishermen that they were not identical; it was only when two fine specimens were brought here the last season, of the *true turbot*, from the the coast of Ireland, that they were satisfied of their mistake; and even then, one of the most experienced of their number insisted that although they differed, the only difference was this, that wherever a *white spot* existed in the American fish, a *spine* took its place in the foreign species, and that opinion he still entertains, although our fish is oblong in its form, and the turbot is nearly circular.

The "*Cyclopterus minutus*" is probably the young of the "*vulgaris.*" Although the "*Echeneis remora*," is here introduced with a plate from Strack, it has not yet been found in our waters.

Twenty pages are devoted to the "*anguilla vulgaris*" and "*muraena conger*," neither of which is found on the coast of New England. The former has been mistaken for the "*mura-*

ena Bostoniensis" of Le Sueur. The latter, is the species *uninjured* which when *defaced*, Dr. Smith called "*Raniceps blennioides*," it is evidently a new genus, which, from the appearance of concealed spines distributed over its head, I have called "*Cryptanthodes*"—and given the specific name of "*maculatus*" on account of its mottled surface, arranging it in the family "BUCCAE LORICATAE, *mailed cheeks*."

Our writer seems to have been ignorant of the fact, that the "*Anarrhichas lupus*"—"*Cat fish*," was used as food among us. Many of our fishermen prefer it to any other species. I have eaten it at my own table, and should never wish a sweeter or more delicate meal than that afforded by a young cat fish. It is a little singular, that instead of Pennant's plate of this species having been copied, which is quite good, and within the reach of all, Strack's plate which is very incorrect, making the anal fin to appear as high as the dorsal, should have been preferred.

Upon page 254, "*Labrus tautoga*" should be "*L. Americanus*;" we read here that "the Boston market is but poorly supplied with them; whenever they are for sale, it seems to be the result of accident." The two last years our market has been *glutted* with them, throughout the season in which they are taken.

Upon page 259, we have a description of the *cunner*, or *marine perch* as it is often called; and it is surprising that after the author observes, "since the commencement of this little volume, no one species has given us more trouble and perplexity in the classification than this;" to find it arranged in a wrong genus, with the sage remark, "to all appearance the *perch* or *cunner* is the *tautog* in miniature; and if it were black it would be supposed to be the young of that fish!" And this too, while the preoperculum of the former is strongly denticulated throughout, and the edge of that of the latter is perfectly smooth!

Among the "*Labroides*," we also find the "*squetee*" arranged as a "*Labrus*," instead of being placed in the family "*Scienoides*"—genus "*Otolithus*."

Upon page 263, Dr. Smith probably refers to the "*Centropristis nigricans*," when he speaks of the "*Perca varia*."

The next eleven pages are occupied with descriptions of nine species, neither of which is found in Massachusetts. We have neither a "*Scorpaena*," nor a "*mugil*," nor a "*surmullus*;" and yet here we find an account of each.

If instead of copying upon page 273, a plate of the *European perch*, from Strack, our only species of "*Perca*" the "*flavescens*" had been delineated, while the writer before us had avoided an error, he would have conferred an obligation.

The "*Bodianus leucos*"—"*rufus*"—and "*pallidus*" are all unknown fishes to me.

Six pages are devoted to the "*striped bass*"—"*Labrax lineata*," here incorrectly called "*Perca labrax*"—the *European species*. Our writer observes, "one old fashioned bass only, is known to us from Cape Cod to Maine:" if he will visit Boston market in any of the spring or autumnal months, he may see another very common and pretty species of bass—the "*mucronatus*"—the "*smaller American bass*," called by our fishermen "*Pond perch*."

The probability of the "*Uranoscopus scaber*" being found here, may be inferred from the following remark of Richardson in his "*Fauna Boreali Americana*"—the "*Uranoscopus scaber*," is common to the Mediterranean and Indian Ocean, without having been detected in the Atlantic."

We are told by the writer that he had not found the "*Trigla lineata*" in Massachusetts—we have no "*Trigla*" on our coast; but the *Prionotus strigatus*," incorrectly called here "*Trigla lineata*," is common at Martha's Vineyard.

Four species of "Cotti"—*sculpins*," are here spoken of; one of which, the "*gobio*," we are told, "is universally known all over New England;" another, the "*quadricornus*" "is found along the whole coast;" the "*scorpius*" is illustrated by a figure from Strack; and with the "*cataphractus*" "the fishermen are particularly familiar under the name of *ruper sculpin—horn sculpin*," &c. Not one of these fishes is ours—the "*aeneus*," and "*Virginianus*" and "*Groenlandicus*" are common along our entire sea-board, but not one of the above mentioned species did I ever hear of being taken.

The "*Batrachus grunniens*" is mistaken for the "*variegatus*" of Le Sueur.

Under the genus "*Lophius*," we have an account of the "*piscatorius*;" our writer tells us he was fortunate enough to obtain one, the body of which, was *four feet in length*, and "when the jaws were open, it could receive a morsel as large as a man's head." What excuse then can be offered for his illustrating this species with the plate of a distinct fish—a foreign species—belonging to another genus, which grows only to the length of ten or twelve inches! the "*Chironectes histrio.*" Such negligence cannot be overlooked; we have the "*piscatorius*" in our waters; or had the author preferred, as he ever seemed to have done, to copy from figures rather than from nature, he could have found a plate of it in any work on Ichthyology.

I have no doubt that Cuvier is correct in considering the "*Scomber grex*" and "*vernalis*" as the same species.

Neither the "*chrysos*" nor the "*plumbeus*" do I know.

Eight pages are occupied with the "*Scomber scomber*"—"*European Mackerel*;" it is not found on our coast.

Respecting the "*Surmullet*," I would only introduce a single remark of Dr. Richardson. "*Mullus*, in its geographical distribution, is confined to the Black Sea, Mediterranean, and European Atlantic, including the Baltic."

Upon page 307, we are told that "the spinous fins (of the *Tunny*) have a yellowish tinge;" as the *finlets* are the only portions of the fish, which are yellow, they are probably intended.

The "*Centronotus ductor*"—"*pilot fish*," may possibly be found within the waters of Massachusetts, although I have never been able to procure one.

The "*Zeus faber*"—*common dory*, I have never seen, nor heard of as being found in our waters.

Although we are told in the volume before us, that the "*Chrysotosus luna*"—("*Lampris guttatus*,") "has been taken within a day's sail of Boston;" and Richardson in his "*Fauna Boreali Americana*" accordingly observes under the head of this fish, that "Dr. Smith enumerates it among the fish of Massachusetts;" I have never been able to learn any thing regarding it, from any of the fishermen, and therefore, although as it is a *northern species*, further investigation may establish its existence in our waters, I should be unwilling to consider the point as proved from the notice here referred to.

Dr. Smith, tells us *two* species of "*Sword fish*" have been discovered: *Cuvier* knew but *one.*

The "*Seserinus alepidotus*" is here catalogued in the family "SQUAMIPENES," instead of the "*Scomberoides*," as it should have been: the only species described, is an inhabitant *only* of the Mediterranean and Black Seas.

Under the head of "*Fistularia*," we find the "*tabacaria*" illustrated by a figure from Strack; and our writer says, "had we not two excellent specimens of this fish taken near Holmes' Hole, its existence would not have been credited so far north of the Equator." One of these "*two excellent specimens*" belongs by purchase to this Society, and is not the foreign fish, but the "*serrata.*"

Thus have I taken a hasty review of that portion of the volume before us which treats of *distinct species:* the remainder of the work I have not referred to, determined to confine myself only to what appeared absolutely necessary to be noticed. The remarks upon the "*Anatomy and Physiology of Fishes*," and the "*Treatise on Angling*," are foreign to my purpose. The accuracy or errors of the *former*, may be ascertained by consulting any standard work on Comparative Anatomy; of the *latter* subject I plead entire ignorance.

A few words more and my unpleasant task is done. The 248 pages over which we have thus rapidly passed, contain notices of 105 species, of which 80 are foreigners, and but 25 are found in the waters of our State. Of these 105 species, 36 are illustrated by figures; of these 36 illustrations, but 9 accompany species which are found on our coast; of these 9 figures, 6 are copied from "*Strack's Plates*," and 3 from Mitchill's "*Fishes of New York!*" Of the 36 plates contained in this "*History*," not one is drawn from nature. If "the chief value of a written history is in its truth, and next in the evidences of its truth,"* what reliance can be placed in us as naturalists, when one of our number is allowed to publish such a work as this, and it is permitted to circulate for years without a word being said or a line written to point out its inaccuracies? Why should we wonder that Yarrell, in his "*History of British Fishes*," should really think that the "*Silurus glanis*" and "*Petromyzon marinus*" were found in Massachusetts, or that Richardson in his "*Fauna Boreali Americana*," guarded as he generally has been in receiving what is stated here, should *almost* believe that the "*Lampres guttatus*," and "*Clupea harengus*," and "*Merlangus vulgaris*," and

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* North American Review, No. 53, p. 439.

"*Echeneis remora,*" were inhabitants of our waters, when not a doubt of the correctness of this compilation is expressed by an American ichthyologist?

I have studiously avoided noticing any of the numerous exaggerated stories which are so liberally distributed throughout the pages before us, feeling they could not deceive the naturalist, to whom alone I would address myself; but what can be thought of the assertion on page 75, that the "*Astacus Bartonii*"—*little craw-fish,* which measures from "the tip of the rostrum to the end of the tail two inches," and the "*Astacus marinus*"—*our common lobster,* are the same species! I will make no comments upon this statement, but beg permission to extract a few lines from the page referred to. "On some of the highest points of the Green Mountains between Massachusetts and New York, in those small basins of water which are formed between different eminences, lobsters are not only numerous, but really and truly formed precisely like those of the ocean; yet they rarely exceed two inches in length. The question at once arises, how came these animals in that locality, if the ova of the lobster were not conveyed there by some bird? The fresh water together with the climate of those high regions, has prevented the full development of these miniature lobsters, though in character, habit, and anatomical structure, there is the most perfect resemblance; and were the ova from the family on the mountain placed under favorable circumstances in the borders of the sea, we have no doubt that the progeny would be as large in one or two generations as any specimens which are exhibited from the ocean."

Such is the "*Natural History of the Fishes of Massachusetts.*" I have endeavored honestly to review it. Believing fully the remark of *Babbage,* "that the character of an observer, as of a woman, if doubted is destroyed,"* I have felt no pleasure in the progress of my examination; the duty has been performed for this Society, that when ridiculed for the publication of one of its members, they may be able to say, *we are aware that these errors exist; they have been pointed out by him who felt called upon to do so.*

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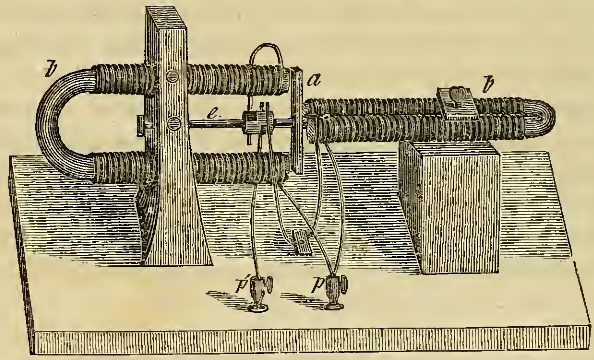
* "Reflections on the decline of Science in England, by C. Babbage." p. 182.

Art. XVIII.—*Electro Magnetism;* by Charles G. Page, M. D., Washington, D. C.

In Vol. xxxv, No. 2, of this Journal, I described a revolving armature and mentioned that the plan admitted of enlargement only with the alteration of the mode of revolution. I must premise here, (as I have heretofore expressed myself,) that I do not suppose this power susceptible of infinite increase, and in giving these descriptions to the public, I am only selecting from the multitude of machines I have constructed, such forms as obviously economize a given galvanic power. A number of machines wherein the poles of the magnets were changed, and others where the poles were not changed, but both systems, the stationary and revolving, were rendered magnetic and non magnetic at intervals, have been laid aside as not worth describing. Another form wherein the magnets were made to revolve and attracted by stationary armatures is obviously defective, as will be readily seen by referring to figure 3d, and supposing the systems reversed. If the armatures were stationary, and the charged magnets revolving, the magnets would always be attracted by the nearest armature; consequently the magnets would be charged only during one half of a revolution. Figures 1, 2, and 3, are modifications on a large scale of the revolving armature described in No. 2, of the last volume of this Journal. In figure 1, *b b*, are two Electro Magnets

Fig. 1.



disposed at right angles to each other, and firmly secured to wooden pillars. Where it is practicable, the magnets should be supported by wood, as every piece of metal of any kind surrounding a magnet, detracts from its action, by reason of closed currents excited by the disturbance of magnetic forces. For the action of closed currents see Vol. xxxv, No. 2, pages 254 and 5. The armature *a*, is mounted upon a brass shaft *e*, as I have heretofore shown by experiment that an iron or steel shaft detracts greatly from the inductibility of the armature. At *e*, firmly secured to the shaft is the electrotome or cut-off, the black portions representing the intersections of ivory or other non conducting material. Two pairs of plates (compound series) are connected by their poles with the cups *p p*. By the revolution of the armature the two magnets are charged in succession, and thus the action is maintained during the entire revolution.

Fig. 2.

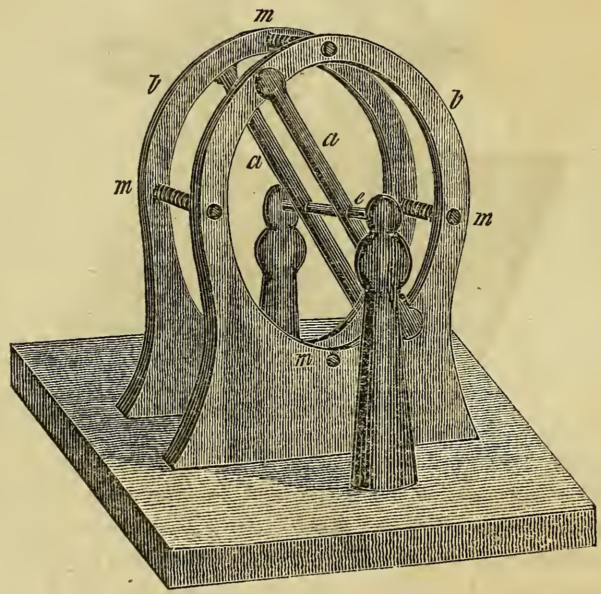
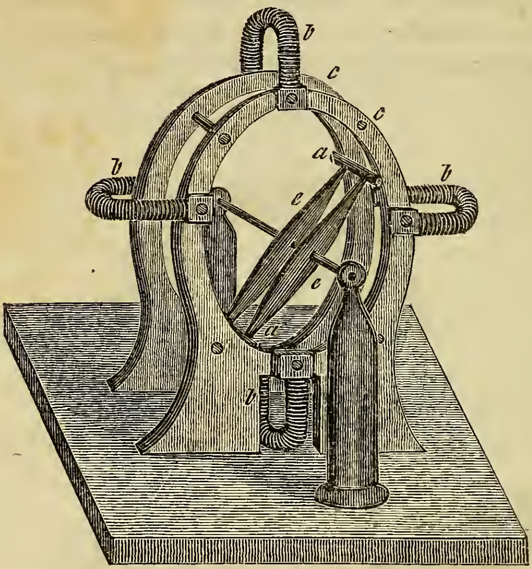


Figure 2, exhibits a machine of more simple construction than the last, or perhaps than any other. It possesses also the advantage of straight magnets much preferable to the U magnet. *b b* are wooden frames or braces supporting the straight magnets *m m*. *a a* are the two armatures upon the brass shaft *e*. The electrotome constructed upon the same principle as that of figure 1 may be placed at *e*, and the wire connexions as before directed. This is at once a very beautiful and simple machine, but in order to realize its full power, the two straight magnets should be charged by separate batteries. It cannot be made very large with any economy, and the proportions should be very different from those seen in the figure; the armatures should be much shorter than the magnets.

Figure 3, represents a revolving armature machine, invented in the month of March, 1838.

Fig. 3.



The magnets *b b b b* are secured by brass screws to the braces *c c*. The armatures *a a* are attached to two arms *e e*, which in this case may be run upon a steel shaft. The electrotome is similarly constructed and placed, and the connexions similar to those of figures 1 and 2. This is the last of a series of experiments made with reference to this subject, and after much attention, I am inclined to give it the preference. Soon after this was invented, a machine of larger size was built by the subscription of several gentlemen in Boston. It contained eight magnets, four revolving armatures and the revolving system was one foot in diameter. Not being able to be present during its construction, some errors were committed, and on the first trial it made only eighty revolutions a minute. The remodeling was delayed until further subscription should warrant the proceeding; and I regret to learn that the recent disastrous fire in Boston has destroyed the machine and batteries.

Art. IX.—*Observations on Electricity;* by Charles G. Page, M. D., Washington, D. C.

It is somewhat singular that the following fact has so long remained in obscurity, especially as the Franklinian theory has derived its principal support from the converse of this fact: "If a pith ball be laid in a groove on the table of the universal discharger, and a Leyden jar or battery be discharged in the direction of the groove, the ball will be propelled in the direction of the passage of the fluid, that is, from the positive to the negative." It must have happened, that in every case of repetition of this experiment, the jar was charged in the ordinary way, viz. the interior or *insulated* coating charged with vitreous or positive electricity; for it will be found that if the *insulated* coating be charged with *negative* or resinous electricity, the ball will be propelled contrary to the supposed direction of the fluid, that is, it will move from negative to positive. "If a card be placed upon the table of the universal discharger, and the wires or directors be brought into contact with the card on opposite sides, but at some distance from each other, the perforation made by a discharge between the points, will be found nearer the negative than the positive wire." By reversing the experiment the same error will be found in this statement. If the negative surface be insulated, the perforation takes place nearest the positive wire. The same correction will apply to the experiment with the flame of a candle between two cups of phosphorus.

Curious result from the configuration of the electric spark at the positive and negative surfaces. If a tapering jet from which issues a stream of hydrogen gas be applied to a conductor charged positively, the gas will be inflamed nearly every time the spark is drawn; but if the conductor be charged negatively, the gas will rarely be kindled, frequently requiring six or more applications before it succeeds.

During the month of October last, I made a number of experiments with a view to ascertain the utility of presenting points only upon one side of the plate in the electrical machine. My attention was called to this subject by a singular experiment shown to me by Mr. Daniel Davis, which for some time appeared rather enigmatical. A circular plate of glass was charged by movable coatings, and on removing the coatings, it frequently happened that both sides of the plate when presented to a charged electroscope, exhibited signs of the same species of electricity. After numerous repetitions with a very careful examination, it appeared that only the central portion of the negative side was charged negatively, while a considerable annular space exterior to this, was charged positively; the redundant positive electricity having forced or spread itself over the edge of the plate. On reversing the experiment and making the redundancy upon the negative side, the negative electricity appeared to pervade both surfaces as did the positive before. Some of our instrument makers have been in the practice of placing the collecting points of the prime conductor only upon one side of the electrical plate, finding that they answered better in many cases, than a row of points upon both sides, although no satisfactory reason has been given for this difference. After witnessing the above experiment, it occurred to me that the difference was owing to the facility with which electricity distributes itself upon glass, especially if it be not entirely clear and dry. Experiment fully confirmed my anticipations, and I was surprised to find to what extent the plate might be discharged by the application of a conductor to any part of its charged surface. The prime conductor having been removed, the plate was turned several times and the silk flap thrown back leaving both sides of the plate exposed in a highly charged state. The hand was then laid upon the plate at some distance from the edge and quickly withdrawn. On examining the plate not only the parts under and contiguous to the hand were discharged, but the whole of that portion directly opposite to the hand on the other side of the plate was found discharged to the same degree, although the distance over the edge of the plate was in some cases fifteen inches. It will be found that single or only two points on each side of the plate and near its circumference will succeed better than numerous points upon one side.

Art. X.—*Additional Account of the Shooting Stars of December* 6 *and* 7, 1838; *communicated* by Edward C. Herrick, Rec. Sec. Conn. Acad.

Various observations made in this country on the shooting stars of December 6 and 7, 1838, were published in the 72d No. of this Journal. By recent intelligence it appears that this meteoric display was also noticed in distant regions.

1. Rev. Peter Parker, M. D. in a letter to my friend, Mr. A. B. Haile, dated Canton, China, January 12, 1839, (received here May 3, 1839,) after referring to the observations made there from 12th to 14th November, 1838, states the following important facts: "On the fifth of December, [1838, at Canton, N. lat. 23° 30′; E. lon. 113° 3′.] however, the falling meteors were still more abundant, [than on the morning of November 14, 1838,] *one hundred and sixty* being counted in the space of one hour from eight and a half to nine and a half o'clock, P. M.; and *a few evenings after this they were much more frequent.* I have often kept a lookout since, but no recurrence has been witnessed." The Canton Register of Dec. 11, 1838, gives the following account of the same event: "With reference to the highly interesting meteorological observations taken on the 12th and 13th ult., we have been informed that a much more remarkable phenomenon was noticed on the evening of the 5th inst., when from half past eight to nine, *one hundred and eight* meteors were counted; and from nine until half past, *fifty two;* the moon and clouds then interrupted the view."

The number of observers is not stated, but it was doubtless insufficient to note all the meteors visible. The evening on which the meteors were most abundant at Canton was probably the *seventh* or *eighth.* The earliest observation after the *third* of the month, which the weather permitted us at New Haven, was on the evening of the *sixth,* about a day and a half later than the first observation at Canton.

2. The *London Times* of Dec. 11, 1838, contains a letter from Mr. George Jeans, a copy of which is here given, with the omission of a few unimportant remarks. "Yesterday evening, Dec. 7, as I was amusing the son of a friend in this neighborhood with a 42-inch telescope, the atmosphere being unusually good for

telescopic observations, and what light airs there were, being from W. N. W., we were surprised by the frequency of those meteoric exhibitions called *falling stars*. From 6 to 7 o'clock, five minutes rarely elapsed without one, and frequently several descended in quick succession, so that by estimation, I should think about *thirty* were seen in that time. But from 7 to 8, it was very seldom that a single minute passed without a meteor, and for a considerable time it literally rained [?] without any intermission. After 8 o'clock they became less numerous again, but still equal to what had been observed at first, till half past 9. Nor had they ceased between 10 and 11; and when returning home after midnight, though the moon was shining brightly, I counted several. They were not of one kind alone, but of all the species usually enumerated; nor did they fall from one part of the heavens only, but were widely diffused, and took various directions, chiefly towards the S. and E., but not always. The mass of them were not brilliant nor rapid, though occasionally there were some splendid specimens of both, and then commonly with a train. Very many of them came apparently from the zenith, faint and blue, and nearly perpendicular. I cannot estimate the number at less than 300; and though it is a mere guess, for I soon found it useless to try and count them, I am inclined to think that below the truth. *Tetney*, (N. lat. 53° 28′; W. lon. 50″) *near Grimsby, Lincolnshire*, Dec. 8, 1838."

This account is much less definite than could be desired. The observations appear to have been made chiefly by *one* person, watching only a part of the time.

3. In a letter dated Savannah, Ga., May 4, 1839, Mr. Thomas R. Dutton communicates the following: "After I wrote you in regard to the December shower of 1838, I obtained some information with regard to it from Captain Dyer of the ship Eli Whitney. He was then on his passage from Boston to this place, and off Cape Lookout, (about N. lat. 34°; W. lon. 77°). He made no memoranda at the time, and is not therefore certain of the date, but thinks it was on the night of the *eighth*; [more probably the *seventh*.] He says, 'The meteors started, with few exceptions, from the meridian or near the zenith, and moved to the W. and sometimes S. W. I noticed a few, however, moving to the E. A great many I observed to commence their movement a little to the W. of Capella, and others to the W. of Aldebaran,

and in a few instances from other parts of the heavens. A few left trails of light, but the most of them did not. The greatest number was seen between 8 o'clock and 12, after which comparatively few were observed.' Capt. D. informed me that he must have noticed as many as *two hundred*, during the four hours above mentioned. His testimony is worthy of entire confidence."

None of the observers, whose statements are cited above, were apprised (so far as I can learn) that any thing unusual was expected to occur at the time. On this account, their testimony will perhaps by some be considered more satisfactory. It is to be regretted that the observers did not notice, with more attention, the region of the heavens from which the meteors appeared to radiate.

In regard to the question of the annual occurrence in December of an uncommonly large number of meteors, I annex the following extracts. The evidence which they contain is quite indefinite, and each one may allow them what importance he pleases.

(1.) "The meteors called Falling-stars were much more frequent during this winter than we ever before saw them, and particularly during the month of December," [1824, at Port Bowen, N. lat. 70° 20′; W. lon. 80° 40′]. Then follows a particular account of several meteors observed on the 8th, 9th, 12th, and 14th December. *Compend of the Journals of Capt. Parry's Three Voyages to the Arctic Seas*, (5 vols. 18mo, Lond. 1828,) vol. 5, p. 49, &c.

(2.) M. J. Milbert, in chap. 3, of his *Voyage Pittoresque à l'Ile de France, etc.* (Paris, 1812, 8vo,) gives a sketch of the meteorology of that island, (S. lat. 20°; E. lon. 57° 30′.) In his account of the character of the month of December, he states that this season is the time in which luminous meteors are seen traversing the heavens.* It cannot be determined whether his statement refers to any particular part of the month.

(3.) "During the severe concussions [of the earthquake] of the 4th and 5th, [December, 1809, at the Cape of Good Hope,] the watches and clocks lost a good deal of time, a fire-ball was ob-

* "Cette saison brûlante est celle aussi ou les météores brillent dans le ciel et se présentent quelquefois comme un énorme globe de feu ou comme une longue fusée qui traverse lentement l'espace, jetant une lumière très vive; d'autres fois ils produisent une détonation aussi forte qu'un coup de canon; il n'est pas rare de voir paraître tout-à-coup dans le ciel ces jets de lumière qui, parfois, se divisent après l'explosion, en laissant une traînée blanchâtre qui forme un léger nuage, et bientôt qui se perd dans l'espace." Tome 2, p. 83.

served over the mountains in the west; various shooting stars appeared; the firmament was completely free of clouds, &c."—*Edinb. Ann. Reg.* for 1809. 8vo, vol. 2, pt. 2, p. 509.

(4.) In an anonymous table of the dates at which unusual numbers of meteors have been seen, contained in the London Monthly Chronicle, (vol. i, No. 9, Nov. 1838,) the *sixth of December*, 1826, is given. What authority there is for it, I do not know. The table seems to be derived chiefly from a similar one published by M. Quetelet, with additions from various papers which have appeared in this Journal.

New Haven, Conn., May 15, 1839.

Art. XI.—*On the Meteoric Shower of April* 20, 1803, *with an account of observations made on and about the* 20*th April*, 1839; by Edward C. Herrick, Rec. Sec. Conn. Acad.

It is generally known that in April, 1803, a remarkable shower of shooting stars was witnessed throughout a large part of the United States. In order that an account of this interesting event may be placed on permanent record, I have collected for this Journal the following statements concerning it.

As hypotheses which I do not credit, are often interwoven with the testimony cited, I take occasion here to express my entire dissent from the suppositions that shooting stars, whether single or in showers, are connected, either as cause or effect, with earthquakes, pestilence, electrical discharges, winds, seasons of heat or cold, or any particular sort of weather; or that the movements of these meteors have any correspondence with the direction of the wind, or with lines of magnetic dip or declination. That they are connected with the causes of the Aurora Borealis, is quite doubtful, yet it is well worthy of notice, that very brilliant displays of the latter have often occurred about the 13th of November.

I. *Meteoric Shower of April* 20, 1803.

1. *General account.*—"The newspapers from North Carolina, Virginia, and New Hampshire, contain accounts of a remarkable exhibition of meteors, or of shooting stars, seen at Raleigh, [N. C.] Richmond, [Va.] and Portsmouth, [N. H.] towards the end of

April, 1803. The beholders have, in several places, given certificates of what they witnessed. They declare that night the heavens seemed to be all on fire, from the abundance of lucid meteors. They passed over head in all directions, and were too numerous to be counted. One witness counted one hundred and sixty-seven in about fifteen minutes, and could not then number them all. This luminous display continued from one until after three o'clock in the morning. Part of the time the light was so great that a pin might be picked up on the ground. The modern opinion of these appearances is, that they consist of phlogistous gas, (inflammable air) catching fire in the upper region of the atmosphere. But it is not easy to explain wherefore the air of so many parts of the continent was so over-charged with hydrogenous vapor so early in the season.[! !] The coruscations are stated from all parts to have been unusually frequent and brilliant."—*Medical Repository*, (8vo, New York,) 2d Hex. vol. i, 1803–4, p. 300.

2. *Observations at Richmond*, Va., N. lat. 37° 32′; W. lon. 77° 26′. "*Shooting Stars.*—This electrical phenomenon was observed on Wednesday morning last at Richmond and its vicinity, in a manner that alarmed many, and astonished every person who beheld it. From one until three in the morning, those starry meteors seemed to fall from every point in the heavens, in such numbers as to resemble a shower of sky rockets. The inhabitants happened at the same hour to be called from their houses by the fire-bell, which was rung on account of a fire that broke out in one of the rooms of the Armoury, but which was speedily extinguished. Every one, therefore, had an opportunity of witnessing a scene of nature, which never before was displayed in this part of the globe, and which probably will never appear again. Several of these shooting meteors were accompanied with a train of fire, that illuminated the sky for a considerable distance. One, in particular, appeared to fall from the zenith, of the apparent size of a ball of eighteen inches diameter, that lighted for several seconds the whole hemisphere. During the continuance of this remarkable phenomenon, a hissing noise in the air was plainly heard, and several reports, resembling the discharge of a pistol. Had the city bell not been ringing, these reports would probably have seemed louder. The sky was remarkably clear and serene, and the visible fixed stars numerous the whole night. We are anxious to know at what distance from Richmond this phenome-

non has extended. It is hoped that persons who have remarked it in other places, will not neglect to inform the public of the particulars; as such information may add in a great degree to the knowledge of meteorology.

"Since writing the above, we have been informed that several of the largest of these shooting meteors, were observed to descend almost to the ground before they exploded. Indeed, many of those which we saw, appeared to approach within a few yards of the house tops, and then suddenly to vanish. Some persons, we are told, were so alarmed, that they imagined the fire in the Armoury was occasioned by one of these meteors, and in place of repairing to extinguish the earthly flames, they busied themselves in contriving to protect the roofs of their houses from the fire of heaven.

"This circumstance of the shooting stars descending within a short distance of the ground, is, however, a fact highly important to be known; as it has been generally supposed that meteors only proceed in a horizontal direction and never fly perpendicularly upwards or downwards. Those which we particularly remarked, appeared to descend in an angle of sixty degrees with the horizon; but as the smaller ones were so numerous and crossed each other in different directions, it was only possible to ascertain with any precision, the paths of the largest and most brilliant." —*Quoted in N. Y. Spectator, of April* 30, 1803, *from the Virginia Gazette, of Richmond, April* 23, 1803.

3. *Observations in Schoharie Co., N. Y.* N. lat. $42\frac{1}{2}°$; W. lon. $74\frac{1}{2}°$.—"In the Balance of the 17th ult. we republished from the Virginia Gazette, an account of a remarkable phenomenon which was observed in Richmond. The same appearance of innumerable meteors or shooting stars, has also been announced from various parts of Massachusetts; and we have just received a communication from a gentleman of veracity and respectability, who resides in Schoharie Co. in this State, which gives in substance the following particulars. He was returning home from a journey, late in the same night that the meteors were observed at Richmond, when he was astonished at the immense number of shooting stars which fell in all directions around him. Some of them approached so near the earth, that he could plainly distinguish them between the high hills on the east and west sides of him, which were distant not more than half a mile. Those that

seemed to fall nearest were apparently as large as a barrel [!] and had tails from 12 to 20 feet in length. He judges there was no intermission (as to numbers and motion) for two hours, during which time the whole hemisphere was illuminated."—*The Balance*, (Hudson, N. Y.) vol. 2, p. 205, June 28, 1803.

4. *Observations at Wilmington, Del.* N. lat. 39° 41′; W. lon. 75° 28′.—"On the 16th and 17th [April, 1803] we had a brisk storm with torrents of rain and lightning; and early in the morning of the 20th, electrical meteors were surprisingly numerous and vivid. Newspaper accounts since inform us that the same phenomena were observed over a great part of the country."—Dr. John Vaughan, in N. Y. Med. Repos. 2d hex. vol. 2, (1805) p. 140.

These are all the accounts of the display which I have been able to procure. They give no information concerning the point of radiation, or the hour of the greatest abundance. The radiant point was doubtless north of the ecliptic; and it is perhaps not unreasonable to conjecture that it was (as seen in this latitude) near the region of the heavens where it appeared to be on the morning of the 19th of April, 1839.*

This meteoric shower appears to be the legitimate successor of those which occurred April 4th,† (morning of 5th,) A.D. 1095, and April 5th, (morning) A. D. 1122, (both of the Julian style, corresponding nearly to the 11th of the Gregorian.) I have not succeeded in finding any meteoric shower in April, between 1122 and 1803, and can not determine whether there has been a regular progression in the time of the recurrence of the phenomenon. No evidence has come to my knowledge, that any such display was seen in April, 1830.

II. *Observations on shooting stars, on and about April* 20, 1839.

1. *New Haven.*—On the morning of Friday the 19th, Mr. Francis Bradley and myself watched from midnight until 3

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* The idea advanced by M Valz, (Com. Ren. Acad. Sci. 1838, 2d sem. p. 977,) that during meteoric displays of the same name, in any two successive years, the meteors appear to move in contrary directions, is irreconcilable with various observations which have been made in this country; and it is quite improbable, viewed theoretically. A short time will determine the question.

† Erroneously stated April 25, 1095, in Com. Ren. 1836, 2d sem. p. 145, from which work this date has been often quoted.

o'clock. The sky was clear, and the moon interfered only until about 1 A. M. One watched in the North quarter, the other in the South. During the three hours, we observed fifty eight meteors as follows:

From 0h. to 1h.	A. M.	in N.	nine;	in S.	nine	= 18
1 " 2	"	"	eleven;	"	six	= 17
2 " 3	"	"	thirteen;	"	ten	= 23

Several of the meteors were large, and left trains, but there was nothing remarkable in this respect. One apparently as large as Jupiter, fell near the horizon in the N. W. about a quarter past two o'clock, which as it burst, shot forth three red fire-balls. The times of flight were generally less than half a second. Soon after we took our stations, we noticed that the apparent paths of the majority of the meteors, if traced back, would meet in a spot somewhere between α *Lyræ* and γ *Draconis*, (about R. A. 273°, N. D. 45°,) and the radiant did not appear to change its place among the stars as they moved westward.

On the morning of the 20th, Messrs. C. P. Bush, M. Canales, J. T. Seeley and myself, began observations at fifteen minutes past midnight. During the hour next following, we observed *nineteen* meteors. The radiant could not be so well determined as on the morning previous. The time was unfavorable:—the moon (then near the first quarter) interfered, and the sky was partially clouded. In good circumstances, we should probably have seen double the number. Considering this quantity as only about equal to the yearly average, we concluded to abandon the field. An accident entirely prevented any further observation on my part, for several days succeeding.

2. *Hudson*, O.—The observations of four members of Western Reserve College were obtained, through the kindness of Prof. Loomis. On the 19th, from 2 h. to 3 h. A. M., two observers, looking from E. to W. by way of S., saw *thirteen* meteors; from 3 h. to 4 h., *twelve*. On the 20th, two observers, saw, from 2 h. to 3h. A. M., *twelve*; from 3 h. to 4 h. *thirteen*.

3. *Geneva*, N. Y.—Mr. Azariah Smith, Jr. watched at various times on the mornings of the 16th, 19th, and 20th. He saw several meteors, (two of unusual splendor on the 19th,) but the number was not above the average. All, or nearly all of them, came from the head of Draco.—Observations at *Rochester*, *N. Y.* and at *Claiborne*, *Ala.* detected nothing unusual. The news-

papers mention that at *Charleston*, S. C., at 10 o'clock, P. M. of the 20th, a fire-ball of great splendor was seen in the North.

The details above given lead to the conclusion, that no unusual display of meteors was visible in this country on the mornings of the 19th or 20th April, 1839. It is to be regretted that no thorough observation was made on the mornings of the 21st and 22d.

It deserves to be mentioned, that the meteoric shower of April, 1803, is by European writers, almost universally referred to the *twenty-second* day of the month. The documents which I have quoted, compel the belief that the true date is the *twentieth*. The only ground for suspicion concerning it, is the apparent failure on this day, for two successive years, of any recurrence of the shower.

Art. XII.—*Notice of a Report on a re-examination of the Economical Geology of Massachusetts;* by Edward Hitchcock, Professor of Chemistry and Natural History in Amherst College. Boston, 1838.

Communicated by Professor C. U. Shepard, at the request of the Editors.

The objects aimed at in the undertaking, were 1st, the collection and analysis of soils, with a view to their amelioration on chemical principles; 2nd, the discovery of coal, marl and ores; 3rd, a more accurate determination of the boundaries to the various rock formations; 4th the scientific geology, and lastly to procure additional specimens for the illustration of the geology and mineralogy of the State.

Prof. Hitchcock confines himself however, in the present report pretty nearly to the first and second topics above enumerated, and dwells particularly upon those developements of valuable materials within the commonwealth, which have been effected since the publication of his earlier reports.

As a preliminary to the consideration of soils, he classifies the different kinds observed as follows:

1. Alluvium from rivers, do. peaty; 2. Tertiary soil, do. sandy; 3. sandstone soil, red, do. gray; 4. Graywacke soil, conglomerate, do. slaty gray, do. slaty red; 5. Clay slate soil; 6. Limestone soil, magnesian, do. common; 7. Mica slate soil; 8.

Talcose slate soil; 9. Gneiss soil, common, do. ferruginous; 10. Granite soil; 11. Sienite soil; 12. Porphyry soil; 13. Greenstone soil.

The principal deposites of the 2d variety of soil occur in the valley of the Connecticut river, and in the counties of Plymouth, Barnstable, Dukes and Nantucket. "The surface on these places is usually covered with a white or yellowish silicious sand, which forms one variety of these soils. Where the sand is washed away, a deposite of clay is exposed, white, or whitish in the southeastern part of the state, but bluish on Connecticut river. This is the other variety of tertiary soils. Either of them in a pure state, is exceedingly barren; but duly mixed, they form a very productive soil." (p. 10.)

The limestone soil is confined to the county of Berkshire. It is thus denominated because it contains more of the salts of lime than any of the other soils of the state, although the calcareous earth even in the limestone soil, is by no means abundant, it having, in the opinion of Prof. H., been partially withdrawn by cultivation.

The specimens of soil for analysis were taken in nearly every instance from cultivated ploughed fields, and when practicable, from land which had been long enough under cultivation to cause the decay of all coarse vegetable fibres. Care was observed to avoid on the one hand, rich soil situated near to houses, and on the other, worn out and neglected fields. The samples were obtained at a depth of three or four inches below the surface; and in the selection, roots, undecayed manure, and large pebbles were rejected. After having been previously spread for several days upon boards, during the dry days of October, they were transferred to tin canisters. A portion of each specimen was withdrawn for analysis, and the remainder was enclosed in a glass bottle, which is intended for preservation in the State collection. One hundred and twenty such bottles were collected, besides fifty others, containing marls, clays, muck-sand, marsh-mud, ochres, &c.

In proceeding to the analysis of these numerous specimens, Prof. H. remarks, that the objects were, 'first, to ascertain the nature and amount of the earths that form the basis of the soils. Secondly, the nature and amount of the salts that act as stimulants to vegetation; and thirdly, to determine the amount and condition of the organic matter which constitutes the nourishment of plants.'

The time at his command, however, was inadequate to a rigid analysis of these soils, according to the rules laid down for the nicest processes of quantitative research. Being forced to conduct many analyses contemporaneously, the use of silver and platinum vessels was of necessity out of the question; nor was there room to verify results by repetition; still he believes that a sufficient approximation to the truth was secured, to answer the purposes intended.

The almost total absence of carbonate of lime is a remarkable feature in the soils of Massachusetts. But seven specimens of the whole number effervesced with hydrochloric acid, when examined with the utmost care to observe this phenomenon; nor did either of these examples afford carbonate of lime in a higher ratio than about 3 per cent.

It was a leading object in the research to determine the quantity of finely divided matter in the soil, since the best soils are usually characterized by their fineness. Prof. H. thinks the main defect of their soils to consist in the coarseness of their texture, and this he very properly attributes to the circumstance of their originating, for the most part, directly from primary rocks.

The salts soluble in water, equalled from 1 to 2 parts in a thousand of the soil, and in every case it was believed to contain sulphate of lime (gypsum.) Carbonate of magnesia was also very frequently an ingredient, though in mere traces. The presence of soda and potassa was not determined. The peroxide of iron exists from 1 to 4 per cent., and upwards in few instances. Prof. H. regards this last as an useful ingredient in soils. The ratio of the alumina to the other ingredients varies from 1 to 18 per cent. The instances are common in which he found it above 10 per cent., which is beyond what might have been supposed for a region where the argillaceous formations are so uncommon as they are in Massachusetts.

In respect to the earthy ingredients of a soil, it is undoubtedly true that a very wide diversity of constitution is compatible with fertility, provided the mechanical condition, and the proportions of salts and organic matter are propitious. Prof. H. is of opinion that 'the salts especially admit of but little variation without producing sterility, either by their deficiency or excess; and hence to determine their amount is an important point in agricultural chemistry. And the differences which are so obvious in soils derived from different rocks, do not depend entirely upon the different proportions of the earths which they contain. For the quantity and nature of the salts resulting from the decomposition of rocks are considerably different. Thus we should expect, that the gneiss and granite soils would contain a larger amount than usual of the salts of potassa, and where sulphuret of iron prevails, of the salts of iron; the porphyry soils, of the salts of soda; the graywacke and sandstone soils, of the salts of lime, magnesia, and perhaps potassa and soda; the mica slate soils, of the salts of magnesia and potassa; the talcose slate soil, of the salts of magnesia: or perhaps more commonly we should find the lime and magnesia *uncombined* with an acid,' (we do not perceive how this can be.)

'Such differences as these in the constituents of soil, will unquestionably affect their fertility; and it would be desirable to ascertain how far they exist in the soils of Massachusetts. I had hoped to accomplish this object; but it will require a great number of delicate and accurate analyses, demanding far more time than has yet been allowed me. As will be seen in the sequel, I have attempted to determine the amount of the salts of lime in all the soils that I have collected; but it will need comparative trials by the ordinary modes of analysis before the peculiar characteristics of the different classes of our soil can be pointed out; and besides I have made no attempt to determine the existence and amount of potassa and soda in my specimens.' p. 27.

Prof. H. next proceeds to the developement of a new method of analysis derived from Dr. Samuel L. Dana of Lowell, Mass., and which Prof. H. regards as a most important contribution to agricultural chemistry. The account is prefaced by the following remarks from Dr. D.

"Geine forms the basis of all the nourishing part of all vegetable manures. The relations of soils to heat and moisture depend chiefly on geine. It is in fact, under its three states of 'vegetable extract, geine, and carbonaceous mould,' the principle which gives fertility to soils long after the action of common manures has ceased. In these three states it is essentially the same. The experiments of Saussure have long ago proved that air and moisture convert insoluble into soluble geine. Of all the problems to be solved by agricultural chemistry, none is of so great practical importance as the determination of the quantity of soluble and insoluble geine in soils. This is a question of much higher importance than the nature and proportions of the earthy constituents and soluble salts of soils. It lies at the foundation of all successful cultivation. Its importance has been not so much overlooked as undervalued. Hence, on this point the least light has been reflected from the labors of Davy and Chaptal. It needs but a glance at any analysis of soils, published in the books, to see that fertility depends not on the proportion of the earthy ingredients. Among the few facts, best established in chemical agriculture, are these; that a soil, whose earthy part is composed wholly, or chiefly, of one earth; or any soil, with excess of salts, is always barren; and that plants grow equally well in all soils, destitute of *geine*, up to the period of fructification,—failing of geine, the fruit fails, the plants die. Earths, and salts, and geine, constitute, then, all that is essential; and soils will be fertile, in proportion as the last is mixed with the first. The earths are the plates, the salts the seasoning, the geine the food of plants. The salts can be varied but very little in their proportions, without injury. The earths admit of wide variety in their nature and proportions. I would resolve all into '*granitic sand;*' by which I mean the finely divided, almost impalpable mixture of the detritus of granite, gneiss, mica slate, sienite, and argillite; the last, giving by analysis, a compound very similar to the former. When we look at the analysis of vegetables, we find these inorganic principles constant constituents—silica, lime, magnesia, oxide of iron, potash, soda, and sulphuric and phosphoric acids. Hence these will be found constituents of all soils. The phosphates have been overlooked from the known difficulty of detecting phosphoric acid. Phosphate of lime is so easily soluble when combined with mucilage or gelatine, that it is among the first principles of soils exhausted. Doubtless the good effects, the lasting effects, of bone manure, depend more on the phosphate of lime, than on its animal portion. Though the same plants growing in different soils are found to yield variable quantities of the *salts* and earthy compounds; yet I believe, that accurate analysis will show, that similar parts of the same species, at the same age, always contain the inorganic principles above named, when grown in soils arising from the natural decomposition of granite rocks. These inorganic substances will be found not only in constant quantity, but always in definite proportion to the vegetable portion of each plant. The effect of cultivation may depend, therefore, much more on the introduction of *salts* than has been generally supposed. The *salts* introduce new breeds. So long as the salts and earths exist in the soil, so long will they form voltaic batteries with the roots of growing plants; by which, the 'granitic sand' is decomposed, and the nascent earths, in this state readily soluble, are taken up by the absorbents of the roots, always a living, never a mechanical operation. Hence so long as the soil is *granitic*, using the term as above defined, so long is it as good as on the day of its deposition; *salts* and *geine* may vary, and must be modified by cultivation. The universal diffusion of granitic diluvium will always afford enough of the earthy ingredients. The fertile character of soils, I presume, will not be found dependent on any particular rock formation on which it reposes. Modified they may be, to a certain extent, by peculiar formations; but all our granitic rocks afford, when decomposed, all those inorganic principles which plants demand. This is so true, that on this point the farmer already knows all that chemistry can teach him. Clay and sand, every one knows: a soil too sandy, too clayey, may be modified by mixture, but the best possible mixture does not give fertility. That depends on salts and geine. If these views are correct, the few properties of geine which I have mentioned, will lead us at once to a simple and accurate mode of analysing soils,—a mode, which determines at once the value of a soil, from its quantity of soluble and insoluble vegetable nutriment,—a mode, requiring no array of apparatus, nor delicate experimental tact,—one, which the country gentleman may apply with very great accuracy; and, with a little modification, perfectly within the reach of any man who can drive a team or hold a plough."

Rules of Analysis.

1. "Sift the soil through a fine sieve. Take the fine part; *bake* it just up to browning paper."

2. "Boil 100 grains of the baked soil, with 50 grains of pearl ashes, saleratus or carbonate of soda, in 4 ounces of water, for half an hour; let it settle; decant the clear; wash the grounds with 4 ounces boiling water; throw all on a weighed filter, previously dried at the same temperature as was the soil, (1); wash till colorless water returns. Mix all these liquors. It is a brown colored solution of all the soluble geine. All sulphates have been converted into carbonates, and with any phosphates, are on the filter. Dry therefore, that, with its contents, at the same heat as before. Weigh—the loss is *soluble geine.*"

3. "If you wish to examine the geine; precipitate the alkaline solution with excess of lime-water. The *geate* of lime will rapidly subside, and if lime-water enough has been added, the nitrous liquor will be colorless. Collect the geate of lime on a filter; wash with a little acetic or very dilute muriatic acid, and you have geine quite pure. Dry and weigh."

4. "Replace on a funnel the filter (2) and its earthy contents; wash with 2 drams muriatic acid, diluted with three times its bulk of cold water. Wash till tasteless. The carbonate and phosphate of lime will be dissolved with a little iron, which has resulted from the decomposition of any salts of iron, besides a little oxide of iron. The alumina will be scarcely touched. We may estimate all as *salts* of lime. Evaporate the muriatic solution to dryness, weigh and dissolve in boiling water. The insoluble will be *phosphate of lime.* Weigh—the loss is the *sulphate of lime;* (I make no allowance here for the difference in atomic weights of the acids, as the result is of no consequence in this analysis.)"

5. "The earthy residuum, if of a greyish white color, contains no insoluble geine —test it by burning a weighed small quantity on a hot shovel—if the odor of burning peat is given off, the presence of insoluble geine is indicated. If so, *calcine* the earthy residuum and its filter—the loss of weight will give the insoluble geine; that part which air and moisture, time and lime, will convert into soluble vegetable food. Any error here will be due to the loss of water in a hydrate, if one be present. but these exist in too small quantities in 'granitic sand,' to affect the result. The actual weight of the residuary mass is 'granitic sand.'

"The clay, mica, quartz, &c. are easily distinguished. If your soil is calcareous, which may be easily tested by acids; then before proceeding to this analysis, boil 100 grains in a pint of water, filter and dry as before, the loss of weight is due to the *sulphate of lime*, even the sulphate of iron may be so considered; for the ultimate result in cultivation is to convert this into sulphate of lime."

"Test the soil with muriatic acid, and having thus removed the lime, proceed as before, to determine the geine and insoluble vegetable matter."* pp. 32–35.

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* In applying Dr. Dana's rules given in the text, to the soils of Massachusetts, I found it necessary to adopt some method of carrying forward several processes together. I accordingly made ten compartments upon a table, each provided with apparatus for filtering and precipitations, also 10 numbered flasks, 10 evaporating dishes, and a piece of sheet iron pierced with ten holes, for receiving the same number of crucibles. I provided, also, a sheet iron oven, with a tin bottom large enough to admit 10 filters, arranged in proper order, and a hole in the top to admit a thermometer. The sand bath was also made large enough for receiving the ten flasks. In this manner I was able to conduct ten processes with almost as great facility as one could have been carried forward in the usual way.

A tabular view is given in the report of 125 analyses of soils, conducted on the principles above laid down. The first column of the table gives the soluble geine, the 2d, the insoluble geine, the 3d, sulphate of lime, the 4th, the carbonate of lime, the 5th, the phosphate of lime, the 6th, the granitic sand, the 7th, the moisture absorbed in 24 hours by 100 grs. of the soil previously heated up to 300° F., the 8th, the absorbing power in proportional numbers, and the last, the specific gravity of the soil.

Notwithstanding the expedition with which examinations according to the foregoing rules are capable of being made, we cannot but express our astonishment at the zeal and patience with which the author must have labored in order to bring forward so many results. And whatever may be the value which the chemical reader may attach to the formula by which they are conducted, taken as a whole, still, in regard to the columns of organic matter, of absorbing power and specific gravity, no objections are likely to be urged.

Of Dr. DANA's hypothesis respecting the state in which vegetable and animal matter exists in the soil, and the changes through which it passes before being taken up by the roots of the plants, it is exceedingly doubtful whether the progress of organic chemistry will ever raise it to the character of chemical theory. Recent researches would rather lead us to regard soluble geine as composed of at least three vegetable acids, viz. the crenic, apocrenic, and ulmic, together with a black matter called by HERMANN (Journ. d' ERDM. t. 12, p. 277,) *earthy extract:* while the insoluble geine is ulmic acid mingled with undecomposed vegetable remains. HERMANN gives the following view of the constitution of the above acids.

	Crenic.		Apocrenic.		Ulmic.
Carbon,	535.	(= 7 atoms.)	1070.1	(= 14 atoms.)	6190.
Hydrogen,	99.8	(= 16 ")	87.3	(= 14 ")	431.
Nitrogen,	88.5	(= 1 ")	265.5	(= 3 ")	1105.
Oxygen,	600.	(= 6 ")	500.	(= 3 ")	2274.
	1323.3	(combining weight.)	1722.9	(combining wt.)	10000.

What therefore Dr. D. considers a simple salt, (a geate,) is more probably a family of salts, viz. a crenate, an apocrenate, and an ulmate, with the addition moreover of earthy extract. How these principles become the nutriment of plants is yet far from being cleared up, although there remains the best reason for supposing that it chiefly depends upon their capacity to afford carbonic acid. The more alkaline the bases united with these acids in a particular soil, the more favorable are the conditions for vegetation, a fact which is apparently connected with the superior solubility of alkalescent salts.

It may be doubted whether the steps directed to be taken in the analysis for the determination of the salts of lime are free from all objection. The treatment of the soil after being freed from geine, with dilute hydrochloric acid, must necessarily take into solution aluminium and iron, beside rendering a portion of the silicic acid soluble. On evaporating the fluid to dryness as directed, and treating the mass with boiling water, it would therefore follow that a residuum of alumina and sesquioxide of iron, (owing to the partial decomposition of the chlorides of aluminium and iron from evaporation to dryness,) together with some silicic acid (rendered insoluble by the same treatment,) would go to increase the weight assumed to be pure phosphate of lime.

As might be anticipated therefore, we find the ratio of phosphate of lime in the soils of Massachusetts exceedingly high, varying from 0.5 to 2 per cent.

Growing out of the same procedure, it appears also, that the proportion of sulphate of lime must generally be rather too high: for if, as we suppose, the hydrochloric acid attacks the aluminium and iron, the aqueous solution regarded in the formula as chlor. calcium only, must contain also the chlorides of iron and aluminium, as well as some silicic acid. Consequently, we find the sulphate of lime quoted in some of these analyses at 3 p. c., and even higher in a few instances.

The foregoing inadvertencies (as they strike us) in Dr. Dana's rules of analysis, are not conceived to vitiate in an important manner the results contained in the report, nor do we mention them because we imagine they were unperceived by the inventor of the formula or by Prof. H.; but through a desire to induce these gentlemen to obviate, if possible, the objections urged against it, and still preserve its claims to convenience on the ground of facility of working and accuracy of result.

The report contains the following remarks respecting the results of these analytic investigations.

They show us the amount of nutriment in the soils of Massachusetts; also how much of it is in a fit state to be absorbed by plants, and how much of it will need further preparation. As this is probably the first attempt that has been made to obtain the amount of geine in any considerable number of soils, we cannot compare the results with those obtained in other places. They will be convenient, however, for comparison with future analyses; and we learn from them, that geine, in both its forms, abounds in the soils of the state, and that it most abounds where most attention has been paid to cultivation. It ought to be recollected, that I took care not to select the richest or the poorest portions of our soils; so that the geine in this table is probably about the average quantity. It is hardly probable that the number of specimens analysed from the different varieties of our soils is sufficiently large to enable us to form a very decided opinion as to their comparative fertility, especially when we recollect how much more thorough is the cultivation in some parts of the state than in others. It may be well, however, to state the average quantity of geine in the different geological varieties of our soils, which is as follows:

		Soluble Geine.	Insoluble Geine.
Alluvium,		2.25	2.15
Tertiary argillaceous soils,		3.94	5.22
Sandstone	do.	3.28	2.14
Graywacke	do.	3.60	4.00
Argillaceous slate	do.	5.77	4.53
Limestone	do.	3.40	4,04
Mica slate	do.	4.34	4.60
Talcose slate	do.	3.67	4.60
Gneiss	do.	4.30	3.40
Granite	do.	4.05	3.87
Sienite	do.	4.40	4.50
Porphyry	do.	5.97	4.10
Greenstone	do.	4.56	6.10

One fact observable in the above results may throw doubts over the fundamental principles that have been advanced respecting geine; viz. that it constitutes the food of plants, and that they cannot flourish without it. It appears that our best alluvial soils contain less geine, in both its forms, than any other variety, except those very sandy ones that are not noticed in the above results, because their number is so small. Ought we hence to infer that alluvium is a poor soil? I apprehend that we can infer nothing from this fact against alluvial soils, except that they are sooner exhausted than others, without constant supplies of geine. For if a soil contain enough of this substance abundantly to supply a crop that is growing upon it, that crop may be large although there is not enough geine to produce another. Now analysis shows that our alluvial soils contain enough of geine for any one crop: and I apprehend that their chief excellence consists in being of such a degree of fineness that they allow air, moisture, and lime, rapidly to convert vegetable matter into soluble geine, and yield it up readily to the roots of plants: but I presume that without fresh supplies of manure, they would not continue to produce as long as most of the other soils in the state. A considerable part of our alluvia are yearly recruited by a fresh deposite of mud, which almost always contains a quantity of geine and of the salts of lime, in a fine condition for being absorbed by the rootlets of plants. And on other parts of alluvial tracts, our farmers, I believe, are in the habit of expecting but a poor crop unless they manure it yearly. Yet so finely constituted are these soils, that even if exhausted, they are more easily restored than most others; so that taking all things into the account, they are among the most valuable of our soils; and yet I doubt whether they produce as much at one crop as many other soils; though the others perhaps require more labor in cultivation.

The amount of soluble and insoluble geine obtained by Dr. Dana's method of analysis, ought to correspond pretty nearly with the amount of organic matter obtained by the old method; and by comparing the two tables of results that have been given, it will be seen that such is the fact. Several circumstances, however, besides errors of analysis, will prevent a perfect agreement. In the first place, by the old method of analysis, 100 grains of the soil are weighed before expelling the water of absorption; but by the new method, not until after its expulsion. Again, by the old method only the very coarse parts of the soil are separated by the sieve: but a fine sieve is used by the new mode, and this removes nearly all the vegetable fibre, which by the other method is reckoned a part of the organic matter. Other causes of difference might be named: and hence we ought not to expect a perfect agreement in the results of the two methods.

The three next columns in the Table contain the salts of lime in our soils. I have already described the infrequency of the carbonate; but very different is the case with the sulphate and the phosphate which were found in greater or less quantity, in every soil analysed. In respect to the sulphate of lime, or gypsum, it may not be unexpected that we should find it in all soils, since we know it to occur in all natural waters throughout the state; and we cannot conceive of any other source from which the water could have derived it, except the soil. But the phosphate of lime has generally been supposed to be much more limited, nay to be scarcely found in soils, except where animal substances have been used for manure. It is possible that in all the soils which I have analysed, such might have been its origin, though not very probable. Yet there is strong reason to believe, that this salt is a constituent of all soils in their natural state. The arguments on this subject are stated so ably by Dr. Dana that I need only quote from his letter.

"When we consider that the bones of all graminivorous animals contain nearly 50 per cent. of phosphate of lime, we might be at liberty to infer the existence of this principle, in the food, and, consequently, in the soil, on which these animals graze. If we look at the actual result of the analysis of beets, carrots, beans, peas, potatoes, asparagus, and cabbage, we find phosphate of lime, magnesia, and potash, varying from 0.04 to 1.00 per cent. of the vegetable. Indian corn too, by the analysis of the late Professor Gorham, of Harvard College, contains 1.5 per cent. phosphate and sulphate of lime. It may be said that this is all derived from the manure. We shall see by and by. Let us look at the extensive crops often raised where man has never manured. Rice, wheat, barley, rye, and oats, all contain notable portions of phosphate of lime, not only in the grain but in the straw, and often in the state of superphosphates. The *diseases* too, *ergot* and *smut*, show *free phosphoric acid.* Can it be that, owing to certain electrical influences of the air, in particular seasons, lime is not secreted by the plant to neutralize the free acid? May not this be a cause of smut and ergot? Does it not point out a remedy? Take too the cotton crop of our country. What vast quantities of phosphates do we thus annually draw from the soil? Cotton gives one per cent. ashes, of which 17 per cent. is composed of phosphate of lime and magnesia. The like is true of tobacco. It contains 0.16 per cent. of phosphate of lime. If we turn to the analysis of forest trees, we find that the *pollen* of the *pinus abies*, wafted about in clouds, is composed of 3 per cent. phosphate of lime and potash. May not this too be one of nature's beautiful modes of supplying phosphoric acid to plants and to soils? If, as the late experiments of Peschier have proved, sulphate of lime, in powder, is decomposed be growing leaves, the lime liberated, and the sulphuric acid combining with the potash in the plant, why may not phosphate of lime, applied by *pollen*, act in the same way? At any rate, the existence of phosphate of lime in our forest soils is proved not only by its existence in the pollen, but by its actual detection in the ashes of pines and other trees.—100 parts of the ashes of *wood* of *pinus abies* give 3 per cent. phos. iron; 100 parts of the ashes of the *coal* of *pinus sylvestris* give 1.72 phos. lime, 0.25 phos. iron; 100 parts of ashes of oak coal, give 7.1 phos. lime, 3.7 phos. iron; 100 parts of ashes of bass wood 5.4 phos. lime, 3.2 phos. iron; 100 parts of ashes of birch wood 7.3 phos. lime, 1.25 phos. iron; 100 parts of ashes of oak wood 1.8 phos. lime; 100 parts of ashes of alder coal 3.45 phos. lime, 9. phos. iron.

"These are the calculated results from Berthier's very accurate analyses, and those very curious crystals—detected in some plants—the '*raphides*' of DeCandolle, are some of them bibasic phosphates of lime and magnesia. Phosphate of iron, we know, is common in turf; bog ore, and some barren and acid soils owe their acidity to *free* phosphoric acid. If we allow that our untouched forest soil contains phosphate of lime, it may be said, that this, being in small quantity, will be soon exhausted by cultivation, and that the phosphates, which we now find in cultivated fields, rescued from the forest, is due to our manure;—I give you the general result of my analysis of *cow dung*, as the best argument in reply. My situation and duties have led me to this analysis. I give you it, in such terms as the farmer may comprehend: water, 83.60; hay, 14.; biliary matter, (bile resin, bile fat and green resin of hay,) 1.275; geine combined with potash, (vegetable extract,) 0.95; albumen, 0.175."

"The hay is little more altered than by chewing. The albumen has disappeared, but its green resin, wax, sulphate and phosphate of lime remain, and when we take 100 parts of dung, among its earthy salts we get about 0.23 parts phosphate, 0.12 carbonate, and 0.12 sulphate of lime. Now, a bushel of green dung as evacuated weighs about 87.5 lbs. Of this only 2.40 per cent. are soluble. Of this portion only 0.95 can be considered as soluble geine."—pp. 43–47.

For the sake of comparison, Prof. H. has subjected a few specimens of soil taken from fertile western lands to the same kind of analysis.

	Soluble Geine.	Insoluble Geine.	Sulphate of Lime.	Phosphate of Lime.	Carbonate of Lime.	Granitic Sand.	Water of Absorption.	Remarks.
Rushville, Illinois,	7.4	2.5	3.4	0.6	1.5	84.6	6.3	
Sangamon co. do.	4.9	5.6	1.2	0.4	1.3	86.6	6.3	
Lazelle county, do.	7.6	13.8	1.4	0.4	3.3	73.5	9.5	Apparently never cultivated.
Peoria county, do.	3.1	4.8	3.5	1.0		87.6	5.7	
Sciota Valley, Ohio,	4.5	6.7	2.1	0.9	2.8	83.0	5.3	Cultivated 14 years without manure.

The above soils are evidently of the very first quality: the geine being in large proportion, and the salts quite abundant enough, while there is still a small supply of carbonate of lime to convert more insoluble into soluble geine, whenever occasion demands. Still, if we compare the preceding analyses with some of those that have been given of the Massachusetts soils, the superiority of the western soils will not appear as great as is generally supposed. And there is one consideration resulting from the facts that have been stated respecting geine, that ought to be well considered by those who are anxious to leave the soil of New England that they may find a more fertile spot in the West. Such soils they can undoubtedly find; for geine has been for ages accumulating from the decomposition of vegetation in regions which have not been cultivated: and for many years, perhaps, those regions will produce spontaneously. But almost as certain as any future event can be, continued cultivation will exhaust the geine and the salts, and other generations must resort to the same means for keeping their lands in a fertile condition as are now employed in Massachusetts, viz. to provide for the yearly supply of more geine and more salts.—pp. 47,48.

Next follows some remarks upon the power of soils to absorb water. This is conceived to depend principally upon the organic matter they contain, and next upon the proportion of alumina, after which cabonate of lime is considered favorable to the imbibition of moisture. These ingredients of soil being essential to fertility, the absorbing power, if correctly ascertained, becomes to some extent a measure of its productiveness. Prof. Hitchcock's method of determining the problem in question, was to expose 100 grs. previously heated to 300° F. in a cellar for 24 hrs. on a small earthern plate. At the end of this period, the plate was again weighed and the increase ascertained.

The power of a soil to absorb moisture is no doubt a very important consideration to the agriculturalist; and it appears to us to depend upon several conditions beside those above hinted at. For example, the mechanical condition of the soil must materially influence its capacity for acquiring moisture. A finely comminuted soil will absorb in a higher ratio than one which is coarse or gravelly. The presence of carbonate of potassa, or chloride of calcium, by their deliquescent properties will also powerfully augment the absorbability of a soil. It is in part owing to the alkaline carbonate referred to, that the light soils in and near New Milford, (Conn.) possess such superior qualities for agriculture. This carbonate is supplied without interruption from the decomposing state of the feldspar in the granitic gneiss hills (called Candle Mt. range) situated west of the village, and which run northward to Cornwall. We know also, that wood-ashes constitute the best amendment for light silicious soils, rendering them productive in almost every species of crop, even when applied with very small quantities of other manure. Illustrations of this fact are frequent upon Long Island and the dry sand soils of the Connecticut valley.

A new method for learning the absorbing qualities of soils has lately been practiced by M. Berthier,* which appears to us as particularly deserving of notice. It consists in filling a small filter with the dry soil, and then thoroughly moistening it until water drops from it; when the water has ceased dropping, the filter with its contents is transferred to one cup of a balance and a moistened filter of the same size to the other, when the gain in weight is noted. The following are some results obtained in this way by Berthier:

A vegetable soil from Ormeson, near Nemours, of a pale ochre yellow color, taken from a vineyard and considered of excellent quality, absorbed 0.36 its weight of water.

Quartzy sand of Nemours, such as is employed in the glass factory of Bagneaux, absorbed 0.227.

Quartzy sand of Aumont pulverized in a mortar, absorbed 0.30.

The kaolin of Limoges, absorbed 0.46.

The chalk of Meudon, when purified and in the condition of Spanish white, gained by the process 0.35 its weight.

The report contains likewise several interesting experiments directed to the converse of this problem, viz. to ascertain the capacity of soils to retain water, which is by no means proportional to their powers of absorption: for these results we must refer the reader to the report.

Prof. Hitchcock comes at the following very just conclusions in respect to the soils of Massachusetts, viz. that the grand desiderata in them are carbonate of lime and an additional supply of geine, or organic matter. He then proceeds to point out numerous sources of these materials in different sections of the state, many of which have been brought to light in the progress of the survey.

An extensive bed of marl is pointed out as existing in the northwest part of Stockbridge, in Berkshire county, on land of Mr. Buck, a second in the same town, four miles from the court house in Lenox, a third in the northeast part of Lee, (the thickness of which in some places is ten feet,) also several beds in West Stockbridge. Numerous other beds have also been noticed in the neighboring towns. The purest of these marls when dry, are white and much lighter than the common soil, and they ea-

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* Ann. des Mines, t. xiv, 1838.

sily fall to powder. They abound in small fresh water shells. They contain from 50 to 90 p. c. of carbonate of lime, with considerable organic matter and traces of phosphate of lime; and cannot fail of proving an invaluable application for the adjoining lands.

The clay-beds of the state are described as frequently containing calcareous matter, particularly those which give rise to those curious rounded and flattened concretions, called clay-stones, and which often consist of carbonate of lime in the proportion of 50 per cent. Calcareous diluvium abounds in Springfield, West Springfield, and South Hadley. It consists of the detrital matter from a red slaty rock, which originally contained a few per cent. of carbonate of lime. The lime serves as a cement, and imparts to the aggregate the firmness of a rock; but on being exposed to the weather, it finally crumbles down and in this condition may be conveniently spread upon land.

The composition of the various limestones in the state is also given, from which research it appears that they are chiefly dolomitic. Several new localities are moreover added to the list; and what to us was quite unexpected, two deposites of green sand, one at Marshfield (in a region of granite) and the other at Gay Head. Hydrate of silica, or the light silicious soil which underlies peat-deposits is also used as a fertilizer to some extent in the state, and no doubt with good reason, inasmuch as its animal origin, (having composed originally the skeletons of infusoria,) its impregnation with peat juice, and its favorable mechanical condition, must each contribute to render it highly serviceable.

Prof. H. next points out the sources of geine, or vegetable neutriment with much particularity and good judgment; and finally concludes this part of his subject with the following remarks:

Though I have dwelt so long upon the analysis and improvement of our soils, it will be seen that I have touched only a few of its more important features, and that even these are but imperfectly considered. Many minor points, of no small importance, however, have been wholly passed over, or only alluded to; and sensible that I cannot do them justice at present, I shall not attempt to discuss them. My great object has been, after ascertaining the greatest deficiences in our soil, to satisfy the Government that we have the means of remedying them and of making great improvements in them, by the aid of chemistry. If I may hope that I have accomplished this object, then I take the liberty to inquire, whether it be not important enough, and whether there is not enough still left to accomplish respecting it, to make the appointment of a *State Chemist* desirable? We ought to have still further experiments made on the subject of geine, and the salts, which the soils contain: also accurate analyses of the crops grown on soils with different manures; and investigations as to the manner in which calcareous matter acts upon vegetable and animal substances: as also experiments directed by an able and experienced chemist, on the best mode of bringing into use the vast deposites of geine and vegetable fibre which our state contains. And since we have chemists of this character among us, why should not the services of at least one of them be secured for this object? The geological surveyor might often collect substances for analysis; but if obliged to go as thoroughly into the chemistry of the subject as is necessary to valuable results, he cannot within any reasonable time accomplish the more appropriate objects of his appointment. In at least one state of the Union, where geological surveys are in progress, one gentleman is appointed, whose time and attention are exclusively devoted to the chemical examination of the soils, ores, &c., collected. And I would fondly believe, that Massachusetts will not rest satisfied, till this work is done at least as thoroughly as in any other state. I believe there is abundant labor for an experienced chemist upon our soils alone: but many other substances, found in the state, ought to be analysed, that their real value may be known.

Among the secondary considerations relative to the soils of Massachusetts, yet unsupplied in the report for want of time, we presume, are descriptions of the subsoils, (or bottoms on which the cultivable lands immediately rest,) the topographical situations of the soils in respect to a supply of water from springs, lakes and rivers, and accurate tables of the rain-guage and thermometer during the warm season; all of which points are entitled to attention among the elements for determining the agricultural capabilities of a country.

Since the publication of Prof. H.'s first report, the prospect of discovering workable beds of anthracite coal in the region of greywacke where it was predicted to exist, has become strongly heightened. The Mansfield coal company have sunk a shaft to the depth of 84 feet, from which a drift is worked horizontally to a short distance into a bed of coal about ten feet thick. Its specific gravity is 1.79. It consists of carbon 96. alumina, iron, &c. 4. The railroad from Boston to Providence passes within 80 rods of this mine.

No attempts have of late been made to re-work the coal at Worcester, which is situated in an older class of rocks. Its specific gravity is 2.12. It contains water 3. carbon 75. earths and oxides 20.

Small and irregular veins of a very superior bituminous coal are found in the sandstone of the Agawam River in West Springfield. It is in fragments mingled along with calcareous spar and pieces of the sandstone rock, from which circumstance Prof. H.

thinks it may have been formed by sublimation, and accordingly he infers that coal may exist beneath this spot, and that the portions visible have been volatilized by the agency of trap, which rock he supposes, from the situation of the sandstone, lies at a depth of between one and two hundred feet below the bed of the river. If Prof. H. is right in his conjecture, the coal must be reached before the above mentioned depth is attained.

Under the head of ores, we make the following extracts:

1. *Carbonate of iron* at Newbury. Sp. gr. = 2.94. Consists of

Carbonate of lime, - - - -	45.67
" magnesia, - - -	8.97
" iron, - - - -	21.76
" manganese, - - -	16.10
Silica and alumina, - - -	3.34
Loss, - - - - - -	4.16

It is very abundant.

2. *Magnetic iron* in Warwick. It is very abundant, but is not worked on account of difficulties experienced in its reduction. Sp. gr. = 4.47. Analysis.

Oxides of iron, - - - - -	66.4
Oxide of manganese, - - - -	16.6
Silica and alumina, - - - -	17.0

3. *Chrome iron ore.* This valuable ore is found in Chester, where it occurs in serpentine, in *couches* from 5 to 18 inches wide. According to Dr. Holland it contains traces of *platinum.*

4. *Limonite* (*Hematite*). This is abundant at several places in Berkshire County, where Prof. H. admits that the beds extend downwards into, and are embraced by the older rocks.

5. *Copperas.* The amount of this annually manufactured at Hubbardston is seventy-five tons.

Several new localities of galena, blende and copper-pyrites are indicated; and the report concludes with brief notices of ochres, clays, water-cement, soap-stone and serpentine-marble.

On the whole, the present work will be found to sustain the character of the more voluminous report by which it was preceded, and cannot fail of advancing the agricultural prosperity of the state, to an elevation corresponding to that which she has reached in the arts and manufactures.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Scientific Proceedings of the Boston Society of Natural History in the months of June, July, and August,* 1838; *drawn up from the Records of the Society, by* Augustus A. Gould, M. D., *Recording Secretary.*

He who makes a valuable discovery and refuses or neglects to impart it, robs mankind of a blessing, and himself of the honor that is his due. So it is with scientific bodies. The toilsome and ingenious labors of many an original discoverer, though gratifying to him in their pursuit, gain him no lasting credit; and he will be supplanted by some succeeding aspirant, because he fails to promulgate his discoveries.

None are so likely to have the fruits of their labors usurped as scientific men in America, where the means of disseminating researches are so limited. In view of this, and from the consideration that our members are entitled to the credit of the description of many objects previously unknown to science, the following abstract of its proceedings, in the manner of the "Proceedings of the Zoological Society of London" has been drawn up by the direction of the Society. It is offered for publication, with the intention that, should it receive a place in the American Journal of Science, it should be continued from time to time.

It may be proper, by way of explanation, to say, that it is the custom to commit the objects presented at the semi-monthly meetings to members, who are to report on them at a subsequent meeting. It may be further added, that most of the new species mentioned in this paper, in which only short, specific descriptions are given, are described at length and illustrated by figures in the "Boston Journal of Natural History, Vol. II, No. 2," recently published.

May 16, 1838.—Geo. B. Emerson, Esq., President, in the chair.

Dr. Charles T. Jackson, reported upon some specimens of limestone from the Welland Canal, presented by Stephen White, Esq. He showed it to be a carboniferous limestone filled with fossil shells, identical with those in the limestone found on the Aroostic River, Maine; and offered reasons for supposing that there was a continuous bed from Quebec to the Aroostic.

Dr. J. announced that three cases of minerals, collected by him on the public domain in the State of Maine, had been ordered by his Excellency, Gov. Everett, to be deposited in our Hall, with the State collection of the minerals of Massachusetts.

Rev. F. W. P. Greenwood and Dr. A. A. Gould, reported upon a paper read at the last meeting by Jos. P. Couthouy, Esq., on a species of

Thracia named by him *Thracia Conradi.* It had been previously regarded as *Th. corbuloides*, Deshayes, and is also described and figured by Mr. Conrad as *Th. declivis*, of authors. From the muscular and palleal impressions, the contour and surface of the shell, they were satisfied that it is a new species.

They also reported at some length on the confused synonymy of the different species of the genus *Thracia*, and showed that recent authors, especially Kiener, had increased, rather than diminished, the confusion previously existing.

Rev. Mr. Greenwood reported upon several fruits from Burmah and Siam, recently presented by Rev. H. Malcom. Among them were the Tamarind, (*Tamarindus Indica*,) which is also found in the W. Indies, where it is named *T. occidentalis*, although the differences in the two hemispheres, if any, are very slight; also the *Anona squamosa*, the *sweet sop* of the English, which also grows in the W. Indies.

He also presented the fruit of the *Mamea Americana*, from the nut of which the peculiar flavor of Noyeau is said to be derived.

Mr. Edward Tuckerman, Jr., presented specimens of the *Geaster quadrifidus* of Persoon, and read a paper upon it. He considers it a new addition to the Flora of North America, as Schweinitz, the only person who mentions it, says "nondum Pennsylvaniæ." It was found on the sands beyond Mount Auburn, in company with *G. hygrometricus.* This last is found on the bare sands only; while *G. 4-fidus* is found in firmer earth under trees. The name *4-fidus* is very far from specific, the number of divisions into which it splits being wholly accidental. The specific name, *fornicatus*, Hudson, is better.

At this locality he found more lichens than at any other place of the size, he had ever examined. The reindeer moss (*Cenomyce rangiferina*) here grows to the length of five inches, eight inches being the usual length in Lapland. A large number of species of the genera *Cenomyce* and *Parmelia* are found here, some of the last genus of unusual size and luxuriance.

Mr. J. E. Teschemacher, presented the palatal tooth of the *Ptychodus polygyrus*, Agassiz, an extinct species of shark. The strength and efficiency of these teeth, viewed as instruments for crushing shells and crustacea, are very remarkable. The palatal teeth of this genus are very rare, though the incisor or jaw teeth are common. Only a very few, and most of those imperfect, are yet found in European cabinets. Mr. T. had seen but two in England.

Dr. D. H. Storer read a letter from J. G. Anthony, Esq., of Cincinnati, in which he states that in his researches among the organic remains of that vicinity, *Trilobites with antennæ* occur; and requests the Society to coöperate in the investigation of this curious genus. The letter and subject were committed to Mr. Teschemacher.

Dr. C. G. Page, of Salem, through Dr. Wyman, presented a specimen of Lilium with very extraordinary markings, found in company with *Lilium Philadelphicum*, and probably a variety of that species.

June 6, 1838.—G. B. Emerson, Esq., President, in the chair.

Joseph P. Couthouy, Esq., presented two species of Cidaris, and accompanied them with a written paper on the generic distinctions of the Echinodermata, especially on those of the genera Echinus and Cidaris. This paper was rendered peculiarly interesting by the writer's personal acquaintance with the economical value of these animals, and by his amusing description of the manner in which they are served up and devoured on the Mediterranean coasts.

Mr. C. also read a paper on the genus *Patelloidea* of Quoy and Gaimard, (*Lottia* of Sowerby,) a genus which is not to be distinguished from *Patella* by the shell, but in which the animal is very essentially different. His principal object was to show, and to illustrate by living specimens upon the table, that the *Patella amœna* of Say, and *Patella alveus*, Conrad, both belonged to this genus. He conjectured that the *P. cærulea* and *P. pellucida* of Europe, would also be found to come under this genus. He showed that in the animal, the anal and genital orifices are not situated, as stated by Quoy and Gaimard, like those of Patella, just back of the head and near the right tentacula, respectively ; but that they are situated at the bottom of the cervical sac, near the base of the branchiæ. He described a thin, subtriangular, corneous plate, situated perpendicularly on each side of the lingual ribbon, of which he had nowhere seen any mention. He had constantly found it both in Patella and Patelloidea, and thought it should constitute a part of their generic characters.

Mr. W. Whittemore, had found *Planorbis armigerus*, *Cyclas similis*, and *Physa heterostropha* of Say, in a small pond in Cambridge, specimens of which he laid upon the table.

Dr. Jeffries Wyman, made a report upon an anomalous substance resembling bone, recently committed to him. On submitting a definite portion to fire, it gave out the odor of burnt leather, leaving a mass of the same magnitude, but with a loss of 25 per cent. in weight, effervescing with sulphuric acid. He remarked, that although concretions had been found in nearly every cavity of the body, none of so large a size had been found except in the alimentary canal or the urinary organs. Its rough prominences forbade the idea that it was derived from the former, and nothing of an analogous character had been taken from the human urinary organs except in one instance. Its structure was laminated. The only conclusion to which he could arrive was, that it was formed in the animal economy, and probably in the system of some of the lower orders of animals.

Dr. W. also made some remarks upon a skeleton of the sloth (*Bradypus tridactylus*) prepared by himself. The following are some of the peculiarities in its structure, viz. its three toes; its walking upon the side of the foot; the divergence of the posterior extremities from the pelvis; the articulation of the fibula as well as of the tibia with the astragalus; the length of the anterior extremities, so that the fore arm, as well as the hand, is planted upon the ground in walking, so as to bring the body into a horizontal position; the extensive coössification which takes place in all the bones of the hand and foot; the peculiar lateral disposition of the claws, and the source of the deception in President Jefferson's notions of the *Megalonyx*, so philosophically and decisively controverted by Cuvier; the bifurcation of the zygomatic process; and especially the existence of nine cervical vertebræ instead of seven, as found in all other animals. This last point, he observed, was still controverted, it being contended that what appears to be a transverse process only, does in fact bear the rudiment of a rib. Dr. W., however, has been unable to detect any thing like an articulating surface in this specimen, an old one, by long maceration of the bones. The eighth vertebra also has a distinct circular foramen for the vertebral artery, which is the distinctive character of the cervical vertebræ.

Dr. J. B. S. Jackson remarked, that in regard to the transverse process bearing a rudimentary rib, something analogous was found in the human fœtus, the transverse process of the seventh cervical vertebra being a separate piece which afterwards becomes coössified.

Dr. Storer stated, that he had received another letter from J. G. Anthony, Esq., of Cincinnati, communicating the discovery of a new genus of the Trilobite family, and that he had submitted it to Mr. Teschemacher.

June 20, 1838.—G. B. Emerson, Esq., President, in the chair.

Joseph P. Couthouy, Esq., began the reading of a monograph of the Family *Osteodesmacea* of Deshayes, embracing the genera *Thracia*, *Anatina*, *Periploma* and *Osteodesma*. He commenced with the genus *Thracia*, and shewed the great confusion which now exists in respect to both the generic and specific characters. This had arisen partly from British writers having confounded the type of the genus, *Anatina declivis*, Pennant, (*Anatina myalis*, Lam.) with another species, *Mya declivis*, Donov. (*Anatina convexa*, Turton,) and more especially by Blainville supposing a shell before him to be *Anat. myalis*, which was not so, but was *Anat. trapezoides*, and which he consequently removed from the genus *Thracia* and made it the type of *Osteodesma*, which genus again, he erroneously considers to be synonymous with *Periploma*, Schumacher. Hence have originated numerous other mistakes in subsequent writers. He then endeavored at great length to reconcile the synonymy of the following species, and the following are the results of his research.

THRACIA PUBESCENS, Leach. *Mya declivis*, Pennant, Maton and Rackett, Wood, Dillwyn and Brown; *Anatina declivis*, Brown; *Mya pubescens*, Pulteney, Montagu, and Turton; *Thracia pubescens*, Blainville, Deshayes, Kiener; *Anatina myalis*, Lam., Blainville.

It is believed that this shell has never been found on our coast; the shell which Mr. Conrad supposed to be identical with it, proving, on further examination, to be a distinct species.

THRACIA CONVEXA, Couthouy. *Mya declivis*, Donovan; *Mya convexa*, Wood, Turton; *Anatina convexa*, Turton, (Brit. Biv.,) Brown; *Ligula distorta*? Montagu.

THRACIA CORBULOIDES, Deshayes, Blainville, Lamarck, Kiener.

The exterior surface of the valves is not smooth, as described by Deshayes, unless when the granular asperities have been accidentally effaced.

THRACIA PLICATA, Deshayes, Lamarck, Kiener.

THRACIA PHASEOLINA, Kiener; *Amphidesma phaseolina*, Lam.

THRACIA SIMILIS, Couthouy. Th. testâ ovato-oblongâ, asperâ, albidâ vel cinereâ, subdiaphanâ, inequilaterali, latere postico longiore, truncato et subcompresso, angulo obtuso ab apice ad marginem infero-posticam decurrente; cardine foveolâ subtriangulari, valva utraque ligamento externè prominulo; intus albâ, impressionibus muscularibus anticè elongatis, quasi clavatis, posticè rotundatis; impressio pallii posticè valdè excavatâ; an ossiculum? Length $\frac{22}{20}$, height $\frac{14}{20}$, diameter $\frac{8}{20}$ of an inch. Hab. Coast of Brazil, not far from Rio Janeiro, whence it was brought by a seaman, containing the animal.

In general aspect and its surface it closely resembles *Th. corbuloides;* but it is destitute of the prominent ridge in the centre of the valves, it is much less inequivalve, and its ligamentary apophysis is much shorter, broader and more triangular, and its anterior muscular impression is simple instead of double, as in that species. In outline it approaches to *Th. phaseolina*, but is distinguished by its rough surface and by its very marked striæ of growth.

THRACIA CONRADI, Couthouy. Th. testâ albo-cinerascente. ovato-transversâ, ventricosâ, subæquilaterali, fragili, paullum hiante, margine sinuato, anticè rotundatâ, posticè subtruncatâ, carinâ obtusâ ab apice ad marginem infero-posticam decurrente, ligamento externè prominente, internè callo nymphale valvâ utraque inserto. Length $2\frac{18}{20}$, height $2\frac{4}{20}$, diameter $1\frac{6}{20}$ inches. Inhabits probably the whole coast of New England.

This shell was described and figured by Mr. CONRAD, in his "American Marine Conchology," as *Th. declivis*, under the supposition that it was identical with *Mya declivis*, Pennant; and besides mistaking ours for the British shell, he has given as synonyms the names of three distinct species. In the "Catalogue of the Animals and Plants of Massachusetts," in Prof. Hitchcock's Report of his Survey of Massachusetts, it is set down as *Anatina convexa*, Wood. In Dr. Storer's excellent translation of Kiener's "Iconographie," it is regarded as identical with *Th. corbuloides*, Deshayes. From this it differs, however, in several important particulars, such as its less elongated form less truncated extremity, smooth surface, and above all in the palleal impression forming posteriorly a deep and almost acute angle instead of the semicircular one of *Th. corbuloides*. The only locality where this shell has been found alive is believed to be Chelsea Beach.

Mr. C. conjectured that *Mya* (Ligula) *distorta*, Montagu, referred by Kiener to *Th. corbuloides*, would prove to belong among the perforating *Corbulæ;* and to these also he was disposed to refer *Anatina truncata*, Turton. Both of them have similar habits of burrowing in the limestone of the British coast.

July 18, 1838.—G. B. Emerson, Esq., President, in the chair.

Mr. Couthouy, continued his paper on the *Osteodesmacea*, and made remarks upon the following species.

Periploma trapezoides, Deshayes. *Periploma* inæquivalvis, Schum.; *Anatina trapezoida*, Lam.; *Osteodesma trapezoidalis*, Blainville.

Blainville was led into the error of placing this shell in the genus *Osteodesma* from supposing it to be identical with Lamarck's *Anatina myalis*. But he has committed another serious error in his generic description, which has been adopted by Rang in his "Manuel des Mollusques." He says the shell is "inéquivalve, la valve gauche plus bombée que la droite," whereas the right valve is more convex than the left. Perhaps they were misled by the peculiar position of the ligament, which is remarkable for being placed anteriorly instead of posteriorly, as in most other shells; a fact not noted in any description. In the very perfect specimen under observation the ossiculum is nearly a complete semicircle. Deshayes speaks of it as triangular.

Osteodesma hyalina, Couthouy. *Mya hyalina*, Conrad.

The genus *Osteodesma*, Deshayes, will doubtless prevail over *Lyonsia*, Turton, and *Magdala*, Leach, MSS., all of which are founded on *Mya Norvegica*, Chemnitz, the *Amphidesma corbuloides* of Lamarck. The name is expressive of the distinguishing feature of the shell. Blainville and Rang were led into the error of supposing *Periploma* and *Osteodesma* to be identical; and Deshayes, though he notices the mistake and refers to his article on *Osteodesma* in the Encyc. Method. for its actual characters, yet by a singular oversight that article is entirely omitted. Consequently, it is to be found only in his recent edition of Lamarck. In the "Catalogue of Animals and Plants of Massachusetts, 1834," it is noted as *Amphidesma corbuloides*, Lam.; but the European shell is twice the size, more elongated, more broadly truncated, more inequilateral, thicker, and covered with a much stronger and more opaque epidermis. Dr. Gould noticed the peculiarity of the ossiculum several years since, and consequently referred the shell to the genus *Lyonsia*.

Mr. Couthouy, also read the description of a new species of *Eolis* lately found by him, and which he named

Eolis diversa. E. corpore limaciformi, posticè acuto, diaphano, luteo-rufescente, capite distincto, sub-orbiculato, depresso; tentaculis gracilibus elongatis duabus instructo, duabusque brevioribus ad partem posticam capitis positis; branchiæ aurantiacæ seriebus binis lateribus dorsi dispositis. Orificia generationis magna, juxta collum ad latus dextrum, ano paullum pone; pede supra laciniato. Length $\frac{24}{25}$, breadth $\frac{7}{20}$ of an inch. Inhabits Massachusetts Bay, Chelsea Beach.

Found among the roots of *Laminaria saccharina*. In its color and general aspect it resembles *E. salmonacea*, Nobis, but differs in the form and position of the tentacula and genitalia. In *E. salmonacea* the lateral tentacula seem to be a prolongation of the fleshy lips, instead of being placed near the neck; the superior ones are long, somewhat compressed, and as it were serrated at the edges, while in *E. diversa* they are short, smooth and round.

Dr. Jeffries Wyman, reported upon a collection of *fossil bones* from the Brunswick canal, Georgia, presented by Mr. Cooper. It consisted of eighteen bones belonging to the genera *Bos*, *Elephas*, and probably *Mastodon*. Among them were the *atlas* of a ruminant, of gigantic size; *metatarsal bone* of right foot of genus *Bos*, about twice the size of the corresponding bone of the common ox which he exhibited by its side, and similar to it in every particular; several *vertebræ* of a *Mastodon;* portions of a *tusk* and *teeth* of an *Elephant*. These teeth resemble those of an Indian elephant, but the layers of enamel are more numerous and closer. An *os calcis* having the hinder portion broken off, but which is now longer than that of our elephant, though not so massive.

Dr. W. had also examined some *fossil bones* brought from Burmah by Rev. H. Malcom. They consist of a portion of the *brim of the pelvis*, probably of a *Mastodon;* tooth exhibiting the longitudinal crescentic layers characteristic of a ruminant, and corresponding with a figure by Mr. Clift in the Trans. of the Geol. Society, vol. vii, of the tooth of a deer from the same locality; *vertebra* of a *Saurian*, also resembling a figure by Mr. Clift, and which he regards as the vertebra of a crocodile, with all probability of truth. This locality on the river Irawaddy, below Ava, is the only locality known where the bones of mammalia and saurians are found associated.

Dr. Wyman had also examined the recent elephant's tooth brought from Singapore by Mr. Malcom. It indicates greater age than any other tooth on record. The successive teeth have 4, 8, 12, 15, &c. transverse plates of enamel, up to the eighth set which has 23 plates, which is the greatest number heretofore recorded. But this tooth has 26 plates firmly solidified, and some others are broken off from the anterior extremity; indicating a very great age for the animal.

Mr. Thomas M. Brewer, alluded to a remark at a former meeting when speaking of the cow blackbird. He had said that its eggs could not be hatched by the golden-finch, because that bird had not been observed to breed before the first of August, which is later than the breeding season of the cow blackbird. This remark had nearly proved false. At the latter part of June, Mr. B. had discovered two pairs of finches building their nests, and they had nearly completed them when the weather suddenly became very warm, the nests were deserted and the birds disappeared. As yet, therefore his former remark holds good.

Dr. A. A. Gould, had examined the marine production presented some time since by Mr. Ballister, and commonly called *Neptune's Goblet.* He had not been able to find any mention of it in Cuvier's Animal Kingdom, or in any scientific work, except in the Asiatic Researches, vol. xiv, p. 180, where it is described and figured by Col. Hardwicke under the name of *Spongia patera.* It is not a true sponge however, although it belongs to the family of sponges. It is common in the vicinity of Singapore.

The President, (G. B. Emerson, Esq.,) read a report on the specimens of paper and pasteboard manufactured from the Beach grass, and presented by its inventor, Mr. Sanderson, of Dorchester. The plant is the *Arundo arenaria,* Lin. It is placed in the genus *Calamagrostis* by Withering and Decandolle, *Ammophila* by Hort and Hooker, *Psamma* by Palissot de Beauvais, Torrey, Eaton and Beck, *Phalaris* by Nuttall. It is called sea-reed or mat-reed, in England, and is found on all the shores from Iceland to Barbary, and all the Atlantic shore from Greenland as far south as New Jersey, at least. Its principal use heretofore has been a negative one, connected with the very terms of its existence. It effectually secures the shifting sands on which it grows; and for that purpose large sums are annually appropriated by government, that by its cultivation important harbors may be preserved.

Mr. E. had not succeeded in finding the ingenious gentleman who had converted the otherwise useless stalks of this plant to so valuable a purpose. The paper is not even, but it is smooth, soft, and pleasant to write upon, and takes ink well. It is firm and very strong, and may be whitened readily. The pasteboard appears to be specially valuable.

Mr. Sanderson has thus opened a new source for industry to the enterprising inhabitants of the most barren parts of New England; and if he is a benefactor to his race who makes two stalks of grass to grow where but one grew before, surely *he* deserves well of his country, who indirectly converts barren sands into fruitful fields.

August 1, 1838.—Mr. J. E. Teschemacher, in the chair.

After the reading of the records of the preceding meeting, Rev. Mr. Malcom who was present, remarked in relation to the fossils brought by him from Burmah, that they are found only at a small stream below the city of Ava, where the region is perfectly sterile. The soil is clayey, and the bones are very numerous and lie in abundance upon the surface. The place abounds with petroleum wells, and this article is the only product from whence the inhabitants derive their support.

He remarked that the *Spongia patera* was found only at Singapore, and always grows below low water mark, and is fished up by divers.

A specimen of Burman tea was presented by him. It is raised in the interior and compressed into globular masses of four or six inches in diameter, some substance, said to be blood however, being mixed in to cause their cohesion. These are brought to the sea ports on the backs of mules and sold at ten cents per pound. The Burmans use no other tea, and yet Mr. M. found it to be unknown at Calcutta. He pronounced it an excellent tea.

Mr. C. B. Adams, read a paper entitled "Remarks on some species of shells found upon the southeastern shore of Massachusetts." They were the results of his observations in several visits to that region, and contain many interesting facts as to the habits, localities, and varieties, and several important characteristic additions to the original descriptions.

Columbella avara, Say. Differs a little from Say's description; costæ 14 to 18 on the body whorl; young shells are carinate at the termination of the costæ. Found at New Bedford and vicinity, Falmouth, Nantucket, Martha's Vineyard, but not north of Cape Cod.

Buccinum vibex, (Nassa vibex, Say.) Number of revolving lines on the body whorl more frequently 9 or 10; as many as 3 to 5 teeth on the inner side of labrum. Rare. He had found five specimens about New Bedford. Mr. P. G. Seabury had found others. They are all old and somewhat cretaceous, but in some the rufous bands are distinctly marked. It has not been found north of Cape Cod.

Buccinum trivittatum, (Nassa trivittata, Say.) The two upper bands of rufous are double, being on each side of one of the revolving lines, and the third is often triple; the upper band is darkest, but in many cases the bands from which the species derives its name are wanting. It is generally covered with a dirty cinereous pigment. Abundant at Nantucket, not unfrequent at New Bedford, and occasionally found living at and near Boston.

B. obsoletum, (Nassa obsoleta, Say.) The cancellate and granulated appearance mentioned both by Say and Kiener (*B. oliviforme*) is not a constant character except in the adult shell; the white band upon the inner side of the labrum is usually well defined. Inhabits not only our estuaries but our ocean shores, though it seems to prefer places not exposed to the surf. The finest specimens grow at Nantucket, where they are abundant. In winter he had observed them to collect together in heaps, filling up slight depressions in the flats.

Purpura lapillus, Lam. He had not seen this common species at New Bedford, Wood's Hole, or Nantucket; but had found *Fusus cinereus* in situations where he expected to find that species.

Ranella caudata, Say. Well described by Mr. Say; the canal is not longer than the spire, but equal or shorter. It is rare, and not found north of Cape Cod.

Fusus cinereus, Say. The fauces are not unfrequently white; sometimes there are bands of purplish red in the fauces; the transverse costæ are often nearly obsolete. Generally found clinging to the wet sides of rocks near low water mark.

Mr. Adams also read descriptions of the following shells recently discovered by him in the waters of Massachusetts.

Jaminia seminuda. J. testâ parvulâ, acuto-conicâ, nitidâ, albidâ, sub-translucidâ; anfractibus septem convexis, decusatim granulosis; anfractu postremo infra striato; aperturâ ellipticâ, basi effusâ; columellâ reflexâ, uniplicatâ. Length .15, breadth .07 inch. Inhabits Dartmouth harbor.

Only four specimens were found, about five feet below low water mark, on valves of *Pecten concentricus*. In size and figure it resembles *Actæon trifidus*, Totten, but differs in its convex whorl, granulous surface, and more distinct and uniform revolving lines; also in its less rounded and more effuse aperture.

Pyramis fusca. P. testâ parvulâ, conicâ, decisâ; epidermide fuscâ, nitidâ; anfractibus sex, convexis; suturâ impressâ, sub-duplicatâ; aperturâ ovali, supra angulatâ, infra rotundatâ; labro tenui; columellâ convexâ, reflexa, haud duplicatâ. Length .15 inch, breadth .07 inch. Inhabits harbors of New Bedford and vicinity.

Cerithium Emersonii. C. testâ parvâ, conicâ, elongatâ, longitudinaliter rugosâ, lineis granulatis cinctâ; anfractibus septemdecim, planulatis; apice acutâ; suturâ sub-impressâ, amplâ; aperturâ subquadratâ; labro pectinato; columellâ in spiram ductâ; caudâ recurvatâ. Length .45 inch, breadth .12 inch. Inhabits New Bedford harbor on the Fairhaven side, and Nantucket (?). A variety has the granules obsolete, or coalescing into simple elevated, revolving lines.

Cerithium nigrocinctum. C. testâ parvulâ, conico-cylindricâ, granulosâ, nigro-rubra; anfractibus tredecim, sinistrorsum volventibus; spirâ elongatâ, acutâ; suturâ sub-duplicatâ; aperturâ sub-ellipticâ, parvâ; caudâ recurvatâ. Length .3 inch, breadth .08 inch. Inhabits Dartmouth harbor, clinging to sea-weed.

Differs from *C. perversum*, Lam., in the black sutural ridge, and in the position of the middle series of granules; and from *Murex adversus*, Montagu, in its recurved canal, its distinct suture and its color.

Mr. Couthouy concluded his paper on the Osteodesmacea, and also instituted a new genus to include shells formerly embraced in genus *Anatina*, but which, having a spoon-shaped hinge, are destitute of an ossiculum. He thus characterized it.

Genus Cochlodesma.

Animal oval, compressed, enveloped in a thin mantle, closed by a membrane in front, except at the anterior inferior extremity, where it opens to give passage to a broad compressed foot, extending along the whole inferior surface of the abdominal mass, which is inconsiderable; edges of the pallium thickened, and a little rugose; siphons long, slender, divided in their whole extent, and opening separately into the branchial cavity.

Shell transversely oval, thin and fragile, sub-equilateral, convexo-depressed, slightly gaping at both extremities, inequivalve, right valve more convex, beaks moderately prominent, inclining a little backwards, summits cloven and sub-nacrous posteriorly; extremities rounded. Ligament double, the external very slight and membranous, the internal received into a horizontal, spoon-shaped process on each valve, supported by one or two divergent falciform costæ, projecting from it obliquely and posteriorly; muscular impressions superficial, remote, the anterior elongated-oval, the posterior small and sub-triangular, united by a palleal impression profoundly indented posteriorly.

The *Anatina Leana*, Conrad, is the type of the genus; and the *Anatina prætenuis*, Turton, probably belongs to it.

Mr. Couthouy then read descriptions of the following new species of shells.

Nucula navicularis. N. testâ parvâ, lævi, fragili, ovali, subæquilaterali, luteo-virescente, anticè rotundatâ, posticè truncatulâ, cardine dentibus octodecim, intus albo-nitescente. Length $\frac{11}{20}$, height $\frac{5}{20}$, breadth $\frac{3}{20}$ of an inch. Inhabits Massachusetts Bay, vicinity of Plymouth.

Beaks more central and basal outline much more strongly curved, than in *N. myalis*, Couth.

Bulla lineolata. B. testâ parvulâ, oblongo-ovatâ, ferrugineâ, transversim obliquè frequenterque striatâ, spirâ, prominulâ, apertura magnâ, ad basim valdè dilatatâ et sub-effusâ. Length $\frac{6}{40}$, breadth

$\frac{3}{40}$ of an inch. Inhabits Massachusetts Bay. Taken from a fish's stomach taken off Race Point, and resembles *B. lignaria* in miniature.

Bulla hiemalis. B. testâ perparvâ, hyalinâ, globosâ, convolutâ, longitudinaliter tenuè striatâ, spirâ nullâ, aperturâ ad basim valdè dilatatâ. Length $\frac{1}{10}$ of an inch, breadth about the same. Inhabits Massachusetts Bay.

Bulla Gouldii. B. testâ parvâ, ovatâ, convolutâ, fragili, albâ, transversim tenuè striatâ, spirâ depressâ, imperforatâ, interdum prominulâ, anfractibus quatuor, supernè rotundatis, suturis impressis, aperturâ supra angustâ, versus basim dilatatâ, columellâ arcuatâ. Length $\frac{11}{40}$, diameter $\frac{5}{40}$ of an inch, nearly. Inhabits Massachusetts Bay. In size and shape much like *B. insculpta*, Totten, but is smoother, more solid and not umbilicated. Often the outer volution forms an elevated, rounded ridge, encircling and rising above the others.

Pleurotoma decussata. P. testâ parvulâ, ovali, fusiformi, albidâ, anfractibus quinque convexis, longitudinaliter plicatis, transversè striis frequentibus tenuibus decussatis, aperturâ elongato-ovali, basi sub-canaliculatâ, labro tenui, lævi, supernè indentato, columellâ nitidâ, depressâ arcuatâ, ad basim sinistrorsum divergens. Operculum rudis. Length $\frac{7}{20}$, diameter $\frac{3}{20}$ of an inch. Inhabits Massachusetts Bay. Distinguished from *Fusus harpularius* by its color, the greater convexity of the whorls, and the angular sinus at the junction of the lip.

Anculotus dentatus. A. testâ rotundata vel sub-conicâ, irregulari, olivaceo-nigrescente; anfractibus quinque, ultimo magno, ventricoso, sæpe fasciis duobus aut tribus radiis cincto; suturis impressis, spirâ obtusâ plerumque erosâ; aperturâ erosâ, basi effusâ; columellâ atrâ arcuatâ, depressâ, ad basim unidentatâ, posticè excavatâ, intus virido vel fusco-albescente. Operculo corneo, unguiculato. Length $\frac{10}{40}$, diameter $\frac{11}{40}$ inch. Inhabits the rapids of the river Potomac, Va.

Greatly resembles *A. monodontoides*, Conrad, but is distinguished by the peculiar flattening of its purple columella, the remarkable fossa in the umbilical region, and its more obtuse tooth situated nearer the base.

Dr. T. W. Harris, made some remarks on the difficulties met with by himself and others in the study of Botany, on account of the want of strict accuracy in our books. Thus, in Bigelow's Florula, *Vaccinium* is placed in Octæandria, while all our species are invariably 10-androus, and are so arranged in all more recent works. *Menyanthus* has the stigma trifid oftener than bifid, and sometimes quadrifid. *Cheledonium*, which belongs to Polyandria, has only 8 to 12 stamens; while *Cratægus*, which belongs to 20-andria, is found with only 10 stamens.

Dr. H. had recently found a *Silene* growing on earth thrown out from a newly dug drain, and had since observed it on the corn-fields, near by. It proves to be *Silene noctiflora*, Sowerby. It flowers in the evening, and Mr. Sowerby says the same flowers open for several successive evenings until they are impregnated. Do H. nds this to be not true. Eaton says the teeth of the calyx tube are equal; but they were alternately longer and shorter. This plant may be considered as naturalized among us.

Beck pronounces the *Lathyrus maritimus*, Bigelow, to be *Pisum maritimum*; but Dr. H. is confident that Dr. Bigelow is correct.

Mr. A. A. Hayes, presented a specimen of native nitrate of soda from Tamarugal in Peru. It contains sulphate of soda, chloride of sodium, *Iodate of soda*, and chloriodide of sodium. In presenting this specimen with its analysis, Mr. Hayes makes the first public announcement of the discovery of *Iodate of soda*, as a new chemical species.

Mr. C. B. Adams, enumerated the minerals in the collections from California by Mr. Kelly, and from Nova Scotia by Rev. Mr. Prior, and made various remarks respecting them, to designate their peculiarities and value.

August 15, 1838.—Dr. T. W. Harris, in the chair.

Dr. Jeffries Wyman, exhibited a fœtal kitten contained in its membranes, showing the peculiar manner in which the placenta encircles the fœtus like a zone. Also the uterus of a mouse, showing its bead-like appearance when impregnated. Also the egg of the snapping turtle near the close of incubation, showing the passage of the umbilical vessels through a hole in the sternum. These are finally cut off and the aperture closed by a peculiar muscle.

Mr. T. M. Brewer, remarked further on the goldfinch alluded to at a preceding meeting;—that on 22d July he again observed the bird at its nest, where there were four eggs. This was three weeks earlier than usual, and the cow-bunting leaves us three weeks earlier still.

Mr. E. Tuckerman, Jr., presented some plants not yet catalogued, as belonging to this country, they were *Cladonia vermicularis*, *Cetraria nivalis*, and a *Parmelia*, all from the White Mountains.

Dr. T. W. Harris read a paper entitled "Remarks on the N. American insects belonging to the genus *Cychrus* of Fabricius, with descriptions of some newly detected species." He proceeded to show that the genus *Scaphinotus*, Dejean, is established on very insufficient characters. Those of *Sphæroderus* are somewhat better. The same also with Mr. Newman's genus *Irichroa*. He concludes that the insects placed in *Cychrus*, *Sphœroderus*, *Irichroa* and *Scaphinotus*, are more closely related to each than to any other genus, and can constitute merely subgenera.

The following are the new species:

Cychrus Andrewsii. Black; thorax deep greenish blue, heart-shaped, narrowed behind, and slightly margined at the sides; elytra deep blue, faintly tinged with violet, slightly carinated at the base and sides, and with punctured striæ. Length, including the mandibles, nine and a half lines. Inhabits North Carolina. Resembles *C. marginatus* and more nearly still *C. cristatus* from Oregon.

Cychrus Leonardii. Black; head transversely striated; thorax violaceous, subquadrate, narrowed behind; elytra broad ovate, carinated at the sides, bronzed violet, deeply crenato-striated. Length, including mandibles, from 11 to 13 lines. Inhabits northern and western parts of Massachusetts and New Hampshire. Hitherto confounded with *C. viduus*, from which it essentially differs in color and its more dilated form.

Cychrus tuberculatus. Black opaque; head rugose and with two longitudinal impressions on the front; thorax rugose, truncato-cordate, contracted behind; coleoptra ovate, very convex, granulated, with a triple series of smooth tubercles on each elytron; epipleura rugosely punctured. Length 7 to 8[1] lines. Inhabits Oregon.

Cychrus angulatus. Black; head carinated; thorax angulated at the sides, much contracted behind; elytra violaceous-brown, somewhat flattened, crenulato-striate; legs brownish-piceous. Length 6½ lines. Inhabits Oregon.

Cychrus cristatus. Black; head carinated; thorax cordate, contracted behind; elytra crenato-striate, with a narrow, blue margin. Length 5¼ lines. Inhabits Oregon.

Dr. Harris exhibited specimens of *Nymphea odorata* (var. sanguinea) from the Botanic Garden, Cambridge; and remarked upon the tendency, strongly exhibited in these specimens, which all the parts of the flower have, to become leaves.

Dr. Gould remarked that this lily was originally brought from Mossy Pond, in Lancaster, where it grows in one small spot. He was inclined to regard it as a distinct species, having constantly found the angles of the leaves more prolonged, the color darker and the size smaller than in *N. odorata.*

Mr. C. B. Adams, had spent a day at Fresh Pond, and gave an account of the shells he had found there. They were the following species, viz.: *Unio nasutus*, *complanatus*, and *radiatus*; *Anodonta implicata*, Say; *Cyclas similis*; *Planorbis trivolvis*, *bicarinatus*, *deflectus?* and *hirsutus*, MS.; *Valvata tricarinata*; *Succinea ovalis*; *Lymnea heterostropha*, *columellaris*, *catascopium*, *Physa heterostropha*, *Paludina decisa*, *lus rica?*

Of *Unio nasutus* only one specimen was found, *U. radiatus* was abundant, clean and beautiful. From one of them dropped a beautiful pearl in the form of a flattened sphere, .16 inch in the longer and .11 inch in the shorter diameter. Of *Anodonta implicata*, Say, he said, that a comparison of adult shells only, with specimens of *A. cataracta* from other localities might lead to the conclusion that they were distinct species; but an examination of them in every stage of growth from the size of the thumb nail upwards, renders it probable that they are only a variety of *A. cataracta.* An undescribed species of *Planorbis* was found abundantly. He first found it in Mansfield, and it has since been found by Dr. Gould in Dedham, and he proposes to describe it under the specific name *hirsutus.* It resembles the European *albus* in the revolving lines of hairs by which it is covered. A minute species of *Paludina* seems also to be new.

2. *African Meteorite.*—(*From the London Nautical Magazine.*)—Extract from a letter, dated Nov. 24, 1838, written by a gentleman (on whom reliance may be placed) residing at the Cape of Good Hope. "I have taken the liberty to transmit under your charge, for Sir John Herschel, the accompanying aërolite, another portion of an enormous aërolite, that exploded in the department called the Cold Bokkeveld, about 112 miles N N. E. of this place, on the morning of the 13th October, (1838,) and which for magnitude ranks with the largest on record of undoubted authority. Judge Menzies, returning from circuit, saw it traversing the atmosphere about 60 miles from the estate, where it exploded with a report equal to the discharge of some heavy pieces of artillery, to the great astonishment of the inhabitants, one of whom had a narrow escape from being destroyed by it. I am making strong efforts to secure a piece, said to have made a hole in the ground that would admit a dining table! This may be exaggerated. A man declares the hole is three feet in diameter. Also to collect information regarding its velocity, course, altitude, &c."

3. *New species of Argulus; notice from Dr. T. W. Harris.*—It may interest some of your readers to be informed of the discovery of another species of ARGULUS in this country. It was found in the gills of a herring, caught upon Brighton bridge from Charles river, during the month of June last. It differs from ARGULUS *foliaceus* of Europe, and from the species described in a former number of your Journal, vol. xxxiv, p. 225, in the size and form of the body, and in the shortness of the legs. Having presented the specimen to Dr. A. A. Gould, for description, I shall not attempt to anticipate him by giving a detailed account of its specific characters at this time.

Cambridge, (Mass.) Feb. 8, 1839.

4. *Cabinet of Minerals for sale.*—The Cabinet of Minerals of the late Dr. Young, of Edenville, N. Y., is offered for sale. This collection was selected with great care by Dr. Young, and embraces the rare and beautiful productions of Orange county, N. Y., and Sussex county, N. J. Its crystals of spinelle, corundum, Franklinite, Brucite, Troostite, melanite, hornblende, bronzite, idocrase, &c., &c., would be an invaluable acquisition to any public cabinet. It has been generally pronounced by min-

eralogists to be one of the most select and beautiful collections ever formed in this country.

Edenville, April 12th, 1839.

5. *Correction.*—In Vol. xxxv, No. 2, p. 375, we mentioned the supposed spontaneous crystalization of liquid carbonic acid in one of Dr. Torrey's tubes. In a letter from him dated New York, March 1, it is remarked that the crystals which we had observed were sulphate of ammonia, which was formed by the combination of sulphuric acid with ammonia during the decomposition of the carbonate to obtain the carbonic acid gas for condensation. He adds, "a very good method of showing the rapid condensation of the carbonic acid, and its *ebullition* at the same time, is to surround the upper part of the tube with a freezing mixture. Place the mixture (ice and salt) in a bottle, the bottom of which is cut off. The mouth is furnished with a perforated cork, through which the upper part of the tube is thrust.

carbonic acid.

sulph. ammonia.

"I have been shooting with a kind of air gun, using my liquified carbonic acid for throwing the balls, and I hope soon to emulate Perkins' steam gun."

6. *Footsteps and Impressions of the Chirotherium, and of various Animals, in sandstone.*—The readers of this Journal are familiar with the reports made by Professor Hitchcock, on the foot marks of birds and perhaps quadrupeds upon the sand stone rocks of the valley of the Connecticut River. See vol. xxix, p. 307, and vol. xxxii, p. 174. We have cited also those observed ten years ago at Corncockle Muir in Scotland, vol. xv, p. 84; and more recently near Hildburghausen, in Germany, vol. xxx, p. 191.

We shall now, from the reports of the doings of the Geological Society of London, cite some other facts of this class. We allude to the now famous quarries of Storeton Hill, near Liverpool, England.

We have recently received from Prof. Buckland fine copies of these impressions, and it is no more possible to doubt the genuineness of their originals, than those of the most recent impression of a foot made in any yielding surface of the present hour. The same is true of the impressions of Prof. Hitchcock, whatever doubt may have been felt by some persons who have never examined them.

The communication which we now cite was made to the Geological Society by the Natural History Society of Liverpool, with drawings by John Cunningham, Esq.

In the early part of last June, there were discovered in the Storeton quarries, on the under surface of several large slabs of sandstone, highly relieved casts of what the workmen believed to have been human hands; and the circumstance having been made known to the Natural History Society of Liverpool, a committee was appointed, who drew up the report communicated to this Society.

The peninsula of Wirral consists of new red sandstone; and towards the northern extremity, the formation may be separated into three principal divisions. The lowest is composed of beds, slightly inclined towards the east, of red or variegated sandstone, occasionally abounding with pebbles partly derived from the coal-measures; and in the bottom strata either angular or little water-worn. Seams of marl are very rare in this division, the argillaceous matter being confined to nodules or concretions of clay of the same color as the sandstone.

The middle division consists of white or yellow sandstone, in some places argillaceous, and frequently containing round concretions of clay, and pebbles. The strata are separated by seams of white or mottled clay, occasionally almost imperceptible, but sometimes several inches thick.

The uppermost division is formed of red or variegated sandstone, inclosing also nodules of clay and pebbles of quartz; and it abounds with strata of red marl.

The Storeton quarries are situated in the middle division; and the casts which have hitherto been noticed, occurred on the under surface of three beds of sandstone, about two feet thick each. The strata incline 8° to the northeast, but they are traversed by several faults, which range in the strike of the beds. The authors of the report are of opinion, that each of the thin seams of clay in which the sandstone casts were moulded, formed successively a dry surface, over which the Chirotherium and other animals walked, leaving impressions of their footsteps; and that each layer was submerged by a depression of the surface. The lowest seam of clay was so thin, that the marks penetrated into the subjacent sandstone. The following account is then given of a hind foot and a fore foot, selected from slabs in the Museum of the Royal Institution, Liverpool.

Hind Foot, consisting of five digits; one of which, from its resemblance to a human thumb, has been generally distinguished by that designation.

	Inches.
Total length from the root of the thumb to the point of the second toe	9
Extreme breadth from the point of the thumb to the point of the fourth toe	6

	Inches.
Breadth across the toes	5
Breadth across the palm	3
Length of the curved line extending from the root of the thumb to its point	$6\frac{1}{2}$
Breadth of the ball of the thumb	$1\frac{1}{2}$
Relief of the ball of the thumb from the surface of the slab .	$\frac{1}{2}$
Length of the first toe from the root to the point . . .	$5\frac{1}{4}$
Length of the second ditto	$5\frac{1}{2}$
Length of the third ditto	4
Length of the fourth ditto	$2\frac{1}{2}$
Average breadth of the first three toes	1
Average breadth of the fourth toe rather less than . . .	1
Relief of the second toe, which presents the greatest prominence	$\frac{6}{10}$

One hind foot has been observed which measured 12 inches in its greatest length.

Judging from the appearance of the casts, the sole of the foot must have been amply supplied with muscles, the casts of the ball of the thumb and the phalanges of the fingers being prominent. The digit which has been called a thumb, is of a tapering shape, and is bent backwards near the extremity, where it ends in a point. It is extremely smooth, and there is no satisfactory evidence of either a nail or a claw. The toes are thick and strong, and had probably three phalanges each, and at the terminations are traces of stout, conical nails or claws. The sole of the foot is supposed to have been covered by a slightly rugose skin, the folds of which are stated to be distinctly visible in the casts of the toes.

Fore Foot. Perfect impressions of the fore feet are extremely rare, owing either to the animal having used those feet lightly, or to the impressions having been obliterated by the tread of the hind feet. The best preserved cast exhibits a thumb and three toes, being deficient of the fourth. The dimensions, which are generally half of those of the hind foot, are as follows:

	Inches.
Length from the root of the thumb to the point of the second toe	$4\frac{1}{2}$
Total breadth not ascertained in consequence of the absence of the fourth toe	
Breadth of the palm	$1\frac{3}{4}$
Length of the thumb	$2\frac{1}{2}$
Breadth of the ball of the thumb	1
Length of the first toe	2
Length of the second toe	$2\frac{1}{4}$
Length of the third toe	$2\frac{1}{4}$
Greatest breadth of the toes	$\frac{3}{4}$

The thumb is slightly bent back, and pointed, and the toes were armed with nails.

Traces of one animal have been observed in a continuous line on a slab ten yards long. The length of the step varies a little, but in general, the distance between the point of the second toe of one hind foot and the point of the same toe in the hind foot immediately in advance, is between 21 and 22 inches. Each fore foot is placed directly in front of the hind, and the thumbs of both extremities are always towards the medial line of the walk of the animal. Some further observations are given by the authors with respect to the progression of the animal, on the supposition that the digit conjectured to be a thumb, was rearly the first. Conceiving such to be the case, they state, that the animal must have crossed its feet three inches in walking, for the right fore and hind feet are placed $1\frac{1}{2}$ inch on the *left* side of the medial line, and the left fore and hind feet $1\frac{1}{2}$ inch on the right side of the same line.

The casts of the Chirotherium, although the most remarkable, are by no means the most numerous, which exist on the Storeton sandstones. Many large slabs are crowded with casts in relievo, some of which are supposed to have been derived from the feet of saurian reptiles, and others from those of tortoises. Occasionally the webs between the toes can be distinctly traced. "It is impossible," say the authors of the report, "to look at these slabs and not conclude, that the clay beds on which they rested, must have been traversed by multitudes of animals, and in every variety of direction."

A note by Mr. James Yates was then read, giving a brief account of sketches of four differently characterized footsteps, traced from casts procured at Storeton, each of which is distinct both from the casts of the Chirotherium and the web-footed animal mentioned in the preceding report.

A paper was afterwards read "On two Casts in Sandstone of the impressions of the Hind Foot of a gigantic Chirotherium, from the New Red Sandstone of Cheshire," by Sir Philip Grey Egerton, Bart., M.P., F.G.S.

These specimens first came under the notice of Colonel Egerton, about 1824, and they were placed in the author's cabinet in 1836; but it was not until the recent discovery of the Chirotherium at Storeton, that their true nature was suspected. The exact locacity, at which the specimens were discovered, is not known; but it is proba-able, that they were obtained from the neighborhood of Colonel Egerton's residence, near Tarporley, and from one of the beds of sandstone, which alternate with the red and green marls in the upper part of the new red system in that part of Cheshire.

The casts, which consists of a rather soft and coarse sandstone, were evidently formed in the impressions of two hind feet; and though they have suffered from exposure to the weather for twelve years, yet they are sufficiently perfect to have enabled Sir Philip Egerton to take the measurements of the different parts, and draw up the accompanying comparative table. It is necessary to state, that though he preserves the use of the term thumb for the convenience of comparison with previous descriptions, yet he is of opinion that the marginal digit which has been so designated, is not the representative of the fifth, but of the first toe.

Direction of the Measurements.	Hessberg Chirotherium.	Storeton Chirotherium.	Large Chirotherium from near Tarporley.
Length from the heel to the point of the 2nd toe - - -	7 8	8 7	15 0
Length from the heel to the point of the thumb - - -	3 4	4 3	8 0
Length from the heel to the angle between the 1st and 2nd toes - -	4 8	5 6	10 0
——— 2nd and 3rd toes	4 4	5 8	11 0
——— 3rd and 4th toes	4 0	5 3	11 0
Greatest breadth across the insertions of the toes - - -	5 0	4 2	8 5
Breadth from the point of the thumb to 4th toe - - -	5 5	5 0	9 0
Breadth from the thumb to point of 4th toe	6 3	6 0	10 6
Breadth across the sole below the thumb	3 6	3 0	6 0
Breadth from 1st toe-point to 4th toe-point	4 6	4 6	9 0

From these measurements it appears, that considerable differences exist in the three specimens of Chirotherium. Upon comparing the footstep from Hessberg with that from Storeton, it will be found, that the former is thicker and more clumsy than the latter; that the sole is shorter and broader, and the toes wider and longer. The most important discrepancy, however, is in the position of the thumb, which is placed much nearer the heel in the Hessberg specimens than in those from Storeton. The cast from near Tarporley resembles the latter more than the former; it nevertheless differs considerably in the proportion of the breadth to the length of the sole, which is greater; and in the proportions of the length of the toes to the length of the sole, which is less than in the Storeton specimens. It is also distinguished by the greater divergence of the toes from each other. From these differences and the gigantic size of the Tarporley specimen, the author conceives that the animal which made the impression was a distinct species; and he proposes for it, in compliance with the adage *ex pede Herculem*, the name of *Chirotherium Herculis*.—*Lond. and Edin. Phil. Mag.*, *Jan.*, 1839.

7. *New Works received.*

From motives of convenience we have omitted, on the present occasion, our usual list of acknowledgments; but we are unwilling to postpone the mention of the following works, which have been presented since our last number.

1. Geological Report on the State of New York, continued from last year, being State Document, No. 275; communicated to the Legislature of the State, by Gov. Seward, Feb. 27, 1839. pp. 351. Copies from L. Vanuxem, E. Emmons, and B. D. Silliman.

2. Geological Report on the State of Michigan in continuation, Doc. No. 23, Feb. 4, 1839, by Douglass Houghton, State Geologist. pp. 123. From A. Sager, and a second copy to the Yale Nat. Hist. Society.

3. Second Annual Report on the Geological Survey of the State of Ohio, by W. W. Mather, and several assistants. Columbus. 1838. From C. B. Goddard, Esq.

4. First and Second Annual Reports on the Geological Survey of Virginia, for 1836 and 7, by and from Prof. Wm. B. Rogers. Univ. Virg. pp. 87.

5. Report on the Geological Survey of Virginia, Doc. No. 56, in continuation, for 1838, by and from Prof. Wm. B. Rogers. Univ. Virg. pp. 32, quarto.

6. Annual Report of the Geologist of Maryland. 1838. pp. 33.

7. Report on the Geology of Indiana, 1837–8, by D. D. Owen, State Geologist. pp. 54.

8. Third Annual Report of the Geological Survey of Pennsylvania, by and from Prof. H. D. Rogers, State Geologist. 1832. pp. 118.

9. Trans. Am. Phil. Soc. Phil. Vol vi, Part I. 1838. p. 152. From the Society.

10. Third edition in quarto of the catalogue of shells in the collection of Dr. John C. Jay, N. Y., 1839. 2 copies. From the author to B. Silliman, Jr., and to the Yale Nat. Hist. Society.

11. The Silurian System founded on Geological Researches in the counties of Salop, Hereford, Radnor, Montgomery, Caermarthen, Brecon, Pembroke, Monmouth, Gloucester, Worcester,

and Stafford, with descriptions of the coal fields and overlying formations, by Roderick Impey Murchison, F. R. S., F. L. S., Vice President of the Geological Society of London, &c. &c. &c., in two parts. Part I, containing over 600 pages, large and full quarto, illustrated by 112 wood cuts and a map; with 13 picturesque views, generally colored, and several of them folded. Part II, Organic Remains and Sections, over 200 pages quarto, making more than 800 for the entire work. There are 27 lithographic plates for the organic remains, containing nearly 700 figures.

The colored sections are nine, generally three folded, and containing 111 distinct sub-sections.

The country described by the author, after seven years of arduous exertion among the mountains and in the cabinet, is represented on a splendid colored map of five feet by three, after the three sheets of which it is composed are duly joined. At the bottom of this map is an ideal colored section, representing all the rocks which are described by Mr. Murchison.

For this magnificent work we are indebted to the accomplished author, who has achieved a signal triumph for British Geology and for the science itself.

12. Seventh Report of the British Association for the advancement of science, Vol. vi, pp. over 700—over 500 for the general meeting, and about 200 for the sections, &c. &c.,—illustrated by thirteen plates and maps, several of them folded. From the Association.

13. British Annual and Epitome of Science, for 1839, edited by Robt. D. Thomson, M. D. From the editor.

14. Annual Reports for 1838 and 9, of the Royal Institution of Civil Engineers London. From the Institution.

15. Journal of the Statistical Society of London, for 1838, January to December inclusive—except August. From the Society through R. K. Kennett, Covent Garden.

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E.

ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

Remarks.—This method of acknowledgment has been adopted, because it is not always practicable to write letters, 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 us, that we may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still our 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, in part, retrospective.—*Eds.*

SCIENCE.—FOREIGN.

Description and use of a dipping needle deflector, invented by Robt. W. Fox, Esq. From Mr. Fox. Cornwall, Eng.

Royal Cornwall Polytechnic Society. Description of the plan for descending and ascending mines, by E. O. Gregelles, C. E. From Mr. Fox.

Report of the Council of the Literary and Historical Society of Quebec. From the Society.

India Review and Journal of Foreign Sciences, edited by F. C. Corbyn, Esq. Vol. II, and Nos. 23, 24, 25, of Vol. III. From the editor. Received through Dr. J. V. C. Smith of Boston.

Traité de Chimie, par J. J. Berzelius. 2e Partie, Chimie Organique, Tome, Sixieme; kindness of the author, by request, to supply a deficiency occasioned by the loss of the same volume.

Theorie des Proportions Chimiques, et table Synoptique des Poids Atomiques, par J. J. Berzelius; for J. D. Dana, (of the South Sea Exploring Expedition.) From the author.

Kongl. Vetenskaps-Academiens Handlingar, för Ar. 1835. Stockholm, 1836. From Prof. Berzelius.

Arsberättelse om Vetenskapernas Framsteg, afgifne af Kongl. Vetenskaps-Academiens Embetsmän, D. 31. Mars, 1835. Stockholm, 1835. The last a duplicate.

Experimental Researches in Electricity, by Sir M. Faraday; eleventh, twelfth, and thirteenth series. From the author, by Dr. Warren of Boston.

Experimental Researches in Electricity, (fourteenth series,) by Sir Michael Faraday, D. C. L., F. R. S., &c. From the author. London. Royal Institution, June, 1838.

On the present state of our knowledge in regard to dimorphous bodies, by J. F. W. Johnston, F. R. S., L. and E., F. G. S. Prof. Chemistry and Mineralogy, Durham, Eng. From the author, for Y. C. Library.

The economy of a coal-field, by Prof. J. F. W. Johnston. Durham. From the author, with a copy for Y. C. Library.

Description and Analysis of a variety of Hatchetine, found in Wopeth colliery, near New Castle, by Prof. J. F. W. Johnston. From the author.

Synopsis of the New Castle museum, late the Allan, formerly the Tunstall, or Wycliffe museum, to which are prefixed memoirs of Mr. Tunstall, the founder, and Mr. Allan. 8vo. with plates, by Geo. T. Fox, Esq., F. L. S. From the author.

Schedule of the monthly meeting of the Linnæan Society of London. Mr. Fox.

Bronn, Lethaea geognostica, (Bogen, 49-60.) From the author.

Four beautiful lithographic plates of the footmarks of the Cheirotherium on the new red sandstone of Cheshire, Eng.: also of an undescribed animal, and of a fossil reed. From Rev. Prof. Buckland.

Supplementary notices to the first and second editions of Dr. Buckland's Bridgewater treatise. London. W. Pickering. From Dr. Buckland.

Histoire Naturelle des Poissons D'Eau douce de Europe Centrale, par Louis Agassiz. Prospectus. From A. Mayor, Esq.

Eighth Quarterly report of the Ophthalmic Hospital, Canton, China, by and from Rev. Dr. P. Parker.

SCIENCE.—DOMESTIC.

Extract from the Report of the Hon. William Kinney, on the public works of Illinois, Dec. 30, 1838. From Mr. Rogers.

Fossils of the Medial Tertiary of the United States, by T. A. Conrad, Phil. 17 plates. From J. Dobson, publisher.

Monography of the family Unionidae, or Naiades of Lamarck, (fresh water bivalve shells,) of N. America. No. 9. Two copies. By T. A. Conrad. J. Dobson, Phil.

Report of the Geological Reconnoissance of Kentucky, made in 1838, by W. W. Mather. From J. A. Tomlinson.

Report of Mr. Foster to W. W. Mather, Principal Geologist of Ohio: two copies, (one for Prof. Shepard.) From Mr. J. W. Foster.

An Introductory lecture on Chemistry and Geology, delivered November 6th, 1838, before the class of the Med. Coll. of Ohio, by Dr. J. Locke. From the author.

Report from Lt. G. M. Bache to the Secretary of the Treasury, on light houses, light boats, &c. From Lt. Bache.

Treatise on Prolapsus uteri and other affections of the Pelvic viscera. Four copies from Dr. Thomson, the author.

Jewett's Family Physician. From Dr. M. Jewett.

Analysis of Blount Shelly and Talladega Spring, in Ala., by Prof. R. T. Brumly, of Alabama University. From Prof. Barnard.

A pamphlet containing new theories of electricity, heat, attraction, repulsion and gravitation, by and from John Tyler, Jr. Wm. and Mary Coll. Va.

Second annual report of Dr. Douglass Houghton, the State geologist of Michigan; two copies: one for the Yale Nat. Hist. Soc. From Dr. A. Sager, Zoologist of the survey.

Second annual Report of the Geological Survey of Ohio, by W. W. Mather, and several assistants. Columbus, Ohio, 1838. From Mr. C. B. Goddard.

Report of a Geological Reconnoissance and Survey of the state of Indiana, made in the years 1837–8, by David Dale Owen, M. D. geologist of the state. From the author. Idianapolis, 1839.

An alphabetical catalogue of shells, fossils, minerals, and zoophytes, in the cabinet of Joseph Sullivan. Columbus, Ohio. Three copies from the author; one for the Yale Nat. Hist. Society.

The Louisville Journ. of Med. and Surgery, Nos. 1, 2, Jan. 1838.

A catalogue of plants found in the vicinity of Milwaukee, Wisconsin Territory, by J. A. Lapham. From the author. 1838.

An inaugural Address delivered Aug. 21, 1838, by Elias Loomis, A. M., Professor of Mathematics and Natural Philosophy in Western Reserve College. Two copies from the author.

Prof. Knight's introductory lecture, Nov. 1838. from Dr. Knight.

An Elementary Treatise on Astronomy, by Prof. William A. Norton. New York. Wiley & Putnam. 1839. From the author.

Letter from the Secretary of the Treasury on Steam Engines: two copies, one from Hon. Mr. Woodbury, and one from Hon. T. T. Whittlesey.

Memorial of Charles Lewis Fleischmann, on the manufacture of beet sugar. House of Rep. No. 62; 25th Congress. From the Hon. H. L. Ellsworth.

An inquiry into the causes of the rise and fall of the great Lakes, embracing an account of the floods and ebbs of Lake Ontario, by Edward Giddins, Esq. Lockport, N. Y. 1838. From the author.

Second Report on the Agriculture of Massachusetts, by Henry Colman, Commissioner for the Agricultural Survey; embracing the county of Berkshire. From the author.

Remarks on the North American insects belonging to the genus Cychrus of Fabricius, with descriptions of some newly detected species, by Thaddeus W. Harris, M. D. From the author.

Boston Journal of Natural History, containing papers and communications read to the Boston Society of Nat. History. Vol. II, No. 2, 1839. From the society.

Medical Recorder. Vol. I, N. 3. Samuel Alley. Cincinnati. March, 1839.

MISCELLANEOUS.—DOMESTIC.

Congressional Directory of the 3d Session of the 25th Congress of the U. S. A. Washington, Dec. 1838. H. L. Ellsworth, Esq.

Official army register for 1838. From Hon. J. Poinsett, Secretary of War.

List of the post offices in the United States. From Hon. H. L. Ellsworth.

Annual Report of the Commissioner of Indian affairs, for 1838–9. From Mr. C. E. Mix.

Catalogue of medical students of Harvard University.

Twenty-second Annual Report of the American Education Society. Boston. 1838.

Report of the Commissioner of Patents, transmitting information in relation to the duties of his office. From Hon. H. L. Ellsworth, Commissioner.

Sixth Annual Report of the trustees of the State Lunatic Hospital, &c. Worcester. From Doct. S. B. Woodward.

A bill to provide for the better security of the lives of passengers on board of vessels propelled in whole or in part by steam, in Senate of U. S., by and from Hon. J. Ruggles, U. S. Senate.

Dr. Miner's Address to the candidates for degrees and licenses in the Medical Institution of Yale College. Feb. 26th, 1839. Several copies from the class.

Catalogue of the Medical College of the State of South Carolina, for 1838–9. Charleston. From Prof. Shepard.

Engineer's report to the New York and Albany Rail Road Company. From Mr. E. F. Johnson, Engineer.

Rev. Mr. Palmer's lecture on study of History. From the author.

The Alabama State Almanac for the year 1839. Tuscaloosa, Ala. From Prof. Barnard.

Commentary on Genesis, by Prof. Geo. C. Bush. N. Y. Author.

Catalogue of the Calliopean Society. Yale College. 1839. From the Society.

An Oration on the Colonization of New England, by Charles Ripley. Louisville, Ky. 1839. From the author.

Funeral discourse, occasioned by the death of Gen. Stephen Van Rensselaer, by T. E. Vermilye, D. D. From Ph. S. V. R.

American Rail Road Journal and Mechanics Magazine. New York. Vol. 3, N. II. From the editor.

List of new and valuable English books imported by Wiley and Putnam.

Address of J. R. Ingersoll at the annual meeting of the Pennsylvania Colonization Society, Oct. 10th, 1838. From Mr. Elliott Cresson.

Remarks of Hon. J. C. Calhoun of South Carolina on the graduation bill; in Senate, Tuesday, Jan. 15th, 1839. From Mr. Calhoun.

Cincinnati Advertiser and Western Journal—Extra, Feb. 1st, 1839: containing the controversy between Cin. Med. Coll. and Med. Coll. of Ohio. From Dr. J. P. Kirtland.

Arrangement of Lectures and Recitations in Harv. Univ., for the second term of the Academic year, 1838–9. From Prof. Webster.

Annual Report of the trustees of the New England Institution for the education of the blind. 1839. From Dr. Howe.

Periodical notice of Rensselaer Institute, Troy, N. Y. From Prof. Amos Eaton.

Catalogue of architectural, embellished, scientific, and historical books for sale; from the library of Major D. B. Douglass. From Major Douglass.

The Advocate of Peace, Vol. 2, No. 10, whole No. 14, March, 1839.

The Hesperian, a miscellany of general literature, original and select. City of Columbus, Ohio. Vol. II, No. 4. From J. L. Riddell, M. D.

The Genesee Farmer and Gardener's Journal, for March 16th, 1839, with a notice of the storm of Jan. 26th, by and from Willis Gaylord, Esq. Otisco, N. Y.

Proceedings of the 3d Annual Convention of professional teachers in the State of Ohio, held at Columbus, Dec. 1838. From Mr. W. G. Williams.

Mr. McDowell's Address. 1838. Princeton, N. J. From Mr. Eli Whitney.

Mr. Tallmadge's report in the Senate of the U. S. on the memorial of Dr. H. H. Sherwood on the subject of terrestrial magnetism.

Address before the Mercantile Library Association, New York, by John H. Gourlie, New York. 1839. From the Association.

W. W. Gilman and Co.'s Catalogue of Morus Multicaulis for sale by them.

Annual Catalogue of the officers and students of Jackson College, for the winter session. 1838–9.

The Cause of Missions the Cause of God, a Sermon, by William S. Gilly, D. D., N. Y. From the editor.

Annual Report on and Catalogue of Harvard University, 1837–8. From Dr. Harris.

Memoir of Dr. Griffin, by W. B. Sprague, D. D. Albany. 1838. From Dr. Sprague.

Religion and Rank, a Sermon succeeding the funeral of the Hon. Stephen Van Rensselaer, by Wm. B. Sprague, D. D. From the author.

Dr. Sprague's Sermon on the ordination of the Rev. Augustus A. Wood. From the author.

Introductory Address, delivered before the Young Men's Association of Albany, Dec. 4, 1838, by and from Wm. B. Sprague, D. D.

MISCELLANEOUS.—FOREIGN.

A Catalogue of Books for sale by William Strong, 26 Clan st. Bristol, Eng. 1838. From Mr. Fox.

What can I do for my Brother? or an appeal to young and old for the cause of Christian missions. London. 1838. From the author.

Durham University Calendar, corrected to Dec. 31st, 1838. From Prof. J. F. W. Johnston.

Oxford Memorial of Cranmer, Ridley, and Latimer, Nov. 1838. Mr. Fox.

View of Central Exchange news room, New Castle upon Tyne, where the 7th meeting of the British Association was held.

NEWSPAPERS.—DOMESTIC.

Monthly Genesee Farmer, Jan. 1838. From the editors.

New Albany Daily Gazette, Friday, Dec. 21st, 1838. From S. Whitman, with a letter on steam boilers: five copies.

The Presbyterian. Phil. and N. Y. Five Nos. for Jan. 5, 12, 19, 26. 1839.

Christian Journal, Vol. I, No. 1. N. Y. Jan. 24, 1836.

Red River Whig. Alexandria, La. Vol. I, No. 33. Dec. 22d, 1839.

New York Times and Commercial Intelligencer, Jan. 26th, 1839, with a notice of this Journal. From G. S. Silliman, Esq.

New England Farmer and Horticultural Register. Boston, Wednesday, Feb. 6th, 1839.

Journal of Education. Marshall, Mich. Dec. 1838. From the publishers.

Westchester Herald. Westchester Co. Pa. Feb. 5th, 1839. Dr. Darlington.

Common School Journal, Vol. I, No. 1. Boston. Nov. 1838. From Messrs. Marsh, Capen & Lyon.

Daily Buffalo Journal. Jan. 31st, 1839. From Mr. R. W. Haskins, with a notice of Vol. 35, No. 2, of this Journal.

Journal of the American Temperance Union. Vol. III, No. 11.

Journal of Commerce, Wednesday, Jan. 23d. Notice of the medical faculty of the University of the city of New York. From Mr. Elliott.

Baltimore Athenæum and visiter. Vol. I, No. 1.

The Rockton Enterprise and Mowhawk Valley News. Vol. I, No. 1. From Mr. E. M. Griffing, editor.

Ohio Republican. Zanesville. Saturday, Feb. 10th, 1839. From J. W. Foster.

The Daily Georgian. Savannah. Wednesday, Feb. 13th, 1839. From Mr. Buckingham, with a notice of his lectures.

Mobile Literary Gazette, devoted to literature, science, &c. Mobile, weekly, for Feb. 1st, 8th, 15th.

Republican Farmer. Bridgeport, Ct. Wednesday, Feb. 27th, 1839. From Rev. James H. Linsley, with remarks on the latitude and longitude of certain places.

Friend of Man—Extra. Utica, N. Y. March 22d, 1839.

Louisville Journal. March 19th, with a notice of the discontinuance of the Louisville Medical Journal.

The Friend, a Religious and Literary Journal, seventh day, 3d mo. 16th, 1839. From Dr. Green, Phil., with notice of the structure of the trilobite.

Tri-Weekly Age, Augusta, Me., with notice of the legislative proceedings in that State. From Dr. C. T. Jackson.

Troy Daily Whig, March 30th, 1839, with a notice of the examination of the Rensselaer Institute. From Dr. Eaton.

FOREIGN.

The Morning Herald, London, Friday, Jan. 11th, 1839. From Mr. Frodsham, F. R. S.

The Court Gazette and Fashionable Guide. London. Saturday, Jan. 12th, 1839.

SPECIMENS.

Cleavage crystal of calc spar from England. Mr. C. Fox.

A Kilee or Boomerang, an Australian weapon. Mr. Fox.

Dr. Thomson's truss for prolapsus uteri. From Mr. Jewett

Five beautifully characterized specimens of minerals from Orange Co. N. Y. From Dr. Wm. Horton.

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